From:	moore.betsy@everyactioncustom.com on behalf of Elizabeth Moore <moore.betsy@everyactioncustom.com>
Sent:	Sunday, February 16, 2025 3:57 PM
To:	CouncilMail
Subject:	Support CB11-2025 for a safe buffer between WR Grace and surrounding neighborhoods
Follow Up Flag:	Follow up
Flag Status:	Flagged

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Dear Howard County Council,

As a Marylander, I'm deeply concerned by W.R. Grace's proposed "advanced recycling" pilot plant. This plant would spew carcinogenic air pollution just 70 meters from local homes in the Cedar Creek neighborhood of Columbia, Maryland.

Let's be clear. "Advanced recycling" is neither advanced nor recycling. This is just a misleading term for burning plastic waste and turning our plastic pollution problem into an air pollution problem. Read more about this harmful practice here:
https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.momscleanairforce.org%2Fresources%2Fchemical-recycling-101%2F&data=05%7C02%7Cianderson%40howardcountymd.gov%7C76b237bcebfc4169835208dd4ecc6784%7C0538130803664bb7a95b95304bd11a58%7C1%7C0%7C638753362122811092%7CUnknown%7CTWFpbGZsb3d8eyJFbXB0eU1hcGkiOnRydWUsIlYiOiIwLjAuMDAwMCIsIlAiOiJXaW4zMiIsIkFOIjoiTWFpbCIsIldUIjoyfQ%3D%3D%7C80000%7C%7C%7C&sdata=CIxRkoorusIpu6bnl2UJJjUfSy%2BDL7W%2BCSHal%2FVfz4w%3D&reserved=0

I urge you to support CB11-2025 to ensure a safe buffer between corporations like W.R. Grace conducting research and development (R&D) and residential neighborhoods.

This proposed facility not only will spew cancerous air pollution, but also is susceptible to fires, explosions, accidents, leaks, and more due to its experimental nature. Residents must be protected from these potential catastrophes by ensuring a safe buffer.

It is crucial that the Howard County Council listens to concerned community members and holds W.R. Grace accountable to public health standards. Please do not set the precedent that chemical companies and serial polluters like W.R. Grace can freely pollute and harm our communities. If this can happen in Cedar Creek, it can happen anywhere. Please protect Maryland families and keep our state safe.

Sincerely,
Elizabeth Moore
311 Cedar Ave Gaithersburg, MD 20877-1904 moore.betsy@gmail.com

From: KaReN Jung <karen_0120@yahoo.com>
Sent: Sunday, February 16, 2025 4:00 PM
To: CouncilMail
Cc: Frannie Jung; Hannah Jung
Subject: Testimony for CB 11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Hello

My name is Hannah Jung. I live in the Cedar Creek neighborhood and I am currently a 7th grader at Clarksville Middle School.

I am here today with my father to standby our neighbors to protect our homes and our health. A chemical company, Grace, wants to release harmful pollution into our air—the same air we breathe every day. This isn't just unfair; it's dangerous. What would people think if Grace released pollution into the air of highly populated residential communities like Cedar Creek and Riverhill?

It certainly has huge risk factors and health impacts. What would happen to all of us then?

When we bought the house in Cedar Creek two years ago, the most exciting fact about moving was what the builder promised us - A nature friendly neighborhood where we could hike to the Robinson Nature Center, bike, run, hang out with our friends, and more. But now, we are learning that Grace, a chemical company, wants to conduct research and release toxic air right next to our community. Toxic air can make us sick. It can cause asthma, cancer, and other serious health problems. Our families, friends, and especially kids don't deserve to suffer just so a big company can make more money.

We have a voice, and we are going to use it. We will continue to speak up, sign petitions, and fight for our right to clean air. Our health and our future are *way* more important than their profits.

Thank you.

Sent from my iPhone

From: Hari Srinivasan <hari9870@gmail.com>
Sent: Sunday, February 16, 2025 2:08 PM
To: CouncilMail
Subject: Testimony FOR CB11-2025 - Hari Srinivasan

Follow Up Flag: Follow up
Flag Status: Flagged

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Please see below for my testimony in support of CB11-2025 along with sources.

—

Hello, my name is Hari Srinivasan and I live in the Cedar Creek Community. Our house was built in 2022, and the proposed facility is under 270 yards from our house. I am a father of a 5-year-old and a 2-year-old, and I am here in support of CB11-2025. This is of the utmost importance to ensure the health and safety of our community members, particularly the many young children who live here.

Matters of health are personal for me. My father was diagnosed with Parkinson's Disease more than two decades ago. His condition steadily worsened over time. Earlier last year, after experiencing a significant progression in his symptoms, several of his bodily functions began to break down, he was placed on a ventilator for several days, moved into hospice, and passed away in June.

Now, some of you may ask what this has to do with the current research facility. The true cause of Parkinson's is unknown, but without any known genetic factors or any family history, we believe that one possible explanation for his disease was some kind of environmental exposure.

I hope that no community members will get Parkinson's because of this research facility. However, the Grace docket does state that the pilot plant will expose the surrounding area to nitrogen dioxide and volatile organic compounds. And there have been multiple studies linking Parkinson's disease risk to higher levels of NO_2 and VOCs. So you can understand how even the possibility of environmental exposure is a concern for my family.

The truth is: no one can guarantee that long-term exposure from this facility won't cause unwanted health consequences to our families who are forced to be around it day after day, year after year.

I'm not averse to data and statistics — in fact, I'm a data scientist, and so my entire job is predicated on looking at data, probability, and statistics. The data shows us that plastic incineration can emit particulate matter, VOCs, PFAS, dioxins, and more which are linked to cancer, respiratory issues, neurological and development delays, and preterm birth just to name a few. When it comes to matters of health and wellbeing as dire as this, if there is even a small probability of something going wrong, then we need to take as much caution as we possibly can.

I ask the people in this room: If you found out that a company near your house was thinking of building a plastic recycling facility, would you be comfortable with that? Also for those in the audience that work for Grace, would you really be here supporting this project if you didn't work for Grace?

Finally, does Grace really want to be the reason why a lot of members of a nearby neighborhood start putting up "for sale" signs up on their yards?

Because a lot of us are actually thinking of doing this if the project happens.How will the media cover this? How will people view Grace after this?

To the council - Please do the right thing for the community and the children that live there and not what a billion dollar company wishes.

—

SOURCES

Nitrogen dioxide and Parkinson's disease risk:

https://jamanetwork.com/journals/jamaneurology/fullarticle/2780249
(https://jamanetwork.com/journals/jamaneurology/fullarticle/2780249)

("In this cohort study including a nationally representative cohort from a metropolitan city in South Korea (n = 78 830), a statistically significant association was found between exposure to NO2, especially at high levels, and incidence of PD.")
https://pubmed.ncbi.nlm.nih.gov/26151951/ (https://pubmed.ncbi.nlm.nih.gov/26151951/)

("In a case-control study of 1,696 Parkinson's disease (PD) patients identified from Danish hospital registries and diagnosed 1996-2009 and 1,800 population controls matched by sex and year of birth, we assessed long-term traffic-related air pollutant exposures (represented by nitrogen dioxide; NO2)…Our findings raise concerns about potential effects of air pollution from traffic and other sources on the risk of PD, particularly in populations with high or increasing exposures.")

VOCs: (note that we are not saying the Grace project VOCs are the exact same VOCs studied here, but underscores the necessity of caution)

https://jamanetwork.com/journals/jamaneurology/fullarticle/2805037
(https://jamanetwork.com/journals/jamaneurology/fullarticle/2805037)
("In one of the best-documented large-scale contaminations in US history, the drinking water supplied

to residents of Marine Corps Base Camp Lejeune in North Carolina was contaminated with TCE, PCE, and several other volatile organic compounds (VOCs) from approximately 1953 until 1987…Risk of PD was 70% higher in Camp Lejeune veterans")

From: Mustafa Omarzad <mu_omarzad@yahoo.com>
Sent: Sunday, February 16, 2025 11:56 AM
To: CouncilMail
Subject: HCC Written Testimony in Support of CB 11-2025(ZRA-211)

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

To Whom It May Concern,

I am a resident of the Cedar Creek submitting this written testimony in support of CB 11-2025(ZRA-211). This Bill as I understand will allow entities in a Planned Employment Center(PEC) to perform research and development but prohibit testing involving commercial plastic pellets or feed stock.

I have lived in the Cross Creek neighborhood for 3 years. For the most part, W.R. Grace and the community have worked well together to ensure that environmental standards are upheld to ensure the safety and security of the Robinson Nature Preserve, and the surrounding residential communities including River Hill. Before the Cedar Creek community was developed , the land that it currently sits on served as a buffer zone between W.R. Grace and the Larger River Hill community. Because of this buffer zone, facilities felt safe from any potential negative environmental hazard that might have its origins a the W.R. Grace facility. Today , there are literally dwellings that are withing 70 meters of the W.R Grace facility located at 7500 Grace Drive which I am one of the residents. This close proximity puts families and especially children in harms way to any potential hazardous toxins or other environmental hazards that might be emitted from W.R. Grace.

I respectfully request that you please pass this CB-11 2025 bill for these children who are the future of Howard County and prevent life threaten issues such as cancer, lung issues, reproductive disorders, physical growth defects.....etc.

Thank you for listening to the community.

Signed,
Mustafa Omarzad

From: nrmantilla@everyactioncustom.com on behalf of Nestor R. Mantilla <nrmantilla@everyactioncustom.com>
Sent: Sunday, February 16, 2025 7:21 AM
To: CouncilMail
Subject: Support CB11-2025 for a safe buffer between WR Grace and surrounding neighborhoods

Follow Up Flag: Flag for follow up
Flag Status: Flagged

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Dear Howard County Council,

As a Marylander, I'm deeply concerned by W.R. Grace's proposed "advanced recycling" pilot plant. This plant would spew carcinogenic air pollution just 70 meters from local homes in the Cedar Creek neighborhood of Columbia, Maryland.

Let's be clear. "Advanced recycling" is neither advanced nor recycling. This is just a misleading term for burning plastic waste and turning our plastic pollution problem into an air pollution problem. Read more about this harmful practice here:
https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.momscleanairforce.org%2Fresources%2Fchemical-recycling-101%2F&data=05%7C02%7Cianderson%40howardcountymd.gov%7Cb8bf214b448848535aaa08dd4e846964%7C0538130803664bb7a95b95304bd11a58%7C1%7C0%7C638753052839863602%7CUnknown%7CTWFpbGZsb3d8eyJFbXB0eU1hcGkiOnRydWUsIlYiOiIwLjAuMDAwMCIsIlAiOiJXaW4zMiIsIkFOIjoiTWFpbCIsIldUIjoyfQ%3D%3D%7C0%7C%7C%7C&sdata=GB90PcVV6U6y8F6dQn6TxDSHPkg5%2FNwyyDO2sxl1LZw%3D&reserved=0

I urge you to support CB11-2025 to ensure a safe buffer between corporations like W.R. Grace conducting research and development (R&D) and residential neighborhoods.

This proposed facility not only will spew cancerous air pollution, but also is susceptible to fires, explosions, accidents, leaks, and more due to its experimental nature. Residents must be protected from these potential catastrophes by ensuring a safe buffer.

It is crucial that the Howard County Council listens to concerned community members and holds W.R. Grace accountable to public health standards. Please do not set the precedent that chemical companies and serial polluters like W.R. Grace can freely pollute and harm our communities. If this can happen in Cedar Creek, it can happen anywhere. Please protect Maryland families and keep our state safe.

Sincerely,
Nestor R. Mantilla
3523 Toddsbury Ln Olney, MD 20832-1355
nrmantilla@gmail.com

From:	Preeta & Hari Srinivasan <preetahari2017@gmail.com>
Sent:	Sunday, February 16, 2025 1:59 PM
To:	CouncilMail
Subject:	Testimony FOR CB11-2025 - Preeta Srinivasan
Attachments:	NRDC Chemical-Recycling-Greenwashing-Incineration.pdf; Benzene exposure in children.pdf; Enclosure- WR Grace Reg. Interpretation Signed.pdf
Follow Up Flag:	Follow up
Flag Status:	Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Hello,

Please see below for testimony I will be providing this Tuesday 2/18, as a resident of Cedar Creek in support of CB11-2025. I have attached three PDF sources to support facts stated in my testimony for the record.

—-

Hello, my name is Preeta Srinivasan and I live in Cedar Creek. Our house was built in 2022, and the proposed facility is less than 800 feet from our house. I am a mother of a 5-year-old and a 2-year-old, and it’s for their sake that I’m standing up to support CB11-2025 and preserve clean air for our community.

In addition to being a mother, I’ve been an analyst at a large investment firm in the area for the past decade. When I make a decision in my job, I don’t just focus on the highest probability outcome. I think about the risk of something going wrong and whether the benefit of making a decision outweighs the risk.

It’s clear to me that the benefit of letting R&D like Grace’s plastic recycling project move forward doesn’t outweigh the risk to our families and to the surrounding area. Here are the facts I’m weighing. Grace claims pyrolysis is not incineration, but the EPA has literally informed MDE in writing that Grace's pilot plant meets the definition of an incinerator. Studies from the NRDC and others have concluded that pyrolysis carries similar risks as traditional incineration, without the purported environmental benefits. We have many small children in our neighborhood, including my own. Benzene is listed in Grace's own project application, which I read, as a toxic air pollutant for this project, and there are studies showing significant increased health risks for children exposed to benzene. Epidemiological studies show that children are particularly vulnerable to air pollution. Children breathe in more air for their size, and their immune systems and lungs are still developing. Air pollution also has documented impacts on terrestrial and aquatic ecosystems. So we need to consider that the large amount of protected forest area within Cedar Creek itself, the Middle Patuxent River (which our community backs right up to), and the Robinson Nature Center (which sits immediately to the east of our community and Grace) could also be at risk.

I think it's also important to consider how past history, even spanning back decades, affects the risk/benefit calculus. While I am someone who always tries to believe in others' good intentions, **I would respectfully contend that Grace's past and recent history of proven and alleged environmental harm** – from the asbestos claims that triggered their Chapter 11 bankruptcy years ago, to an active lawsuit from Baltimore City surrounding contamination and pollution – **objectively increases the potential risk for our community. It warrants erring on the side of caution to protect our families and the environment around us.**

In conclusion, I believe passing CB11-2025 is the absolute best risk-adjusted decision that Howard County can make. Thank you for your time.

From: Preeta & Hari Srinivasan <preetahari2017@gmail.com>
Sent: Sunday, February 16, 2025 1:59 PM
To: CouncilMail
Subject: Testimony FOR CB11-2025 - Preeta Srinivasan
Attachments: NRDC Chemical-Recycling-Greenwashing-Incineration.pdf; Benzene exposure in children.pdf; Enclosure- WR Grace Reg. Interpretation Signed.pdf

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In conclusion, I believe passing CB11-2025 is the absolute best risk-adjusted decision that Howard County can make. Thank you for your time.

NRDC

FEBRUARY 2022
IB: 22-02-A

ISSUE BRIEF

RECYCLING LIES:
"CHEMICAL RECYCLING" OF PLASTIC IS JUST GREENWASHING INCINERATION

Plastic waste is everywhere in the modern world. An estimated 242 million metric tons of it is generated globally every year, polluting our cities and clogging the oceans, and the United States is one of the top generators.[1] However, America recycles only about 8.7 percent of its plastic waste.[2] This small percentage is recycled by mechanical means: sorted by type, cleaned, shredded, and then processed into plastic pellets used to generate new products. The other 90 percent or so is incinerated or landfilled or ends up in the environment.[3]

As public concern grows about mountains of plastic trash, the plastics industry is promoting technologies that it misleadingly calls "chemical recycling" (also known as advanced recycling, molecular recycling, and chemical conversion) and touts as a solution to the plastic crisis. But it is a false solution.

© Justin Sullivan/Getty Images

A bulldozer pushes a pile of waste, including plastic trash.

For more information, please contact:
Veena Singla
vsingla@nrdc.org

The term "chemical recycling" encompasses many processes that fall into two categories: plastic-to-fuel and plastic-to-chemical components. Plastic-to-fuel conversion is done using pyrolysis or gasification, both of which use heat and chemical processes to break plastic waste down into products that are turned into fuels (see "Terminology" text box).[4] Plastic-to-chemical components uses treatments such as heat and solvents to create feedstocks that proponents claim can be further processed into other chemicals or new plastics.[5] Methods used include solvent-based processes and depolymerization (see "Terminology"); proponents claim pyrolysis and gasification can also be used to convert plastic waste to chemical components. Both categories of "chemical recycling" are fraught with health, environmental, social, and economic concerns (Table 1).

TERMINOLOGY

Pyrolysis: Categorized as a type of "thermal depolymerization." Uses high temperatures and low-oxygen conditions to thermally degrade plastic. The primary product is a liquid/oil that can be refined into fuels or further processed to create chemicals or plastic.[6]

Gasification: Categorized as a type of "thermal depolymerization." Uses high temperatures with air or steam to degrade plastic. The primary product is a gas called "synthesis gas" (or "syngas") that can be processed into fuels or chemicals.[7]

Solvent-based processes: Also called solvent-based purification or recycling. Uses solvents and other chemicals to dissolve plastics and separate polymers from other components. Recovered polymers must be further processed to create new plastics.[8]

Chemical depolymerization: Uses thermal and chemical reactions to break the plastic polymer chain into individual units (monomers). The monomers are recovered and purified and can be made into new plastic. The process is currently applicable only to certain types of plastic. It is distinct from solvent-based processes because the polymers are broken down.[9]

TABLE 1: ISSUES BOTH SHARED AND UNIQUE TO DIFFERENT "CHEMICAL RECYCLING" TECHNOLOGIES
Pyrolysis and gasification can be used to convert plastic to fuel, while proponents claim that pyrolysis, gasification, solvent-based processes, and chemical depolymerization can be used to convert plastic to chemical components.

Issue	Pyrolysis, gasification	Solvent-based processes, chemical depolymerization
Generates large quantity of hazardous waste	X	X
Stores or releases hazardous chemicals on site	X	X
May be sited in low-income communities or communities of color	X	X
May encounter difficulty scaling up[10]	X	X
May produce contaminated end products[11]	X	X
Creates fuels whose burning generates the same harmful air pollutants as burning fossil fuels[12]	X	
Has large carbon footprint[13]	X	?
Requires ongoing virgin plastic production, with its associated harms	X	X
May cause fires at plants due to high heat	X	
Exists primarily at the lab or pilot scale		X

Producing fuel from plastic waste does not qualify as recycling by international standards.[14] Additionally, it requires continued plastic inputs to create fuels that, just like typical fossil fuels, produce harmful air pollution and greenhouse gases when burned; thus, plastic-to-fuel is incompatible with circular-economy or zero-carbon goals.[15] Previous analyses have found that plastic-to-chemical components "recycling" is barely present on a commercial scale in the United States; plastic-to-fuel processes are more common.[16]

To understand more about "chemical recycling" facilities in this country that are operational or may become operational, we reviewed reports to generate an initial list of facilities. We then narrowed that list to facilities about which we could find information in one or more U.S. Environmental Protection Agency (EPA) databases, environmental permit information, and/or other relevant information (see Appendix).[17] While a lack of information and transparency on these facilities made it difficult to determine their operational status or capacity, we found eight that met these criteria, most of which fall into the plastic-to-fuel category (Figure 1). We also found that numerous facilities had opened and then shut down a short time later, consistent with what we had learned from previous reports.[18]

FIGURE 1: CHEMICAL RECYCLING FACILITIES WE IDENTIFIED IN THE UNITED STATES. THE MAJORITY ARE PLASTIC-TO-FUEL

*Though Agilyx states it produces material that is used to make new plastic, data indicate that a high volume of its outputs are burned (more below).[19]

- Plastic-to-Fuel (pyrolysis)
- Plastic-to-Chemical Components (pyrolysis)*
- Carpet-to-Nylon (depolymerization)
- Plastic-to-Chemical Components (solvent-based)

Our review of the eight selected "chemical recycling" facilities in the United States revealed that:

- the majority of facilities are not recycling any plastic;
- the facilities generate large quantities of hazardous waste;
- they release hazardous air pollutants; and
- they are often sited in communities that are disproportionately low income, people of color, or both.

Given these issues, "chemical recycling" cannot be the solution to our plastic problem—no matter how the plastic industry tries to spin it.

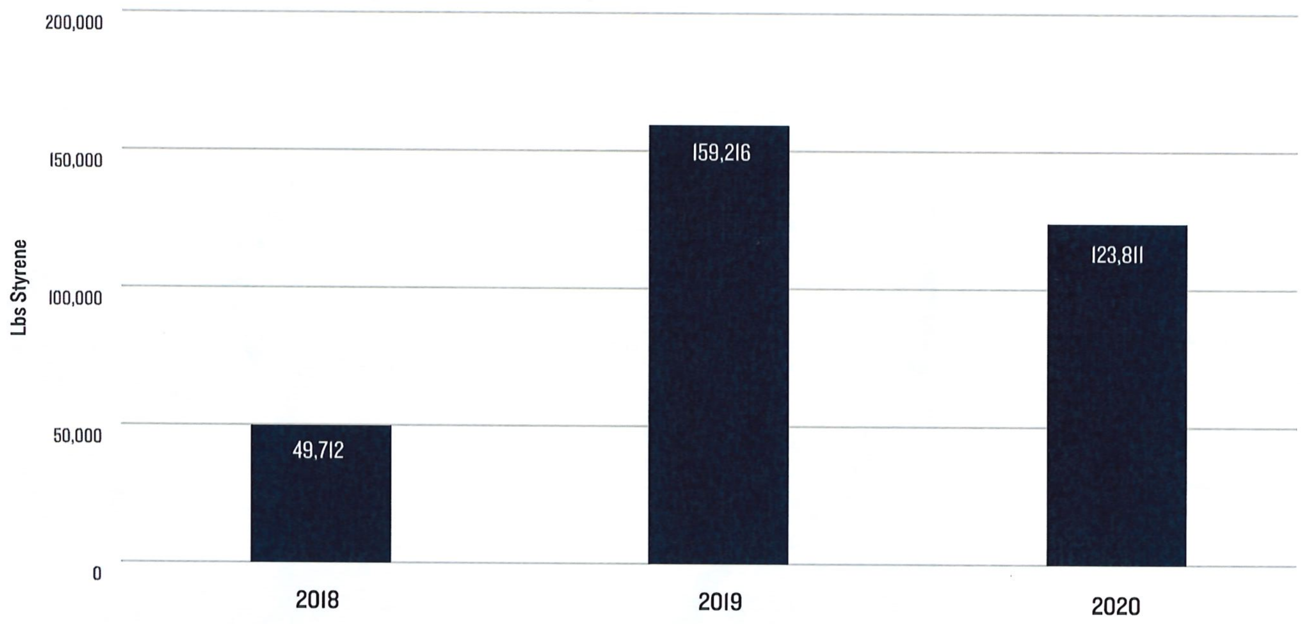
MOST "CHEMICAL RECYCLING" FACILITIES IN THE UNITED STATES ARE NOT RECYCLING ANY PLASTIC.

"Chemical recycling" most often creates materials that are burned—not turned into new plastic—and thus is not recycling at all.

Agilyx, a polystyrene pyrolysis plant in Tigard, Oregon, is held up by industry as a prime example of commercial-scale "chemical recycling." In theory, Agilyx takes waste polystyrene, a common type of plastic, and uses pyrolysis to turn it back into styrene, which is then used to make new polystyrene.[20] However, this facility in fact produces a large volume of styrene that is shipped off site to be burned instead of being converted into new plastic. Since 2018, Agilyx has shipped hundreds of thousands of pounds of styrene across the country to be burned (Figure 2).[21]

FIGURE 2: STYRENE SENT OFF SITE BY AGILYX TO BE BURNED, 2018–20

This amount has nearly tripled from 2018 to 2019. 2018 is the the first year in which the company focused on polystyrene.[22] Agilyx reported this styrene as sent to "energy recovery," which is the term used when an incinerator converts heat from the burning of waste materials into electricity; this is still incineration. In 2020, Agilyx reported implementing pollution prevention measures for onsite styrene releases.



Burning, or incineration, of chemicals and wastes has major climate, public health, and environmental justice impacts. Even if incinerators can convert some amount of the released heat into electricity (called "energy recovery"), the process still emits more greenhouse gases than fossil fuel–fired power plants and releases harmful air pollution and toxic chemicals.[23] Moreover, incineration sites are disproportionately located in communities where more than 25 percent of people identify as a racial minority, live below the federal poverty level, or both.[24]

Agilyx is not an outlier in this regard; since most facilities are creating fuel rather than new plastic, the outputs of all their intensive processing will ultimately be burned.

BOTH PLASTIC-TO-FUEL AND PLASTIC-TO-CHEMICAL COMPONENTS "CHEMICAL RECYCLING" FACILITIES GENERATE HAZARDOUS AIR POLLUTANTS AND LARGE QUANTITIES OF HAZARDOUS WASTE.

Nearly 500,000 pounds of hazardous waste were reported in 2019 from one "chemical recycling" facility alone.

Data from the EPA shows that Agilyx generated nearly 500,000 pounds of hazardous waste in 2019 alone, sending most of it off site to be burned (Table 2). This waste consisted primarily of benzene, along with other toxics such as lead, cadmium, and chromium (Table 2).[25]

TABLE 2: BURNING HAZARDOUS WASTE FROM AGILYX IN 2019

Agilyx sent hazardous waste to six locations across the United States for disposal.[26] The disposal methods all involve burning, though they may be called "incineration," "energy recovery," or "fuel blending"; the latter refers to mixing the hazardous waste with commercial fuel that is burned to power incinerators or cement kilns.

Where was hazardous waste disposed of?	Chemicals sent to this location	Total pounds sent (2019)
Tacoma, WA	Ignitable waste, benzene, and corrosive waste	353,292
Henderson, CO	Ignitable waste, benzene, barium, cadmium, chromium, lead, and selenium	66,190
Hannibal, MO	Ignitable waste, corrosive waste, cadmium, chromium, benzene, and 1,2-dichloroethane	64,122
Kimball, NE	Ignitable waste, corrosive waste, cadmium, chromium, benzene, and vinyl chloride	990
Arlington, OR	Benzene and 1,2-dichloroethane	66
East Chicago, IN	Ignitable waste and benzene	30
		Total: 484,690

Hazardous waste generation does not appear to be limited to pyrolysis facilities like Agilyx. PureCycle Technologies in Ohio states it will perform plastic-to-chemical components "chemical recycling" with solvent-based purification, employing solvents strong enough to break plastic waste down into its chemical components and separate it from contaminants.[27] PureCycle is registered as a large-quantity hazardous waste generator, meaning it plans to generate more than 2,200 pounds of hazardous waste per month in total.[28] We do not currently have details on the exact contents of PureCycle's hazardous waste, though permits indicate the facility plans to store toxic metals and solvents at its Hanging Rock, OH site, which is located in a community that is disproportionately low-income (Table 4).[29]

Hazardous waste and air pollutants generated by "chemical recycling" facilities are toxic chemicals that can cause cancer, harm the developing fetus, damage the reproductive system, and lead to other serious health problems.

The chemicals in the hazardous waste generated by Agilyx are toxic—many are carcinogens and/or neurotoxicants (Table 3). Much of this waste is benzene, a known cancer-causing chemical that can also be harmful to reproduction and the developing fetus.[30]

State-level permit data for Agilyx, Alterra Energy, Braven Environmental, Brightmark, Nexus Fuels, and PureCycle Technologies indicate that "chemical recycling" facilities release or are permitted to release hazardous air pollutants (HAPs), chemicals known or suspected to cause cancer or other serious health effects like birth defects (Table 3).[31] These chemicals are released directly from "chemical recycling" facilities as a by-product of the production process and can impact people living in proximity to the facility (Table 4).

TABLE 3: HEALTH HAZARDS OF CHEMICALS GENERATED BY "CHEMICAL RECYCLING" FACILITIES
(1) Health hazards of chemicals sent off site as hazardous waste by Agilyx and (2) hazardous air pollutants (HAPs) listed in Agilyx's Air Toxics Emissions Inventory and in air permits for Agilyx, Alterra Energy, Braven Environmental, Brightmark, Nexus Fuels, and PureCycle Technologies.[32] Data on hazard traits from California Safer Consumer Products Candidate Chemicals list.[33]

Chemical	Carcinogen	Reproductive toxicant	Developmental toxicant	Neurotoxicant	Persistent	Bioaccumulative	Liver toxicant	Cardiovascular toxicant	Respiratory toxicant	Kidney toxicant	Skin toxicant	Eye toxicant
(1) Hazardous waste sent offsite by Agilyx												
Lead	X	X	X	X	X	X	X	X		X		
Cadmium	X	X	X	X	X	X			X	X		
Selenium			X	X	X	X	X	X	X		X	
Benzene	X	X	X	X			X	X	X			
1,2-dichloroethane	X			X			X	X		X	X	
Chromium	X											
Vinyl chloride	X			X					X			
Barium				X			X	X				
(2) Hazardous air pollutants (HAPs) associated with multiple facilities												
Styrene	X	X	X	X			X					X
Benzene	X	X	X	X			X	X	X			
Toluene			X	X			X	X	X	X		X
Mercury	X			X	X	X	X	X	X		X	
Arsenic	X		X	X			X	X	X		X	
Dioxins	X	X			X	X	X				X	
Ethyl benzene	X		X	X			X		X	X		X
Xylenes			X	X			X		X	X		X
Naphthalene	X			X	X	X	X		X			X
Acetaldehyde	X								X		X	X
Formaldehyde	X						X		X			X
Hydrochloric acid									X		X	X
Methanol			X	X								
Hexane		X		X								

Moreover, according to EPA data, both Agilyx and Nexus were out of compliance with relevant HAP or hazardous waste regulations at least once during the past three years. Agilyx was in violation during 8 out of 12 quarters, with violations relating to pre-transport storage of hazardous waste and record-keeping, while Nexus's violation concerned the release of hazardous air pollutants.[34]

"CHEMICAL RECYCLING" FACILITIES ARE LOCATED IN COMMUNITIES THAT ARE DISPROPORTIONATELY LOW INCOME, PEOPLE OF COLOR, OR BOTH.

Communities of color already disproportionately bear the burden of health risks from plastics manufacturing, a process that releases highly toxic chemicals, because these facilities are often located in their neighborhoods.[35] There is a similar pattern of unequal impacts when it comes to "chemical recycling" facilities (Table 4). Of the eight facilities researched, six are in communities that are disproportionately Black or brown, and five are in communities where a disproportionate percentage of households have an income below $25,000, relative to national averages.[36] A combined total of about 380,000 people currently live within three miles of the eight facilities and could be impacted by their toxic emissions.

TABLE 4: DEMOGRAPHIC ANALYSIS OF COMMUNITIES WITHIN A THREE-MILE RADIUS OF IDENTIFIED "CHEMICAL RECYCLING" FACILITIES
Seven of the eight plants are in communities that are disproportionately low income, people of color, or both.[37] Orange highlights indicate where the percentage of people of color or percentage of people with a yearly household income below $25,000 was greater than the national average.
*Represents population of all census block groups intersecting with the three-mile buffer around the facility.

Facility	Agilyx	Alterra	Aquafil	Braven	Brightmark	New Hope	Nexus Fuels	PureCycle	U.S. Average
Location of facility	Tigard, OR	Akron, OH	Phoenix, AZ	Eagle Rock, NC	Ashley, IN	Tyler, TX	Atlanta, GA	Hanging Rock, OH	
Population within 3-mile radius of facility*	119,130	63,396	97,114	13,072	2,499	38,275	50,100	3,602	
Percentage with household income below $25,000	15%	31%	38%	17%	17%	37%	29%	29%	20%
Hispanic or Latino	10%	2%	79%	14%	2%	41%	13%	2%	18%
Non-Hispanic or Latino									
White alone	77%	70%	12%	60%	96%	26%	8%	91%	61%
Asian/ Pacific Islander	7%	2%	1%	0%	0%	0%	1%	0%	5.6%
Black or African American alone	2%	21%	5%	23%	0%	31%	77%	4%	12%
American Indian	>1%	>1%	2%	0%	0%	0%	>1%	0%	>1%
Other/multiracial	4%	4%	1%	2%	1%	1%	1%	4%	2.4%

POLICY RECOMMENDATIONS

Overall, it is clear that all forms of "chemical recycling" are plagued with problems and do not represent a solution to the plastic waste crisis. We need policies that reduce plastic production and waste, promote greater transparency about "chemical recycling," ensure the protection of environmental justice communities that are disproportionately impacted by these facilities, and do not greenwash the plastic-to-fuel processes as recycling.

Ensure comprehensive regulatory safeguards. Maintain health protections, and do not exempt "chemical recycling" facilities from solid waste permitting and regulations.

Multiple states have recently introduced or passed legislation to change the classification of "chemical recycling" plants so they are no longer considered solid waste facilities—and thus would be subject to weaker regulations related to reporting air and water pollution as well as waste.[38] However, because "chemical recycling" facilities handle discarded plastic waste, they should be treated and regulated as solid waste facilities. These facilities are expected to generate hazardous air pollutants and large quantities of hazardous waste—information that would not be public if the facilities were exempt from reporting requirements.

Additionally, two of the eight plants we researched had fires on site within their first year of operation: Fires occurred at New Hope Energy in Tyler, Texas, in May 2020 and at Brightmark in Ashley, Indiana, in May 2021.[39] Such accidents indicate that safety laws need to be enforced more, not less, at "chemical recycling" facilities to protect workers and nearby communities. Classifying "chemical recycling" facilities as solid waste facilities is necessary to ensure transparency and data access and to protect environmental and human health, particularly in the overburdened communities where these facilities are often located.

Maintain robust recycling definitions and standards that continue to exclude plastic-to-fuel processes.

Using pyrolysis and gasification to convert plastic into fuel should not be considered recycling, and recycling standards must continue to exclude such processes. Plastic-to-fuel is not considered recycling by ISO standards, the EU Environmental Commission, the Ellen MacArthur Foundation, and many other groups.[40]

Despite the fact that plastic-to-fuel does not recycle plastic, the industry continues to strongly support it.[41] This is likely because plastic-to-fuel creates a mirage of "recycling" to assuage public concerns about increased plastic use and waste but does not disrupt new plastic production. This paves the way for continued profits and the expansion of plastic production facilities.[42] Ensuring that plastic-to-fuel remains excluded from official definitions of recycling will make it difficult for plastic manufacturers to succeed in this greenwashing.

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Reusable and refillable products are key to reducing plastic waste. Zylaa, 10, filling a water bottle in the kitchen sink at her home in Washington, DC.

Invest taxpayer dollars in real solutions that reduce plastic production and waste. Do not support federal loan guarantees for "chemical recycling" facilities.

The plastics industry is attempting to secure federal loan guarantees for "chemical recycling" facilities, but this cannot be allowed. Supporting "chemical recycling" facilities with taxpayer dollars is unconscionable given the hazardous chemicals stored on site, the large amounts of hazardous waste generated, and the potential to disproportionately impact environmental justice communities. The current administration has prioritized advancing environmental justice and economic opportunities for disadvantaged communities and investing in these facilities runs directly counter to those commitments. Instead, real solutions include:

- eliminating problematic and unnecessary plastics, such as single-use plastics;
- innovating and scaling up reuse and refill models;[43]
- creating nontoxic materials to replace fossil fuel–derived plastics; and
- scaling up proven mechanical recycling or composting solutions.

The world is drowning in plastic, and we need to turn off the tap. "Chemical recycling" is a false solution that doesn't halt the deluge of plastic waste and creates new harms—it's a toxic distraction.

APPENDIX

TABLE A1: DATA SOURCES IDENTIFIED FOR EACH FACILITY
ECHO = Enforcement and Compliance History Online; TRI = Toxics Release Inventory; RCRA = Resource Conservation and Recovery Act.

Facility	Permit Data	ECHO Data	TRI Data	RCRA Data	Other Evidence re. Operational Status	EJScreen Analysis[44]	Address Used for EJScreen Analysis
Agilyx	X[45]	X[46]	X[47]	X[48]		X	13240 SW Wall Street, Tigard, OR, 97223
Nexus Fuels	X[49]	X[50]				X	500 Waterfront Dr. SW, Atlanta, GA 30336
Alterra Energy	X[51]	X[52]				X	1200 E Waterloo Rd., Akron, OH 44306
Brightmark	X[53]					X	3240 W 800 S, Ashley, IN 46705
Braven Environmental	X[54]					X	517 Industrial Dr., Eagle Rock, NC 27591
PureCycle	X[55]			X[56]		X	1125 County Rd. 1-A, Hanging Rock, OH
New Hope Energy	X[57]					X	1775 Duncan St., Tyler, TX 75702
Aquafil					X[58]	X	3555 W. Washington St., Phoenix, AZ 85009

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Health Risks Associated With Benzene Exposure in Children: A Systematic Review

Mark A. D'Andrea, MD, FACRO[1] and G. Kesava Reddy, PhD, MHA[1]

Abstract

Currently, there is a paucity of studies evaluating the adverse health effects of benzene exposure in children or clinical findings of those children who have been exposed. However, emerging studies show that benzene exposure can cause deleterious health effects in children. The objective of this study was to evaluate and summarize published studies on the adverse health effects of benzene exposure in children. More than 77 articles were examined and only the articles that dealt with adverse health effects on pediatric populations were included in the study. The evaluation of those studies provided current understanding of the health effects of benzene exposure in children. Findings from the currently available studies reveal that benzene exposure is associated with abnormalities in hematologic, hepatic, respiratory, and pulmonary functions in children. Published studies clearly support the need for further assessment of the potential adverse effects of benzene exposure in children, and clinical and laboratory findings of these children.

Keywords

benzene poisoning, blood disorders, chemical exposure, health impact, hematological toxicity, hepatotoxicity, Illness symptoms, pediatric populations, psychological effects, respiratory function.

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Introduction

Benzene is a clear colorless flammable solvent with an almost sweet yet gasoline-like odor that easily volatilizes into vapors in air. It is a natural component of both crude and refined petroleum and is formed as a result of the incomplete combustion of fossil fuels such as petroleum products and coal.[1] Benzene ranks in the top 20 most abundantly produced chemicals in the United States.[2] It is a commercially important intermediate of many chemicals manufactured in the industry. In addition, benzene is the most widely used chemical in the synthesis of various polymers, resins, and synthetic fibers. More than 98% of the benzene produced is derived from the petrochemical and petroleum refining industries.[3] The major sources of most of the ambient benzene is from petroleum refineries, emissions from coal and oil combustion, motor vehicle exhaust, evaporation from gasoline service stations, industrial solvents, and hazardous waste sites. Benzene is also a major component of tobacco smoke.[4] As a volatile organic compound, it is one of the main contributors to air pollutants in the environment.[5,6] It is found in the environment as a contaminant from both human activities and natural processes.[7,8]

Environmental benzene exposure is an important health concern. It has been clearly established that human exposure to benzene leads not only to hematologic cancers[9,10] but also to a wide range of adverse noncancerous effects including functional aberration of respiratory, nervous, immune, hematological, hepatic, renal, cardiovascular, and reproductive systems.[5,11-15] Additionally, benzene exposure can affect both B-cell and T-cell proliferation, reduce the host resistance to infection, and produce chromosomal aberrations.[16] These deleterious health effects of benzene exposure have been very well established, especially in adults. However, there is a paucity of investigations evaluating the clinical findings and adverse health effects of

[1]University Cancer and Diagnostic Centers, Houston, TX, USA

Corresponding Author:
G. Kesava Reddy, University Cancer and Diagnostic Centers, 12811 Beamer Road, Houston, TX 77089, USA.
Email: kreddy_usa@yahoo.com

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benzene exposure in children. Although the literature on the health consequences of benzene in children is scant, emerging studies show that benzene exposure can cause deleterious health effects in children. Moreover, epidemiological evidence suggests that environmental benzene exposure is potentially a major cause of childhood leukemia and other hematologic cancers.[17-20]

Children at various developmental stages have unique physical risk factors when exposed to environmental toxins including benzene due to their levels of mobility, oxygen consumption, hormonal production, and overall growth. In addition, the toxicodynamic processes that determine exposure, absorption, metabolism, excretion, and tissue vulnerability are all age related.[21] Moreover, children have a higher unit body weight exposure to benzene or other toxins than adults because of their heightened activity patterns and different ventilation tidal volumes and frequencies. Furthermore, children are more susceptible to leukemogenesis because their hematopoietic cell populations are differentiating and undergoing maturation. The incomplete metabolic systems, immature host defenses, high rates of infection by respiratory pathogens, and activity patterns make children more vulnerable to the toxic effects of benzene exposure.[22,23] The physiology, immature enzyme systems, and clearance mechanisms play a critical role in determining the susceptibility of children to toxins.[21-24] In particular, the pharmacokinetics of benzene differ widely between children and adults due to children's incomplete metabolic systems, rapid tissue regeneration, immature host defenses, activity patterns, and high rates of infection by respiratory pathogens.[22,23] Thus, children are more susceptible to the effects of environmental toxic pollutants. However, the susceptibility to benzene may vary due to its effect that arises, in part, from genetic variations in its metabolism, DNA repair, genomic stability, and immune function.

The precise mechanism of benzene-induced toxicity is not completely understood but it is believed that there are multiple mechanisms of action involved in benzene toxicity (Figure 1).[25-27] More specifically, the toxic effects of benzene are believed to arise from its metabolites such as benzene oxide, phenol, benzoquinone, muconaldehydes, hydroquinone, and catechol. Following absorption, benzene is metabolized by cytochrome P450 in the liver resulting in the production of its metabolites phenol, catechol, hydroquinone, and benzene oxide.[26] These metabolites undergo further metabolism in the bone marrow to form a benzoquinone. Numerous studies have shown that many of these benzene metabolites are directly responsible for both its cytotoxic and genotoxic effects.[28-30] In the bone marrow, formation of benzoquinone from the metabolism of benzene produces myelotoxicity due to its high reactivity to form adducts with proteins and DNA.[26,31] These protein and DNA adducts interfere with the cellular functions and cause damage in the hematopoietic cells in addition to chromosomal aberration, oxidative stress, gene expression alteration, error-prone DNA repair, epigenetic regulation, apoptosis, and disruption of tumor surveillance.[32] The generation of free radicals leading to oxidative stress, immune system dysfunction, and decreased immune surveillance has been described as the possible mechanisms underlying benzene-induced toxicity.[33]

Given the importance of the toxicity of benzene, this review article provides summaries of the current scientific knowledge and understanding of the clinical findings and health consequences of benzene exposure among children. Specifically, this article summarizes the quantitative changes in hematological and hepatic functions in addition to qualitative changes among somatic symptom in children exposed to benzene.

Methods

We sought all published studies, primarily in the peer-reviewed literature using electronic databases such as MEDLINE via PubMed and Google Scholar. The combinations of the keyword "benzene exposure" with any of the association to the following terms was used for the search in the database search: children, pediatrics, adverse health effects, blood disorders, chemical exposure, hematological toxicity, hepatotoxicity, illness symptoms, psychological effects, and respiratory function. We also searched reference lists in those publications that we obtained in an attempt to find additional relevant publications. Nonindexed journals were manually searched. The search was restricted to English-language articles. Abstracts that had been published in English were also included in this study.

Results

Figure 2 shows the steps involved in the selection process of the published articles for the study. On reviewing the articles' titles, abstracts, and full text content of the study, most of the articles were excluded. The main reasons for exclusion were that they were either nonquantitative, nonanalytical, or lacked clinical data. Articles with clinical data were reviewed, and the information that related to the health effects of benzene exposure in children was assessed and summarized in this review article (Table 1).

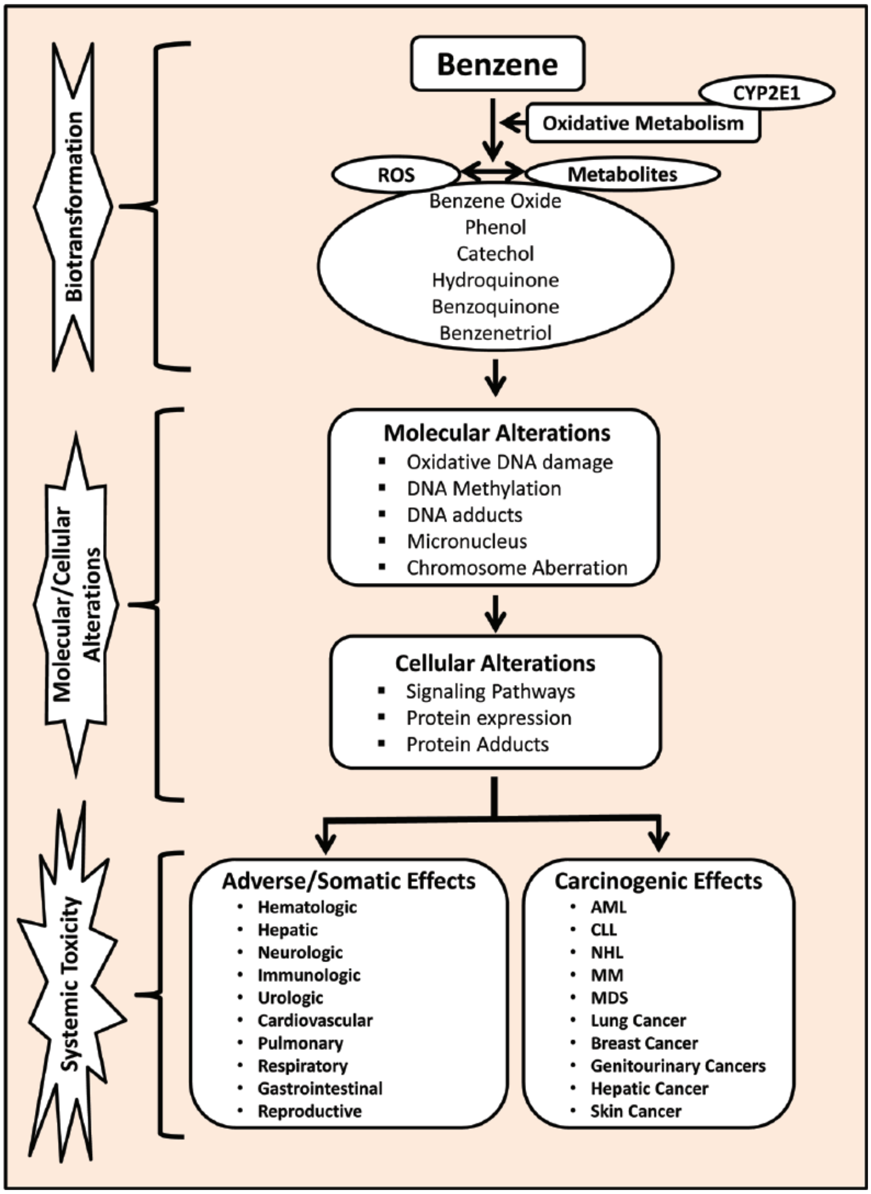

Figure 1. A schematic illustration of benzene metabolism, its mechanisms of toxicity, and its toxic effects in humans. Abbreviations: AML, acute myeloid leukemia; CLL, chronic lymphocytic leukemia; CYP2E1, cytochrome P450 2E1; MDS, myelodysplastic syndrome; MM, multiple myeloma; NHL, non-hodgkin lymphoma; ROS, reactive oxygen species.

Hematological Effects of the Benzene Exposure in Children

A cohort study by Lee and coauthors[34] assessed the hematological changes in children living near the petrochemical estate region in Ulsan, Korea, who were environmentally exposed to volatile organic compounds containing low levels of benzene. This study included a total of 192 children between the ages of 8 and 11 years who were living in close proximity to a petrochemical estate region or suburban region of Ulsan, Korea. The exposed group was composed of 48 boys and 49 girls who lived near the petrochemical estate region and went to an elementary school located near the petrochemical estate. The unexposed group was composed of 46 boys and 49 girls who had lived in the suburban region 10 miles from the petrochemical estate region. Both unexposed and benzene-exposed groups

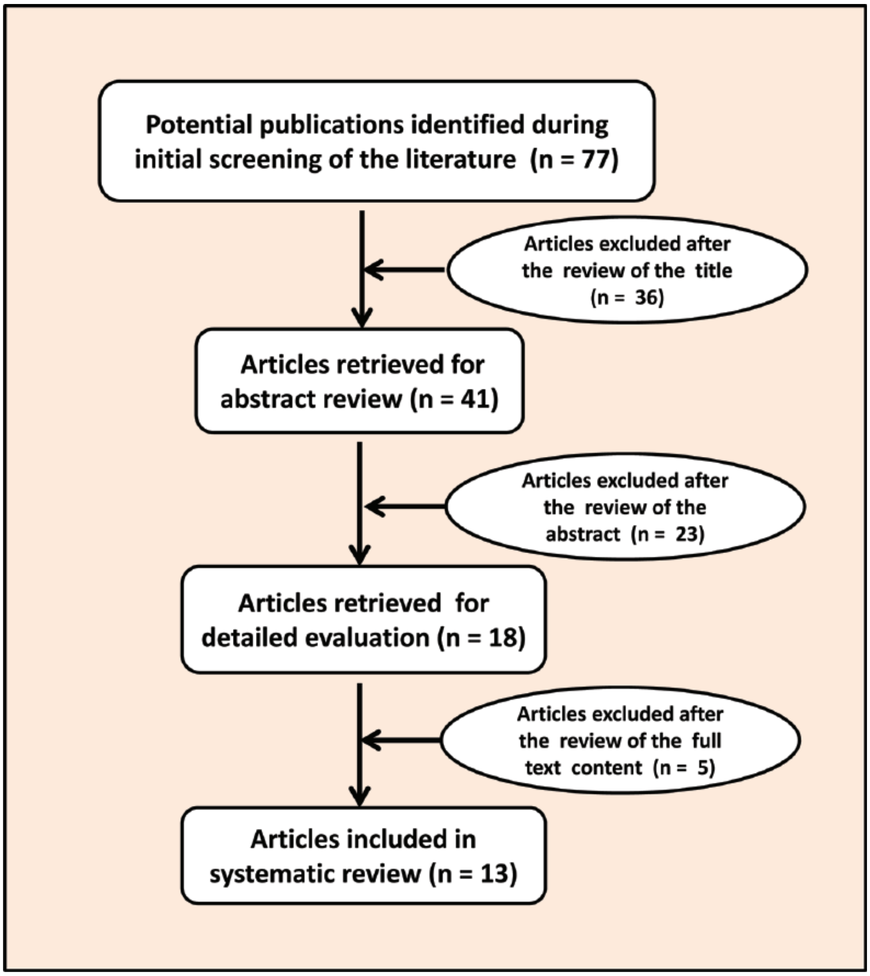

Figure 2. A flow chart illustrating the selection of articles for the study.

had similar age and sex distributions. Hematological assessment revealed that the total white blood cell (WBC) counts and absolute lymphocytes counts of 11-year-old children living near the petrochemical estate region were significantly lower than those of children living in the suburban region ($P = .009$, $P = .032$, respectively). Although the 8-year-old children living near the petrochemical estate region had decreased WBC counts and absolute lymphocytes counts compared with those living in the suburban region, they did not reach statistical significance. The red blood cell (RBC) counts and hemoglobin levels of the 8-year-old exposed children were significantly lower than those of the unexposed children ($P < .001$, $P < .001$, respectively). A similar, but not statistically significant, trend was seen in the parameters in the 11-year-old exposed and unexposed groups. Whereas the platelet counts were significantly decreased in both 8- and 11-year-old exposed children compared with unexposed children ($P = -.001$, $P = -.001$, respectively). A follow-up assessment at 3 and 6 months after the initial evaluation yielded similar differences but there were not consistent findings in the exposed and unexposed groups of the 8- and 11-year-old children.

The generalized linear model analysis of variance for the complete blood count values showed that the region where the exposure took place was a significant independent variable for the total WBC counts, RBC counts, and platelet counts ($P = .007$, $P = .004$, and $P = .036$, respectively), and the children's sex was a significant independent variable for the RBC counts ($P = .001$). Similarly, age was a significant independent variable for the total WBC counts, absolute lymphocyte counts, and platelet counts ($P < .001$, $P = .004$, and $P = .005$, respectively). Overall, the study findings showed that environmental exposure to volatile organic compounds containing

Table 1. Summary of Studies on the Effect of Benzene Exposure Among Children.

Location of Study	Study Design	Children's Age	Sample Size	Observed Clinical Health Effects	Reference
Ulsan, Korea	Cohort	8-11 years	192 (97 benzene exposed and 95 control) children	Reduced WBC, RBC, platelets, and lymphocytes counts, decreased hemoglobin in benzene-exposed children compared with unexposed children	Lee et al (2002)[34]
Texas City, TX	Cohort	8-11 years	312 (157 benzene exposed and 155 control) children	Reduced WBC counts, increased platelet counts, elevated creatinine levels, and increased liver enzymes such as ALP, AST, and ALT in benzene-exposed children compared with unexposed children	D'Andrea and Reddy (2013)[35]
Texas City, TX	Cohort	8-11 years	899 (641 benzene exposed and 258 control) children	Reduced WBC counts, increased platelet counts, decreased hemoglobin, hematocrit, and BUN levels, and increased liver enzymes such as ALP, AST, and ALT in benzene-exposed children compared with unexposed children	D'Andrea and Reddy (2016)[36]
Kanawha County, WV	Cohort	7-8 years	7796 children	Increased incidence of chronic respiratory symptoms in children attending schools located in a close proximity to chemical industries. Significant trends were observed for asthma-related responses such as a physician's diagnosis of asthma, persistent wheezing, and attacks of shortness of breath with wheezing in school children enrolled within a close proximity to chemical plants regions than those in the nonindustrial region.	Ware et al (1993)[37]
La Plata, Argentina	Cohort	6-12 years	1 191 (282 living close to the petrochemical plants, 270 exposed to heavy traffic, and 639 living in nonpolluted areas)	Significantly elevated asthma and respiratory symptoms including wheezing, cough, dyspnea, and rhinitis, and reduced lung function in children living near the petrochemical plant compared with those living in nonpolluted areas	Wichmann et al (2009)[38]
Rio Grande do Norte, Brazil	Cross-sectional	0-14 years	209 children	Higher incidence of respiratory symptoms in children exposed to petrochemicals	Moraes et al (2010)[39]
El Paso, TX	Panel study	6-12 years	36 children	Increased Asthma Control Questionnaire score in children exposed to traffic pollution with benzene, toluene, and other toxins	Zora et al (2013)[40]
Asturias, Gipuzkoa, Sabadell, and Valencia, Spain	Cohort	12-18 months	2199 infants	Increased respiratory tract infections	Aguilera et al (2013)[41]
Los Angeles, CA	Panel study	10-16 years	21 children	Increased asthma and lung function among the children exposed to benzene	Delfino et al (2003)[42]
Viseu, Portugal	Panel study	6-8 years	51 children	Deteriorated lung function in children exposed to benzene	Martins et al (2012)[43]
Texas City, TX	Cohort	8-11 years	312 (157 benzene exposed and 155 control) children	Upper respiratory (67%), neurological symptoms (57%), diarrhea (25%), cough (24%), dermatological (24%), nausea/vomiting (21%), gastrointestinal (12%), wheezing (9%), chest pain (6%), vision (6%), painful joints (6%), and urinary irritation (3%)	D'Andrea and Reddy (2016)[44]

Abbreviations: WBC, white blood cells; RBC, red blood cells; ALP, alkaline phosphatase; AST, aspartate aminotransferase; ALT, alanine aminotransferase; BUN, blood urea nitrogen.

low levels of benzene was associated clinically with a higher prevalence of hematological abnormalities in children living near the petrochemical estate region.

A pilot study by D'Andrea and Reddy[35] evaluated the hematological function in children who were less than 17 years old and exposed to benzene following British Petroleum's (BP) flaring incident in Texas City, Texas. A total of 312 children were included in the study. Of the 312 children, 157 were exposed to benzene and 155 were not exposed to benzene. Both unexposed and benzene-exposed groups had similar age and sex distributions. Clinically, hematologic analysis showed that WBC counts were significantly decreased in benzene-exposed children compared with the unexposed children ($P = .022$). Conversely, the platelet counts were increased significantly in the benzene-exposed group compared with the unexposed group ($P = .005$). Similarly, the serum creatinine levels were significantly increased in the benzene-exposed children compared with the unexposed children ($P = .000$). However, no significant alterations were observed in the mean hemoglobin or hematocrit or blood urea nitrogen levels between the benzene exposed and unexposed children. The results of this pilot study indicated that environmental exposure to benzene is associated clinically with altered hematological profiles in those children who were exposed to the benzene from the flaring incident at the BP refinery facility in Texas City, Texas.

A later larger cohort study by the same authors assessed the hematological changes in children exposed to benzene following the flaring incident.[36] A total of 899 children aged <17 years were included in the study. Of the 899 children, 258 were unexposed and 641 were exposed to benzene. The mean age of the unexposed and exposed children was 10.5 and 9.5 years, respectively. Among the unexposed children, there were 57% male and 43% female children. In the benzene-exposed group, there were 52% males and 48% females.

Hematological analysis indicated that those children exposed to benzene had significantly decreased mean WBC counts compared with the unexposed children ($P = .001$). Conversely, the mean platelet counts in the benzene-exposed group were significantly higher when compared with the unexposed children group ($P = .001$). Whereas the mean hemoglobin levels decreased significantly in the benzene-exposed group compared with the unexposed group ($P = .001$). Similarly, the percentage of hematocrit decreased significantly among the benzene-exposed children compared with the unexposed children ($P = .001$). Blood urea nitrogen was also found to be reduced significantly in benzene-exposed group compared with the unexposed group ($P = .001$). However, no significant differences were noted in the serum creatinine levels between the benzene exposed and unexposed groups. Furthermore, subanalysis indicated that, regardless of age or gender, significant alterations in the hematological profiles were seen in those children exposed to benzene. Overall, the findings of the hematological profiles confirmed the pilot study findings indicating that children who have been exposed to benzene have significantly increased health risks compared with unexposed children.

Effect of Benzene Exposure on Hepatic Function in Children

Currently, there are no published studies in literature that evaluated the clinical effect of benzene exposure on the liver function in children except 2 recent reports published by the authors.[35,36] The initial pilot study included 157 benzene-exposed and 155 unexposed children and assessed their liver function enzymes such as alkaline phosphatase (ALP), aspartate aminotransferase (AST), and alanine aminotransferase (ALT). The study findings revealed that benzene-exposed children had clinically significantly higher levels of ALP ($P = .04$), AST ($P = .015$), and ALT ($P = .005$) compared with the unexposed children.

Subsequently, the larger cohort study[36] assessed the liver function enzymes in 641 benzene-exposed children and compared with the 258 unexposed children. Serum ALP, AST, and ALT levels were reported to be increased significantly in children exposed to benzene compared with the unexposed children ($P = .001$). Furthermore, subgroup analysis indicated that, regardless of age or gender, significant alterations in hepatic enzymes were seen in children exposed to benzene. Overall, the findings of the hepatic profiles confirmed the pilot study findings indicating that children who have been exposed to benzene have significantly increased health risks compared with unexposed children.

Benzene Exposure and Illness Symptom Profiles in Children

Among all, respiratory illness symptoms are the most often studied health complaints in children exposed to benzene or petrochemicals/urban traffic pollutants. Upper respiratory symptoms were the most (67%) frequently reported, followed by neurological symptoms (57%), diarrhea (25%), and cough (24%). Logistic regression analysis indicated that neurological symptoms ($R^2 = 0.75$), chest pain ($R^2 = 0.64$), joint pain ($R^2 = 0.57$), and vision difficulty ($R^2 = 0.54$) were positively associated with increasing age. Other studies have shown that asthma symptoms such as those related to wheezing, cough, and shortness of breath or chest tightness were the most frequently reported respiratory illness symptoms in benzene-exposed children. A study by Ware and co-investigators[37] evaluated respiratory and irritant health effects of ambient volatile organic compounds in 7796 children attending 74 elementary schools located in chemical industry regions. The findings indicated that exposure to volatile organic compounds from chemical manufacturing plants were associated with an increased incidence of chronic respiratory symptoms in children attending schools located in a close proximity to chemical industries. Significant trends were observed for asthma-related responses such as a physician's diagnosis of asthma, persistent wheezing, and attacks of shortness of breath with wheezing in school children enrolled within a close proximity to regions containing chemical plants than those in the nonindustrial regions.

Similar findings were reported in a study by Wichmann et al[38] that assessed the effects of exposure to petrochemical pollution on the respiratory health of children aged 6 to 12 years living close to petrochemical plants (n = 282) and compared them with those living in a region with exposure to heavy traffic (n = 270) or in relatively non-polluted areas (n = 639) in La Plata, Argentina. The findings showed that children living near the petrochemical plant had significantly elevated asthma and respiratory symptoms (wheezing, cough, dyspnea, and rhinitis) and significantly reduced lung functions than those living in nonpolluted regions ($P < .001$). Moraes and coworkers[39] investigated the health impacts of living near petrochemical plants by assessing respiratory illnesses in 209 Brazilian children. The results from this study revealed that respiratory symptoms were found to be increased in children among communities in the vicinity of a petrochemical complex particularly those living downwind from the plant.

A panel study conducted by Zora et al[40] assessed the associations between urban air pollution of benzene and pediatric asthma control using an Asthma Control Questionnaire (ACQ) score in 2 elementary schools located in high- and low-traffic areas of El Paso, Texas. Eligibility criteria included age of the children between 6 and 12 years, a physician diagnosis of asthma, no other lung disease or major illness, a nonsmoking household, and residence proximal to their school. Data were reported for 36 of the 38 children who completed the protocol. The study found that benzene levels in the air of a school located in the high-traffic area ranged from 0.2 to 2.4 μg/m^3. Although no significant associations between benzene and other pollutants with an increase in ACQ score were found, an increase in ACQ score was related with an increase in benzene levels among children inhaling corticosteroids daily. Aguilera et al[41] investigated the association of air pollution exposure during pregnancy and respiratory illnesses, ear infections, and eczema during the first 12 to 18 months of life in a Spanish birth cohort of 2199 infants. These authors observed that during the second trimester of pregnancy, an increase in 1.0 μg/m^3 of benzene exposure was associated with an increased risk of lower respiratory tract infections in those infants.

In a panel study, Delfino et al[42] examined the longitudinal relationship of the daily asthma severity among asthmatic children exposed to volatile organic compounds such as benzene. The study included 21 asthmatic children between 10 and 16 years of age. The study revealed that increased mean concentrations of benzene (5.7 μg/m^3) levels were associated with increased asthma and poor lung function among the children. Martins and coauthors[43] evaluated the relationship between air polluted by benzene exposure and airway changes in a group of wheezing children. The investigators included a total of 51 wheezing children with a mean age of 7.3 years from Viseu, Portugal. Benzene levels were monitored for 4 weeks, and using a dispersion model, personal exposure was determined based on time-activity patterns according to the estimations. These authors reported that an increase in 10.0 μg/m^3 of benzene exposure was associated with deteriorated lung function-related outcomes in wheezing children.

In a pilot study, we investigated the clinical presentation of the illness symptoms experienced by children who were exposed to benzene following a flaring incident at the BP refinery in Texas City, Texas.[35] The study included a total of 157 children who were exposed to benzene. Among the illness symptoms, neurological symptoms such as unsteady gait, memory loss, and headaches were the most (80%) frequently reported symptoms in children exposed to benzene. Upper respiratory symptoms were reported by 48% of the benzene-exposed children followed by cough (48%), nausea/vomiting (43%), dermatological (36%), shortness of breath (32%), wheezing (27%), dizziness (22%), chest pain (15%), painful joints (15%), and weight loss (13%). To complement these findings, recently we conducted a full-fledged study in 641 children who were exposed to benzene following a flaring incident at the BP refinery in Texas City, Texas.[44] A total of 1790 illness symptoms were observed in 641 children exposed to benzene.

Among all clinically presented illness symptoms, upper respiratory symptoms occurred as the most frequently (67%) followed by neurological symptoms (57%), diarrhea (25%), and cough (24%). Logistic regression analysis indicated that neurological symptoms ($R^2 = 0.75$), chest pain ($R^2 = 0.64$), joint pain ($R^2 = 0.57$), and vision difficulty ($R^2 = 0.54$) were positively associated with increasing age of the children. Overall, the findings revealed that children exposed to benzene experienced range of illness symptoms indicating their vulnerability to increased risks and health complications.

Discussion

The literature reviewed in this article indicates there is a growing interest in evaluating the clinical and health consequences of benzene exposure among children. The literature on both clinical and health effects of benzene exposure in children is scarce, and studies evaluating the hematological, hepatic, and respiratory effects of benzene exposure are starting to emerge based on established biological mechanisms of benzene toxicity. Overview of the findings of the studies included in this review indicates that benzene exposure among children was clinically associated with alterations in hematologic, hepatic, and respiratory functions. In addition, benzene exposure was associated with the clinical presentation of several illness symptoms in children.

Clinical evidence further suggests that hemotoxicity is the major effect and is unique to benzene. Exposure to benzene causes bone marrow injury resulting in hemotoxicity leading to changes in WBCs, platelets, hemoglobin, hematocrit, and other blood cells formation. Multiple mechanisms including alterations in the expression of numerous genes and proteins, DNA methylation patterns, and RNA profiles appear to play an important role in benzene-induced hemotoxicity in exposed children.[27]

Although several studies have investigated the effect of benzene exposure on the hematological changes in adults, only a handful of studies published so far have evaluated the clinical changes in the hematological functions among children following their exposure to benzene.[34-36] The findings of these studies demonstrate that children exposed to benzene experienced significantly reduced hematological indices compared with those unexposed children. However, conflicting findings in platelet counts were observed in benzene-exposed children. Our recently published studies demonstrated significantly elevated platelet counts in children who were exposed to benzene compared with unexposed children.[35,36] However, in the study reported by Lee and associates,[34] significantly decreased platelet counts were observed in children exposed to benzene compared with unexposed children. Although the discrepancies in the platelet counts in benzene-exposed children currently cannot be explained, Ceresa and coworkers[45] previously found that thrombocytopenia was not a constant finding in most of the adult subjects who were exposed to benzene. Nevertheless, additional studies are warranted to clarify the effect of benzene exposure on the platelet counts in children.

The liver is the principal organ of xenobiotic metabolism, and hence, it is very important to monitor its function in people exposed to benzene or other toxins. It is well known that phosphatases, aminotransferases, and dehydrogenases are important enzymes in the biological processes. They are involved in the detoxification, metabolism, and biosynthesis of energetic macromolecules for different essential functions. Any interference in these enzymes leads to biochemical impairment and changes in the tissue and cellular function. Thus, the measurement of these liver enzyme such as ALP, AST, and ALT are routinely assessed as indicators for hepatic dysfunction and damage.[46,47] In normal conditions, these enzymes are confined to the cells but are released into circulating blood when there is necrosis or injury. Despite its importance, until recently, there were no published studies available in the literature evaluating the effect of benzene exposure on the hepatic function in children. The 2 recent studies reported by the authors[35,36] revealed that the serum levels of ALP, AST, and ALT were found to be elevated among those children who were exposed to benzene indicating hepatic abnormalities in these children. The increase in the levels of these liver enzymes in their serum suggests the impairment of the hepatic function in children exposed to benzene.

Studies assessing the somatic or clinically presenting illness symptoms such as respiratory, neurological, gastrointestinal, and other symptoms in children exposed to benzene were also limited in the published literature. However, evidence from available studies suggests that benzene exposure is associated clinically with sickness symptoms in children. The most common clinical presentations of the illness symptoms include neurological, respiratory, shortness of breath, wheezing, dizziness, chest pain, and painful joints.

Conclusions

Together, studies evaluating the clinical changes in the hematologic, cardiac, hepatic, renal, and other vital organ functions in children who were exposed to benzene are sparse. We have yet to learn and understand the full extent of all the adverse effects that benzene exposure has on pediatric populations. Findings from the currently available studies reveal that benzene exposure is associated with clinical abnormalities in the hematologic, hepatic, respiratory, and pulmonary functions in children. The hematological abnormalities were characterized by changes in RBC, WBC, absolute lymphocytes, platelets, hemoglobin, hematocrit, and creatinine in benzene-exposed children. Similarly, the hepatic abnormalities were characterized by elevated levels of ALP, AST, and ALT enzymes in the serum of the children exposed to benzene. Few studies have evaluated the somatic or illness symptoms such as respiratory, neurological, gastrointestinal, and other symptoms in children exposed to benzene. These findings indicate that exposure to benzene may lead to clinically detectable detrimental health effects in children. However, to fully understand the importance and nature of these effects, further longitudinal and mechanistic studies on the health effects of benzene exposure in children are warranted.

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Author Contributions

MAD: Contributed to design; contributed to acquisition; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
GKR: Contributed to conception and design; contributed to acquisition; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

Declaration of Conflicting Interests

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ORCID iD

G. Kesava Reddy https://orcid.org/0000-0002-1936-6972

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REGION 3
PHILADELPHIA, PA 19103

January 8, 2025

VIA ELECTRONIC MAIL
RETURN RECEIPT REQUESTED

Ms. Suna Yi Sariscak
Manager
Maryland Department of the Environment
Air Quality Permits Program
Air and Radiation Administration
1800 Washington Blvd,
Baltimore, MD 21230

RE: Applicability Determination Request - OSWI Rule and Proposed Pilot Plant in Maryland

Dear Ms. Sariscak:

We have received your December 13th, 2024 letter requesting an Applicability Determination for W.R. Grace & Co.-Conn and applicability of 40 CFR Part 60, Subpart EEEE - Standards of Performance for Other Solid Waste Incineration (OSWI).

Background

The December 13th letter and supplemental application describe a proposed Research and Development lab to be constructed by W.R. Grace & Co.-Conn ("Grace"). The proposed R&D facility intends to construct a catalytic pyrolysis unit, for the purposes of:

> …researching the scaling up of an innovative process to convert 1kg/hr of plastics back to their original components. The reactor in this proposed process will use a catalyst and heat in the form of steam to carry out this reaction. The Product from the reactor is a vapor. The vapor is sent via pipe to a condenser. The vapor that is liquified in the condenser is the product, which is then stored in drums. The drums are sent off site for disposal once data is collected. Non condensables from the condenser are sent via pipe to an electric flameless thermal oxidizer to control any VOC that may be present in the gas stream.

Furthermore, two phases will occur in which phase 1 will utilized virgin plastic as feedstock and if the project is determined to be "technologically feasible" and "commercially viable" phase 2 will consist of

processing recycled plastics. It's stated that Grace "cannot directly process plastic waste" and will need to source cleaned, pelletized recycled plastics.

Determination

Subpart EEEE has three applicability requirements, which are:

(a) Your incineration unit is a new incineration unit as defined in § 60.2886.
(b) Your incineration unit is an [Other Solid Waste Incinerator] OSWI unit as defined in § 60.2977 or an air curtain incinerator subject to this subpart as described in § 60.2888(b). Other solid waste incineration units are very small municipal waste combustion units and institutional waste incineration units as defined in § 60.2977.
(c) Your incineration unit is not excluded under § 60.2887.

The proposed catalytic pyrolysis unit, when constructed would be "new" as defined in §60.2886, which is defined to mean having a construction date after December 9, 2004. Additionally, the unit would meet the definition of an Other Solid Waste Incinerator, as OSWI expressly includes pyrolysis units. Despite the first two applicability requirements being satiated, the proposed catalytic pyrolysis unit would meet an exemption under § 60.2887.

§ 60.2887 states that "Your unit is excluded if it burns samples of materials only for the purpose of chemical or physical analysis." If the catalytic pyrolysis unit is operated for the sole purpose of research, the unit would be exempted from other requirements promulgated in 40 CFR Part 60, Subpart EEEE - Standards of Performance for Other Solid Waste Incineration (OSWI). Please note that rules such as 40 CFR 60 – Standards of Performance for New Stationary Sources do change occasionally, and any future changes to Subpart EEEE should be evaluated.

The EPA's response hereinabove to the request for applicability determination was coordinated with EPA's Office of Enforcement and Compliance Assurance (OECA) and EPA's Office of Air Quality Planning and Standards (OAQPS). EPA's applicability determination is specific to the facts provided in the December 13th, 2024 letter and supplemental application from W.R. Grace & Co.-Conn and any differences in the constructed facility or its operations may invalidate this response. If you have any questions regarding this response, please contact Steve Ott, of the Enforcement and Compliance Assurance Division at (215) 814-2267 or ott.steven@epa.gov.

Sincerely,

Karen Melvin
Director
Enforcement and Compliance Assurance Division

CC:
Cristina Fernandez, EPA Region 3, fernandez.cristina@epa.gov
Kristen Hall, EPA Region 3, hall.kristen@epa.gov
MaryCate Opila, EPA Region 3, opila.marycate@epa.gov
Steve Ott, EPA Region 3, ott.steven@epa.gov

From: Rakhi Singh <rakhisingh08@gmail.com>
Sent: Sunday, February 16, 2025 10:00 PM
To: CouncilMail; Ramnik Aulakh
Subject: I am for the CB11-2025 Bill

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

To Whom it May Concern,

Please find below a copy of my testimony in support for CB11-2025 Bill:

Thank you for the opportunity to testify. My name is Rakhi Singh. I am a resident of Cedar Creek Community. My husband and I bought our first home in this neighborhood and moved here when our daughter was just 6 months old. Before moving to this community, I thought I had done my research and besides just relying on the builder's word, I called Grace twice and spoke to individuals who stated that the location near our neighborhood was just an office building and did not conduct any research. Sadly, I was misled. Grace began this pilot project right after all the homes were built in the neighborhood. It was obviously planned from the beginning.

This research project should not be conducted near neighborhoods, where hundreds of families reside. This will affect the health of hundreds of people long term.

A few weeks ago, I had the opportunity to speak to residents at the Robinson Overlook Community, which is an equal opportunity housing development located on Grace drive. Many of those community members have multiple medical comorbidities and they will be affected by this R & D. Unfortunately, they were all uninformed of the harmful research project proposed by their neighboring building.

I am a physician. I spend the majority of my day managing patients and ensuring their health and safety. My hope is to come home and be able to spend just a few hours everyday with my family in a healthy environment with clear air. Unfortunately, that is being threatened by Grace.

I strongly urge you to pass the CB11-2025 Bill. This R&D has no place in a PEC zone next to residential neighborhoods.

Thanking You,
Rakhi Singh

From: Ramnik Aulakh <ramnikaulakh@gmail.com>
Sent: Sunday, February 16, 2025 9:54 AM
To: CouncilMail
Subject: I am for the CB11-2025 Bill

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

To Whom it May Concern,

Please find below a copy of my testimony in support for CB11-2025 Bill:

Thank you for the opportunity to testify. My name is Ramnik Aulakh and I am accompanied here by my wife Rakhi Singh and my daughter Riyana Aulakh, we live in the Cedar Creek community, our home was built in 2022. We are parents to a three year old daughter. This R&D has no place in a PEC zone next to residential neighborhoods. This is crucial to protecting the health of our kids and community from the carcinogenic air pollution this facility will spew.

My parents moved our family to Howard County in 1989 so I was fortunate to grow up and go to school in Howard County, a graduate of Atholton High School. One of the main reasons why my wife and I decided to move to Howard County and buy our first home in the Cedar Creek community is because of the school systems, safe neighborhoods and clean air. We should be able to raise our family's and live our lives without fear of carcinogens, explosions, fires, leaks, accidents and other hazards just a stone's throw away from our homes. Columbia, MD is known as one of the best places to raise a family in Maryland.

Advanced recycling is neither advanced nor recycling. It's a chemical company's new strategy to evade environmental protections meant to protect communities. Plastic incineration can emit particulate matter (soot), volatile organic compounds (VOC's) and dioxins which can cause Cancer, Worsened Asthma and respiratory issues, neurological and developmental delays. Children are especially vulnerable to air pollution since their bodies are still developing and because children breathe in more air for their size than adults.

W.R. Grace have polluted the soil water and air and are still cleaning the water under the consent order from the EPA. For smaller gain, they sold the land for residential development (Cedar Creek) and removed the buffer but still continued with research. The permit was applied for after all houses in the Cedar Creek were constructed and did not engage the Cedar Creek development. The environmental justice index was developed based on the 2020 consensus and the Cedar Creek development was not included. The Curtis Bay facility of Grace in Baltimore is under litigation. EPA's letter to MDE has classified their process as incineration and should be addressed under the Clean Air requirements. MDE has limited funds to monitor W.R. Grace's activities and now their funds for air monitoring is frozen by Washington D.C. and now will have very little supervision and monitoring.

Once again, I strongly urge you to pass the CB11-2025 Bill. This R&D has no place in a PEC zone next to residential neighborhoods and is crucial to creating a safe, healthy and livable neighborhood and future for our children and the families of Cedar Creek and all neighboring communities. Thank you for your time.

Ramnik Aulakh

From: Sara Noonan <saracnoonan@gmail.com>
Sent: Sunday, February 16, 2025 11:33 PM
To: CouncilMail
Subject: Braven Environmental & W.R. Grace

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear County Council,

I implore you to read the two articles at the bottom of this email. I have summarized key findings for your review below:

Braven Environmental's Zebulon facility in North Carolina serves as a cautionary example of the potential discrepancies between a company's public assurances and its operational practices. The significant environmental and safety violations highlight the importance of rigorous oversight and transparency, especially when introducing emerging technologies like pyrolysis into communities. ***Currently, there is no reporting of toxic emissions from waste incinerators.***

Braven Environmental collaborated with W.R. Grace & Co. to explore the co-processing of renewable and recyclable feedstock derived from advanced recycling. This partnership aimed to enhance the “recycling” of post-consumer plastic waste into valuable products.

The American Chemistry Council, the country’s leading petrochemical industry trade group, claims that chemical recycling will create a “circular economy” for the bulk of the world’s plastic, diverting it from oceans and landfills. Plastic giants have gone so far as to dub the process “advanced recycling,” but environmentalists say this is a misnomer because the majority of the plastic processed at such facilities is not recycled at all. ***In fact, researchers have found that the process uses more energy and has a worse overall environmental impact than virgin plastic production. Numerous companies have tried and failed to prove that chemical recycling is commercially viable.***

“Chemical recycling is really a greenwashing technique for burning up a bunch of petrochemicals in a new way, and it’s releasing tons of air pollutants into the environment,” said Alexis Luckey, executive director of Toxic Free NC, in an interview. “What we’re talking about is incinerating carcinogens and neurotoxicants in a community.”

Certain industrial facilities must annually report their chemical emissions for inclusion in the EPA’s Toxics Release Inventory. Since pyrolysis facilities are classified by the EPA as waste incinerators, they’re required to meet Clean Air Act guidelines but are excluded from TRI reporting requirements. This makes it difficult to assess the full health risks that Braven and other plastic pyrolysis units could pose to surrounding communities. In April, more than 300 environmental and public health organizations filed a petition with the EPA for the inclusion of waste incinerators in the database.

There’s very little actual monitoring data from these facilities that are doing plastic pyrolysis,” Veena Singla, a senior scientist at the Natural Resources Defense Council, told The Intercept. “It’s an open question for a number of these facilities what it is they're actually producing and what it's used for."

The risk is too high for this pilot plant in the middle of our community. Please pass CB11-2025.

Waste Incinerators' Toxic Output Should Be Reported
peer.org

They Promised “Advanced Recycling” for Plastics
and Delivered Toxic Waste
theintercept.com

Thank you,

Sara Noonan Morrell
240-593-9258
Saracnoonan@gmail.com

From: Sara Noonan <saracnoonan@gmail.com>
Sent: Sunday, February 16, 2025 1:32 PM
To: CouncilMail
Subject: Sara Morrell, Cedar Creek Resident for CB-11 2025
Attachments: letter for MDE.PDF

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear County Council Members,

I hope this letter finds you well. I am writing to bring to your urgent attention the detrimental implications of W.R. Grace's Permit Docket 16-23, which would allow an incineration research and development facility to be established just 70 yards away from the Cedar Creek development (and my home) in Columbia, MD.

Attached you will find a letter to MDE written by my daughter's pediatric pulmonologist, Dr. Sara Sadreameli at John Hopkins Hopsital.

She provides an expert opinion on how the W.R. Grace Pilot Project could greatly exacerbate and/or worsen my one year old daughter's rare interstitial lung disease. In addition, she speaks to the harmful effects on children without respiratory complications and the overall pulmonary harm for local residents.

The health and safety of our community are depending on you. Thank you for your attention to this critical matter and we thank you immensely for your help and guidance on this issue. Please pass bill CB-11 2025 and safeguard our growing children and communities.

Thank you,

Sara Morrell
240-593-9258
Saracnoonan@gmail.com

S. Christy Sadreameli, MD, MHS
Johns Hopkins School of Medicine
Department of Pediatrics
Eudowood Division of Pediatric Respiratory Sciences
200 North Wolfe Street/Suite 3077
Baltimore, Maryland 21287-2533
(410) 955-2035
(410) 955-1030 (fax)
ssadrea1@jhmi.edu

JOHNS HOPKINS
MEDICINE

August 29, 2024

To: Maryland Department of the Environment

Re: Proposed WR Grace plastic burning activities and health risks

I am the pediatric pulmonologist taking care of Reese Morrell, who has interstitial lung disease. Reese's condition is poorly understood, but quite serious. She relies on supplemental oxygen continuously with sleep, she breathes at a fast rate, and she requires extra caloric supplementation to grow. She is already at high risk for hospitalization due to her lung condition. Despite her health problems, she is also a beautiful 15-month-old girl who is growing, developing, and thriving. Reese's parents, Sara and Aidan, recently told me about their home's proximity to WR Grace and the proposed plan to burn plastics on site. This activity is likely to result in harmful emissions, including fine particulate matter (e.g., $PM_{2.5}$), volatile organic compounds, and many other toxic and dangerous compounds (polycyclic aromatic hydrocarbons, greenhouse gases, other toxic gases, microplastics, and more). I am very concerned about the harm this activity could have on my patient, Reese. I have advised her family about this. Exposure to these emissions could lead to increased pulmonary symptoms, pulmonary exacerbations, hospitalizations, and impaired lung growth. There is also a chance that this activity could worsen her overall disease progression and have negative effects on her long-term prognosis. Her condition is rare and poorly understood.

I am also concerned about the overall health impacts with respect to the lungs of other children living in this community, even if they do not have pulmonary conditions like Reese. I have focused on the pulmonary harms because of my specialty of pulmonology, but I must also mention that the risks extend beyond children and lungs. Plastic burning and recycling and associated emissions pose risks to people of all ages, including developmental harms, cancer, nervous system damage, and fertility impacts.

All children, including Reese, should be able to play outside safely. Children need clean and healthy air to grow and develop to their fullest potential. Please consider the impacts of this proposal on my patient Reese and for all the children living in this community.

Sincerely,

S. Christy Sadreameli, MD, MHS

Ref: Center for Environmental Health. https://ceh.org/chemical-recycling-and-plastic-burning-faq/#:~:text=The%20main%20component%20of%20this,as%20lead%2C%20cadmium%20and%20chromium Accessed August 29, 2024

From:	Sreevatsan Narayanan <sreevats.ns@gmail.com>
Sent:	Sunday, February 16, 2025 5:10 PM
To:	CouncilMail
Subject:	I am for the CB11-2025 Bill
Follow Up Flag:	Follow up
Flag Status:	Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

My name is SREEVATSAN NARAYANAN and I live in cedar creek. I support CB11-2025

Regards
Sreevatsan Narayanan

From: ctupino@gmail.com
Sent: Monday, February 17, 2025 7:29 PM
To: CouncilMail
Subject: Testimony in Support of CB11-2025 (Sending on behalf of Adriana Tupino - Student)

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Howard County Council,

My name is Adriana Tupino, and I am 13 years old that lives in Cedar Creek. I love being outside—whether I'm playing lacrosse, riding my bike, or walking with my friends or family or eating outside. Clean air is really important to me because I want to enjoy these activities without worrying about pollution making it harder to breathe.

I support CB11-2025 because it allows research and development while keeping harmful pollution out of our community. Plastic recycling is known to make the air dirty and unhealthy. I don't want my friends or me to develop asthma or other health problems just because we're outside having fun.

I also want to be doctor one day so I can help people stay healthy. Protecting the air we breathe is one way to keep our community safe ensuring Howard County is a great place to live and where kids like me can play outside without worrying about pollution and getting sick. Please support CB11-2025 to protect our air, our health, and our future.

Thank you for listening.

Sincerely,
Adriana Tupino
Cedar Creek Resident
7703 Cross Creek Drive
Columbia, MD

From: Aisha Hasan <aishaahasan@gmail.com>
Sent: Monday, February 17, 2025 6:30 PM
To: CouncilMail; CouncilDistrict5@howardcountymd.gov; CouncilDistrict3@howardcountymd.gov; Walsh, Elizabeth; Jones, Opel; Jung, Debra; Rigby, Christiana
Subject: Support For CB11-2025

Follow Up Flag: Follow up
Flag Status: Flagged

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Testimony:

I live around 900 feet from W.R. Grace. **I am in SUPPORT for CB11-2025 to ensure safety for me, my family, my toddlers, other kids in the neighborhood, elderly folks in the neighborhood, and everyone else in the neighborhood.**

Ever since learning about Grace's R&D efforts, including their proposed plastic project, I have been **distraught** and **fearing for the safety and health of my kids**. I have asthma and had bronchitis recently; having clean air to breathe is vital for my health and everyone's health.

I can't understand how there isn't a rule in Howard County to have a humanitarian safe distance between neighborhoods and chemical facilities conducting R&D where they emit carcinogens, carbon monoxide, and other harmful chemicals into the air that next door neighbors will breathe. Companies should not be allowed to conduct hazardous R&D next to neighborhoods about 70 meters distance.

Simply put: Howard County's zoning regulations need to be fixed. Incompatible zoning uses should not be next to each other for a commercial /industrial zoning next to residential zoning. Howard County should ensure the safety of humans is at the forefront of the work done in the county, including when "innovative" R&D is being done. R&D done adjacent to neighborhoods should not be hazardous.

CB11-2025 ensures neighborhoods next to companies doing R&D are not allowed to conduct hazardous R&D. There needs to be safety for Howard County residents from air emissions, explosions, accidents, fires, leaks, odors, and noise.

Health authorities recommend safety guidelines between residential areas and companies doing R&D with hazardous materials. Rhode Island's HB 5923 sets guidelines to prevent siting such projects near sensitive populations.

Companies like The Dow Chemical Company have buffers they themselves implement between neighborhoods and their facilities.

Distances under 2,000 feet from sources emitting hazardous air pollutants may expose residents to higher levels of pollutants due to wind patterns, atmospheric conditions, and cumulative exposure over time. And this does not take into account that if the distance is closer, smoke, debris, flames, etc. **<u>can literally come into the homes</u> next to the R&D facilities causing damage to homes and injury and potential death to residents.**

The 2019 Deer Park Plant Explosion highlights how air travels and hazardous R&D should not be done next to neighborhoods. The plant caught on fire and nearby residents' were impacted immediately **<u>AND</u>** symptoms of respiratory issues were later connected to chemicals with prolonged exposure related to cancer, brain damage, kidney issues, etc.

As a mother, I get emotional talking about this. I want to protect the health of my kids and the kids in surrounding neighborhoods.

My baby is a NICU survivor. Any parent of a NICU baby knows the horror of not knowing whether their child will live or die. I cannot bear the thought of her being back in the hospital due to illness or harm caused by accidents or health issues from toxic R&D.

These kids are the future of Howard County.

I was raised in Howard County, went off to school, got married and brought my husband back to Howard County to raise our family. He didn't want to come – he is a Virginia man – but I told him Howard County is supposed to be the "best" place to raise a family, especially Columbia. This has not proven to be true. Please work for the Howard County residents and help make this a reality for ALL Howard County residents.

I came back to Howard County because I believe the County has the best interest of its residents. That the County will protect **ALL** of its residents, including those in Cedar Creek, from harm.

We beg you, Howard County, to please do the right thing and approve this bill to allow for safety in ALL Howard County neighborhoods. PLEASE PLEASE PLEASE KEEP US SAFE!

Thank You.

From: AmiCietta Duche Clarke <amiciettaclarke@gmail.com>
Sent: Monday, February 17, 2025 6:59 PM
To: CouncilMail
Subject: Fwd: Submission in support of CB11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Testimony in Support of CB11

Good evening, members of the Howard County Council.

My name is AmiCietta Clarke, and my husband, children and I live in River Hill. I'm here as a concerned resident, a mother of two young children, and a wellness advocate. This issue is personal to me. At 25, I was diagnosed with an autoimmune disease that turned my life upside down. I had to completely reevaluate my environment—the air I breathed, the food I ate, and the chemicals I was exposed to—just to regain my health. When I moved to Howard County, I believed I was bringing my family to a place where they could thrive. **But now, W.R. Grace wants to build a plastics-burning incinerator in our backyard, and I cannot stand by while our health and safety are put at risk.**

CB11 is critical because it ensures that research and development facilities involving dangerous processes—like burning plastics—**cannot be built near homes, schools, and environmentally sensitive areas.** W.R. Grace argues that this bill unfairly targets them. But let's be clear—this bill is about **protecting the health and safety of Howard County residents.**

The Truth About W.R. Grace's History

Grace claims to be a responsible corporate citizen, but their track record tells a different story.

- In Curtis Bay, Baltimore, Grace had a nitric acid spill that endangered local residents.
- They were sued by Baltimore County for plastics misuse.
- And we don't even have to look far to see the damage they've done elsewhere—just ask the communities in Libby, Montana, or Woburn, Massachusetts about the toxic legacies they left behind.

When a company has this kind of history, they do not deserve the benefit of the doubt. They deserve scrutiny, and they must be held accountable.

MDE's Permitting Process is Not Enough

Grace argues that Maryland Department of the Environment (MDE) has a robust permitting process to ensure safety. But the reality is that MDE's permitting process is not enough to protect us. Air quality checks, which are crucial to monitoring pollution, are not even happening right now due to federal funding freezes. That means we have no way of fully understanding the risks posed by this facility. How can we rely on a process that lacks the resources to monitor compliance?

Even if the permitting process were fully functional, it was never designed to prevent bad projects from being built in the wrong locations—it only regulates them after they're built. That is why CB11 is necessary. We cannot afford to wait until people get sick before taking action.

The Incinerator Issue: MDE and EPA Have Classified It as a Pyrolysis Incinerator

W.R. Grace has repeatedly told the public that their pilot plant is not an incinerator. However, communications between the Maryland Department of the Environment (MDE) and the Environmental Protection Agency (EPA) clearly define it as a pyrolysis incinerator.

Despite this designation, it does not appear that MDE is intending to regulate the facility as an incinerator. This is deeply concerning. If Grace's own facility meets the criteria for an incinerator but is not being held to those regulatory standards, what does that mean for our health and safety?

Even more troubling, this facility is planned within 200 feet of homes and backyards, where families and children live. This should alarm every local resident, elected official, and community leader. If Howard County allows this project to move forward, we are setting a dangerous precedent—one that could open the door for other companies to build hazardous facilities under the guise of "research and development."

I have spoken to many of my neighbors and none of us would have chosen to live near W.R. Grace had we known they intended to build an incinerator.

The Economic Argument Doesn't Add Up

Grace claims that they are a major contributor to the local economy, stating that they pay $1 million in property taxes annually. But let's put that into perspective—they are a $2 billion company. Meanwhile, the residents of Cedar Creek and River Hill presumably collectively pay significantly more in property taxes than Grace does. The argument that we should accept potential pollution because they've given money to local charities is offensive. No corporate donation can erase the harm this facility could cause.

This project doesn't benefit the people of Howard County—it puts them at risk.

Conclusion: CB11 is About Protecting Our Community

This is not an anti-business bill. This is a **pro-community, pro-health, pro-environment bill.** If W.R. Grace wants to innovate, they can do it in a location that does not put children, families, and vulnerable populations in harm's way.

We are asking you to do the right thing. **Protect the people you were elected to serve. Vote YES on CB11.**

Thank you.

Best,

AmiCietta

AmiCietta Clarke, Esq.
Resident of River Hill

From: Hasan, Anwer <anwer.hasan@wsp.com>
Sent: Monday, February 17, 2025 8:10 PM
To: CouncilDistrict1@howardcountymd.gov; CouncilDistrict2@howardcountymd.gov; CouncilDistrict3@howardcountymd.gov; CouncilDistrict4@howardcountymd.gov; CouncilDistrict5@howardcountymd.gov; Jung, Debra; 'lwalsh@howardcountymd.gov'; Jones, Opel; Yungmann, David
Subject: FW: CB11-2025 my testimony for the approval of the bill and how Dow Chemical establish buffer and EPA determination of the W R Grace project as Incineration
Attachments: AnwerhasanCB11testimony.docx; BufferDowresponse.pdf; Enclosure- WR Grace Reg. Interpretation Signed.pdf

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Council Members

I am sending my testimony related to the W R Grace Plastic project at 7500 Grace Drive**. I am strongly in support of the CB11-2025 bill**. This project should not go forward as it will be harmful to the residents of the Cedar Creek, Robinson, and Village of River Hill communities. I have attached as to how responsibly Dow Chemical operates when they take into consideration projects which could have harmful impact on the communities. Also, I have included the EPA interpretation of the W R Grace project as an incinerator.

Please protect the children who are the future of the County

Regards
Anwer Hasan
Board of Regents, University System of Maryland
Senior Vice President II|Program and Construction Management
Maryland, DC , Virginia and West Virginia
WSP USA Inc.

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-LAEmHhHzdJzBITWfa4Hgs7pbKI

My name is Anwer Hasan, I am an Engineer, Environmentalist and has been living in Howard County for past 27 years and a resident of Cedar Creek Development

Good evening, council members and especially the children and their parents who have shown up in the support of CB-11 2025.

CB11-2025 allows the Planned Employment Center to perform research and development but prohibits research involving plastic. Focusing on growth but responsibly by protecting the health and safety of Howard County residents.

The Cedar Creek, Robinson and the Village of River Hill family's nightmare started on April 29, 2023, when they heard for the first time about the W R Grace plastic project during the MDE public meeting.

W R Grace di no outreach with their immediate neighbors Cedar Creek and Robinson. The EJ Index was prepared on 2020 Census knowingly that the Cedar Creek was 100% built in April of 2023 prior to applying for the MDE air emission permit. **These are huge red flags.**

The area on which Cedar Creek Development is build was a buffer between W R Grace and Village of River Hill. It was sold for a financial gain by W R Grace to build their Headquarter.

Now the families with small children are living seventy meters from the W R Grace facility at their 7500 Grace Drive. When the houses on the mainstream way open their windows especially in Winter, they can see through the tree lines Buildings 16 and 30 where research are conducted.

EPA at the request of MDE has defined W R Grace process of converting plastic into fuel as pyrolysis which is incineration and regulated under the Clean Air Act (See attached letter). The incinerator requires stringent Air Monitoring

Considering what is happening in Washington DC with EPA and the freezing of $13.7M MDE funds related to air monitoring are of a higher concern to the Cedar Creek, Village of River Hill, and Robinson. The residents are looking towards the local council to protect them from toxic air pollutants leaks, explosion, and fire.

We all recognize that jobs are important but if you do not have the health then nothing seems important in one's life. Currently 66% of American has one or multiple diseases, this project will increase it more. Health is a gift from the god and human being should not attempt to take it away.

Corporate Stewardship is important. Dow Chemical Company has developed a Greenbelt standard for citing their facilities which could be harmful. There are five requirements of the greenbelt standard which if applied keep the community safe. I hope and pray that other companies involved in chemical research become more responsible including W R Grace.

I humbly request that please pass this CB-11 2025 bill for these children who are the future of Howard County.

Thank you and God Bless you.

Site Selection and Buffer Zone Maintenance

Karen Study, P.E. ▪ **John Currie** ▪ The Dow Chemical Company

Establishing and maintaining buffer zones as additional space between the community and hazardous operations or chemical storage is an essential consideration for risk management.

Incidents such as the 2013 West Fertilizer Company and the 2015 Tianjin, China explosions demonstrate why it is crucial to maintain adequate buffer zones between hazardous chemicals and the community. A buffer zone is an expanse of land that separates hazardous operations and chemicals from public receptors (*e.g.,* homes, schools, and hospitals).

As part of a set of risk mitigation measures, it is vital that manufacturers site new operations with adequate buffer zones between industry and the community, as well as maintain and improve buffer zones at existing facilities. Additionally, it is critical that the chemical industry partners with government agencies to ensure that existing buffer zones are not compromised due to local development.

This article discusses why buffer zones are important to establish and maintain around chemical processing facilities. It introduces the buffer zone requirements that one chemical company has implemented to protect local communities around operational sites.

Past incidents necessitate buffer zones

Many incidents involving chemical processing facilities and storage sites have confirmed the importance of land use planning. One such incident is the 2013 West Fertilizer Company (WFC) fire and explosion that resulted in 15 fatalities and over 260 injured *(1)*. When the fertilizer facility was first built in 1962, primarily open fields surrounded the facility. Over the years, the city of West, TX, encroached closer and closer to the WFC facility. This encroachment ultimately led to the significant amount of destruction associated with the 2013 explosion.

The blast caused the complete destruction of a 22-unit apartment complex (450 ft from the explosion), a 145-bed nursing home (500 ft from the explosion), an intermediate school (552 ft from the explosion), and a high school (1,263 ft from the explosion). The explosion destroyed around 70 residential homes and damaged approximately 60 more.

In 2006, an explosion fueled by vapor released from a

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2,000-gal tank of highly flammable liquid at the CAI/Arnel manufacturing facility rocked the town of Danvers, MA *(2)*. The explosion and subsequent fire heavily damaged dozens of nearby homes and businesses; 24 homes and six businesses were damaged beyond repair. Fortunately, since the incident occurred at 2:40 AM, most of the home occupants were in their beds covered with blankets, which protected them from flying glass and other debris. In total, only ten people were injured. It is likely that fatalities could have resulted had the explosion occurred during the daytime.

Much like the WFC incident, the population gradually encroached closer to the CAI/Arnel facility in the years leading up to the explosion. Over several decades, the peninsula where the CAI/Arnel facility was located transitioned from a sparse population to one with many residential homes. Some homes were only 150 ft away from the facility. During the same period, the facility transitioned from handling a few hundred gallons of flammable liquids to thousands of gallons.

Another catastrophic incident occurred in August 2015 at the Port of Tianjin, China *(3, 4)*. A series of explosions at a container storage station resulted in 173 fatalities, and hundreds of people were injured. The explosion forced several thousand people living near the port to leave their homes and seek refuge elsewhere.

All three incidents are similar in that there was a lack of proper land use planning. In West, TX, there were no zoning regulations requiring residential areas to be separated from the fertilizer facility. In Tianjin, there was a requirement that prohibited public buildings and facilities within 3,300 ft of the container station. However, the requirements for separation in Tianjin were not followed, and at least three major residential communities were located within this perimeter. In Danvers, MA, property licensing laws and regulations did not address storing or using toxic chemicals.

A more recent explosion which speaks to the dangers of allowing dense populations near hazardous chemicals occurred in August 2020 at the Port of Beirut, Lebanon *(5)*. A series of explosions, caused by ammonium nitrate that had been stored for six years at a warehouse in the port, resulted in 220 fatalities and injured more than 6,500 people. The nearby dense residential and commercial areas were severely damaged, leaving ~300,000 people homeless. Additionally, this disaster damaged nine of the capital's hospitals and hampered access to healthcare for nearly 160,000 patients.

The Dow Chemical Company Greenbelt Standard

The Dow Chemical Company (Dow) has implemented a standard set of buffer zone (*i.e.,* greenbelt land) requirements to protect the communities located near our operating facilities. The five requirements of the Greenbelt Standard are:

- *Review projects and new facilities.* Projects (*e.g.,* construction of a new facility or expansion of an existing facility) that result in off-site impacts are reviewed by upper-level leadership.
- *Maintain land around existing facilities.* Greenbelt land around the site must be maintained to minimize the risk to the community and to limit community exposure to hazardous chemicals, in addition to other protection layers to manage hazards.
- *Develop site-specific land use strategies.* Sites with potential off-site impact scenarios should develop and maintain a land use strategy for land within the impacted area. The land use strategy summarizes the potential offsite impacts that a site can pose and details the land owned by the company. In addition, it lists potential areas of acquisition so that the buffer zone can be expanded if desired. The land use strategy also places restrictions on the use of the buffer zone land itself to prevent increasing the risk to the community.
- *Conduct land transaction reviews.* Transactions involving land impacted by Dow operations are reviewed and approved by process safety and upper-level leadership.
- *Evaluate new owners or tenants.* Prior to selling or leasing land to other chemical or petrochemical operators, the proposed company is evaluated to determine if they meet fundamental process safety management principles. The proposed owner/tenant is expected to identify any potential impacts from their operations beyond their facility boundaries. If their operations can impact Dow facilities, or if our hazards can impact their operations, the proposal is reviewed and approved by upper-level leadership.

History of the Greenbelt Standard

In 2011, senior leadership within Dow requested a formal protocol for managing buffer zones around our operations. Dow issued the protocol in 2012 as a company guidance document. After the WFC explosion in 2013, Dow leadership decided to strengthen the protocol by making the Greenbelt Standard a mandatory standard for all Dow operations. The guidance was re-issued as a formal standard in 2014. Prior to the Greenbelt Standard, land use for capital projects and changes to our greenbelt areas were managed at the site level using the management of change work process. The Greenbelt Standard required higher-level reviews and approvals as well as the standardization of the key considerations used to evaluate potential land transactions and facility changes with potential off-site impacts.

When the Greenbelt Standard was implemented in 2014, broad training was offered within Dow to communicate the new requirements. Land use strategies were developed for

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all sites with the potential to have off-site impacts. These strategies included plans for existing greenbelt land and any potential expansion of the buffer zone.

Drive for continuous improvement

Since implementing the 2014 Greenbelt Standard, we have learned a great deal. As a result, in 2019, the standard was updated and re-issued.

The need for clarification and consistency was the first main driver for updating the standard. Changes related to clarification and consistency included:

- Consistent criteria for calculating extent distances for potential off-site impacts were established.
- Expectations for leaders of Dow facilities operating within a non-Dow owned industrial park (iPark) were established; leaders are now expected to notify iPark leadership of any hazards from Dow operations that may extend beyond the iPark site perimeter.
- A minimum revalidation/update frequency for each site's land use strategy was determined.

The need for greater transparency in documentation and required representation was the second key driver for updating and re-issuing the Greenbelt Standard. Changes were made to the standard such that each site's land use strategy must now include required documentation of the maximum extent distances for potential hazard impacts from the site and the potential off-site population that could be impacted. In addition, when developing or revalidating land use strategies, process safety, emergency services, and security personnel must be represented.

Although we wanted to ensure consistency in endpoint distance calculations, we allow facility safety managers to use the process safety tools they prefer to estimate those distances (in an effort to reduce non-value-added work). With this approach, most facilities were able to refer to existing process hazard analysis studies and did not have to perform new calculations. Some of the typical modeling tools we use include DNV's PHAST software, Baker Risk's SafeSite3G software, and the Risk Analysis Screening Tool (RAST) originally created by Dow, which is now publicly available via the Center for Chemical Process Safety (CCPS).

After the Greenbelt Standard was updated, a broad communication was sent to impacted leaders and supplemental training opportunities were offered. Additionally, all site leaders received an action to report progress on achieving compliance with the standard such that progress could be monitored at a corporate level.

Program results

The land use strategy documentation requirement proved to be an effective way to ensure thoughtful consideration of hazards and the potential impact those hazards could have on the surrounding community. Since the original 2012 issue of guidance on greenbelt management, some notable achievements include:

- Off-site impacts were estimated for more than 100 sites and land use strategies were developed as needed.
- Leadership at many of our sites began advocating for land use planning within local forums. For example, Dow successfully advocated against a charter school development that was proposed to be located near our operations. As a result, the school permit was denied.
- Additional land has been acquired to improve buffer zones at 16 of our sites.
- Conservation sales or donations have occurred for land near four of our sites. This allows the land to serve as an open space and preserves the space as a natural habitat.
- Well over 130 proposed land transactions have received process safety reviews. In some cases, otherwise economically advantageous transactions were rejected due to process safety concerns.

Program partnership

As part of Dow's 2025 sustainability goals, Dow committed to a business decision process that values nature *(6)*. This commitment delivers business value and natural capital value through projects that are good for business and ecosystems. Specialized tools were developed with The Nature Conservancy nonprofit for this purpose; these tools provide the data needed to assess the value provided by the ecosystem and compare it with alternatives. This allows us to make business decisions that take nature into account.

In 2017, the team responsible for the Greenbelt Standard formed a partnership with Dow's "Valuing Nature" team. As a result, we use the valuing nature evaluation protocol to screen all greenbelt real estate acquisitions to identify opportunities for engineered solutions that provide co-benefits for the environment. Some examples where we have benefited the environment through our use of our buffer zones include:

- *constructed wetlands (Figure 1)*. To meet suspended solids requirements for wastewater treatment, a constructed wetland was installed instead of a more traditional sequencing batch reactor *(7)*. The lifecycle assessment of both options indicated that the lower energy and material inputs to the constructed wetland would yield lower potential environmental impacts. These include fossil fuel use, acidification, smog formation, and ozone depletion that likely lead to lower potential impacts for global warming and marine eutrophication.
- *drying ponds*. To allow recycling of filtered water, drying ponds were installed within a buffer zone. The drying ponds increased water supply resiliency for the site and reduced freshwater intensity and demand on the nearby river basin.

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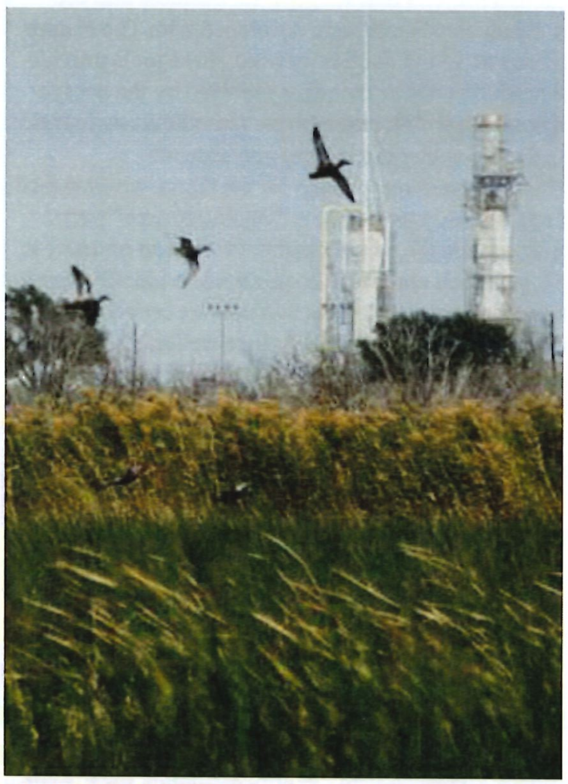
• *sustainable land management.* To enhance biodiversity while also lowering operating and maintenance costs, land intervention, such as mowing, was scheduled based on safety and access needs. Land that did not require periodic access was used for habitat creation and installation of native species.

• *land conservation.* To prevent settlement of buffer zone land, some land was divested and placed in conservation through sale or lease.

Effective greenbelt management case studies

To illustrate greenbelt management practices, three case studies are detailed. The specific case studies utilize generic names but reflect true accounts of how the work process has been applied to effectively manage greenbelt areas.

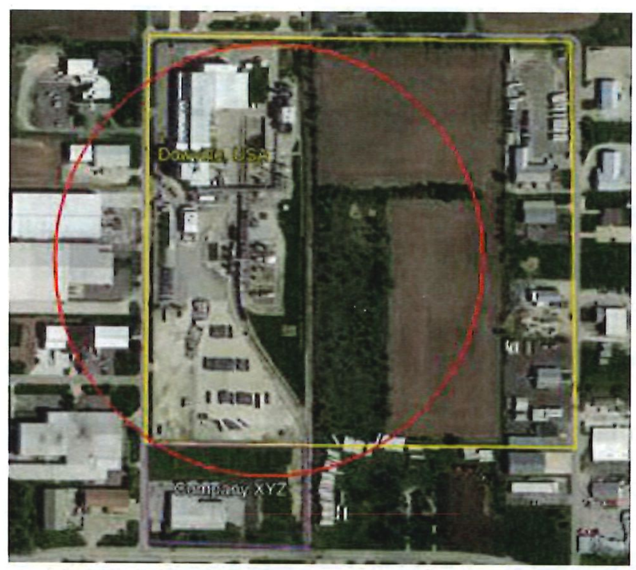
Study 1. Dowville. The Dowville site handles flammable and toxic chemicals, and multiple protection layers are in place to prevent inadvertent releases. However, in a worst-case scenario, the impact could extend up to 820 ft, as shown in Figure 2. There is adequate greenbelt space to the east of the facility to prevent community impact, but there is a potential to impact industrial neighbors to the west and south.



▲ **Figure 1.** The constructed wetlands within the buffer zone area of an operating facility were used to meet requirements for wastewater treatment instead of a more traditional sequencing batch reactor.

Following Dow's Corporate Greenbelt Standard, a land use strategy was developed for the site. As part of Dowville's land use strategy, a local real estate firm was engaged to monitor for purchase opportunities within the potential impact area. In 2017, the real estate firm notified site leadership of an opportunity; the industrial neighbor to the south, Company XYZ, was relocating operations and placed their property on the market. The property was approximately five acres and included a 25,000-ft^2 building. Although a local paint brush manufacturer was also interested in the property, Dowville managed to win the bid with a purchase price of $500,000, thus increasing their greenbelt to the south. Properties to the west are still monitored for additional greenbelt expansion opportunities.

Study 2. Dow-Crossing. Dow-Crossing is a valve station that handles propane at 1,200 psig. Although this facility has multiple protection layers in place to prevent inadvertent releases, in a worst-case scenario, flammable impacts from Dow-Crossing could extend up to 700 ft (Figure 3). In 2018, Company Astro informed Dow that they were interested in purchasing a portion of the undeveloped land at Dow-Crossing. Company Astro wanted to buy the land indicated in the purple-shaded region in Figure 3 to build a warehouse. The potential impact area from a worst-case scenario, indicated in red, included a portion of the land being evaluated for divestiture. Based on a review of the potential flammable impacts



Dowville perimeter
Dowville potential impact distance for worst-case scenarios
Company XYZ perimeter

▲ **Figure 2.** The Dowville site managed to purchase land that falls within their potential impact area, further increasing their greenbelt buffer zone.

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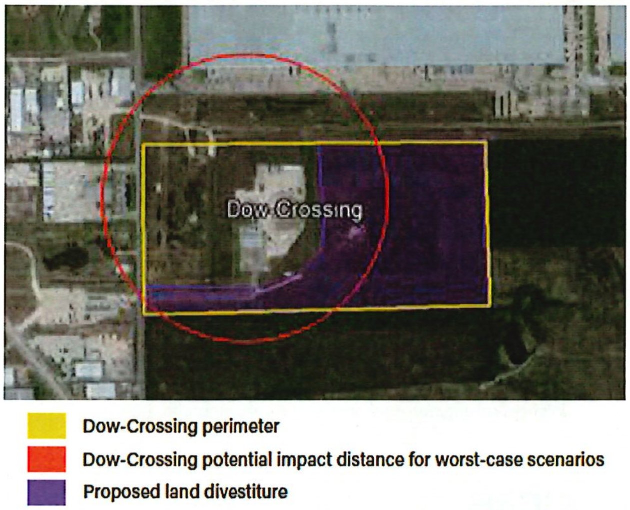
on the land and consistent with Dow's Corporate Greenbelt Standard, a recommendation was made to not accept the offer. Upper management supported the decision, and the offer was declined.

Study 3. Dow Green site. The Dow Green facility purchased some land offsite with the objective of increasing their buffer zone from the community. They are working with a local partner to plant native grasses and trees, thereby creating a pollinator garden (Figure 4). This represented a good opportunity to widen the buffer zone while contributing to nature and creating an improved aesthetic for the community.



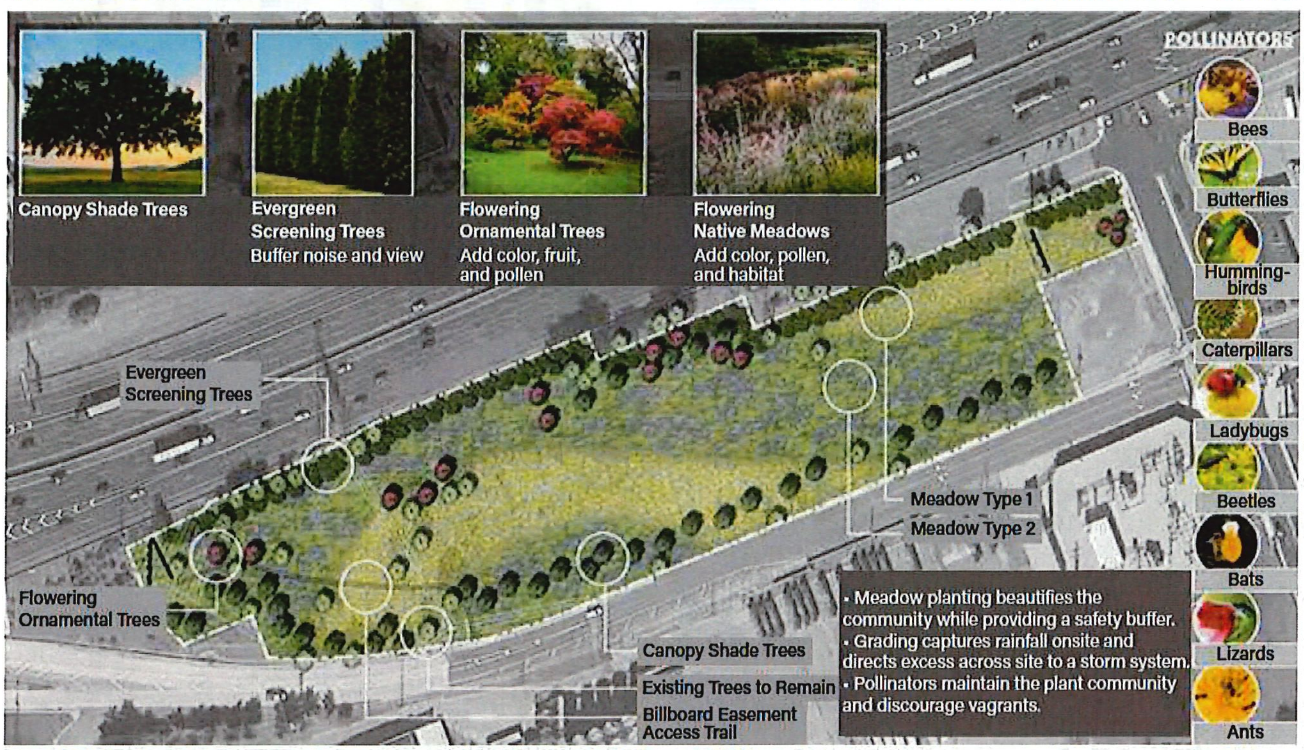
▲ **Figure 3.** An offer was received to purchase a portion of land within Dow-Crossing. Because the proposed land divestiture fell within the potential impact area, Dow declined the offer.

Best practices and future improvements

Land use strategies are not static; they are influenced by operational changes on site as well as by changes to land use around the facility. Therefore, facilities are expected to review their strategies at least every four years. Several sites have established standing land use committees that monitor for changes within or outside of the facility that could impact the land use strategy and review and update the strategy more frequently. This is an approach that can be leveraged to increase the effectiveness of the greenbelt program.

A future extension of the greenbelt program will include similar types of reviews and approvals for land and building transactions (leases, property transfers, and sales) within our site boundaries to ensure the application of a consistent approach that adequately manages potential risks. Elements of the Greenbelt Standard are being incorporated within the mergers and acquisitions due diligence work process; this will ensure that a site buffer zone evaluation will occur prior to acquiring assets.

It is also important for the chemical industry — and the



▲ **Figure 4.** The Dow Green site's pollinator garden highlights the ability to enhance nature within a site's buffer zone.

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surrounding communities — to lobby for land use regulations that enable economic growth while sensibly restricting zoning and limiting new construction close to operating chemical facilities. Dow has successfully lobbied against developments near some of our operations. As mentioned previously, a charter school with outdoor soccer fields was proposed to be built near one of our operating facilities. The proposed location was undeveloped land well within our operations' potential impact area. Site leadership met with local government officials and made a strong case to only allow industrial development in the area. Agreement was reached and the charter school permit was denied.

Conclusion

It is clear from past incidents that it is vital to maintain adequate separation between industry and the community. Dow's formal protocol for greenbelt management has served to ensure that the areas around our operations are evaluated, and strategies are created to appropriately manage buffer zones. The requirements of the Greenbelt Standard are straightforward; however, strong support from corporate leadership is key to achieving success from any program of this nature.

While Dow's program for buffer zone management is a great step toward further limiting the consequences of potential hazard scenarios, more action is required. The approach described in this paper is highly leverageable, and other companies are urged to develop similar approaches to ensure that they maintain adequate separation between potential hazards and the community. It is vital that the chemical industry seek to site new operations with adequate buffer zones between industry and the surrounding community and to proactively maintain and improve existing buffer zones. Additionally, it is critical that companies in the chemical process industries partner with local governments and regulators to ensure that buffer zones are not compromised due to local development and/or lack of regulation. CEP

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KAREN STUDY, P.E., is the Director of the Personal Safety and Industrial Hygiene Expertise Center at The Dow Chemical Company (Email: kstudy@dow.com). In this role, she provides oversight to ensure that global environmental, health, and safety (EHS) goals are met through the optimization of existing requirements, training, work processes, technology, and tools. She also represents to industry, government, and other external stakeholders the company's EHS standards, programs, work processes, and tools, to create a favorable framework for achieving the company EHS objectives. Study received her BS in chemical engineering from the Univ. of Texas.

JOHN CURRIE, PhD, is a Senior Process Safety Manager at The Dow Chemical Company (Email: john.s.currie@dow.com). As part of this role, he is the owner of the Greenbelt Standard, which provides corporation-level support for sites and businesses in establishing and maintaining buffer zones. He also supports higher-level safety studies as part of the Process Safety Expertise Center through consequence modeling analysis. Currie received his BEng and PhD in chemical engineering from the Univ. of Edinburgh.

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REGION 3

PHILADELPHIA, PA 19103

January 8, 2025

<u>VIA ELECTRONIC MAIL</u>
<u>RETURN RECEIPT REQUESTED</u>

Ms. Suna Yi Sariscak
Manager
Maryland Department of the Environment
Air Quality Permits Program
Air and Radiation Administration
1800 Washington Blvd,
Baltimore, MD 21230

RE: Applicability Determination Request - OSWI Rule and Proposed Pilot Plant in Maryland

Dear Ms. Sariscak:

We have received your December 13th, 2024 letter requesting an Applicability Determination for W.R. Grace & Co.-Conn and applicability of 40 CFR Part 60, Subpart EEEE - Standards of Performance for Other Solid Waste Incineration (OSWI).

<u>Background</u>

The December 13th letter and supplemental application describe a proposed Research and Development lab to be constructed by W.R. Grace & Co.-Conn ("Grace"). The proposed R&D facility intends to construct a catalytic pyrolysis unit, for the purposes of:

> …researching the scaling up of an innovative process to convert 1kg/hr of plastics back to their original components. The reactor in this proposed process will use a catalyst and heat in the form of steam to carry out this reaction. The Product from the reactor is a vapor. The vapor is sent via pipe to a condenser. The vapor that is liquified in the condenser is the product, which is then stored in drums. The drums are sent off site for disposal once data is collected. Non condensables from the condenser are sent via pipe to an electric flameless thermal oxidizer to control any VOC that may be present in the gas stream.

Furthermore, two phases will occur in which phase 1 will utilized virgin plastic as feedstock and if the project is determined to be "technologically feasible" and "commercially viable" phase 2 will consist of

processing recycled plastics. It's stated that Grace "cannot directly process plastic waste" and will need to source cleaned, pelletized recycled plastics.

Determination

Subpart EEEE has three applicability requirements, which are:

(a) Your incineration unit is a new incineration unit as defined in § 60.2886.
(b) Your incineration unit is an [Other Solid Waste Incinerator] OSWI unit as defined in § 60.2977 or an air curtain incinerator subject to this subpart as described in § 60.2888(b). Other solid waste incineration units are very small municipal waste combustion units and institutional waste incineration units as defined in § 60.2977.
(c) Your incineration unit is not excluded under § 60.2887.

The proposed catalytic pyrolysis unit, when constructed would be "new" as defined in §60.2886, which is defined to mean having a construction date after December 9, 2004. Additionally, the unit would meet the definition of an Other Solid Waste Incinerator, as OSWI expressly includes pyrolysis units. Despite the first two applicability requirements being satiated, the proposed catalytic pyrolysis unit would meet an exemption under § 60.2887.

§ 60.2887 states that "Your unit is excluded if it burns samples of materials only for the purpose of chemical or physical analysis." If the catalytic pyrolysis unit is operated for the sole purpose of research, the unit would be exempted from other requirements promulgated in 40 CFR Part 60, Subpart EEEE - Standards of Performance for Other Solid Waste Incineration (OSWI). Please note that rules such as 40 CFR 60 – Standards of Performance for New Stationary Sources do change occasionally, and any future changes to Subpart EEEE should be evaluated.

The EPA's response hereinabove to the request for applicability determination was coordinated with EPA's Office of Enforcement and Compliance Assurance (OECA) and EPA's Office of Air Quality Planning and Standards (OAQPS). EPA's applicability determination is specific to the facts provided in the December 13th, 2024 letter and supplemental application from W.R. Grace & Co.-Conn and any differences in the constructed facility or its operations may invalidate this response. If you have any questions regarding this response, please contact Steve Ott, of the Enforcement and Compliance Assurance Division at (215) 814-2267 or ott.steven@epa.gov.

Sincerely,

Karen Melvin
Director
Enforcement and Compliance Assurance Division

CC:
Cristina Fernandez, EPA Region 3, fernandez.cristina@epa.gov
Kristen Hall, EPA Region 3, hall.kristen@epa.gov
MaryCate Opila, EPA Region 3, opila.marycate@epa.gov
Steve Ott, EPA Region 3, ott.steven@epa.gov

From:	Carolyn Parsa <carolyn.parsa@mdsierra.org>
Sent:	Monday, February 17, 2025 6:33 PM
To:	Walsh, Elizabeth; Ball, Calvin; Jones, Opel; Rigby, Christiana; Jung, Debra; Yungmann, David; CouncilMail
Subject:	[WARNING: AMP - ATTACHMENT(S) MAY CONTAIN MALWARE]Written Testimony For CB11-2025
Attachments:	HoCo Sierra Club Testimony CB11 2-18-2025 final with exhibits.pdf

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

County Council,

Please find the written testimony from the Howard County Sierra Club in favor of passing CB11-2025.

--
Carolyn Parsa
Sierra Club Howard County Chair

February 18, 2025

George Howard Building
3430 Court House Drive
Ellicott City, MD 21043

RE: CB11-2025

Members of the County Council,

The Howard County Sierra Club is in support of passing CB11-2025 introduced by Deb Jung. This bill would amend the Howard County Zoning Regulations to add Research and Development Laboratory use to the Planned Employment Center (PEC) zoning district and prohibit research that uses commercial plastic pellets or feedstock which produces flue gas and requires a permit from the state of Maryland.

Howard County, by many metrics, is a great place to live and raise a family. It was designed to encourage full enjoyment of the outdoors with its many parks and trails. The school system is excellent and many families choose to move to Howard County for that benefit, as well as many others. It is in the best interest of all the residents of Howard County to keep the county a healthy, vibrant, and enjoyable place to live.

The processing of plastic pellets in an effort to develop chemical recycling is counter to our county's mission and core values and we must now allow it.

The process of chemical recycling is breaking down plastics into their chemical components and then using them for other purposes. The most common outcome to date is burning these chemicals for energy. Both the depolymerization (or separation) and the incineration of these chemical components of plastic are extremely toxic, polluting, and emit large amounts of CO2. (Exhibit A). This process is also inefficient, energy-intensive, and expensive. In decades of operation, most of these chemical recycling plants have shut down, showing that they are not the solution to the plastic problem (Exhibit C).

It is important to understand the difference between plastic recycling and chemical recycling. Plastic recycling is the mechanical breaking down of plastic, melting and making into pellets. These pellets are then used to make new products. The mechanical plastic recycling process results in fewer greenhouse gas emissions than chemical recycling (Exhibit B). The process of chemical recycling, that is proposed as a means of recycling plastic, is much worse for the environment than the process of mechanical breakdown, melting and reforming method which is more commonly used today.

These technologies will not solve our plastic pollution crisis, they only justify the continued large-scale production of single use plastic. The actual solution is to cut back on the production of single use plastics. However, this common-sense solution would reduce overall plastic production, so the industry offers chemical recycling as a solution instead (Exhibit C).

The processing of plastic pellets also comes with health and safety risks that threaten nearby residential communities. It is important to note that the nearby homes are occupied by many families which include people of all ages. The very young and the very old are especially susceptible to degraded air quality and air pollutants. Additionally, anyone with impaired health and diminished breathing capacity will also be adversely affected. The County has a duty to protect the most vulnerable of its citizens.

We need to refuse to allow this operation to proceed in our county and continue to look for better solutions to the plastic pollution crisis, such as return and reuse models. The Maryland Bottle Bill proposed in the General Assembly right now is one such practical solution that would raise return and recycling rates of beverage bottles from currently 25% to up to 90%.

We respectfully ask the you to pass CB11-2025.

Carolyn Parsa, Chair
Howard County Sierra Club
carolyn.parsa@mdsierra.org

Exhibits:

A. False Solutions to the Plastic Pollution Crisis (www.no-burn.org)
B. Questions and Answers: Chemical Recycling (www.no-burn.org)
C. Chemical Recycling; A Dangerous Deception Why Chemical Recycling Won't Solve the Plastic Pollution Problem, October 2023 Beyond Plastics, Bennington College. (https://www.beyondplastics.org/publications/chemical-recycling)

Exhibit A

FALSE SOLUTIONS TO THE PLASTIC POLLUTION CRISIS

Linear economy

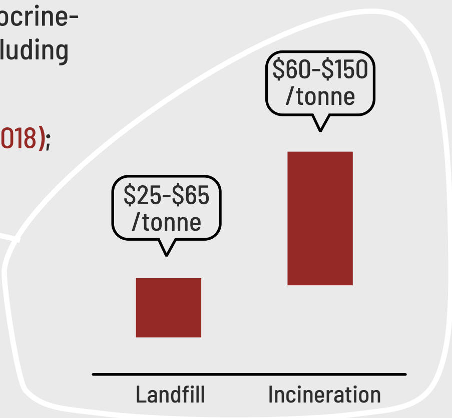
Perpetuates plastic production

It is a common myth that the plastic pollution crisis is solely a waste management problem. This narrative points the finger at leakages from waste management systems in Global South countries, and often asserts the need for technological fixes, such as waste-to-energy incineration and chemical processing of plastic waste. Unfortunately, even the most modern waste management systems cannot cope with the exponential rise of plastic production and waste. Overproduction of plastic also puts an extra burden on municipalities, forcing them to manage increasing quantities of plastic, most of which is not recyclable. Any response that prioritize end-of-pipe technology over addressing the root cause will not only be futile but also increase emissions of toxic and climate pollutants to the environment.

Incineration:

"waste-to-energy," co-incineration in cement kilns and other industrial boilers, refuse-derived fuel

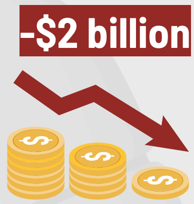
- Not climate-friendly: burning **one tonne** of plastic emits nearly **3 tonnes** of CO_2 (Material Economics, 2018)
- Toxic hazard: emits toxicants including cancer-causing, endocrine- and immune-disrupting dioxins and furans; heavy metals including mercury, cadmium and lead; particulate matter (GAIA, 2019)
- Incineration is more expensive than landfilling (World Bank, 2018); aging incinerators require significant additional public funds for upgrades (The New School, 2019)
- Socio-economic and racial injustice: facilities are disproportionately sited in low-income and marginalized communities (The New School, 2019)
- Competes with and undermines mechanical recycling (Nordic Council of Ministers, 2019)



Plastic-to-fuel:

gasification, pyrolysis, and plasma arc

- High costs and low returns: has a track record of major failures and lost more than $2 billion as of 2017 (GAIA, 2017)
- Not climate-friendly: emits CO_2 in both production and burning of plastic-derived fuel, which is another fossil fuel (GAIA, 2020)
- Toxic hazard: releases pollutants in gaseous emissions and by-products in a similar way to waste incineration (GAIA, 2020)



Chemical recycling

(plastic Repolymerization)

- Unproven technology: few projects are operational and claims are largely inflated (Hindenburg Research, 2020)
- Often, outputs are burned due to low quality and high levels of contamination (GAIA, 2020)
- Not climate-friendly: processing **one tonne** of plastic in a pyrolysis facility emits at least **3 tonnes** of CO_2 (GAIA, 2020)
- Toxic hazard: releases toxicants in plastic into the environment as air emissions and residues (GAIA, 2020)

www.no-burn.org

gaia

Downcycling ("plastic-to-road," "plastic-to-brick")

- Toxic hazard: hazardous chemicals can leach when downcycled materials are exposed to heat, UVs, and water (Oropeza, 2019)
- Resulting microplastics can attract more pollutants like polychlorinated biphenyls (PCBs) (Oropeza, 2019)
- Turns plastic waste into materials with lower quality or value — products become no longer recyclable (Greenpeace, 2019)
- Plastic-based construction materials are a significant fire hazard (Easton, 2020)

Compostable bio-based plastic

- Not climate-friendly: produces more GHG emissions than fossil-based plastic and widescale adoption could require 5% of all arable land. (Zheng & Suh, 2019)
- Toxic hazard: has similar levels of toxicity to conventional plastic (Zimmermann, 2020)
- It also takes up to **1 year** to degrade per item unless supported by nearby industrial composting facilities (Rethink Plastic, 2018) 1 year
- Often mismanaged, contaminating plastic recycling streams and ending up landfilled or incinerated (Rethink Plastic, 2018)

! **Oxo-degradable plastic** is fossil-based and fragments into micro and nano-plastic in presence of UV light or heat; banned in the EU (Zero Waste Europe, 2019) BANNED

Circular economy

REAL SOLUTIONS TO THE GLOBAL PLASTIC CRISIS

Comprehensive policy solutions addressing the petrochemical industry hold the key to reducing fossil fuel extraction and shifting our plastic production and consumption patterns. Bans on unnecessary single-use plastic are already beginning to make a mark on plastic waste generation at city, national, and regional levels, and a growing number of communities are implementing zero waste initiatives in order to maximize waste prevention and reduction through toxic-free, just, circular loops.

RECOMMENDATIONS

Produce less plastic. The petrochemical industry will not voluntarily scale back production, so public policies are required. These can include bans on single-use and other unnecessary plastics; a ban on constructing new or expanded plastic production facilities; a quantitative cap on plastic production; and a tax on plastic production. These measures would function most effectively in the framework of a global plastics treaty, given the global nature of the petrochemicals economy.

Encourage alternative service delivery models. A growing number of zero waste businesses aim to displace plastic with reusable packaging or providing services that eliminate the need for plastics.

Support recycling. To revitalize recycling, eliminate additives, mixed-polymer and mixed material plastics (e.g. sachets); mandate recycled content standards; require producer financial responsibility for post-consumer plastics; and integrate the informal sector.

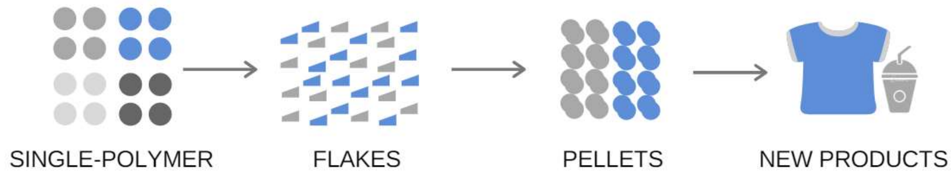
Avoid false solutions.

QUESTIONS AND ANSWERS: CHEMICAL RECYCLING

Q. How is plastic recycled?

A. Plastic is collected, sorted, washed, ground into flakes, sorted again, and then melted into pellets, which are used to make new products. This process is called "mechanical recycling." Recently, the plastics industry has been proposing the use of new technologies that they call "chemical recycling."

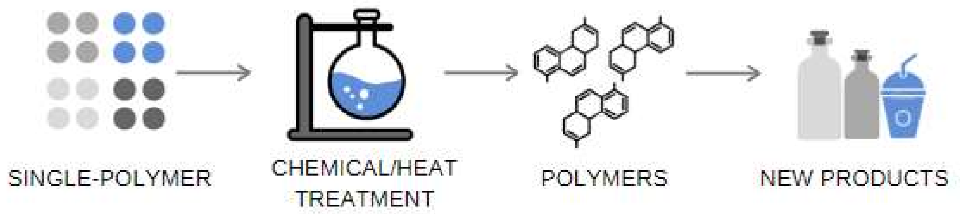
Mechanical Recycling:



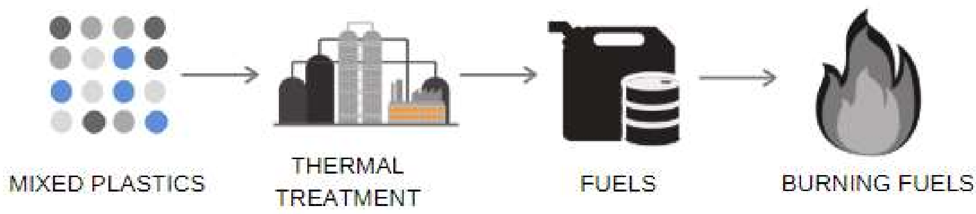
Q. What is chemical recycling?

A. "Chemical recycling" is an industry greenwash term used to lump together various plastic-to-fuel and plastic-to-plastic technologies. These processes turn plastic into liquids or gases which could be used to make new plastic but in practice are usually burned. The terms "pyrolysis", "solvolysis", and "depolymerization" are also used to refer to different technological variants of this process. **Whatever the process is called, if the end-products are burned, it's plastic-to-fuel.**

Repolymerization:



Plastic-to-Fuel:



Q. Why is it called recycling?

A. In principle, the liquids and gases can be turned back into plastic, a process which is better called "repolymerization." However, this is at present technically challenging and uneconomical. Industry uses the term "chemical recycling" to deliberately blur the distinction between recycling (plastic to plastic repolymerization) and incineration (plastic-to-fuel).

Q. Why is it important to distinguish plastic-to-plastic from plastic-to-fuel?

A. Repolymerization produces new plastic, which reduces the demand for fossil fuels, lessening the environmental impact of producing plastic. Turning plastic into fuel to be burned does nothing to address the many forms of pollution created by producing ever-increasing quantities of plastic. The European Union's Waste Framework Directive is crystal clear that producing fuels from waste cannot be labeled or counted as "recycling."

Q. Is plastic-to-fuel climate-friendly?

A. No, almost all plastic is made from oil and natural gas, so **it is still a fossil fuel**. Greenhouse gases are released in the production of plastic, in transforming it into fuel, and in burning the fuel.

Q. Are there other problems with plastic-to-fuel?

A. Plastic-to-fuel facilities are both waste and petrochemical factories, with the ensuing toxic emissions, liquid effluent, and solid waste. In addition, the plastic-derived fuel releases toxic substances when burned. Plastic-to-fuel technology is energy inefficient and costly, and has had several high-profile failures, including facility fires and explosions.

The problems of plastic-to-fuel

Q. Is repolymerization economical?

A. Repolymerization requires collecting post-consumer plastic, cleaning it, and sorting it according to polymer type and additives. This is highly expensive. Meanwhile, new polymer made from fracked natural gas is very cheap, so plastic manufacturers use new polymer rather than recycled polymer, further adding to the plastics and climate crises. Repolymerization is even more expensive than mechanical recycling, which is struggling to find markets.

Q. How does repolymerization compare with traditional (mechanical) recycling?

A. Both usually require input streams that consist of a single type of plastic (polymer). Mechanical recycling generally downgrades plastic by shortening the polymer length. It also has trouble with additives and contaminants in the plastic. Repolymerization can produce plastic that is similar in quality to new plastic. It is also more tolerant of some additives and contaminants. However, repolymerization is much more energy-intensive than mechanical recycling, resulting in greater greenhouse gas emissions.

Q. What is the operational history of "chemical recycling"?

A. Most plants that claim to do chemical recycling are turning plastic into fuel. A few pilot-scale projects do produce plastic, but they handle relatively limited inputs, not the full range of plastic waste. Many such plants use pyrolysis, which is not a new technology; it has been around for decades, but has never been technically or commercially successful. Despite the industry hype, the European Union Commission has said that repolymerization technology is at least ten years away from commercial application -- far too long to tackle the climate and pollution issues posed by plastics.

Q. What is the environmental track record for repolymerization?

A. Because the operators are not forthcoming with their emissions data, **little is known about these technologies' toxic air emissions, liquid effluent, or solid waste streams**, but they are probably comparable to other petrochemical facilities. A particular concern is the fate of contaminants and additives, including toxic metals, in the plastic, and their post-processing management. These questions will need to be impartially studied under real-world operating conditions to understand the full environmental impact of repolymerization.

Q. If "chemical recycling" is an immature technology, why are we hearing so much about it?

A. The oil, gas, and petrochemical industries are rapidly expanding plastic production; they aim to increase 40% in the next decade. To quell growing concern, they are trying to convince the public that they can clean up the plastic pollution problem with technology. This is a distraction tactic to avoid talking about the real solution, which is to stop fracking and produce less plastic, especially single-use plastic products.

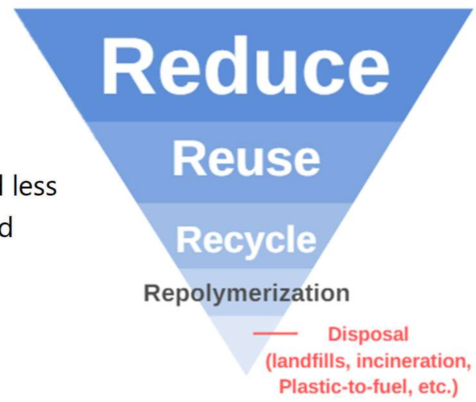
Q. Who is promoting these technologies?

A. The chemical recycling companies are pretty small, but they are financially backed by the oil and gas majors, incineration giants, and large petrochemical firms. For example, a major promoter is the Alliance to End Plastic Waste, which includes BASF, ExxonMobil, Occidental Petroleum, PepsiCo, Reliance Industries, SABIC, Shell Oil, Suez, and Veolia among others.

Q. How should "chemical recycling" be regulated?

A. Regulations should clearly distinguish between repolymerization and plastic-to-fuel. Plastic-to-fuel should be phased out, along with other fossil fuels. Repolymerization should not benefit from subsidies, regulatory incentives, or environmental deregulation. These could help it compete against preferable activities including mechanical recycling, which has a smaller carbon footprint and less toxic byproducts. Such facilities must be carefully monitored for toxic and greenhouse gas emissions, waste and effluent handling.

Repolymerization in the waste hierarchy



Q. What should we do with plastics that cannot be safely recycled?

A. Landfilling plastic is the "least bad" option; plastics in landfills are relatively inert, as long as the landfills do not burn. Incineration and plastic-to-fuel are worse; they release large quantities of greenhouse gases and toxic air emissions. Open dumping of plastic is problematic for other reasons: it creates microplastics, threats to wildlife, water pollution, and more. The real solution is to stop making so much plastic, beginning with hard-to-recycle, disposable, and single-use plastics.

So what is the real solution to the plastic problem?

Make LESS Plastic. It's that simple.

Glossary

- **Depolymerization:** One of several technologies that breaks plastic down into its constituent building blocks.
- **Effluent:** Liquid waste, generally requiring wastewater treatment.
- **Plastic-to-fuel:** A process for turning plastic into a liquid or gas that is then burned for energy.
- **Polymer:** One of several distinct types of plastic, each with its own chemical structure. Different polymers generally cannot be recycled together.
- **Pyrolysis:** The process of heating waste in the absence of oxygen to produce a liquid or gas fuel.
- **Gasification:** Similar to pyrolysis, heating waste in a low-oxygen environment.
- **Repolymerization:** The process of turning plastic waste back into plastic by breaking it down into its constituents and reconstructing the plastic polymers.
- **Solvolysis:** Technologies that use solvents to depolymerize plastic.

Resources

- **[Report]** Zero Waste Europe. (2019). El Dorado of Chemical Recycling, State of play and policy challenges.
- **[Report]** GAIA. (2017). Waste Gasification & Pyrolysis: High Risk, Low Yield Processes for Waste Management
- **[Journal article]** Rollinson, A. (2018). Fire, explosion and chemical toxicity hazards of gasification energy from waste. Journal of Loss Prevention in the Process Industries, 54, pp.273-280.
- **[Journal article]** Rollinson, A. and Oladejo, J. (2019). 'Patented blunderings', efficiency awareness, and self-sustainability claims in the pyrolysis energy from waste sector. Resources, Conservation and Recycling, 141, pp.233-242.
- **[Briefing]** GAIA. (2018). False solutions to the plastic pollution crisis
- **[Campaign]** GAIA. (2018). Say NO to Dow's Dirty Energy Bag!

This publication was made possible in part through funding support from the Plastic Solutions Fund.

Exhibit C

SUMMARY

CHEMICAL RECYCLING: A DANGEROUS DECEPTION

WHY CHEMICAL RECYCLING WON'T SOLVE THE PLASTIC POLLUTION PROBLEM

October 2023

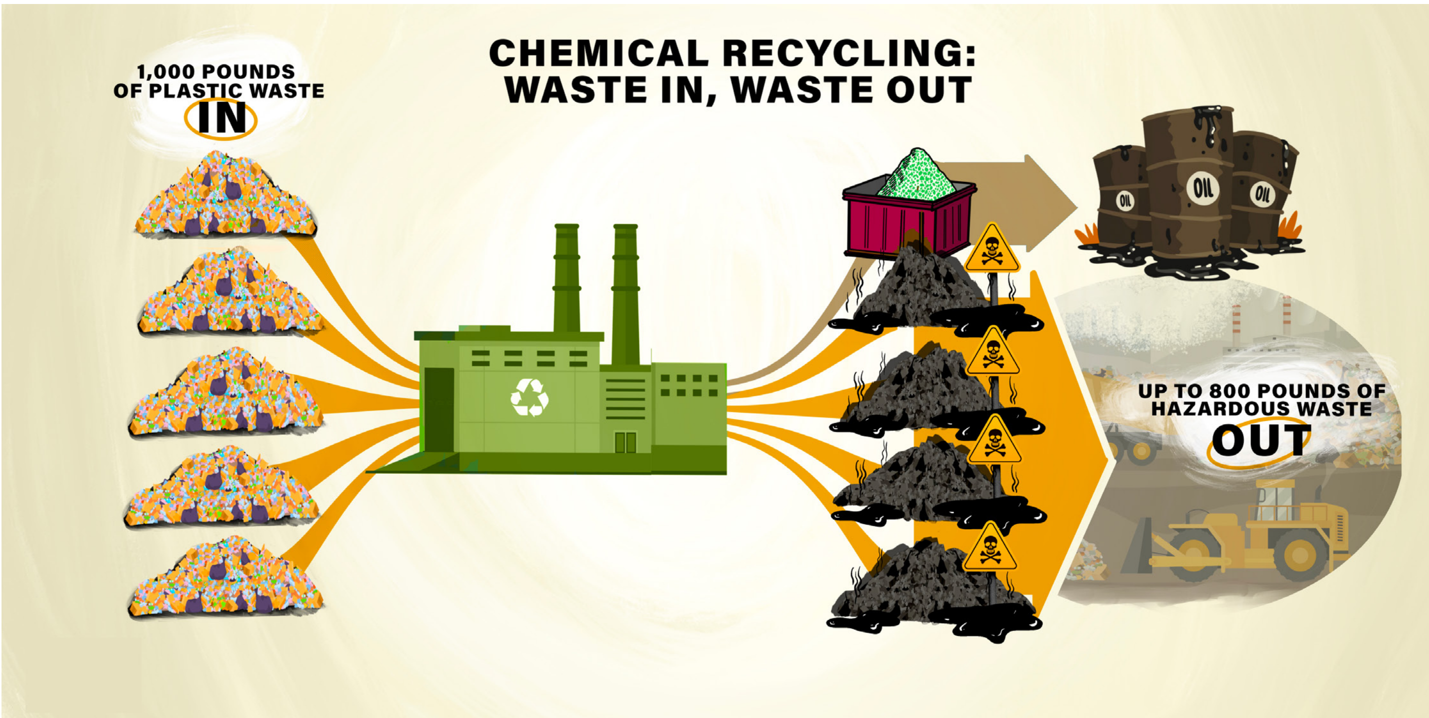
TO VIEW THE FULL REPORT, **CLICK HERE**.

BEYOND PLASTICS
BENNINGTON COLLEGE

IPEN
for a toxics-free future

KEY FINDINGS AND RECOMMENDATIONS

The report **Chemical Recycling: A Dangerous Deception** produced by IPEN and Beyond Plastics examines the plastic industry's claims that chemical recycling, also known as "advanced recycling," will play a significant role in reducing global plastic pollution. In fact, the science and data outlined in our report show that chemical recycling has failed for decades and will not contribute significantly to resolving the plastics crisis. The report exposes chemical recycling as an industry ploy to support the ongoing expansion of plastic production while causing unacceptable levels of environmental and social harm and impacts on human health, through emissions, waste generation, energy consumption, and contaminated outputs.



KEY FINDINGS

Chemical recycling is a false solution to plastic pollution. Chemical recycling has failed for decades, continues to fail, and there is no evidence that it will contribute to resolving the plastics pollution crisis.

Plastics are inherently risky to recycle. Plastics are made with toxic chemicals and when recycled, these chemicals go into the recycled plastic or product. Toxic chemicals can also be created in recycled plastics from cross contamination and heating, resulting in ongoing and often increased chemical threats to our health and the environment.

Chemical recycling is inefficient, energy-intensive, and contributes to climate change. According to U.S. government researchers, the energy needs (derived from plastic waste itself or additional fossil fuels) of chemical recycling can create as much as 100 times more damaging environmental and climate impacts than virgin plastic production.

Chemical recycling creates large amounts of toxic waste. Regardless of what products facilities are attempting to create, chemical recycling — at best — produces small amounts of usable products from large amounts of plastic waste. Typically, most of the plastics going into chemical recycling facilities will become waste (often hazardous waste), be burned as fuel, or be landfilled.

Chemical recycling is dangerous and dirty. Chemical recycling facilities release toxic emissions, create hazardous waste, and are prone to fires and explosions.

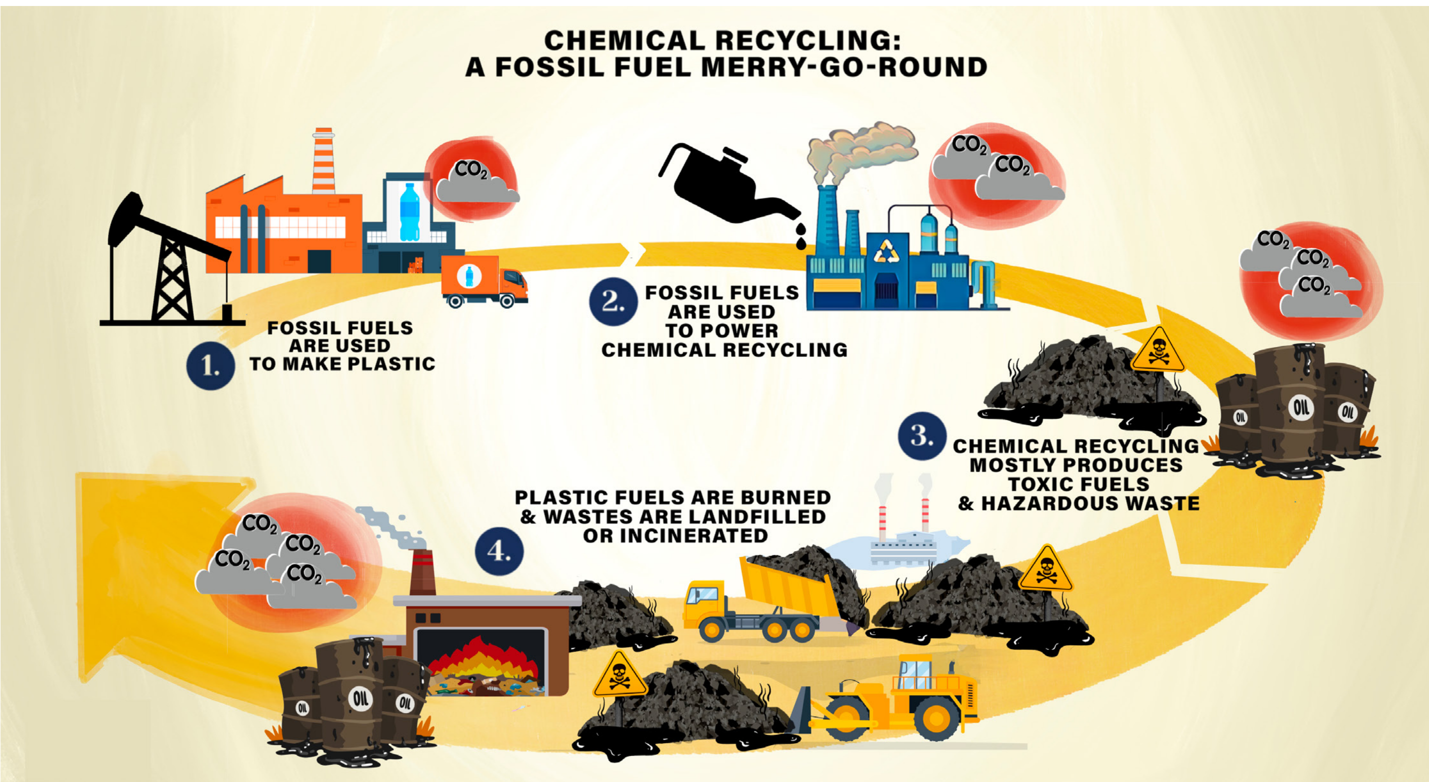
Chemical recycling will not supplement conventional (mechanical) recycling. Proponents say chemical recycling is needed for mixed plastics that are difficult to recycle mechanically, but there is no evidence that chemical recycling can economically or effectively recycle mixed plastic waste. To the extent it works at all, chemical recycling uses the same kinds of plastics as conventional recycling. Thus, chemical recycling will likely compete with, not supplement, conventional recycling.

Burning plastic as fuel is dirty and unsustainable from start to finish. These operations can create unacceptable risks to nearby communities, posing threats to environmental justice. Weak regulations will increase these health and environmental risks. Using chemical recycling to turn plastic waste into fuel creates a toxic, dirty fuel that is harmful to human health and disastrous for the climate.

Making plastic into fuel to burn is not recycling. According to internationally accepted definitions, plastic to fuel is not recycling. It is a dirty and dangerous disposal method.

Eliminating or relaxing regulations puts our health at risk. Chemical recycling facilities emit cancer-causing chemicals and substances that have been banned globally because they are among the most toxic chemicals known. Yet in the United States, many states eliminate or relax environmental and health rules to incentivize new plants, and the industry often evades federal clean air rules. Environmental justice communities that already face unequal health risks from toxic pollution will face the highest health risks from expansion of chemical recycling.

Public funds should support sustainable solutions, not chemical recycling. Government subsidies for chemical recycling are risky investments in a dirty, unproven technology. We need to support innovation for safe, clean materials to create sustainable alternatives that can replace plastics.



Prima America chemical recycling facility in Northumberland, New Hampshire. Source: Google Maps

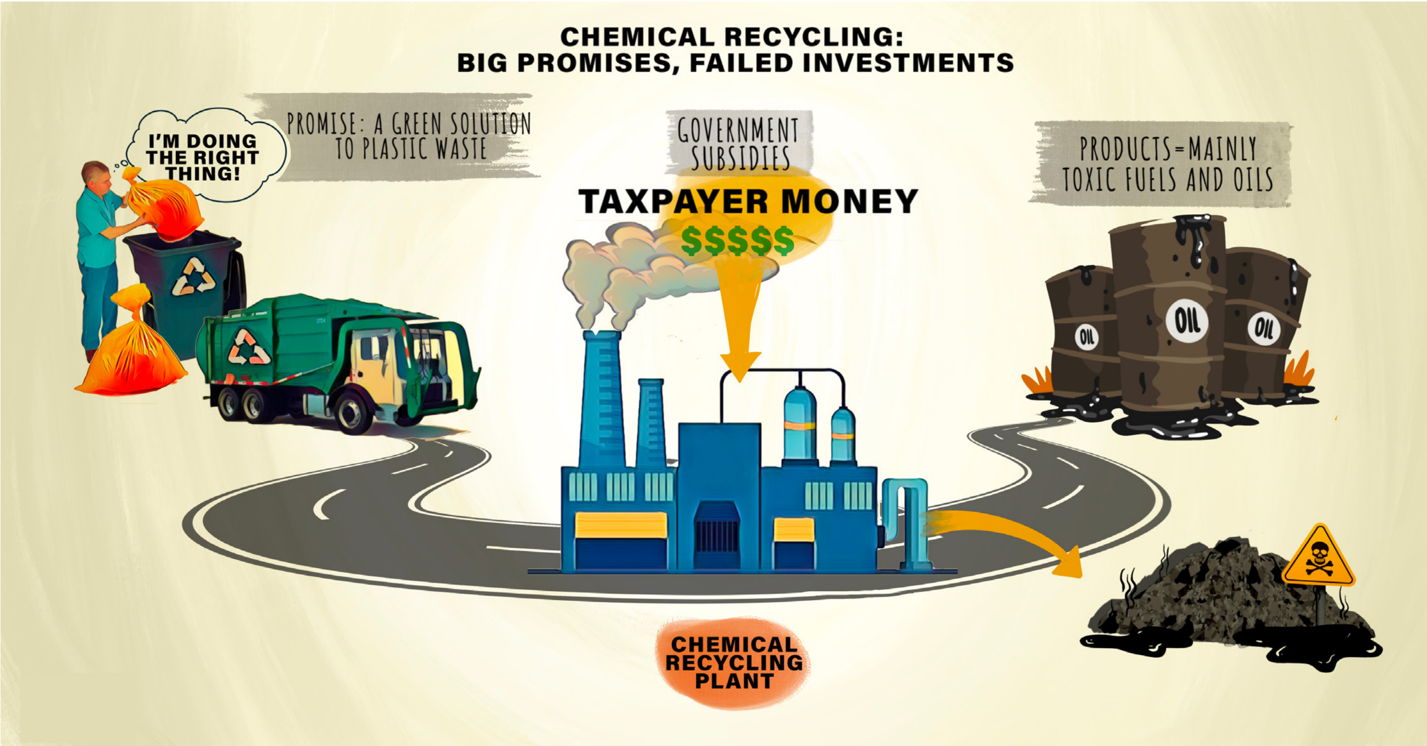
KEY FINDINGS FROM THE CASE STUDIES: FAILURE IS THE ONLY CONSTANT

As of September 2023, 11 chemical recycling facilities have been constructed in the United States. The report provides detailed case studies of each facility, exposing a long list of failures, toxic emissions, and dangerous operations. The key findings are:

1. Chemical recycling processes insignificant amounts of plastic waste.
2. Chemical recycling rarely produces recycled plastic so it is not recycling. It mostly produces low-quality fossil fuels for burning.
3. Chemical recycling harms the environment and human health and threatens already overburdened environmental justice communities.
4. Chemical recycling is expensive and risky and draws public funds that could be used for truly renewable, sustainable projects.
5. Industry secrecy makes it difficult to determine how much chemical recycling costs and its impact on public health, the environment, and managing plastic waste.
6. Companies market the technology as successful and "green" with little to no accountability.
7. While each facility takes a somewhat different approach, failure is a constant.

Some "lowlights" from the case studies include:

- A 2018 collaboration between Dow and Reynolds Consumer Products promised residents of Boise, Idaho, that their chemical recycling plant would take their plastics and recycle them into clean, green recycled plastics for reuse. The project was shuttered after the companies found that the collected plastics contained 10 times more contamination than expected.
- In 2012, a chemical recycling plant in Tigard, Oregon, opened, but today the plant has yet to prove commercially viable, and despite its low output, regulators say the operation is a "large quantity generator" of hazardous waste.
- After 10 years of testing, a Braven chemical recycling facility in Zebulon, North Carolina, is classified as a "large quantity generator" of hazardous waste, even though it remains unclear whether the plant is producing any significant outputs. A recent news investigation found numerous company misstatements to regulators and repeated environmental violations.
- In June 2020, Brightmark Energy claimed its chemical recycling plant in Ashley, Indiana, would reach a yearly plastic waste recycling capacity of 100,000 tons by early 2021. But to date the plant remains at the "test" phase, has processed just 2,000 tons of plastic waste, and has been plagued by fires, oil spills, and worker health and safety complaints.
- A 2020 statement by New Hope Energy company claimed its chemical recycling plant would process 50,000 tons of plastic waste annually, but in June 2022 a company official optimistically noted the plant was "on track" to process about one-third of this amount by the year's end.
- After a decade of testing its pyrolysis unit with different waste products, a representative for the Prima America company in Northumberland, New Hampshire, said in a 2020 interview that the company could take "all the plastic on the East Coast." But by March 2023, a plant manager admitted the facility was still in its "test" phase and noted its diesel fuel was too expensive to be sold economically.



10 RECOMMENDATIONS

1. **Declare** a national moratorium on new chemical recycling plants.
2. **Require** extensive analyses and testing of existing chemical recycling plants' toxic emissions, releases, waste residues, wastewater, output contamination levels, and fire and explosion risks.
3. **Deny** approval or permitting of chemical recycling plants if risks from their emissions or products (for example, fuels) exceed a one in 1 million excess public cancer risk.
4. **Mandate** testing of oils and other outputs from chemical recycling before they can be used as fuel or plastic feedstock to prevent widespread contamination of products and human exposure to unacceptable toxic risks.
5. **End** all federal, state, and local incentives for establishing chemical recycling plants, including public funds, subsidies, tax breaks, investment bonds, carbon credits, landfill diversion credits, and other schemes.
6. **End** siting of chemical recycling plants in environmental justice communities.
7. **Prohibit** plastic-to-fuel projects, which recreate (rather than displace) fossil fuels that pose dangers to the climate and the environment.
8. **Implement** the "polluter pays" principle and ensure that the petrochemical industry bears all financial risks of chemical recycling and the manufacture, use, and disposal of plastics.
9. **Prohibit** chemical recycling of any form to count toward recycling targets or recycled content goals in any public policy or program, including but not limited to extended producer responsibility (EPR) programs.
10. **Prohibit** use of free-allocation mass balance accounting in determining recycled content of products that incorporate chemical recycling outputs.

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for a toxics-free future

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From: Cheryl Johncox <cheryl@peopleoverpetro.org>
Sent: Monday, February 17, 2025 12:01 PM
To: CouncilMail
Subject: CB11-2025
Attachments: Howard Co. Testimony.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Good Afternoon,

Please see the attached testimony concerning CB11-2025.

--

Cheryl Johncox
Regional Coordinator
People Over Petro Coalition
740-360-0420
Schedule a meeting with me

Hello, I am Cheryl Johncox, representing The People Over Petro Coalition, and we are a coalition of 50 organizations and frontline communities who work to put our community's health and well-being over petrochemical profits. We are in favor of **CB11-2025**.

We have been researching and supporting local communities concerned about chemical recycling and the greenwashing tactics of the chemical industry to dupe communities into believing their goal is to solve the plastic pollution crisis. This is what I can tell you about this technology. Ohio is home to two of the nine chemical recycling facilities in the United States. Shareholders recently sued one company for withholding information about its inability to produce a product[1]. The other has failed its Clean Air Act stack tests multiple times over the past two years, polluting the surrounding community with cancer-causing Dioxin. Given that federal funds coming from the US EPA are frozen, and environmental regulations are on the chopping block, it is more important than ever that local governments take the necessary steps to protect their constituents.

One-quarter of the handful of facilities operating in the US have experienced fires or explosions, with one plant in Texas catching on fire four times in three years.[2] An Indiana facility caught fire twice and blanketed the town with toxic smoke.[3] Chemical/Advanced recycling, during its operation process, releases carcinogens, neurotoxicants, cardiovascular toxicants, and numerous other hazardous pollutants. More concerning is the record of spills, dioxin releases, explosions, and fires from this unproven technology.

We support **CB11-2025**, a bill prohibiting companies in PEC zones (industrial areas near residential neighborhoods) from engaging in experimental plastic "recycling" processes that could produce harmful emissions.

We demand clean air for the kids and families of Howard County. No company—present or future—should be allowed to pollute the air and put children's health at risk.

Cheryl Johncox

Regional Coordinator

People Over Petro Coalition

Cheryl@peopleoverpetro.org

[1] https://www.plasticsnews.com/news/purecycle-settles-lawsuit-claiming-misleading-statements-12m
[2] https://tylerpaper.com/news/local/fourth-fire-in-three-years-at-east-texas-plastics-recycling-plant/article_e5731ff1-e000-54cf-9781-7e5f4ddc6db9.html
[3] https://www.fastcompany.com/90913791/indiana-plastics-recycling-plant-oil-spills-fires-toxic-vapors

From: Christina Bui <DrBui@hocofootankle.com>
Sent: Monday, February 17, 2025 3:11 PM
To: CouncilMail
Subject: Testimony for February 18, 2025

Follow Up Flag: Follow up
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[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Good evening, Council Members and fellow residents. My name is Christina Bui and this is my husband Justin Edell with our newborn son, Oliver. We live in the Cedar Creek neighborhood here in Howard County. I am here today to strongly support Council Bill 11-2025 because it prioritizes the safety and well-being of our community while allowing for responsible economic growth.

As residents, we deserve to feel confident that the air we breathe and the environment we live in remain safe. CB11-2025 helps ensure this by requiring an 1,800-foot setback for research activities that need a Maryland Department of Environment air quality permit. This is a crucial safeguard, especially for families like mine and my neighbors, who want to live in a community free from unnecessary health risks. By implementing this setback, the bill strikes the right balance—allowing businesses to grow while making sure our homes, schools, and public spaces are protected.

Additionally, this legislation clarifies and restores research and development as a permitted use in Planned Employment Center (PEC) zoning districts, providing stability for businesses. However, it does so responsibly by making sure their operations do not endanger surrounding residential neighborhoods.

The unanimous recommendation from the Planning Board reinforces that this bill is the right move for our county. I urge the Council to pass CB11-2025 to protect the health and safety of residents while promoting sustainable economic growth. Let's ensure our neighborhoods remain places where families can thrive safely. Thank you.

Sent from mobile

Dr. Christina Bui, DPM, MPH
Howard County Foot & Ankle, CEO + Founder
P: 410-405-7444
Howardcountyfootandankle.com

From: ctupino@gmail.com
Sent: Monday, February 17, 2025 6:59 PM
To: CouncilMail
Subject: Testimony in Support of CB11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Members of the Howard County Council,

My name is Christine Tupino, and I am a resident of Cedar Creek, a mother, an asthmatic, and a cancer survivor. I am writing in strong support of CB11-2025 because it prioritizes public health while fostering responsible research and development.

We moved from Anne Arundel County to Howard County, specifically Columbia because of the allocates for schools and community at large such as being ranked highly as the Best City to Live in, Healthiest Community in the US and Happiest City to live in. Companies like WR Grace threaten the quality of life we have here as what they are proposing is known to be dangerous to our health and the environment, see attached article. Allowing companies like WR Grace to "recycle plastics" undermines the aforementioned values that Columbia and the County prides itself on.

As someone who has battled cancer and lives with asthma and has a heart condition, I understand firsthand how air pollution can devastate health. So called "Recycling" of plastics is known to cause and increase the likelihood of cancer, heart problems, asthma, respiratory illness and harm reproductive health due to the hormone disrupters, carcinogens, VOCs, metals, PFAS and other chemical byproducts and toxins that are released/created in "recycling" process. I cherish time outdoors with my family, but poor air quality forces us inside. Walking and enjoying nature has many health benefits and in a day and age when heart problems and disease is the number one killer, we should try and mitigate as many factors known to contribute as possible and CB11-2025 does just that. By prohibiting research involving commercial plastic pellets or flue gas-producing feedstock near residences, CB11-2025 protects families like mine from harmful emissions that worsen respiratory conditions and increase cancer risks. Companies that are known to use these processes such one in North Carolina, and that WR Grace is doing business with, promised to deliver "advanced recycling" instead delivered toxic waste and received offset and plastic credits to benefit their bottom line at the expense of the community, see attached article. Additionally, it should be mentioned with funds frozen at MDE who will oversee and make sure companies are compliant with the few regulations that do exist?

Public safety and health are of the utmost priority and can been seen at the state level in the General Assembly with proposed legislation to protect residents and the environment by banning forever chemicals such as PFAS. Howard County should do the same and demonstrate that they too value their residents' health, safety and wellbeing first and foremost.
Howard County should support innovation without compromising the health of its residents. CB11-2025 strikes a responsible balance, promoting research while ensuring clean air for our families. I urge you to vote in favor of CB11-2025.

Thank you for your time and consideration.

Sincerely,

Christine Tupino
Cedar Creek Resident

Cross Creek Drive
Columbia, MD

Reference: [They Promised "Advanced Recycling" for Plastics and Delivered Toxic Waste]

From:	Dave Arndt <roseca2010@gmail.com>
Sent:	Monday, February 17, 2025 8:55 AM
To:	CouncilMail
Subject:	Testimony for CB11-2025
Attachments:	WR Grace County Permit .pdf; WR Grace Testimony for Howard Co Feb18 Hearing .pdf
Follow Up Flag:	Follow up
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[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Hello,

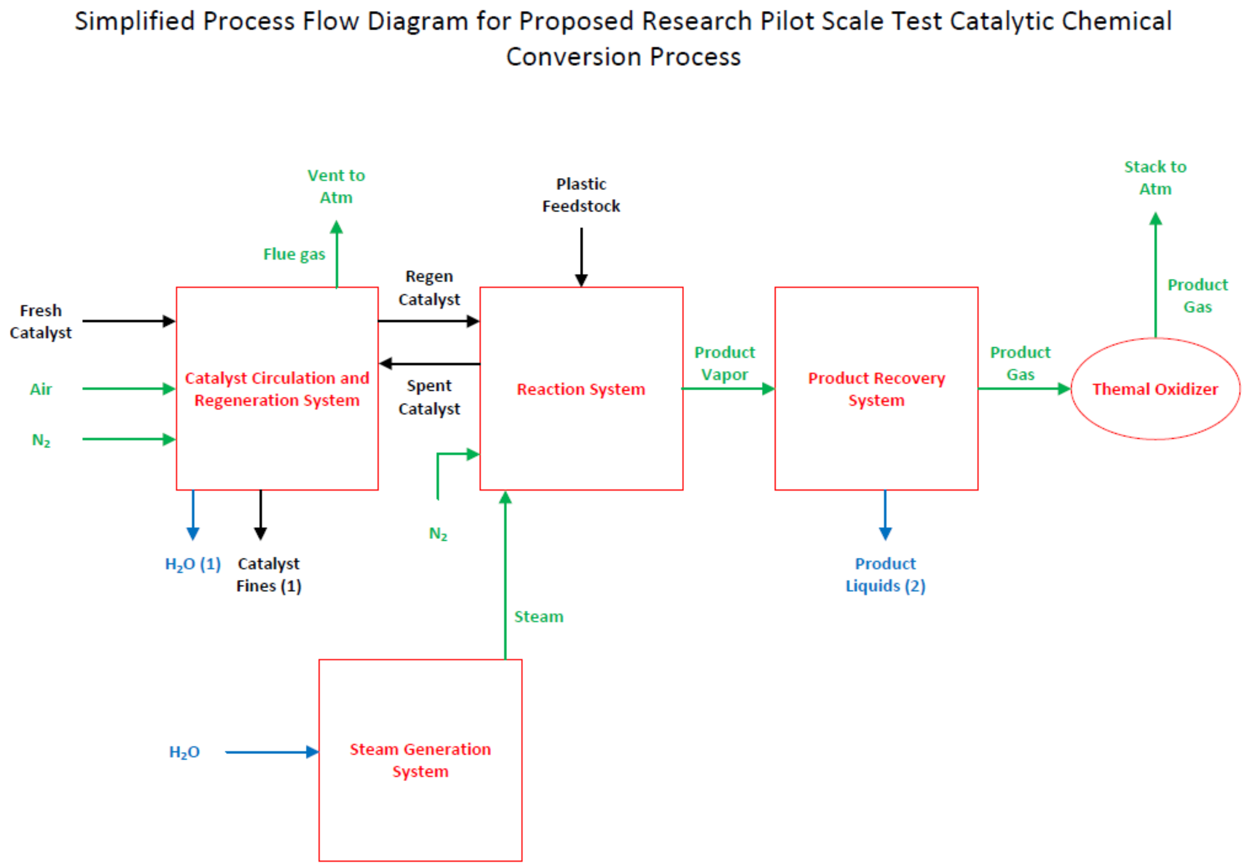
Attached is my favorable testimony for CB11-2025.

If you have any questions or comments, please let me know.

Kind Regards,
Dave

Dave Arndt
roseca2010@gmail.com
240-328-7383
Co-Chair MLC Climate Justice Wing

Submission of comment for WR Grace MDE Permit – Docket #16-23



I have several issue and comments that need to be addressed with this application.

1. **The operation of the Flameless Thermal Oxidizer**

By definition a Flameless Thermal Oxidizer is an incinerator. It performs the same task whether a flame is present or not. Basically, this is a combustion process. Combustion typically requires the presence of a source of carbon, the oxidant, and the presence of sufficient energy. A flame is not necessary for combustion because, if the temperature of a material is raised significantly it can "autoignite" and there is no need for a separate ignition source. And we know oxygen is present because of the emissions of CO2 and H2O.

Flameless Thermal Oxidation is a destructive technology for off-gas treatment of volatile organic compounds(VOCs) and semi-volatile organic compounds (SVOCs). The process converts aromatic and chlorinated VOCs to carbon dioxide, water, and hydrogen chloride without exposing the vapors to a flame. The technology achieves uniform thermal oxidation of VOCs using a heated packed-bed reactor filled with ceramic pieces. The vapors are oxidized when they come into contact with the heated bed of ceramic pieces. Temperatures are typically maintained at 1600°-1850° Fahrenheit.

Limitations and Concerns for this incinerator

Products of incomplete combustion (PICs), which could be emitted to the atmosphere, are a major concern with this technology. Oxidations vary in temperature. The flameless oxidizer provides a controllable uniform heating zone to control this variable. However, temperature variation is only one culprit in the formation of PICs.

Dioxins and furans are unavoidably created in the oxidation process. Unless they are further captured, they are emitted to the environment. Dioxins are highly toxic and can cause cancer, reproductive and developmental problems, damage to the immune system, and can interfere with hormones. Some dioxins and furans are toxic in the parts per trillion range.

WR Grace has stated that the materials that they are going to feed into their reactor are "hard to recycle" plastics, resin identification code 1-7. These plastics have been found to include the following items which have been documented to be released in incineration emissions:

PFAS, Bisphenols, Phthalates, Chlorine, Florine, Lead, Cadmium, Selenium, Benzene, 1,2-dichloroethane, Chromium, Vinyl chloride, Barium, Styrene, Benzene, Toluene, Mercury, Arsenic, Dioxins, Ethyl benzene, Xylenes, Naphthalene, Acetaldehyde, Formaldehyde, Hydrochloric acid, Methanol, Hexane and PM2.5. Please note that this is not an all-inclusive list, there may be other compounds released depending on the plastic feedstock being used.

WR Grace only presents that 0.218 lb of VOCs will be emitted daily, however that don't give the chemical make up of the VOCs being emitted. Some VOCs are highly carcinogenic and even at that volume should not be release to the public.

There are a lot of estimation for emission by WR Grace in their application, however there is very limited monitoring. And since this is a pilot operation that WR Grace is going to learn from, emissions need to be monitored at all times. Items to be monitored for are all the contaminates I listed previously in this document. Plus, WR Grace need to proactively report daily emissions rates to the public and have documented shut down procedures that need to go into effect when emissions surpass the limits allowed by Maryland law.

2. The catalyst cleaning operation with vent to outside

The catalyst cleaning operation with vent to outside has very little documentation and WR Grace needs to provide further information. We know that WR Grace will be cleaning deposits off of the catalyst via combustions however they do not document what the deposits are made of. So here again, by definition, they are using an incinerator without an EPA permit or a MDE permit to operate. Plus, since the only description we have is "Regenerator hot combustion flue gas will be treated prior to venting to the atmosphere. The flue gas will go through a knock-out filter pot", we have to assume it is composed of the same plastic material that goes through the Thermal oxidizer, therefore it needs all of the same monitoring, reporting and shut down procedures as recommended for the thermal oxidizer.

3. Liquid Product Disposal

WR Grace gives no description of the makeup of their liquid product which is described as potentially usable energy-containing liquids. This itself must be assumed to be a highly toxic/cacogenic mixture that needs to be highly monitored and reported on. Basically, WR Grace states that the collected liquid will be transferred, daily, to 55-gal drums in the warehouse, and ultimately shipped to a 3rd party waste treatment facility. This is not adequate reporting. Every drop needs to be accounted for, plus shipment dates and times, method of shipment and name of the treatment facility must be documented. Therefore, a hazardous liquid permit must also be obtained before operations can begin.

4. **More information needs to be presented on their lab-bench prototype**

WR Grace has stated that this Research Pilot Scale is based off of lab experiments, however they have not given any details of these lab experiments. For example, how long did it operate, how did they monitor the emissions, did they use virgin plastics or plastics found in the real world. Unfortunately, we have found that self-regulation does not work and this type of information is essential to see if their design is trustworthy.

5. **We need a Howard County test plan**

Since there are so many unknowns about the emissions and disposal of waste, we need a Howard County test plan to monitor and inspect the operations. This should include a once-a-year scheduled inspection and a once-a-year unschooled inspection. The test plan also needs to include reporting on usage volumes and emissions and a community notification plan. Finally, it needs to include stringent shutdown requirements and penalties for non-compliance.

Hello, my name is Dave Arndt, a resident of Baltimore MD, a chemical engineer, a retiree of The National Institutes of Health and a Co-Chair of the Maryland Legislative Coalition – Climate Justice Wing, a group of 30 grass root organization throughout Maryland, focused on Maryland state climate policy through an equity lens.

Overall, looking strictly on advancing their project, WR Grace is following the proper process of scaling up a lab experiment to a R&D pilot operation, however in their permit application, they have made a lot of assumptions. These need to be proven in their scaled-up process, however they don't appear to have any procedures in place to test and verify if their assumptions are correct. Also, if their assumptions are wrong, they don't appear to have shut down plans and community notifications plans of the possible dangers.

Let's take a look at possible issues:

WR Grace has stated that the materials that they are going to feed into their reactor are "hard to recycle" plastics, resin identification code 1-7. You might think, what is the big deal, we handle these plastic products daily. However, making things out of plastics is like playing a game with molecules. The aim is to re-organize them into new shapes without their changing color, sticking to the mold, or doing anything that could spoil the finished article. Additives help with all these problems. In fact, processing plastics without additives is virtually impossible. Additives come in 19 different categories defined by their purpose and in each category, there may be 100s of compounds. By the way, I worked at the world largest polyester plant where I saw them being used for production from catalysts, lubricants, Flame Retardants and Stabilizers, most are added at the request of customers. By the way most beverage containers are made from polyester.

Plastics included in code 1-7 have been found to include the following items which have been documented to be released in incineration emissions:

PFAS, Bisphenols, Phthalates, Chlorine, Florine, Lead, Cadmium, Selenium, Benzene, Chromium, Vinyl chloride, Benzene, Toluene, Mercury, Arsenic, Dioxins, Formaldehyde, Hexane and PM2.5. Please note that this is not an all-inclusive list, there may be other compounds released depending on the plastic feedstock being used. Many of these compounds are known carcinogens, others are known to cause brain development issues and items like PFAS, we are just beginning to understand their effects, the EPA is just now putting restriction on PFAS in drinking water.

Please note that additives are found in virgin plastic feedstock, WR Grace's phase one of test, they are part of the manufacturing process and are not something that contaminates them in the pickup and recycling process. Furthermore, if they go to phase two, pelletized recycled plastics will just have more variable amounts of additives and concentrations may change dramatically with each batch run.

Also, new data suggest that black plastic cookware, typically made in China has recycled plastic from computer circuit boards, making even cooking with them dangerous. There is nothing preventing WR Grace from using these materials.

The design of their reactor is to use a Flameless Thermal Oxidizer, which by definition is an incinerator.

Dioxins and furans are unavoidably created in the oxidation process. Unless they are further captured, they are emitted to the environment. Dioxins are highly toxic and can cause cancer, reproductive and developmental problems, damage to the immune system, and can interfere with hormones. Some dioxins and furans are toxic in the parts per trillion range.

WR Grace has stated that this Research Pilot Scale is based off of lab experiments, however they have not given any details of these lab experiments. For example, how long did it operate, how did they monitor the emissions, did they use virgin plastics or plastics found in the real world, what plastic codes did they use?. Unfortunately, we have found that self-regulation does not work and this type of information is essential to see if their design is trustworthy.

There are a lot of estimation for emission by WR Grace in their application, however there is very limited monitoring. And since this is a pilot operation that WR Grace is going to learn from, emissions need to be monitored at all times. Items to be monitored for are all the contaminates I listed previously in this document.

What I just talked about was only one of their processes in their design. There is also a catalyst cleaning operation, which can also be classified as an incinerator, with venting to the outside, this process has even less documentation, however it has the same concerns as above.

Even though documentation from the EPA and MDE admits these are incineration units, both agencies have declined to prevent the operation of this pilot operation on a technicality since they plan to “burn samples of materials only for the purpose of chemical or physical analysis.” This mean, go ahead and incinerate, just don’t sell the end use product. Since this unit is operated for the sole purpose of research, there are no regulations around monitoring and reporting. Basically, the whole operation is self-regulated and it is up to WR Grace to keep the residents around their facility safe.

Make no mistake, this is an incineration process that will produces deadly compounds, fires, explosions, accidents and leaks, can happen. Unfortunately, we all have seen that time and time again that self-regulation does not work. Unless the county or neighbors put up monitors is now way to know what if any this is being emitted is benign or cancerous.

WR Grace claims that they have emissions control system that monitors air emissions and that if something goes wrong, they will shut down their system. But what are they actually monitoring for? All of the dangerous compounds that could be emitted from their incinerator? Remember that some of the possible emissions have no save levels, especially for children. Will they allow the public to review and adjust their procedures? Will they notify the public that they needed to shut down.

Since the EPA and MDE are allowing another sacrifice zone in Maryland, please do your part in ensuring clean air for your kids and community by adopting CB11-2025.

Thank you for your time.

Dave Arndt

Co-Chair MLC Climate Justice Wing

From: Shamieka Preston <snixon2993@gmail.com>
Sent: Monday, February 17, 2025 1:16 PM
To: CouncilMail
Cc: ICE Justin Preston
Subject: Fwd: submission in support of CB11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Hi, my name is Dawson and I'm 12 years old. I am here because I support Bill CB11-2025.

I want to talk about how this new plant might affect kids and families who live around here. I've made great friends at school, and my family and I were excited to start a new chapter here. But, if there's a plant so close by that's causing worries about air quality and the environment, people might decide to move away or avoid this area altogether.

For me, that would mean losing friends I see every day, maybe even having to move myself if my parents feel it's unsafe. My parents have already had to think twice about inviting Grandma to come live with us because we're just not sure how safe it will be in the long run.

I know my friends and their families care about clean air, green spaces, and a healthy place to grow up. If we lose those things, then Columbia won't feel like the community we hoped it would be.

Thank you for voting for CB11-2025.

Dawson Preston, Cedar Creek resident

From: coffee316@everyactioncustom.com on behalf of Eileen Coffee <coffee316@everyactioncustom.com>
Sent: Monday, February 17, 2025 3:25 PM
To: CouncilMail
Subject: Support CB11-2025 for a safe buffer between WR Grace and surrounding neighborhoods

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Howard County Council,

As a Marylander, I'm deeply concerned by W.R. Grace's proposed "advanced recycling" pilot plant. This plant would spew carcinogenic air pollution just 70 meters from local homes in the Cedar Creek neighborhood of Columbia, Maryland.

Let's be clear. "Advanced recycling" is neither advanced nor recycling. This is just a misleading term for burning plastic waste and turning our plastic pollution problem into an air pollution problem. Read more about this harmful practice here:
https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.momscleanairforce.org%2Fresources%2Fchemical-recycling-101%2F&data=05%7C02%7Cianderson%40howardcountymd.gov%7C6144a0b569a14b65120c08dd4f911ede%7C0538130803664bb7a95b95304bd11a58%7C1%7C0%7C638754206920011899%7CUnknown%7CTWFpbGZsb3d8eyJFbXB0eU1hcGkiOnRydWUsIlYiOiIwLjAuMDAwMCIsIlAiOiJXaW4zMiIsIkFOIjoiTWFpbCIsIldUIjoyfQ%3D%3D%7C0%7C%7C%7C&sdata=apjbLRrM474iBq4OnisrmAvH92cvb5081EiO0mvnI7A%3D&reserved=0

I urge you to support CB11-2025 to ensure a safe buffer between corporations like W.R. Grace conducting research and development (R&D) and residential neighborhoods.

This proposed facility not only will spew cancerous air pollution, but also is susceptible to fires, explosions, accidents, leaks, and more due to its experimental nature. Residents must be protected from these potential catastrophes by ensuring a safe buffer.

It is crucial that the Howard County Council listens to concerned community members and holds W.R. Grace accountable to public health standards. Please do not set the precedent that chemical companies and serial polluters like W.R. Grace can freely pollute and harm our communities. If this can happen in Cedar Creek, it can happen anywhere. Please protect Maryland families and keep our state safe.

Sincerely,
Eileen Coffee
403 Devonshire Ct Aberdeen, MD 21001-1948 coffee316@comcast.net

From: Farnoush Allen <drfaraallen@gmail.com>
Sent: Monday, February 17, 2025 5:23 PM
To: CouncilMail
Subject: CB11-2025

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dr. Farnoush and Richard Allen
7984 Lawndale Circle
Columbia, MD 21044
Cell 410-241-0663

My name is Fara Allen, and I am testifying *in favor of* CB11-2025.

My home in Cedar Creek, built over two years ago, stands about 120 feet from Grace's multiple exhaust pipes protruding from the ground.

We moved to Cedar Creek from our exceptional home near Connecticut Avenue, primarily to escape traffic pollution.

For years, I was one of the very few oral surgeons and dentists who routinely provided care to the needy in D.C. while also running my own practice.

By relocating to Columbia, I aimed to be close to the MSDA projects, focusing on underserved children in Howard County. I also hoped to be near the College of Oral Surgery, especially after selling my practice, and to continue my work as Dean's faculty, an unpaid position.

Our health has significantly declined since moving near Grace's exhaust pipes, which were initially buried in the greens and were only painted white after a year.

I suffer from occipital and trigeminal neuralgia due to a faulty medical procedure performed by an orthopedist in Columbia many years ago.

Our discoveries about Grace have tremendously aggravated my neuralgia and my husband's early-onset Parkinson's symptoms.

For many days during the warm season,, an individual used to drive around in a cart, checking the locks and fences surrounding Grace, which display intimidating signs like "Under Surveillance" and "Violators Will Be Prosecuted." These fences were also installed by Grace over a year after we had moved in.

We now see technicians adding on to the existing exhaust pipes.

My family, friends and especially children have expressed disappointment in our surprising decision to build so close to Grace. They no longer leave the grandkids with us, worried that the air and soil may already be contaminated and that, in the event of a fire or industrial accident, we wouldn't have enough time to escape safely.

Given Grace's criminal history, we live in constant anxiety—not only about the noise and the exhaust pipes but also about possible explosions, leaks, and unknown hazards.

Neither my husband, an Army veteran, nor I can tolerate breathing not only toxic but also poor-quality air.

I believe everyone should read *A Civil Action*, the book documenting a lawsuit against Grace; it was part of my son's law school curriculum 20 years ago.

We are strongly for CB11-2025.

Thank you for your consideration,

Farnoush Allen

From: Francis Jung <jungfrancis@gmail.com>
Sent: Monday, February 17, 2025 9:26 PM
To: CouncilMail
Subject: Testimony for CB11-2025
Attachments: antioxidants-10-01787.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Council Members,

I am a resident of the cedar creek community. I also work as a physical therapist in Columbia Maryland to help clients to improve cardiovascular fitness. I am submitting this written testimony in support of CB 11-2025 for safety of Howard County residents near Grace Chemical company.

Howard County's vision is to be a model of communities to foster health equality and wellness & safety for all the residents or visitors to safely live, work or play. Allowing chemical company, WR Grace, to do harmful chemical burning right next to resident communities does not seem to align with what Howard County is promoting for their vision statements for health and safety.

In general, physical activity promotes improved overall health, and positively impacts mental health, quality of life, cognitive function, and healthy weight. However, we are in danger of having basic rights to conduct physical activities outside of our own resident if Grace is permitted to do harmful experiments. This will exponentially increase risk of cardiovascular function causing increased inflammation, increased oxidative stress and its response. Its relative risk odd ratio significantly increases to anyone who perform physical activities outside, but more susceptible to children and elderly with preexisting illness.

For this reason, providing appropriate measures of environmental factors controlling air pollution near residential communities is very important for local council members and policy makers to protect residents according to current evidence and guidance of the World Health Organization. I strongly urge council members to pass this important bill.

Thank you for your time.

--
Francis C Jung, PT, DPT
Clinical Director, Columbia Physical Therapy In Motion
Physical Therapist, Doctor of Physical Therapy
****
OCS, CVR, Cert. MDT, COMT, CMTPT, FAAOMPT
Orthopedic Clinical Specialist in Physical Therapy

Certified Vestibular Rehabilitation Specialist
Certified McKenzie & Mailtand Method Provider
Certified Manual Trigger Point Release & Dry Needling Provider
Fellow of The American Academy of Orthopedic Manual Physical Therapists

"Grant me the courage to change the things that I can,
the strength to accept those that I can't,
and the wisdom to know the difference."

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From: aduasa99@gmail.com
Sent: Monday, February 17, 2025 12:11 AM
To: CouncilMail
Cc: Snixon2993@gmail.com; 'Ama :-) Wk Cell Adadey'; aduasa99@gmail.com; aduasa622@outlook.com; 'Aisha Hasan'
Subject: Support of CB11-2025
Attachments: ZAR _Golash testimony_2-18-2025_sp_ga.docx

Importance: High

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Council members,
I have attached my statement in support of bill CB11-2025 that is dear to my heart.

Golash's Testimony

I am Golash Adadey, and I support CB11-2025. I live on Mainstream Way in Cedar Creek Neighborhood in Columbia, MD. My house is 229 feet from W.R. Grace. There is **no buffer** between Grace and my house. The photos I gave you show how close my house is to Grace.

From day one we moved to Cedar Creek community in December 2021; I hear noise from Grace around the clock from whatever R&D they are doing now. I immediately contacted the Site Manage at WR Grace in January 2022 to complain about the noise, A few days later, I received an email from the Site Manage that there was a defective exhaust system and that had been fixed to reduce the noise. However, you can still hear this noise 24/7. I also smell an odor scent in our basement. ***Operations like Grace's that involve chemical processing, waste management, or incineration produce noticeable noise and odors are bad for residential neighborhoods like us. Persistent exposure to these factors***, especially at close range, could affect quality of life and cause stress and respiratory illness. I suffer from asthma, and I inhale almost every night. This is all happening **BEFORE** Grace has even started their plastic project. The noise, odor, and health issues may be worse once the plastic project starts. Please stop this project in our neighborhood.

For health and safety reasons, it is imperative that Howard County **and Grace move their R & D projects to their manufacturing site.**

A recent example of dark plumes of smoke and off-gassing of chemicals resulting in shelter-in-place for nearby residents was in the BioLab Conyers Fire and Chemical accident in Georgia last year or **the chemical explosion that on November 12, 2024, in Louisville, KY, injuring eleven people and requiring shelter in place for several hours.** If Grace had an accident like this next to Cedar Creek, the noise, smoke, off-gassing, odors, carcinogens, and chemicals that would be inserted into the air would be catastrophic for my house 229 feet from Grace. About half our population are children. And about 80% of us are minorities.

In 2023, the hydrogen fluoride and chlorine leak at Honeywell's Carville facility in Louisiana resulted in shelter-in-place orders for nearby residents. This plant, located close to residential areas.

Philadelphia Energy Solutions refinery had a fire and explosion which sent hazardous chemicals in the air over South Philadelphia, a densely populated area. Residents are **still** voicing concerns about long-term health risks due to benzene and other pollutants.

Benzene is a carcinogen that Grace says will be an air emission in their plastic project.

I implore you, Howard County Council members, to keep families like mine, who are a stone's throw away from Grace with **no buffer**, and others in Cedar Creek neighborhood and surrounding neighborhoods safe from potential chemical companies' R&D explosions, fires, leaks, accidents, noise, and odors. **We can't even open our bedroom windows since we moved here, because we are scared of the air that we will breathe.**

Please approve the bill CB11-2025 so that companies like Grace can complete their R&D somewhere else and neighborhoods like Cedar Creek can be safe.

Sources for the Howard County Council members

- BioLab Chemical Facility fire/accident in Georgia this year: https://www.ems1.com/hazmat/shelter-in-place-order-extended-indefinitely-during-ga-chemical-plant-fire

- Honeywell Facility Accident in Louisiana: https://www.csb.gov/us-chemical-safety-board-launches-investigation-into-another-release-of-toxic-hydrofluoric-acid-at-honeywell-facility-in-geismar-louisiana/

- Fire and Explosions at Philadelphia Energy Solutions Refinery: https://www.csb.gov/assets/1/20/pes_final_report_published_october_2022_r1.pdf?16845

- W R Grace docket 16-23, benzene reference pages 35 and 36: https://mde.maryland.gov/programs/permits/AirManagementPermits/Documents/Public-Review/new%20public%20review%20documents/WR%20Grace%20Combined%20init%20and%20Sub%201%20and%202%2016-23.pdf

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- Fire and Explosions at Philadelphia Energy Solutions Refinery: https://www.csb.gov/assets/1/20/pes_final_report_published_october_2022_r1.pdf?16845

- W R Grace docket 16-23, benzene reference pages 35 and 36: https://mde.maryland.gov/programs/permits/AirManagementPermits/Documents/Public-Review/new%20public%20review%20documents/WR%20Grace%20Combined%20init%20and%20Sub%201%20and%202%2016-23.pdf

From: Jeff Dwyer <jeff.w.dwyer@gmail.com>
Sent: Monday, February 17, 2025 11:32 AM
To: CouncilMail
Subject: Testimony for hearing on CB11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Good evening, council members, and everyone in attendance.

Many of our neighbors have already outlined the technical risks and potential environmental and health impacts of this project, so I won't repeat them. Instead, I want to focus on what their testimony reflects: a deep, widespread concern among residents who believe this project threatens the well-being of their families and their community. These concerns are not abstract—they are real, they are well-founded, and they deserve serious consideration.

I am not here to debate the well-credentialed employees of WR Grace who have also spoken tonight. Instead, I want to speak directly to you, the county council—not just as our elected officials, but as people who were once in our position, looking for a place to call home and choosing to put down roots in this community.

Columbia is consistently recognized as one of the best places to live and raise a family in the United States. This reputation extends beyond our state, reaching across the country and even beyond our borders. Just in my neighborhood of Cedar Creek, we had neighbors who moved here from California, Florida, and even Canada. That's not accidental. It's the result of deliberate choices made by local leaders who have prioritized the health, safety, and well-being of our community. A key part of what makes Columbia special is its commitment to environmental stewardship—a principle that has guided its development and remains central to its identity today.

Many of us moved here for exactly this reason—to live in a community that values sustainability, prioritizes public health, and maintains a strong local government that upholds these commitments. But what makes Columbia truly special isn't just the policies that shape it—it's the people who choose to invest in it.

Those you see before you today are not passive residents; we are engaged members of this community. We send our children to local schools and participate in the PTA, shop at neighborhood businesses, and serve in roles that make Columbia stronger. We are teachers shaping the next generation in county classrooms, nurses and doctors caring for residents in local hospitals, public servants working in local government offices, and small business owners taking the leap to build a better life for their family here in this area. And yes, we also take the time to show up on Tuesday nights to participate in zoning board and county council meetings—because we care about the future of this place. I don't say these things in an attempt to curry favor or ask for preferential treatment, but to highlight what an engaged, invested community looks like.

We understand that economic development plays a crucial role in Columbia's success, and we support responsible growth that aligns with the values that make this community thrive. But economic growth should never come at even the slightest expense to health or safety. Columbia's success has always been built on balance—between progress and preservation, between innovation and responsibility.

When we moved here, we did so with trust in our local institutions and their commitment to protecting the quality of life for all residents. That trust is now being tested. In a time when faith in government institutions has been shaken—especially given recent events at the federal level—your leadership at the local level matters more than ever.

We urge you to uphold the values that have made Columbia what it is—not just in words, but in action. Zoning decisions should reflect the long-term interests of the community, safeguarding the health and well-being of both current and future residents. We ask you to take the necessary steps to protect the neighborhoods that would be most directly affected—Cedar Creek, Simpsonville, and River Hill—as well as any future communities that could face similar threats from projects like this.

Thank you for your time and consideration.

From: ksteranka3@everyactioncustom.com on behalf of kathleen steranka <ksteranka3@everyactioncustom.com>
Sent: Monday, February 17, 2025 4:41 PM
To: CouncilMail
Subject: Support CB11-2025 for a safe buffer between WR Grace and surrounding neighborhoods

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Howard County Council,

As a Marylander, I'm deeply concerned by W.R. Grace's proposed "advanced recycling" pilot plant. This plant would spew carcinogenic air pollution just 70 meters from local homes in the Cedar Creek neighborhood of Columbia, Maryland.

Let's be clear. "Advanced recycling" is neither advanced nor recycling. This is just a misleading term for burning plastic waste and turning our plastic pollution problem into an air pollution problem. Read more about this harmful practice here:
https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.momscleanairforce.org%2Fresources%2Fchemical-recycling-101%2F&data=05%7C02%7Cianderson%40howardcountymd.gov%7C995be0068e1b427d571f08dd4f9bd0e4%7C0538130803664bb7a95b95304bd11a58%7C1%7C0%7C638754252844520708%7CUnknown%7CTWFpbGZsb3d8eyJFbXB0eU1hcGkiOnRydWUsIlYiOiIwLjAuMDAwMCIsIlAiOiJXaW4zMiIsIkFOIjoiTWFpbCIsIldUIjoyfQ%3D%3D%7C0%7C%7C%7C&sdata=Dag1BP7PIJ6q6XRKUVCmEg82s0Sd5toH96HjaVB%2BsCI%3D&reserved=0

I urge you to support CB11-2025 to ensure a safe buffer between corporations like W.R. Grace conducting research and development (R&D) and residential neighborhoods.

This proposed facility not only will spew cancerous air pollution, but also is susceptible to fires, explosions, accidents, leaks, and more due to its experimental nature. Residents must be protected from these potential catastrophes by ensuring a safe buffer.

It is crucial that the Howard County Council listens to concerned community members and holds W.R. Grace accountable to public health standards. Please do not set the precedent that chemical companies and serial polluters like W.R. Grace can freely pollute and harm our communities. If this can happen in Cedar Creek, it can happen anywhere. Please protect Maryland families and keep our state safe.

Sincerely,
kathleen steranka
2265 Ballard Way Ellicott City, MD 21042-1712 ksteranka3@gmail.com

From: Leonard Boyd <leonard.boyd@gmail.com>
Sent: Monday, February 17, 2025 1:52 PM
To: CouncilMail
Cc: Walsh, Elizabeth; Jones, Opel; Jung, Debra; Rigby, Christiana
Subject: Testimony in Support for CB11-2025
Attachments: Testimony in Support for CB11-2025.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

To whom it may concern,

Please find below in the body of this email and attached as a PDF for your convenience and reference, my testimony in support for CB11-2025.

My name is Leonard Boyd, and I am a resident of the Cedar Creek neighborhood in Howard County, MD and I am submitting this written testimony in support of CB11-2025. My understanding is that this bill will allow entities in a Planned Employment Center (PEC) to perform research and development but prohibit testing involving commercial plastic pellets or feedstock.

My family began searching for a new home in 2021, looking for more space for our two children, now ages 11 and 8, and to accommodate aging parents if needed. We chose Cedar Creek, a new development by NVHomes near Cedar Lane and Sanner Roads, adjacent to the River Hill community and W.R. Grace's corporate headquarters. We were assured that this Grace location was primarily administrative. In June 2021, we purchased our home near the W.R. Grace property, moving in by February 2022.

Soon after moving in, we noticed issues due to our proximity to W.R. Grace. At night, we began hearing a loud industrial fan from their property. With the trees thinned in winter, the sound became even more pronounced, and we could clearly see the Grace buildings from our home. I mention this not to complain about the noise, but to illustrate just how close their facility is to our home.

Our children became curious about what they call the "secret lair," but this raised safety concerns, as the fence separating W.R. Grace from our property was down in certain areas due to fallen trees. Although the fence has since been repaired, the facility's presence remains unsettling, with eerie lights and unusual patrols. I've included unedited and unenhanced photographs from our back porch to illustrate just how visible and close the Grace facility is, carrying out all-too-real activities and potentially posing real dangers. I reiterate the facility is less than 120 yards from our back porch.

When news of manufacturing accidents, like the recent one in Louisville, Kentucky, surfaces, it becomes harder to reassure my children of their safety. I considered bringing them today to testify in their own words, but I worried that this might heighten their anxiety. In the event of a disaster, would we have time to evacuate? And if we were forced to leave, would we even have homes to come back to?

The Grace proposed facility is simply too close to residential housing. I can see inside the facility most mornings. Aside from the physical health concerns, for my kids and I to live in fear of a catastrophic event, takes quite a mental toll. Let’s keep Howard County family friendly and out of the news. Let's support the future mental and physical health of our children. Please support CB11-2025.

Thank you for your time and consideration,

Leonard A. Boyd
7244 Mainstream Way
Columbia, Maryland 21044
Howard County Resident
Concerned Citizen

Exhibit 1
An Unenhanced Picture of the W.R. Grace Facility from my back porch during the day.

Exhibit 2
An Unenhanced Picture of the W.R. Grace Facility from my back porch at night.

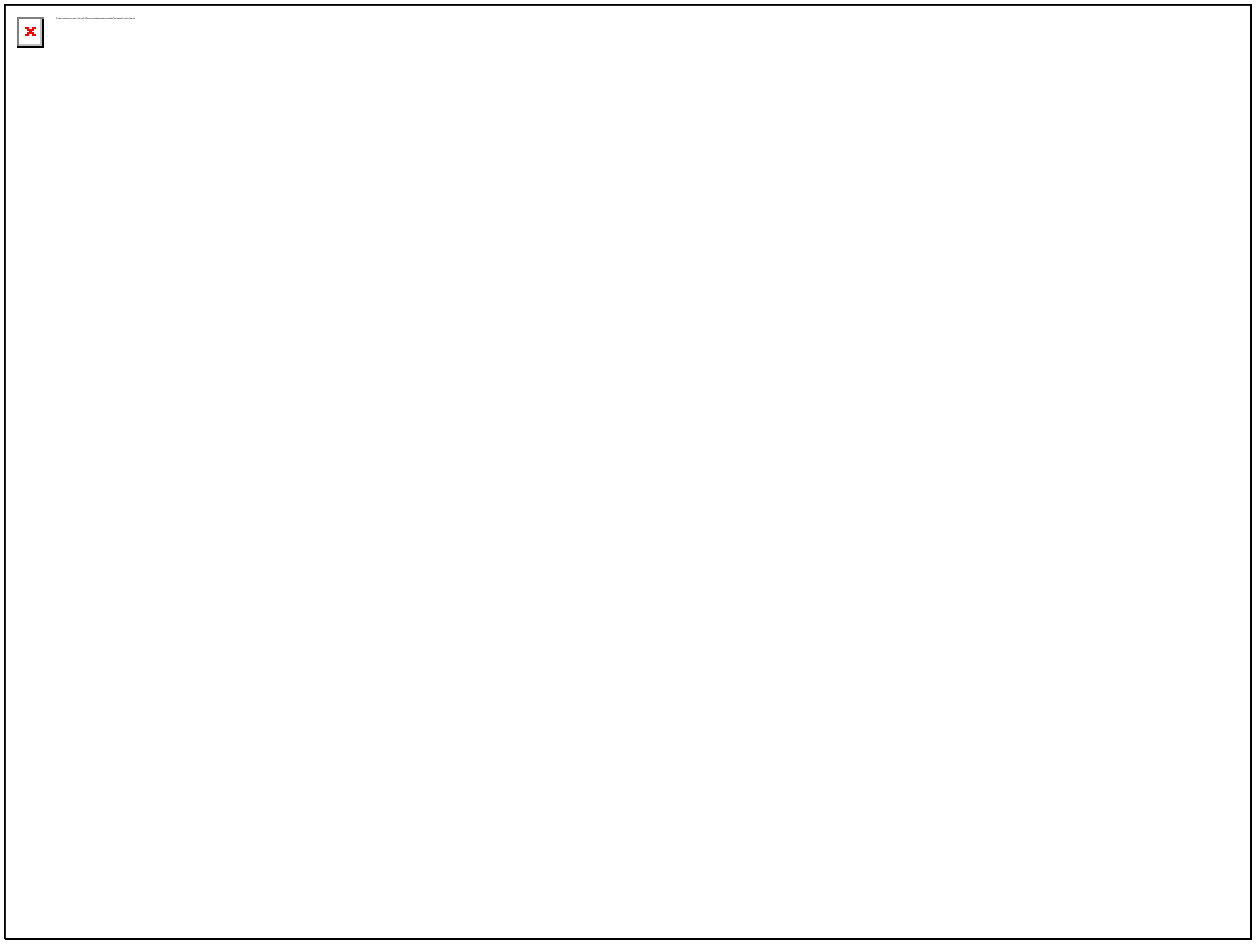
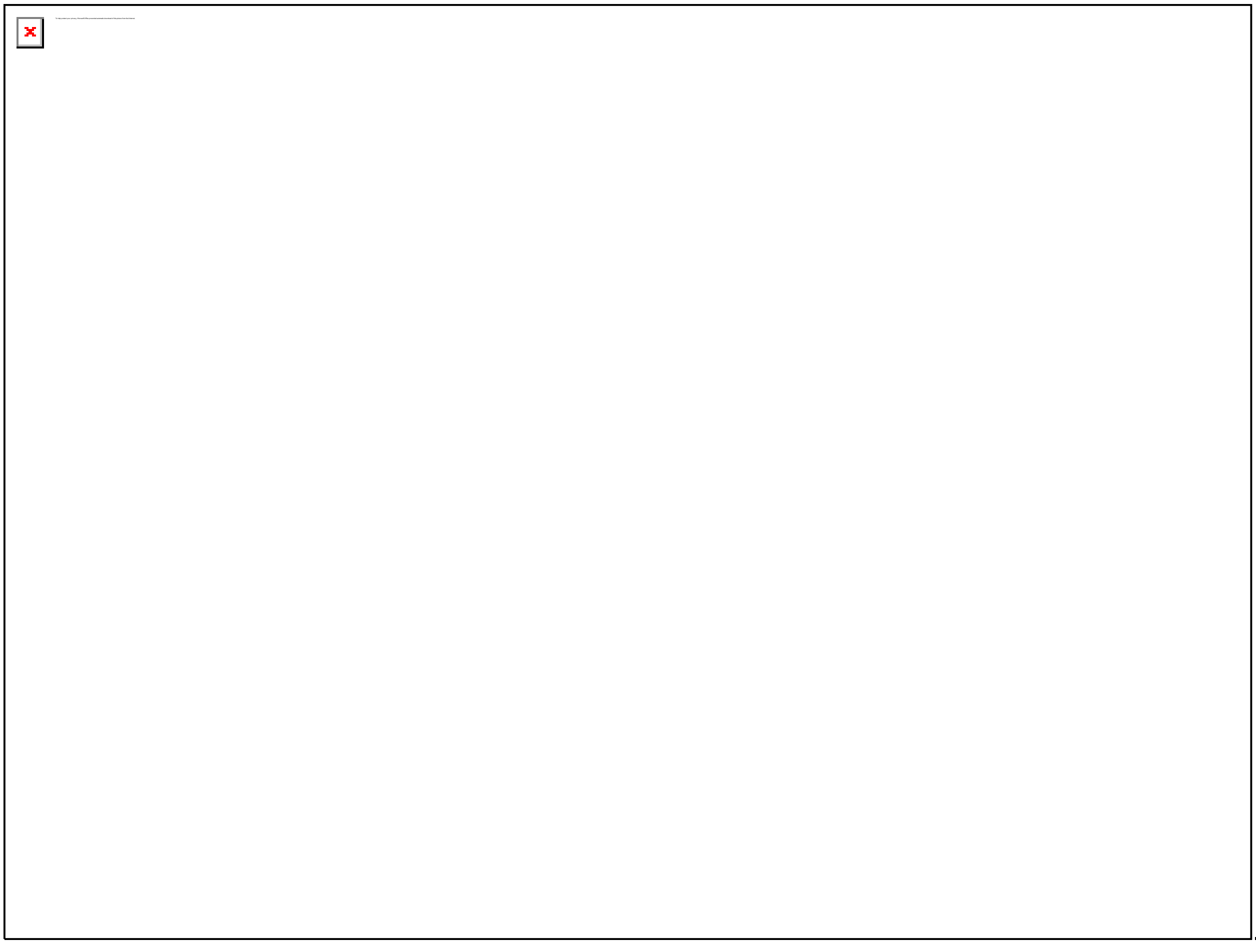


Exhibit 3
Picture inside of the W.R. Grace Facility from my back porch with zoom on an Iphone.


To help protect your privacy, Microsoft Office prevented automatic download of this picture from the Internet.

Support for CB11-2025

My name is Leonard Boyd, and I am a resident of the Cedar Creek neighborhood in howard County, MD and I am submitting this written testimony in support of CB11-2025. My understanding is that this bill will allow entities in a Planned Employment Center (PEC) to perform research and development but prohibit testing involving commercial plastic pellets or feedstock.

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Thank you for your time and consideration,

Leonard A. Boyd

7244 Mainstream Way
Columbia, Maryland 21044
Howard County Resident
Concerned Citizen

Exhibit 1

An Unenhanced Picture of the W.R. Grace Facility from my back porch during the day.

Exhibit 2

An Unenhanced Picture of the W.R. Grace Facility from my back porch at night.

Exhibit 3

Picture inside of the W.R. Grace Facility from my back porch with zoom on an Iphone.

From: LISA MARKOVITZ <lmarkovitz@comcast.net>
Sent: Monday, February 17, 2025 9:58 PM
To: CouncilMail
Subject: CB11-2025 support
Attachments: cb11-25.docx

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Lisa Markovitz, MSF
President, The People's Voice

The People's Voice, LLC
Ethics Ballot ™

3600 Saint Johns Lane, Suite D, Ellicott City, MD21042

Testimony on CB11-2025 - Support

It was commendable that the Planning Board recommended to approve this ZRA now CB11. This actually importantly fixes a problem with R&D changes that had unintended consequences.

Creating reasonable setbacks for chemical emissions is paramount. We must implement accountability and rational definitions of uses and their impacts. Please pass this Bill.

Allowing potentially dangerous emissions to adjacent properties is inexcusable and unnecessary within the uses that are supposed to be supported.

Chemical emissions are detrimental to health. A purpose of Zoning Regulations is to protect the public health and welfare by ensuring that various uses are compatible and appropriate. CB-11 proposes to not allow heavy industrial uses in primarily residential areas. This conflict must be resolved. It is not acceptable to allow these incompatible uses in close proximity. The zoning issues here need these clarifications.

Please vote for CB11-2025.

Thank you,

Lisa Markovitz

President, The People's Voice

From: Michael Ruddock <mikeruddock@gmail.com>
Sent: Monday, February 17, 2025 3:30 PM
To: CouncilMail
Subject: Public Testimony in Support of CB11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Hello -

My name is Mike Ruddock, and I am a resident of Cedar Creek, the community directly adjacent to the WR Grace facility on Grace Drive. I am here today to voice my strong support for CB11-2025. This amendment is critical to ensuring that the health, safety, and long-term well-being of residents in our area are not compromised by the recently disclosed plans for expanded research and development activities at the WR Grace site or other areas within the county.

If you have been unable to visit our community, Cedar Creek is a large community with approximately 750 residents, with about 200 are under the age of 18, and many residences housing multigenerational families.

Cedar Creek includes 101 detached homes and 83 townhomes with values ranging from $825,000 for the townhomes to more than $1.5M for the detached homes. In total, Cedar Creek contributes approximately $3.5M annually to Howard County in tax revenue. That includes $2M in property taxes and $1.5M in income taxes.

In addition to our tax contributions, we support local businesses, work and volunteer in the community and contribute to the diversity that Columbia is known for. Our homes represent a significant investment for our families, and we chose this area for its beautiful surroundings, walking trails and the promise of a safe and thriving environment.

What makes our concerns particularly pressing today, is that the land on which our homes were built was previously owned by WR Grace. If WR Grace intended to expand its research operations, why did they sell this land for residential development? We invested in our futures here under the assumption that this would be a safe residential community and not a buffer zone for expanded research and development operations. We worry about the potential for hazardous emissions or other environmental impacts that could affect our health over time. We also fear the long-term implications for our property values.

I am not here to oppose business growth or innovation, but I believe it must be balanced with the rights and health of residents. The residents of Cedar Creek and surrounding neighborhoods deserve transparency, accountability, and safeguards. CB11-2025 is a necessary step toward ensuring that WR Grace and other industrial operators cannot quietly escalate their research activities without due consideration of the residential communities they now border. Our community contributes just as much to Howard County as WR Grace does and I ask that you consider this as you determine your support for this amendment.

Please support and pass this amendment to ensure that our health, safety, and investments are protected. Thank you for your time and consideration.

Michael Ruddock | 7668 Cross Creek Drive, Columbia, MD 21044

From: Mildred Lockhart-Boyd <mlockboyd@gmail.com>
Sent: Monday, February 17, 2025 4:49 PM
To: CouncilMail
Cc: Walsh, Elizabeth; Jones, Opel; Jung, Debra; Rigby, Christiana; Yungmann, David
Subject: Testimony in Support for CB11-2025
Attachments: Test 2.2025.docx

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

To Members of the County Council and Citizens of Howard County,

Please find below in the body of this email and attached as a PDF for your convenience and reference, my testimony in support for CB11-2025.

My name is Mildred Lockhart Boyd, and I am a resident of Howard County, MD and I am submitting this written testimony in support of CB11-2025. I understand this bill will allow entities in a Planned Employment Center (PEC) to perform research and development but prohibit testing involving commercial plastic pellets or feedstock.

I have resided in Howard County for over forty years. I have watched and participated in its development into a safe and much-desired place to live. As a scientist, I have watched the development of the Grace facilities over the years because of its history and visibility in Howard County. WR Grace has a history of environmental violations, including the hazardous waste cleanup at their current facility in and around Columbia.

The Grace proposed facility is too close to residential housing and the Howard County population for plastic recycling and/ or plastic burning.

If a manufacturing accident like the recent one in Louisville, Kentucky occurs the air quality of all of Howard County would be impacted. Allow Grace to continue research but not Chemical Recycling or plastic burning so that all of us in Howard County can keep our community safe.

Howard County has worked hard to become an environmentally safe place to live for children, adults, and its older citizens. Please support CB 11=2025

Thank you for your support,

Mildred Lockhart Boyd, Ph.D.
6014 River Meadows Dr.
Columbia, MD 21045

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Testimony in Support of CB11-2025
February 17, 2025

To Members of the County Council and Citizens of Howard County,

Please find below in the body of this email and attached as a PDF for your convenience and reference, my testimony in support for CB11-2025.

My name is Mildred Lockhart Boyd, and I am a resident of Howard County, MD and I am submitting this written testimony in support of CB11-2025. My understanding is that this bill will allow entities in a Planned Employment Center (PEC) to perform research and development but prohibit testing involving commercial plastic pellets or feedstock.

I have resided in Howard County for over forty years. I have watched and participated in its development into a safe and much desired place to live. As a scientist I have watched the development of the Grace facilities over the years because of its history and visibility in Howard County. WR Grace has a history of environmental violations, including the hazardous waste cleanup at their current facility in and around Columbia.

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If a manufacturing accident like the recent one in Louisville, Kentucky occurs the air quality of all of Howard County would be impacted. Allow Grace to continue research but not Chemical Recycling or plastic burning so that all of us in Howard County can keep our community safe.

Howard County has worked hard to become an environmentally safe place to live for children, adults and it's older citizens. Please support CB 11=2025

Thank you for your support,

Mildred Lockhart Boyd, Ph.D.

From: Monika Gangadi <mgangadi24@gmail.com>
Sent: Monday, February 17, 2025 6:56 PM
To: CouncilMail
Cc: councilmember@howardcountymd.gov; CouncilDistrict5@howardcountymd.gov; councilman@howardcountymd.gov
Subject: Cedar Creek resident's Testimony

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Good evening Council Members,

Here is my Testimony for tomorrow's hearing:

Good evening, members of the Howard County Council Board and my beloved neighbors.

Thank you for the opportunity to testify today in strong support of the proposed Zoning Regulation Amendment. My name is Mounika Gangadi and I am a resident in the Cedar Creek community and my home was built in 2021. I am a responsible parent of 2 kids of 3 years and 1 year. The proposed facility would be built just 300 feet from my house, so I am here to ensure the proper safe buffer distance is created from our families and this dangerous facility. This amendment represents a critical step toward ensuring that Howard County remains a vibrant, sustainable, and inclusive community for all its residents.

Columbia, MD was ranked top as the best place to raise a family in Maryland, so we decided to move from Norfolk, VA and gradually kept decreasing to #8 position, and who knows in future this might no longer be true for your family.

As a parent of 2 kids and a responsible community member, I want my family and my community to live a life without any fears of carcinogens, explosions, fires, leaks, accidents and hazards.

Since the day I learnt about WR Grace's plans to build an "advanced recycling" facility, I've been deeply anxious about the potential environmental pollution. I'm constantly worried about my kids and community members being exposed to toxic air, which has taken a toll on my mental well-being and left me feeling exhausted.

“Advanced recycling” is neither advanced nor recycling. It’s chemical companies’ new strategy to evade environmental protection meant to protect communities.

Health Harms: Plastic incineration can emit particulate matter (soot), volatile organic compounds (VOCs), per/polyfluoroalkyl substances (PFAS), and dioxins which can cause…

◆ Cancer

◆ Worsened asthma and respiratory issues

◆ Neurological and developmental delays

◆ Reproductive issues such as preterm birth, low birth weight, miscarriage, stillbirth, and birth defects

Children’s Vulnerability: Children are especially vulnerable to air pollution since their bodies are still developing and because children breathe in more air for their size than adults. Breathing in more air can mean breathing in more air pollution.

Climate Pollution: Chemical facilities like this one emit climate-warming air pollution that threatens the future of our planet, exacerbates climate change, and worsens extreme weather.

*We’re not saying this R&D can’t happen, we’re just urging Howard County to pass CB11-2025 so that this type of research doesn't happen near our neighborhood.

In conclusion, passing this Zoning Regulation Amendment is not merely a policy decision; it is a demonstration of Howard County’s commitment to thoughtful planning, equity, and sustainability. I respectfully urge the Board to pass CB11-2025, so that this type of research doesn't happen near our neighborhood to create safe, healthy, livable neighborhoods for my kids, family and my community.

Thank you for your time and consideration.

Thank you,
Mounika.

From: Nana Adadey <nana.adadey@gmail.com>
Sent: Monday, February 17, 2025 10:11 PM
To: CouncilMail
Cc: Shamieka Preston; Golash Adadey; Opoku Adadey; Aisha Hasan
Subject: In Support of CB11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

My name is Nana Adadey and I live on Mainstream way. I support CB11-2025.

To add to my husband's testimony without sounding too repetitious, it has been scary to live with Grace knowing the R&D right in our backyard. The noise is constant, the chimney smoke puffs out visibly, and one wonders what it contains. Please help us by supporting CB11-2025
and add additional regulations to what can be done with an R&D permit.

We moved to Columbia in Howard County to retire because of its reputation as one of the best and safest places in the country. We are unable to enjoy our new home knowing chemicals are being released in the air within 300 feet. We do not open our windows and are afraid to sit outside on the porch or deck. Keeping our windows shut does not necessarily keep us safe either!

We were so looking forward to having our grandchildren spend time with us but now we are unable to for fear of them inhaling chemicals that would introduce carcinogens causing damage to their young lives forever.

We are pleading with you, Howard County Planning Board, to keep our neighborhood clean so we can enjoy fresh air free of harmful chemicals. There are too many examples of accidents from labs and refineries, and we do not want to be added to the unfortunate statistics. Please help keep our neighborhood safe so we can enjoy our simple lives, our friends, family and neighbors with no fear of breathing impure air.

We are counting on you!

Thank you for your time and consideration.

Nana Adadey

From: Atayee 1 <atayee1@outlook.com>
Sent: Monday, February 17, 2025 9:18 PM
To: CouncilMail
Subject: RE: Testimony for Agenda: CB11-2025
Attachments: Mubasher Atayee.docx; Mudaser Atayee.docx

Follow Up Flag: Flag for follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Hello,

Please kindly find the revised testimonies for CB11-2025.

Thanks!

From: Atayee 1 atayee1@outlook.com
Sent: Monday, February 10, 2025 12:24 PM
To: councilmail@howardcountymd.gov
Subject: Testimony for Agenda: CB11-2025

Good morning,

I hope all is well. My children will present the attached testimonies at the Legislative Public Hearing on February 18, 2025, at 7 p.m. Agenda: CB11-2025

Thank you,
Cedar Creek Resident

Hello, and thank you for the opportunity to speak today. My name is Mubasher, and I live at **Cedar Creek,** a place my family and I proudly call home**. I am in support of CB-11, 2025**

Home is more than just a place to live. It's where we rest after a long day, feel safe, and be with the people we love. It is where we seek comfort, peace, and safety. As the saying goes, "There's no place like home." But imagine how it would feel and what happens when home is no longer a safe haven.

I am speaking today not only for myself but also on behalf of my two siblings and the hundreds of children in our community who may not be here tonight, children whose health and well-being are directly impacted by W.R. Grace's plastic-burning project.

When I hear my family and our community's concerns about the W.R. Grace plastic burning project as a child, I find this alarming and unsafe. It makes me wonder, is the air I'm breathing safe? My lungs are still growing, and like other children, they are sensitive to air pollution, making us particularly vulnerable to its harmful effects.

My family moved from Towson to Columbia, hoping to find a quiet, safe, and healthy community. Unfortunately, that hope has not been fully realized. My parents, neighbors, and I worry about the long-term health consequences of breathing in this polluted air daily.

At my age, I should not have to think about pollution, health risks, or environmental hazards. I should be able to enjoy my childhood—playing outside with friends without the fear of inhaling harmful air. I want to play, run, and laugh with my friends without being afraid of what's in the air.

I am here to ask you to help protect our community, our health, and our future. We need clean air, peace of mind, and action. Please help us clean our air and feel safe in our homes and in the playground. I urge you to pass CB-11 2025.

Thank you

Hello, and thank you for letting me speak today. My name is **Mudaser**. I am 10 years old and live in **Cedar Creek**. I am here to support CB-11 2025

After I learned about the W.R. Grace plastic burning project, I became concerned and wondered: What is it doing to my lungs? To my friends? To my family? **We all deserve to grow up without worrying if the air we breathe will make us sick.**

I don't know what chemicals are in the polluted air, but I know that you, other adults, and my parents know it. My mom tells me to stay inside when she thinks the air is polluted and not safe to breathe. **No child should stay inside because the air is dangerous to breathe.**

I don't want to spend my childhood thinking about smoke and sickness. **I want to play and breathe freely—without fear.**

I may be young, but I know this: **Clean air is not a luxury; it's a right. And I need the adults in charge to protect that right for me, my friends, and** all the kids who live here.

Please, don't let pollution take away our rights to a safe home. Don't let the air that fills our lungs also fill us with worries. We are just kids—we need you to protect us. Please pass CB-11 2025 and help us enjoy our childhood.

Thank you.

From: nwaka Ifudu <nwaka.ifudu@gmail.com>
Sent: Monday, February 17, 2025 12:31 AM
To: CouncilMail; councilmember@howardcountymd.gov
Subject: The W.R. Grace Recycling Project - Against

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

To Whom It May Concern,

I am a resident of the Cedar Creek community, and I strongly oppose the W.R. Grace plastic recycling project. When my family and I moved to Cedar Creek in 2022, like many other families, we had concerns about the Grace facility and its operations. We were assured by the developer that this location was designated for corporate offices only and that all research and development had been shut down.

Since moving here, my interaction with Grace has been minimal—limited mostly to running past their grounds during my morning jogs. However, in the fall of 2023, when Grace filed with the county for permission to restart research at this site, they failed to notify our HOA, despite their close proximity to our community. This omission is concerning, especially considering that Grace originally owned the land on which our homes now stand and was fully aware it would be developed into residential housing.

Several neighbors who share a direct border with Grace have already experienced disturbances from noise and light pollution, leading to interactions with Grace, including facility tours. Despite this, Grace did not feel it necessary to engage with our community before moving forward with their request. Instead, they placed a notice in a local Howard County newspaper—one that many new residents were unaware even existed.

According to W.R. Grace's website, they claim to have developed a new plastic recycling solution with the "potential" to reduce emissions and environmental impact. They reference scientific evidence included in their Maryland Department of the Environment (MDE) application that supposedly demonstrates the project's safety. Grace also highlights their established safety protocols and their collaboration with local authorities, including MDE and Howard County Fire & Rescue, to ensure the safety of their 600 on-site employees and the surrounding community.

But who exactly is this "surrounding community"? Does that include us, the residents of Cedar Creek? Or the Robinson Overlook neighborhood? If Grace truly cared about the well-being of its neighbors, why didn't they extend the courtesy of informing us directly about their request? We are their neighbours, do they know they're ours?

Since voicing our concerns, residents have been accused of fear mongering and emotional manipulation simply for raising valid issues about the potential impact on our environment, air quality, and—most importantly—our health. Meanwhile, at the hearing, Grace argued that their 600 employees could face job losses if this project were denied, as if jobs and lives hold equal weight. Our health is not something we can gamble with. There is no antidote for the harm this facility could cause. Who, then, is truly engaging in emotional blackmail?

Grace asserts that this project “will have no impact on the health or well-being of our local community or their employees.” But let’s be clear—Grace employees do not live on-site. They work standard shifts and go home at the end of the day. If something were to go wrong, it is we, the residents living here 24/7, who would bear the full consequences.

Furthermore, the claim of “no impact” is questionable. A similar facility in North Carolina, Braven Environmental—which I understand has ties to W.R. Grace—is under scrutiny for misrepresenting the safety and environmental impact of its pyrolysis operations. Reports indicate that Braven’s facility has generated hazardous waste, released pollutants such as carbon monoxide, benzene, and styrene, and faced multiple violations, including mishandling oil-contaminated stormwater and raising concerns about soil contamination.

I urge the board to hear our community’s plea and deny Grace’s permit request. Approving this project would come at the cost of our lives and the health of our loved ones.

This is not just about science—it is about people. Grace's tagline and my question is which people?

Sincerely,
Nwaka Anosike

From: Padma Swamy <padma.swamy@gmail.com>
Sent: Monday, February 17, 2025 6:03 PM
To: CouncilMail
Cc: Hubs; CouncilDistrict5@howardcountymd.gov; Walsh, Elizabeth; ojones@howardcountymd.org; djung@howardcountymd.org; crigby@howardcounty.org
Subject: Written Testimony in Support of CB11-2025
Attachments: Padma_SwamyTestimony.docx; smolker-et-al-2024-the-association-between-exposure-to-fine-particulate-air-pollution-and-the-trajectory-of.pdf; PFAS_Inflammation.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

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Dear Council Members,

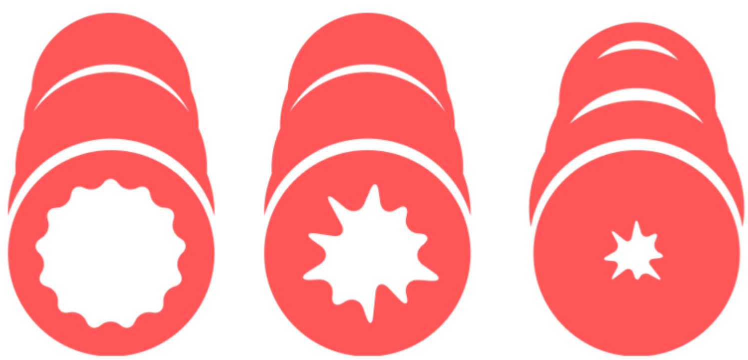
Thank you for your service. I have attached my written testimony along with some journal articles to review which provide information on the safety impacts of having such a facility built near a community. Please reach out for any questions.

Thank you,

Dr. Padma Swamy

My name is Dr. Padma Swamy and I am a pediatrician. I care passionately about issues that impact child health. I have a background in public health and have published research and textbooks on the impact of the social drivers of health on child health. As a pediatrician, I can attest that having this facility built behind so close to our neighborhood will hurt the health of our children - specifically, their ability to breathe freely and develop healthily and happily.

I care for children living with asthma on a daily basis. Breathing in pollutants like those emitted from this facility will irritate the lungs of growing children and increase their risk of asthma. Children due to their size and their breathing are inherently more likely to be impacted by all of the chemicals released by this facility in particular VOCs and PFAS. We are now going to take a look at the tubes in the lungs; the one to the far right is normal, you see how open it is allowing air to pass easily. The one in the middle is tight where it is hard to have air pass through and the one on the left is almost shut due to swelling and irritation. We can't fix this with just inhalers; until the environment is clean a patient's asthma would continue to persist.



In addition, PFAs that would be released by this facility can cause otherwise preventable developmental delay in children, which would further strain county resources and severely impact our childrens' well being. Access to the Maryland Infant's and Toddlers program will be impacted, as more children need to utilize this resource thereby also using state resources.

The mental health impacts to children and our community can't be ignored either. A recent study looking at particulate matter in the air in 9-11 year olds found that children exposed to high particulate matter in the air had higher rates of anxiety and depression. I have attached an article to this testimony from an article that was published in August 2024.

I can say that this pilot plant, literally behind my yard, spewing harmful chemicals makes me anxious and worried at night. Even more worrying is the freeze on MDE funds that would be utilized for air pollution monitoring. I am a mother as well, and I worry about the health of my one year old and unborn child and the impact of this facility on their life not only now but throughout their lifetime.

As a community we cannot allow this. This is completely avoidable if we act now. As a pediatrician and mother, I urge the county leadership to ensure the safety of the community by approving CB11-2025. I moved to Howard County and in particular chose this community because it is family oriented. I have been looking forward to seeing my son grow up with the children living in Cedar Creek. Children love superheroes whether it is Batman, Wonder Woman or Spider-Man. Like the quote from Spider-Man: with great power comes great responsibility. You as county leaders have both this power and responsibility and can be superheroes for children living in this community now and future generations to come. Thank you for your tim

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The Association between Exposure to Fine Particulate Air Pollution and the Trajectory of Internalizing and Externalizing Behaviors during Late Childhood and Early Adolescence: Evidence from the Adolescent Brain Cognitive Development (ABCD) Study

Harry R. Smolker,[1] *Colleen E. Reid,*[2,3] *Naomi P. Friedman,*[4,5] *and Marie T. Banich*[1,5]

[1]Institute of Cognitive Science, University of Colorado Boulder, Boulder, Colorado, USA
[2]Department of Geography, University of Colorado Boulder, Boulder, Colorado, USA
[3]Institute of Behavioral Science, University of Colorado Boulder, Boulder, Colorado, USA
[4]Institute for Behavioral Genetics, University of Colorado Boulder, Boulder, Colorado, USA
[5]Department of Psychology and Neuroscience, University of Colorado Boulder, Boulder, Colorado, USA

Background: Exposure to high levels of fine particulate matter (PM) with aerodynamic diameter ≤2.5 μm ($PM_{2.5}$) via air pollution may be a risk factor for psychiatric disorders during adulthood. Yet few studies have examined associations between exposure and the trajectory of symptoms across late childhood and early adolescence.

Objective: The current study evaluated whether $PM_{2.5}$ exposure at 9–11 y of age affects both concurrent symptoms as well as the longitudinal trajectory of internalizing and externalizing behaviors across the following 3 y. This issue was examined using multiple measures of exposure and separate measures of symptoms of internalizing disorders (e.g., depression, anxiety) and externalizing disorders (e.g., conduct disorder), respectively.

Methods: In a sample of more than 10,000 youth from the Adolescent Brain Cognitive Development (ABCD) Study, we used a dataset of historical $PM_{2.5}$ levels and growth curve modeling to evaluate associations of $PM_{2.5}$ exposure with internalizing and externalizing symptom trajectories, as assessed by the Child Behavioral Check List. Three distinct measures of $PM_{2.5}$ exposure were investigated: annual average concentration during 2016, number of days in 2016 above the US Environmental Protection Agency (US EPA) 24-h $PM_{2.5}$ standards, and maximum 24-h concentration during 2016.

Results: At baseline, higher number of days with $PM_{2.5}$ levels above US EPA standards was associated with higher parent-reported internalizing symptoms in the same year. This association remained significant up to a year following exposure and after controlling for $PM_{2.5}$ annual average, maximum 24-h level, and informant psychopathology. There was also evidence of an association between $PM_{2.5}$ annual average and externalizing symptom levels at baseline in females only.

Discussion: Results suggested $PM_{2.5}$ exposure during childhood is associated with higher symptoms of internalizing and externalizing disorders at the time of exposure and 1 y later. In addition, effects of $PM_{2.5}$ exposure on youth internalizing symptoms may be most impacted by the number of days of exposure above US EPA standards in comparison with annual average and maximum daily exposure. https://doi.org/10.1289/EHP13427

Introduction

Fine particulate matter (PM) with aerodynamic diameter ≤2.5 μm ($PM_{2.5}$) air pollution is one of the leading contributors to disease burden in the modern world.[1] To date, much of the research on the adverse health effects of $PM_{2.5}$ exposure has focused on impacts on cardiopulmonary health in adults,[2] yet a growing body of evidence suggests that $PM_{2.5}$ may also directly impact the brain, increasing both short- and long-term risk for mental illness in both children[3–9] and adults,[10–12] as well as in samples including both children and adults.[13–16] Dynamic neurodevelopmental processes that unfold across late childhood and early adolescence may make this developmental stage a particularly sensitive period for adverse impacts of $PM_{2.5}$ exposure on mental health.[17–19] Despite general improvements in air quality over recent decades,[20] over 90% of children worldwide were exposed to unsafe levels of $PM_{2.5}$ at some point during 2016 alone,[21] and critical questions remain as to the impacts of such exposure. Evidence suggests that prenatal exposure is associated with poor outcomes later in childhood,[5] but the degree to which the temporal pattern of $PM_{2.5}$ exposure during late childhood is associated with symptoms of internalizing and externalizing disorders as youth transition from childhood into adolescence is unclear. We investigate this issue using growth curve modeling in a large-scale, longitudinal dataset of adolescent health to test for effects of multiple measures of $PM_{2.5}$ exposure at 9–11 y of age on the trajectory of internalizing and externalizing symptoms across the ensuing 3 y as participants transition into adolescence.

$PM_{2.5}$ Exposure Levels during Adulthood Affect Psychopathology

Though several common air pollutants negatively impact health, $PM_{2.5}$ may be particularly detrimental to mental health because its component particles are small enough to pass through the blood–brain barrier and impinge on neural tissue.[22] Epidemiological research investigating effects of exposure on psychopathology suggests that short- and long-term exposure to high levels of $PM_{2.5}$ elevates both immediate and future risk for mental illness during adulthood.[15,23–30] Supporting immediate effects, several studies have found increased hospital admissions for a range of psychiatric conditions on days with high levels of ambient $PM_{2.5}$, including hospitalizations for depression, suicide attempts, and psychotic episodes.[15,23–25] Supporting effects of long-term exposure, higher average exposure from the months to years prior has been associated with an increased risk for depression and anxiety, among other disorders, including a higher probability of a diagnoses, higher symptom levels, and higher rate of psychiatric medication use and

Address correspondence to Harry R. Smolker, Institute of Cognitive Science UCB 344, MUEN PSYCH Building D418 University of Colorado Boulder, Boulder, CO 80309 USA. Email: harry.smolker@colorado.edu

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services.[26–30] Thus, it appears that high $PM_{2.5}$ exposure during adulthood may affect mental health on multiple levels. Yet important questions remain as to the long-term effects of $PM_{2.5}$ exposure during brain development, including whether exposure during late childhood is associated with altered trajectories in psychopathology across adolescence.

$PM_{2.5}$ Exposure and Psychopathology during Childhood

Exposure to high levels $PM_{2.5}$ during childhood may have particularly long-lasting and detrimental effects. Evidence in rodents suggests high exposure disrupts a range of neurodevelopmental processes that set the stage for brain structure and function in adulthood, with notable effects on behavior.[31] To date, the developmental literature of $PM_{2.5}$ exposure in humans has focused on prenatal exposure, with high exposure during this critical developmental period associated with a range of poor outcomes years later in childhood, including alterations in brain structure, motor deficits, and cognitive impairments.[32–34] Yet far fewer studies have investigated how exposure during late childhood may affect the trajectory of internalizing and externalizing symptoms as children transition into adolescence, the focus of the current study.

Internalizing and externalizing symptom trajectories during adolescence have been shown to be predictive of problems later in life, even when symptom levels do not reach criteria for clinical disorder during adolescence.[35–36] Thus, understanding effects of air pollution on symptom trajectories during late childhood and adolescence is of considerable importance when it comes to both public policy and personal health decisions aimed at reducing the long-term impacts of air pollution exposure. To date, a handful of studies have investigated the effects of exposure during late childhood on later development of psychopathology, with evidence that exposure at 12 y of age is associated with increased risk for major depression at age 18, but not at age 12,[12,37] whereas exposure during late childhood was associated with an altered trajectory of conduct problems, with high exposure associated with less of a normative reduction in symptoms over time.[38] Yet important questions remain, including whether $PM_{2.5}$ exposure differentially affects symptoms of internalizing or externalizing disorders and the degree to which associations between exposure and symptom trajectories may differ between the sexes. These issues are investigated in the current study.

Current Study

Using data from the Adolescent Brain Cognitive Development (ABCD) Study, the current study implemented latent growth curve modeling to investigate several unanswered questions regarding associations between $PM_{2.5}$ exposure during late childhood and the trajectory of internalizing and externalizing symptoms into early adolescence. Specifically, we used two broadband measures that differentially capture symptoms of internalizing (e.g., anxiety and depression) and externalizing (e.g., conduct disorder) disorders. We hypothesized that associations between $PM_{2.5}$ exposure and symptom trajectories will be observed for both internalizing and externalizing disorders and that these associations would be observed both during the year of exposure, as well as for multiple years following exposure. In addition, we tested for associations between symptom trajectories and three distinct measures of $PM_{2.5}$ exposure, allowing us to evaluate the unique impacts of different patterns of exposure (e.g., acute vs. chronic) on mental health.[39] Finally, we tested for sex differences in both the underlying trajectories of symptoms as well as the association of exposure levels with individual differences in these trajectories. We hypothesized that, despite differences in internalizing and externalizing trajectories between the sexes, the associations between these trajectories and exposure will be consistent across females and males.

Methods

Participants

All data were drawn from the ABCD Study National Data Archive (NDA) data release 4.0 (NDA 4.0). The ABCD Study is a longitudinal project following 11,876 youth from the general population, with yearly assessments for 10 y, beginning at 9–10 y of age. Data used in the current project were collected between 2016 and 2021. ABCD participants were recruited from 21 sites across the United States, with sampling techniques designed to reflect the sociodemographic variability of the United States in regard to age, gender, race/ethnicity, socioeconomic status, and urbanicity, with target demographic distributions derived from the American Community Survey and third and fourth grade enrollment data from the National Center for Education Statistics.[40] Specifically, recruitment was done through probability sampling of schools within the 21 research site catchment areas, and the demographic distribution of the resulting sample was monitored during initial recruitment. If the sample was found to deviate from the target demographic distributions, recruitment was increased in schools with overrepresentation of the specific demographic in question. A listing of participating research sites can be found at https://abcdstudy.org/consortium_members/. In addition to the environmental and psychopathology measures used in the current report, the ABCD protocol includes an array of other measures, including neuroimaging and genetic and cognitive variables, collected at yearly longitudinal intervals.[41]

Analyses in the current report used data on internalizing and externalizing behaviors from four distinct time points, restricting the sample to participants with at least a single time point of internalizing and externalizing symptom data as well as data for all three of the $PM_{2.5}$ measures of interest, measured at the baseline time point (see section " $PM_{2.5}$ Exposure Estimation" for information on the measures of interest). Of the 11,876 participants with data in the ABCD Study, two were excluded due to missing internalizing and externalizing symptom data at all time points, and 649 were excluded because of missing data on all three $PM_{2.5}$ measures of interest. In addition, we elected to exclude data from any participant who was missing any of the three $PM_{2.5}$ measures used in the current study, which resulted in the exclusion of an additional 442 subjects. These additional subjects were excluded because all three $PM_{2.5}$ measures were drawn from the same source datasets, meaning quality control issues for a one $PM_{2.5}$ measure likely applied to the other measures. However, the measures were released in different data releases, and it is unclear the degree to which they underwent the same or distinct quality control procedures. As a result, we assumed that missing data on any of the three $PM_{2.5}$ measures indicated potential quality control issues across all three $PM_{2.5}$ measures. After these exclusions, the final sample in the current project consisted of data on 10,783 participants. To determine the degree to which these exclusions resulted in sampling bias, we used Mann-Whitney–Wilcoxon tests, comparing the analysis sample ($n = 10{,}783$) to the excluded sample ($n = 1{,}093$) on continuous covariates of interest (see Table S1; see Table S2 for information comparing analysis and excluded samples on distribution of categorical variables).

Because all participants were under 18 y old, written, informed consent was obtained from a parent or guardian, and assent was obtained from the participant. Research protocols across the 21 ABCD sites were approved by the University of California–San Diego institutional review board (IRB; protocol number 160091), the IRB of record for the entire ABCD Study. Data from the baseline time point through year 2 were drawn from parent-report questionnaires, which were administered via a computer tablet, except for address history, which was obtained through an interview with the parent, and pubertal status, which was completed by the youth participant on a computer tablet. Some year 3 data were collected from an online form due to a pause in on-site data collection resulting from the COVID-19 pandemic. All parent responses were obtained from a single parent or guardian.

$PM_{2.5}$ Exposure Estimation

We used three measures of $PM_{2.5}$ exposure based on participants' home addresses at baseline available in the ABCD NDA 4.0 release: annual average of daily ambient $PM_{2.5}$ levels across 2016, number of days during 2016 with ambient $PM_{2.5}$ levels above the US Environmental Protection Agency (US EPA) National Ambient Air Quality Standard for mean 24-h $PM_{2.5}$ exposure ($>35\,\mu g/m^3$), and maximum 24-h $PM_{2.5}$ level in 2016. Estimates of $PM_{2.5}$ exposure were calculated based on participants' primary address as reported by their parent or caregiver. Addresses were geocoded to latitude and longitude coordinates and then linked to a preexisting spatiotemporal $PM_{2.5}$ dataset from Di et al.[42] that provides daily historical estimates of ambient $PM_{2.5}$ across the United States at a 1-km^2 resolution from 2000 to 2016. $PM_{2.5}$ exposures were derived based on the spatial intersection of this 1-km^2 grid with geocoded primary addresses during 2016, the year of the baseline ABCD assessment.

Longitudinal Indicators of Internalizing and Externalizing Symptoms

Internalizing and externalizing symptom levels were measured through the parent-reported Child Behavior Checklist (CBCL), with outcomes of interest including the internalizing subscale, which measures symptoms related to anxiety and depression, as well as the externalizing subscale, which measures symptoms related to conduct disorder and related disorders.[43] Parental informants rated the degree to which specific statements were true for their child using a three-point Likert scale: "0 - not true", "1 - sometimes true", or "2 - always true." Subscales were calculated by adding informant responses on the relevant items, with the internalizing score as the sum of all items related to "withdrawn," "somatic complaints," and "anxious/depressed problems" and the externalizing score as the sum of all items related to "rule breaking" and "aggressive behaviors." Raw scores can range between 0 and 64 for the internalizing scale and 0 and 56 for the externalizing scale. For the internalizing subscale, in children 6–11 y of age, raw scores of 12 or greater in boys and 14 or greater in girls are indicative of a clinical disorder, whereas in children 12–18 y of age, scores of 14 or greater in boys and 15 or greater in girls are indicative of a clinical disorder. For the externalizing subscale, in children 6–11 y of age, scores of 16 or greater in boys and 15 or greater in girls are indicative of a clinical disorder, whereas in children 12–18 y of age, scores of 19 or greater in boys and 16 or greater in girls are indicative of a clinical disorder. The ABCD NDA 4.0 release contains CBCL data across four time points, including a baseline timepoint in 2016, as well as three follow-up time points roughly a year apart, herein referred to as baseline, year 1, year 2, and year 3. Mean scores in general population samples for the current age group across multiple countries have been shown to range between 6.0 and 6.5 for the internalizing subscale and 7.0 and 7.5 for the externalizing subscale.[44–45]

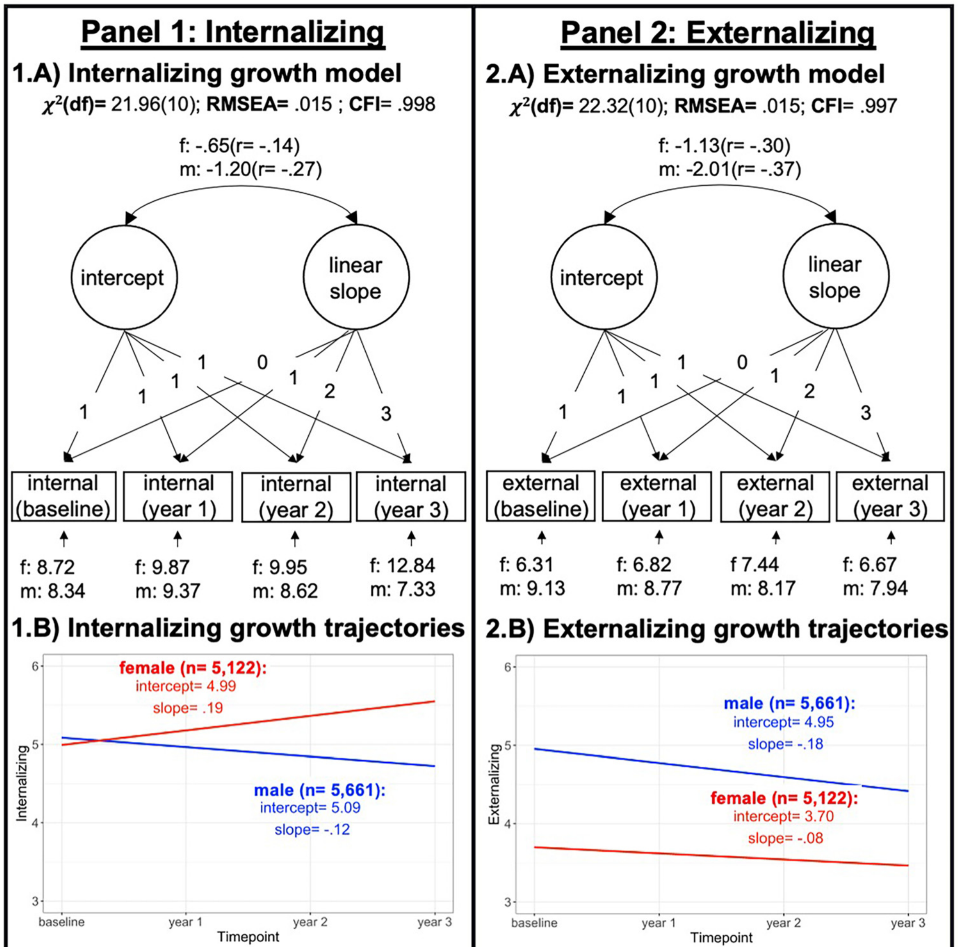
Covariates

In the analyses testing for associations between internalizing and externalizing symptom trajectories and $PM_{2.5}$ exposure, we used time invariant covariates from the baseline time point, including continuous measures of pubertal level, Area Deprivation Index (ADI)[46] total score for participants' home address, and total psychopathology problems of the parent caregiver, as gleaned from the Achenbach System of Empirically Based Assessment Adult Self Report.[47] Categorical covariates included child race (White, Black, Asian, Hispanic, and mixed/other), parental combined income ("<USD $25,000," "USD $25,000–$49,999," "USD $50,000–$74,999," "USD $75,000–$99,999," "USD $100,000–$200,000," and "above USD $200,000"), parental marital status (married, not married, missing information), and parental maximum education level ["did not complete high school/GED" (12th grade or below), "completed high school" (high school graduate or GED), "some college," "completed associate degree," "completed bachelor's degree," and "completed graduate degree" (professional, master's, or doctoral degree)]. Age was used as a continuous time-varying covariate and was regressed from CBCL symptom levels at all four time points. Although there is considerable debate over what racial categories are measuring beyond social constructions,[48] we elected to control for race because previous evidence suggests racial differences in both $PM_{2.5}$ exposure[49] and CBCL scores,[50] even after accounting for confounding variables such as socioeconomic status. Pubertal level was quantified as an average of the five items on the Pubertal Development Scale (PDS), including three general items, as well as two sex-specific items.[51] Pubertal level was included as a covariate to block puberty as a pathway driving $PM_{2.5}$–symptom trajectory associations, allowing us to test for the existence of other pathways. The ADI, an aggregate measure developed to quantify socioeconomic disadvantage within an area, was derived using census tract data from the 2011–2015 American Community Survey.

Although the original income data had 10 different income bins, we collapsed "<USD $5,000," "USD $5,000–$11,999," "USD $12,000–$15,999," and "USD $16,000–$24,999" into a single bin of "<USD $25,000" as well as collapsed "USD $25,000–$34,999" and "USD $35,000–$49,999" into a single bin of "USD $25,000 – $49,999," resulting in six bins: "<USD $25,000," "USD $25,000–$49,999," "USD $50,000–$74,999," "USD $75,000 – $99,999," "USD $100,000–$200,000]," "above USD $200,000." Marital status originally had seven bins, including "married," "widowed," "divorced," "separated," "never married," "living with partner," and "refuse to answer." These seven bins were collapsed into three, with "married" treated as one bin, "refuse to answer" treated as its own bin, and all other responses collapsed into a "not married" bin. Race, income, and parental maximum education were all deviation coded, comparing each group (minus one) to the unweighted mean of all groups. Informants reported participants' race as being either White, Black, Asian, Hispanic, or Other/Mixed race, and this variable was contrast coded, treating White as the "minus one" group, meaning we did not include a code comparing White with the grand mean. For parental combined income and maximum education, participants with missing responses were treated as their own group, and these groups were not compared with the grand mean. Participant sex was based on parent report of their child's sex at birth.

Statistical Analysis

The MPlus software package was used to conduct latent growth curve modeling of internalizing and externalizing trajectories (MPlus; version 7.1.4).[52] To account for missing continuous data and nonnormality, all analyses used robust full information maximum likelihood



1.C) Internalizing means/variances

Sex	Factor	Parameter	Estimate(SE)
female	intercept	mean	4.99(.08)
		variance	21.27(1.06)
	slope	mean	.19(.03)
		variance	1.09(.16)
male	intercept	mean	5.09(.07)
		variance	22.15(.98)
	slope	mean	-.12(.03)
		variance	.88(.13)

2.C) Externalizing means/variances

Sex	Factor	Parameter	Estimate(SE)
female	intercept	mean	3.70(.07)
		variance	19.83(1.12)
	slope	mean	-.08(.03)
		variance	.71(.15)
male	intercept	mean	4.95(.08)
		variance	30.59(1.40)
	slope	mean	-.18(.03)
		variance	.98(.17)

Figure 1. Latent growth curves for Child Behavior Checklist internalizing and externalizing subscales in full sample ($n = 10{,}783$) of ABCD cohort. Panels 1 and 2 show growth curves for internalizing and externalizing, respectively, unconstrained across the sexes. All estimates are unstandardized. Estimated trajectories for females and males are shown. Note: CFI, Comparative Fit Index; χ^2, chi-square; df, degrees of freedom; RMSEA, root mean square error of approximation; SE, standard error; f, female; m, male; r, standardized correlation coefficient.

estimation through the "ESTIMATOR = MLR" option, and sandwich estimation was used to adjust the fit and standard errors for the nonindependence of participants from the same family through the "TYPE = complex" option. Because robust estimation can account for nonnormality often present in CBCL scores, we measured CBCL levels using raw, untransformed scores.[53] Growth curve models included latent intercept and slope factors of CBCL subscales, with all latent factors specified to have both means and variances, as well as covariance between them, and all indicators specified to have residual variances (see Figure 1 for schematic and Supplemental Material for relevant MPlus syntax). Loadings between the longitudinal CBCL indicators and the intercept factor were all set to 1, whereas loadings between the indicators and the slope factors were specified as linear (i.e., 0, 1, 2, 3). With these loadings, the intercept factor captured symptom levels at the baseline time point, and the slope factor captured the linear rate of change of symptoms over the following three time points, measured in raw CBCL scores.

Participants were excluded if they were missing CBCL scores at all time points or did not have all three $PM_{2.5}$ measures of interest. However, as the MLR estimator in MPlus uses full information maximum likelihood and hence can accommodate different patterns of missing data, participants were not excluded due to missing covariate data. Instead, continuous covariates were brought into the model by specifying a latent mean and variance for each covariate, whereas for categorical covariates, participants with missing data were treated as their own level (see Tables 1 and 2 for information on demographics, covariates, and data missingness).

To first characterize the trajectories of internalizing and externalizing behaviors, and whether they differed between the sexes, we used chi-square difference tests (appropriately scaled for MLR)[54] comparing multigroup models in which model parameters of interest were constrained to be equal across females and males with models in which these parameters were allowed to differ between the sexes (parameters of interest include covariance between intercept and slope factor, means of the intercept and slope factors, and residual variances for the four timepoints of CBCL data). After determining whether females and males should be modeled as having distinct trajectories, we then evaluated the degree to which individual differences in the intercept and slope of these trajectories were associated with the $PM_{2.5}$ exposure at the baseline time point while controlling for several potentially confounding covariates (see "Covariates" section). Associations between $PM_{2.5}$ exposure levels and the intercept factor would suggest that exposure during childhood is associated with concurrent levels of internalizing or externalizing symptoms at the baseline time point, whereas associations between exposure and the slope factor would suggest that exposure levels at the baseline time point may influence the rate of change in internalizing and externalizing symptoms in the years that follow as children enter adolescence.

Six sets of models were run, regressing the two growth curve factors (internalizing symptoms, externalizing symptoms) on the three exposure measures (annual average, days above EPA standards, maximum), separately. Within each set, we tested for sex differences in effects of exposure on internalizing and externalizing symptoms through chi-square difference tests, comparing models with the $PM_{2.5}$ regression coefficient constrained to be equal and unequal across males and females.

To test for nonlinear associations between $PM_{2.5}$ exposure and symptom trajectories, we ran initial models in which we included independent variables for both $PM_{2.5}$ exposure (i.e., linear term) and that exposure squared (i.e., quadratic term) for each $PM_{2.5}$ measure separately. We then evaluated the degree to which the quadratic term was significantly associated with the intercept and slope of the symptom trajectories. In the absence of significant associations, we dropped the quadratic term from the model and proceeded with models that included only linear associations between $PM_{2.5}$ exposure and symptom trajectories.

We used a combination of model fit indices including root mean square error of approximation (RMSEA), comparative fit index (CFI), and standardized root mean square residual (SRMR). Models were deemed a good fit if they had RMSEA <0.06, CFI >0.95, and SRMR <0.08.[55] To investigate sex differences in individual parameters, including $PM_{2.5}$-symptom regression coefficients, we carried out chi-squared differences tests (appropriately scaled for MLR),[54] comparing a model in which all growth and regression parameters were allowed to differ between females and males to a model in which the parameter of interest was constrained to be equal across the sexes. The standard chi-square significance threshold of $p < 0.05$ was used to determine the significance of chi-squared differences tests of sex differences.

To determine the statistical significance of regression analyses while accounting for multiple comparisons, we used false discovery rate (FDR).[56] FDR correction was carried out across p-values for the twelve coefficients of interest [two psychopathology subscales (internalizing and externalizing) by three $PM_{2.5}$ exposure measures (average, days above US EPA standard, and maximum)

Table 1. Descriptive statistics for continuous variables of the ABCD cohort.

	Full ABCD sample ($n = 10{,}783$)					Female-only ABCD sample ($n = 5{,}122$)					Male-only ABCD sample ($n = 5{,}661$)				
Variable	Mean (SD)	Median	Min	Max	n (%)	Mean (SD)	Median	Min	Max	n (%)	Mean (SD)	Median	Min	Max	n (%)
Psychopathology (CBCL raw scores)															
Internal: baseline	5 (5.5)	3	0	51	10,779 (99%)	5 (5.5)	3	0	51	5,120 (>99%)	5.1 (5.5)	3	0	49	5,659 (>99%)
Internal: 1 y	5.1 (5.5)	3	0	48	10,204 (94%)	5.2 (5.6)	3	0	45	4,839 (94%)	5 (5.5)	3	0	45	5,365 (95%)
Internal: 2 y	4.9 (5.6)	3	0	50	7,448 (68%)	5.1 (5.7)	3	0	38	3,529 (69%)	4.8 (5.4)	3	0	50	3,919 (69%)
Internal: 3 y	5.1 (5.8)	3	0	44	5,757 (53%)	5.6 (6.1)	4	0	40	2,709 (53%)	4.7 (5.4)	3	0	44	3,048 (54%)
External: baseline	4.4 (5.8)	2	0	49	10,779 (99%)	3.7 (5.1)	2	0	40	5,120 (>99%)	5 (6.3)	3	0	49	5,659 (>99%)
External: 1 y	4.1 (5.6)	2	0	47	10,204 (94%)	3.6 (5)	2	0	47	4,839 (94%)	4.7 (6)	3	0	46	5,365 (95%)
External: 2 y	3.9 (5.5)	2	0	50	7,448 (68%)	3.4 (5.1)	1	0	43	3,529 (69%)	4.4 (5.8)	2	0	50	3,919 (69%)
External: 3 y	3.9 (5.3)	2	0	43	5,757 (53%)	3.4 (4.8)	2	0	43	2,709 (53%)	4.4 (5.7)	2	0	41	3,048 (54%)
$PM_{2.5}$ exposure															
$PM_{2.5}$ avg. ($\mu g/m^3$)	7.7 (1.6)	7.7	1.7	15.9	10,783 (100%)	7.7 (1.6)	7.8	2.1	14.5	5,122 (100%)	7.6 (1.6)	7.7	1.7	15.9	5,661 (100%)
$PM_{2.5}$ days US EPA (no. of days)	1.2 (2.5)	0	0	20	10,783 (100%)	1.2 (2.4)	0	0	20	5,122 (100%)	1.3 (2.6)	0	0	20	5,661 (100%)
$PM_{2.5}$ Max. ($\mu g/m^3$)	39.9 (27.5)	27.8	5.7	199.3	10,783 (100%)	39.9 (27.4)	27.9	6.1	188.8	5,122 (100%)	40 (27.7)	27.5	5.7	199.3	5,661 (100%)
Covariate															
Area Deprivation Index	94.5 (21.2)	98.7	1.1	125	10,562 (97%)	94.6 (21.5)	98.9	1.1	125.8	5,017 (98%)	94.4 (21)	98.4	1.1	125.8	5,545 (98%)
Age: baseline (months)	119.1 (7.5)	119	107	133	10,783 (99%)	118.9 (7.5)	119	107	132	5,122 (100%)	119.2 (7.5)	119	107	133	5,661 (100%)
Age: 1 y (months)	131.2 (7.7)	131	116	149	10,218 (94%)	131 (7.7)	131	117	149	4,844 (95%)	131.3 (7.7)	131	116	149	5,374 (95%)
Age: 2 y (months)	144.1 (7.9)	144	127	168	9,472 (87%)	144 (8)	144	128	168	4,484 (88%)	144.2 (7.9)	144	127	166	4,988 (88%)
Age: 3 y (months)	154.8 (7.7)	155	137	174	5,865 (54%)	154.6 (7.6)	155	137	171	2,757 (54%)	155 (7.7)	155	138	174	3,108 (55%)
Pubertal Development Scale (sum)	1.7 (0.5)	1.6	1	4	10,721 (99%)	1.7 (0.5)	1.6	1	4	5,092 (99%)	1.7 (0.5)	1.6	1	4	5,629 (99%)
Adult self-report: parent total problems (raw)	21 (17.8)	16	0	141	10,780 (99%)	20.6 (17.6)	16	0	141	5,120 (>99%)	21.4 (18)	16	0	132	5,660 (>99%)

Note: ABCD, Adolescent Brain and Cognitive Development Study; CBCL, Child Behavior Checklist; Max, maximum value; Min, minimum value; n (%), number of participants and percentage of sample with nonmissing data; PM, particulate matter; $PM_{2.5}$, fine particulate matter with aerodynamic diameter $\leq 2.5\ \mu m$; $PM_{2.5}$ avg., annual average of $PM_{2.5}$ air pollution at participants' home address in 2016 ($\mu g/m^3$); $PM_{2.5}$ Days US EPA, number of days in 2016 with $PM_{2.5}$ levels at participants' home address above US Environmental Protection Agency standards for ambient $PM_{2.5}$ ($>35\ \mu g/m^3$); $PM_{2.5}$ max., maximum daily level of $PM_{2.5}$ at participants' home address during 2016 ($\mu g/m^3$); SD, standard deviation.

Table 2. Descriptive statistics for categorical variables of the ABCD cohort at baseline.

Variable	Full ABCD sample ($n = 10,783$) n (%)	Female-only ABCD sample ($n = 5,122$) n (%)	Male-only ABCD sample ($n = 5,661$) n (%)
Sex			
Female	5,122 (48%)	5,122 (100%)	0 (0%)
Male	5,661 (52%)	0 (0%)	5,661 (100%)
Race/ethnicity			
Hispanic	2,171 (20%)	1,039 (20%)	1,132 (20%)
Black	1,536 (14%)	765 (15%)	771 (14%)
White	5,712 (53%)	2,654 (52%)	3,058 (54%)
Asian	236 (2%)	124 (2%)	112 (2%)
Multiracial	1,126 (10%)	539 (11%)	587 (10%)
Missing	2 (<1%)	1 (<1%)	1 (<1%)
Parent marital status			
Not married	3,348 (31%)	1,635 (32%)	1,713 (30%)
Married	7,353 (68%)	3,453 (67%)	3,900 (69%)
Missing	82 (1%)	34 (1%)	48 (1%)
Parent max. education			
Did not complete high school/GED	509 (5%)	264 (5%)	245 (4%)
Completed high school/GED	986 (9%)	464 (9%)	522 (9%)
Some college	1,350 (12%)	622 (12%)	728 (13%)
Completed Associate's degree	1,417 (13%)	667 (13%)	750 (13%)
Completed Bachelor's degree	2,771 (26%)	1,302 (25%)	1,469 (26%)
Completed graduate degree	3,727 (35%)	1,795 (35%)	1,932 (34%)
Missing	23 (<1%)	8 (<1%)	15 (<1%)
Parental income (USD)			
<\$25,000	1,435 (13%)	668 (13%)	767 (14%)
\$25,000–\$49,999	1,413 (13%)	704 (14%)	709 (13%)
\$50,000–\$74,999	1,371 (13%)	642 (13%)	729 (13%)
\$75,000–\$99,999	1,443 (13%)	696 (14%)	747 (13%)
\$100,000–\$199,999	3,077 (29%)	1,443 (28%)	1,634 (29%)
\$200,000 or greater	1,144 (11%)	549 (11%)	595 (11%)
Missing	900 (8%)	420 (8%)	480 (8%)

Note: ABCD, Adolescent Brain and Cognitive Development Study; CBCL, Child Behavior Checklist; GED, general education diploma; Max, maximum value; Mdn, median value; Min, minimum value; n (%), number of participants and percentage of sample with nonmissing data; PM, particulate matter; $PM_{2.5}$, fine particulate matter with aerodynamic diameter ≤ 2.5 μm; $PM_{2.5}$ avg., annual average of $PM_{2.5}$ air pollution at participants' home address in 2016 (μg/m^3); $PM_{2.5}$ Days US EPA, number of days in 2016 with $PM_{2.5}$ levels at participants' home address above US Environmental Protection Agency standards for ambient $PM_{2.5}$ (>35 μg/m^3); $PM_{2.5}$ max, maximum daily level of $PM_{2.5}$ at participants' home address during 2016 (μg/m^3); SD, standard deviation; USD, United States dollars.

by two growth curve factors (intercept and slope)]. FDR calculations were carried out separately for models testing for linear and quadratic associations, respectively. An FDR-adjusted q-value of <0.05 was used as significance threshold. Uncorrected p-values were determined according to the z-statistic of the coefficient of interest (i.e., estimate divided by standard error).

For all models with significant regression coefficients between $PM_{2.5}$ exposure and the intercept or slope growth factors, we conducted post hoc analyses evaluating whether the effects of interest remained significant when controlling for the two other $PM_{2.5}$ exposure measures, as well as the parental informant's own total psychopathology at the baseline timepoint, as measured by the Achenbach System of Empirically Based Assessment Adult Self Report. By controlling for the other two $PM_{2.5}$ measures, we can determine if associations of a given $PM_{2.5}$ measure with internalizing and externalizing trajectories are indeed unique to that measure, potential demonstrating that certain temporal patterns of exposure are particularly problematic as compared with others. For example, if both annual average of exposure and number of days of exposure above EPA standards were associated with the same aspect of symptom trajectories, it would be unclear whether the annual average association was in fact driven by the few days with exposures above the standards. By running post hoc analyses that include all three measures as simultaneous predictors, we can help address this issue as to the specificity of any observed effects.

For any significant associations between the intercept factors and $PM_{2.5}$ exposure in our main analyses, we changed the slope factor loadings, so the intercept factor was capturing means and variances in internalizing and externalizing symptoms at the later time points (i.e., years 1–3) and then reran the models for each of these later time points, separately. These analyses provided a post hoc significance test, allowing us to ascertain whether any observed association between exposure and internalizing and externalizing symptoms at the baseline timepoint remained significant at later time points.

Finally, to evaluate the degree to which any significant associations between exposures and internalizing and externalizing symptom trajectory factors may be explained by residual confounding, we computed E-values for that coefficient, which estimates the degree of unmeasured confounding needed to fully explain the observed association.[57] E-values were computed using the "Evalue" R package (version 4.0.2; R Development Core Team), using the following parameters: standardized regression coefficient, standard error of the regression coefficient, variance of the factor in question (i.e., intercept or slope), and a delta of 1.

Results

Demographics, Descriptive Statistics, and Zero-Order Correlations

For complete demographic data and descriptive statistics, see Tables 1 and 2. Comparisons of covariates between the analysis sample and the excluded sample can be seen in Tables S1 and S2. For zero-order Spearman correlations between all measures across the full sample and in females and males, separately, see Supplemental Figures S1–S3. In brief, using a standard significance threshold of $p < 0.05$, Mann-Whitney–Wilcoxon tests revealed that

Table 3. Linear growth curve model fit statistics of models in which all parameters are constrained to be equal and unequal between the sexes in the ABCD cohort ($n = 10{,}783$; female $n = 5{,}122$; male $n = 5{,}661$).

CBCL subscale	Model	χ^2 (df)	Scaling factor	Scaled $\Delta\chi^2$ (df)	RMSEA (90% CI)	CFI	TLI	SRMR
Internalizing	Equal across sexes	116.1 (19)	2.3700	83.3 (9)	0.031 (0.026, 0.036)	0.984	0.990	0.045
Internalizing	Unequal across sexes	22.0 (10)	2.0086	—	0.015 (0.006, 0.023)	0.998	0.998	0.014
Externalizing	Equal across sexes	181.4 (19)	3.2867	134.7 (9)	0.040 (0.035, 0.045)	0.966	0.979	0.106
Externalizing	Unequal across sexes	22.3 (10)	2.6585	—	0.015 (0.007, 0.024)	0.997	0.997	0.018

Note: Model fit and chi-square difference comparisons between models in which growth factor parameters are constrained or unconstrained across females and males. Growth curve parameters for the unconstrained models can be seen in Figure 1. For chi-square differences tests of individual parameters, see Table S3. 90% CI, 90% confidence interval; ABCD, Adolescent Brain and Cognitive Development study; CBCL, Child Behavior Checklist; CFI, Comparative Fit Index; CI, confidence interval; df, degrees of freedom; $\Delta\chi^2$, change in chi-square; RMSEA, Root Means Square Error of Approximation; SRMR, Standardized Root Mean Squared Residual; TLI, Tucker-Lewis Index.

the excluded sample was younger at all time points (baseline: $W = 5{,}540{,}112$, $p = 0.001$; year 1: $W = 4{,}857{,}411$, $p = 0.003$; year 2: $W = 4{,}275{,}128$; $p = 0.034$; year 3: $W = 1{,}045{,}184$; $p = 0.011$), while also having significantly higher ADI ($W = 2{,}637{,}922$; $p < 0.001$). In addition, we found that the excluded sample was slightly higher in $PM_{2.5}$ annual average ($W = 2{,}515{,}342$; $p = 0.038$) but interpret this result with caution, given the concerns regarding the quality of $PM_{2.5}$ data in the excluded sample. We did not compare the analysis sample and the excluded sample on the other two $PM_{2.5}$ measures because there were only five participants in the excluded sample with data on these measures. Notably, the excluded sample was disproportionately drawn from one site (site 19), which represented $\sim 5\%$ of the participants in the analysis sample but $\sim 18\%$ of participants in the excluded sample and had a higher percentage of Black participants ($\sim 14\%$ in analysis sample and $\sim 23\%$ in excluded sample). As a result, we saw some evidence of selection when comparing the analysis sample and the excluded sample, though it is unclear as to how this selection may bias the results.

Latent Growth Curve Modeling of Internalizing and Externalizing Symptom Trajectories

The internalizing and externalizing symptom growth models fit well in both constrained and unconstrained models, all RMSEA <0.06, CFI >0.95, and SRMR <0.08 (see Table 3 for model fit information, Figure 1 for model parameters and estimated trajectories, and Supplemental Table S3 for chi-square differences tests of individual model parameters). Chi-square difference tests revealed that a model in which all growth curve parameters (i.e., means, variance, covariances, residual variances) were allowed to differ between the sexes provided a significantly better fit than when the parameters were constrained to be equal across the sexes for both internalizing and externalizing symptom trajectories (internalizing: $\Delta\chi^2[9] = 83.3$, $p < 0.001$; externalizing: $\Delta\chi^2[9] = 134.7$, $p < 0.001$).

As illustrated in Figure 1 and Supplemental Table S3, females and males had similar initial levels of internalizing symptoms (females: mean of intercept factor = 4.99; males: mean of intercept factor = 5.09; $\Delta\chi^2[1] = 1.336$, $p = 0.248$) but significantly diverged over time, with females showing an average increase in internalizing symptoms and males showing an average decrease (females: mean of slope factor = 0.19; males: mean of slope factor = -0.12; $\Delta\chi^2[1] = 54.311$, $p < 0.001$). For externalizing, females were lower than males at baseline (females: mean of intercept factor = 3.70; males: mean of intercept factor = 4.95; $\Delta\chi^2[1] = 115.690$, $p < 0.001$) and although both sexes decreased in externalizing symptoms over time, this decrease was significantly greater in males than females (females: mean of slope factor = -0.08; males: mean of slope factor = -0.18; $\Delta\chi^2[1] = 7.190$, $p = 0.007$). Variances and covariances of the intercept and slope factors for both internalizing and externalizing trajectories were all significant, whereas sex difference analyses revealed that the internalizing residual variance at year 3 ($\Delta\chi^2[1] = 19.876$, $p < 0.001$), as well as the externalizing slope factor variance ($\Delta\chi^2[1] = 34.775$, $p < 0.001$), and the externalizing residual variances at baseline ($\Delta\chi^2[1] = 8.630$, $p = 0.003$) and year 1 ($\Delta\chi^2[1] = 6.618$, $p = .010$) all significantly differed between females and males. As a result of the considerable sex differences in growth curve factor parameters, we allowed all growth parameters to differ between the sexes in analyses regressing the growth curve factors on $PM_{2.5}$ exposure.

Regressing Growth Curve Factors on $PM_{2.5}$ Exposure

In initial models testing for nonlinear associations between $PM_{2.5}$ exposure and symptom trajectories, there were no FDR-corrected significant regression coefficients between the quadratic exposure terms and the growth curve factors (see Supplemental Table S4 for FDR-corrected results and Excel Tables S1–S12 for results including all covariates in both constrained and unconstrained models). As a result, the quadratic term was dropped from all models, which were then rerun testing for linear associations only. See Table 4 for statistics on regression coefficients between symptom trajectory factors and $PM_{2.5}$ measures when these coefficients were constrained to be equal across the sexes. For regression coefficients of all covariates in both constrained and unconstrained models, see Excel Tables S13–S24. After FDR correction these analyses revealed that a higher number of days above US EPA standards was associated with alterations in internalizing symptom trajectories, but not externalizing. Specifically, for every additional day of exposure above the $PM_{2.5}$ standard, there was a 0.098 increase in the internalizing intercept [standardized $\beta = 0.052$; 95% confidence interval (CI): 0.027, 0.077], FDR-adjusted $p = 0.006$, E-value = 1.28), but this reduced in magnitude at a rate of -0.030 per year after exposure, as indicated by a significant association between days above the $PM_{2.5}$ standard with the internalizing slope factor (standardized $\beta = -0.069$; 95% CI: -0.108, -0.030, FDR-adjusted $p = 0.006$, E-value = 1.33). Thus, $PM_{2.5}$ exposure was more strongly associated with concurrent internalizing symptoms for time points closer to exposure.

Follow-up post hoc analyses tested whether the significant associations between $PM_{2.5}$ measures and symptom growth curves remained significant when controlling for the other two $PM_{2.5}$ measures, as well as informant total psychopathology levels (Excel Table S25). When including these measures as additional predictors of internalizing growth factors, the associations between days above the $PM_{2.5}$ standard and internalizing symptom factors remained significant and of a similar magnitude (internalizing intercept: standardized $\beta = 0.051$; 95% CI: 0.022, 0.080, unadjusted $p = 0.001$, E-value = 1.32; internalizing slope: standardized $\beta = -0.064$; 95% CI: -0.115, -0.013, unadjusted $p = 0.013$, E-value = 1.32), despite a strong association between informants' total psychopathology levels and the internalizing factors (intercept: standardized $\beta = -0.609$; 95% CI: 0.578, 0.640, unadjusted $p < 0.001$, E-value = 3.49; slope: standardized $\beta = -0.204$; 95% CI: -0.282, -0.126, unadjusted $p < 0.001$, E-value = 1.72).

Finally, we evaluated whether effects of number of days above the $PM_{2.5}$ standard at baseline on internalizing levels remained

Table 4. Regression coefficients of growth curve factors on $PM_{2.5}$ measures in full sample ($n = 10{,}783$) of ABCD cohort, constrained to be equal across the sexes.

CBCL subscale	$PM_{2.5}$ measure	Factor	Unstand. b (SE)	Stand. β (95% CI)	b/SE	FDR *p*-value
Internalizing	Average	Intercept	0.055 (0.036)	0.019 (−0.005, 0.043)	1.544	.211
—	—	Slope	−0.011 (0.014)	−0.017 (−0.059, 0.025)	−0.799	.440
Internalizing	Days US EPA	Intercept	0.098 (0.024)	0.052 (0.027, 0.077)	4.031	.006
—	—	Slope	−0.030 (0.008)	−0.069 (−0.108, −0.030)	−3.502	.006
Internalizing	Max	Intercept	0.002 (0.002)	0.012 (−0.012, 0.036)	0.975	.395
—	—	slope	−0.002 (0.001)	−0.044 (−0.083, −0.005)	−2.193	.084
Externalizing	Average	Intercept	0.053 (0.039)	0.019 (−0.009, 0.047)	1.35	.266
—	—	Slope	−0.01 (0.013)	−0.018 (−0.064, 0.028)	−0.772	.440
Externalizing	Days US EPA	Intercept	0.038 (0.022)	0.021 (−0.003, 0.045)	1.709	.209
—	—	Slope	−0.019 (0.008)	−0.055 (−0.098, −0.011)	−2.496	.052
Externalizing	Max	Intercept	−0.002 (0.002)	−0.014 (−0.038, 0.010)	−1.165	.325
—	—	Slope	−0.001 (0.001)	−0.001 (−0.002, 0.000)	−1.57	.211

Note: For regression statistics of covariates, see Excel Tables S13–S24. 95% CI, 95% confidence interval; ABCD, Adolescent Brain and Cognitive Development Study; Average, annual average of $PM_{2.5}$ air pollution at participants' home address in 2016 ($\mu g/m^3$); CBCL, Child Behavior Checklist; CI, confidence interval; Days US EPA, number of days in 2016 with $PM_{2.5}$ levels at participants' home address above US Environmental Protection Agency standards for ambient $PM_{2.5}$ ($>35\ \mu g/m^3$); FDR *p*-value, false discovery rate adjusted *p*-value; Max, maximum daily level of $PM_{2.5}$ at participants' home address during 2016 ($\mu g/m^3$); PM, particulate matter; $PM_{2.5}$, fine particulate matter with aerodynamic diameter $\leq 2.5\ \mu m$; SE, standard error; Stand. β, standardized regression coefficient; Unstand. b, unstandardized regression coefficient.

significant in the years following the measured exposure and baseline symptom measurement. To do so, we iterated through which of the year 1 to year 3 time points was the intercept in the growth curve and regressed the resulting intercept factor on the days above the US EPA $PM_{2.5}$ standard and the covariates used in the main analyses (Excel Tables S26–S28). These analyses revealed that, despite getting smaller with time, the association between days above the $PM_{2.5}$ standard and higher internalizing score remained significant 1 y after exposure (standardized $\beta = 0.036$; 95% CI: 0.012, 0.060, unadjusted $p = 0.002$) but not at the later time points. Thus, the number of days with $PM_{2.5}$ above US EPA standards is not only associated with higher concurrent internalizing symptoms in youth but also higher internalizing symptoms 1 y following exposure, and these effects appear to be unique to youth when controlling for informants psychopathology levels.

Sex Differences in Associations between $PM_{2.5}$ Exposure and Symptom Trajectories

Chi-square differences tests evaluating sex differences in associations between the $PM_{2.5}$ quadratic terms and symptom trajectory found no evidence of sex differences in nonlinear associations between exposure and growth curve factors (see Supplemental Table S5). Chi-square differences tests evaluating sex differences in linear $PM_{2.5}$-symptom trajectory associations demonstrated that the association between annual average of $PM_{2.5}$ and the externalizing intercept significantly differed between the sexes, albeit weakly ($\Delta\chi^2[1] = 4.006$, $p = 0.045$) (see Supplemental Table S6). Specifically, for every increase of 1 $\mu g/m^3$ in average $PM_{2.5}$ levels, the externalizing intercept factor (i.e., externalizing levels at baseline) increased by .113 in females but not males (females: standardized $\beta = 0.040$; 95% CI: 0.003, 0.077, unadjusted $p = 0.035$, E-value = 1.24; males: standardized $\beta = -0.008$; 95% CI: −0.021, 0.037; unadjusted $p = 0.621$). No other regression coefficient of interest showed significant sex differences. Post hoc analyses revealed that the association between annual average of $PM_{2.5}$ and the externalizing intercept in females was reduced to the point of no longer being significant after controlling for the other exposure measures and informant psychopathology (standardized $\beta = 0.024$; 95% CI: −0.011, 0.059; unadjusted $p = 0.183$; Excel Table S29). Thus, although there was weak evidence of an association between annual average and externalizing in female youth, this effect does not appear to reflect unique effects of the annual average measures and was not specific to youth when controlling for informants' psychopathology levels.

Discussion

Using latent growth curve modeling in a large-scale, longitudinal dataset of youth development, the current study found evidence that a higher number of days with ambient $PM_{2.5}$ levels above EPA standards ($>35\ \mu g/m^3$ 24-h average) during late childhood was associated with higher levels of internalizing symptoms during the same year and up to 1 y later, regardless of an individual's sex. This association between number of days above US EPA standards and internalizing symptoms was found over and above associations with annual average and maximum level, suggesting that repeated high levels of $PM_{2.5}$ exposure (i.e., days above US EPA standards) may be more impactful to internalizing psychopathology than the typical level of exposure (i.e., annual average) or highest level of exposure (i.e., maximum) over the same exposure period. Finally, there was weak but notable evidence that females and males differed in their associations between annual average of $PM_{2.5}$ and externalizing symptom levels, with higher annual average associating with higher levels of externalizing symptoms at baseline in females only. In the remainder of the discussion, we integrate the current results with previous literature and highlight critical unanswered questions.

$PM_{2.5}$ Exposure is Associated with Concurrent and Future Internalizing Symptoms

Several studies have reported similar effects between $PM_{2.5}$ exposure and internalizing symptoms in adult or general population samples, including studies linking daily $PM_{2.5}$ levels to hospital admission for psychiatric episodes,[58–61] cross-sectional studies linking level of exposure to concurrent mental health,[62,63] and longitudinal studies demonstrating effects of exposure on adjacent or future mental health.[9,26,27,64] However, the current findings extend this literature in important ways. First, previous research linking childhood $PM_{2.5}$ exposure to psychopathology has found evidence of long-term associations between $PM_{2.5}$ exposure during childhood and later internalizing diagnoses,[9] as well as concurrent associations between childhood exposure in children 6–11 y of age and subclinical externalizing symptoms,[64] but there has been little evidence of effects of $PM_{2.5}$ exposure during late childhood on concurrent internalizing symptoms, as was observed in the current report. Indeed, two recent studies both suggested that air pollution exposure across adolescence was associated with internalizing and externalizing symptoms at the end of the exposure window, but that these effects were specific to NO_x exposure, not $PM_{2.5}$.[65–66] As such, the specific findings in the current report align with previous work demonstrating effects of air pollution exposure on subclinical symptoms of psychopathology in youth but also contrast with this work as to the specific pollutant implicated, because they found no associations with $PM_{2.5}$.

It is notable that the current study failed to conceptually replicate a related study which found that higher $PM_{2.5}$ exposure during late childhood was associated with a flattening in the trajectory of conduct problems over time, a central aspect of externalizing symptoms.[38] Whereas externalizing symptoms generally have been found to decrease over time across late childhood and early adolescence,[67] Karamanos et al.[38] found that higher $PM_{2.5}$ exposure was associated with a flattening of conduct problems trajectory, with levels of conduct problems not decreasing at as fast a rate. Yet in the current study the association between annual average of $PM_{2.5}$ and the externalizing symptoms slope factor was nonsignificant. However, important methodological differences make it difficult to compare these studies, including differences in how sex was modeled, with Karamanos et al. controlling for sex, whereas the current report treated sex as a grouping variable, allowing us to test for moderating effects of sex on associations between $PM_{2.5}$ exposure and psychopathology symptoms. Indeed, as discussed in the following section, the current report found weak but notable sex differences in both the trajectory of externalizing symptoms, as well as the association between $PM_{2.5}$ exposure and initial levels of externalizing, highlighting the importance of explicitly testing for sex differences in research on youth psychopathology.

With data on more than 10,000 youth, the current study had considerably more power than previous investigations. As a result, even very small effects could be detected, effects which would be deemed nonsignificant in studies with smaller sample sizes. The association between $PM_{2.5}$ and internalizing symptoms in the current report was small in nature (standardized $\beta = 0.052$; 95% CI: 0.027, 0.077), yet in line with effect sizes observed using ABCD Study data when trying to link individual differences in behavior to biological measures.[68] However, the small effect sizes do not mean the associations between $PM_{2.5}$ exposure and internalizing symptoms are trivial. First, even if effects of $PM_{2.5}$ on mental health are small, if enough people are exposed, the cumulative societal impact of these effects may be quite large, as has been demonstrated elsewhere.[1] Second, because only a small part of the overall exposome, $PM_{2.5}$ is just one of many common pollutants that may exacerbate mental illness and, when considered together, the cumulative effect of these pollutants may add up to a substantial impact.[69] In addition, certain risk factors not investigated in the current report may moderate effects of air pollution exposure, putting specific individuals at increased risk for negative impacts of exposure, with effects of exposure being stronger in certain subpopulations. As a future direction, our research group plans to use additional environmental and genomic data within the ABCD dataset to identify genetic risk factors that may moderate effects of environmental exposures on mental health.

In addition to demonstrating associations between $PM_{2.5}$ exposure in late childhood and concurrent internalizing symptoms, the current study also differed from previous work by using alternative measures of $PM_{2.5}$ exposure that go beyond the temporal averaging that is commonly used in the literature. A central aim of the current study was to compare different temporal models of $PM_{2.5}$ exposure to determine if youth symptom trajectories were most affected by annual average, days above EPA standards, or maximum daily level. Results suggested that youth symptoms were most affected by the number of days above US EPA standards and that these effects were independent from the other temporal patterns of exposure. Specifically, this finding suggests that persistent moderate levels of exposure (i.e., $PM_{2.5}$ annual average) and the actual level of highest exposure (i.e., $PM_{2.5}$ maximum daily exposure) are less impactful to mental health than having multiple days of relatively high exposure, even if these days are infrequent. This possibility has several important implications. First, relying solely on annual average measures of exposure, as is commonly done in the literature, likely misses effects that are unique to specific temporal patterns of exposure. Thankfully, a recent proliferation of air monitoring systems and related databases are beginning to provide researchers with a wealth of data to model different patterns of $PM_{2.5}$ exposure. Second, from a public health perspective, this finding points to a specific pattern of exposure that may put youth at heightened risk for mental health problems as they transition into adolescence, potentially providing a template for identifying youth who may particularly benefit from interventions aimed at ameliorating the long-term impacts of $PM_{2.5}$ exposure. Finally, the association between internalizing symptom trajectories and number of days of exposure above US EPA standards provides additional support to these standards. Although the nature of the ABCD dataset prevents us from comparing the specific standard of $35\,\mu g/m^3$ to other potential thresholds, the current results suggest that the current standard may be meaningful for reducing risk of symptoms of psychopathology across adolescence. A deeper understanding of the specific temporal patterns and levels of exposure that are most problematic to mental health could provide valuable information when it comes to developing prevention and intervention strategies aimed at ameliorating the psychiatric impacts of air pollution exposure.

It is important to note that the negative association between number of days above US EPA standards and the internalizing slope factor suggests that the magnitude of the association gets smaller the further in time from exposure, at least across the 3 y and outcomes investigated in the current study. This result aligns with recent research suggesting that cognitive impairments from acute $PM_{2.5}$ exposure may be temporary, at least in older adults.[70] However, other studies have demonstrated associations between childhood exposure and long-lasting psychiatric and neural outcomes, including developing a mental health disorder[9] and alterations in neuroanatomy.[4,5,71,72] These studies together suggest that effects of exposure may be diverse in both the domain affected and the timing of when they manifest. We speculate that around the time of exposure, these impacts may manifest as subtle, temporary increases in subclinical symptoms of mental illness, potentially due to an acute, transitory neuroimmune response. On a longer-term basis, however, effects may manifest as increased risk for disorders, potentially due to brain pathologies caused by chronic, elevated immune responses. This diversity in the apparent impacts of $PM_{2.5}$ exposure underscores the importance of longitudinal, multimodal datasets measuring a breadth of phenotypes to investigate the full scope of $PM_{2.5}$'s impact on youth mental health, such as the ABCD Study. A critical future direction is understanding the relationship between more immediate and long-term effects of exposure, including the degree to which they may represent common or distinct mechanisms of pathology. As additional time points of ABCD study data become available, we plan to extend this program of research to investigate additional years of internalizing and externalizing symptoms, as well as additional longitudinal outcomes, including the trajectory of brain development and cognition.

Sex Differences in Association between $PM_{2.5}$ Exposure and Externalizing Symptoms

Despite substantial differences in the trajectories of internalizing and externalizing symptoms between female and male youth, there was little evidence of sex differences in the associations of $PM_{2.5}$ exposure with these trajectories, with one exception: Females and males marginally differed in the annual average–externalizing intercept association, with higher annual average of $PM_{2.5}$ associated with higher initial levels of externalizing in females only. This finding adds to a growing body of evidence suggesting sex differences in the impacts of air pollution on health more broadly.[73–76] One compelling mechanism potentially driving sex differences in the psychiatric impacts of $PM_{2.5}$ exposure are sex differences in immune function and inflammatory responses,[77–78] both of which are influenced by sex hormones central to puberty and thus youth development.[79–80] Immunocompetent cell function and inflammatory signals have been shown to regulate brain development and health in a partially sex-specific fashion, ultimately contributing to sexual dimorphisms in the brain and subsequent behavior.[78] Yet these same cells and signals are considered central to the deleterious neural impacts of $PM_{2.5}$, with chronic exposure leading to increased immune cell functioning and inflammatory signaling which themselves can cause neuronal damage and death.[81,82] As such, if immune cells and inflammatory signals contribute to brain development in a sex-specific fashion, are modulated by sex hormones that abound during puberty, and are affected by air pollution exposure, then the neuropsychiatric impacts of air pollution exposure during and around puberty should at least partially differ between the sexes as well. The current findings broadly align with this framework, demonstrating associations between exposure and internalizing symptoms that are consistent across the sexes, but these findings also demonstrate that associations between exposure and externalizing symptoms that are sex-specific occur only in female youth.

Limitations

This study is not without limitations. First, the lack of longitudinal $PM_{2.5}$ data limited our ability to determine whether the effects of $PM_{2.5}$ exposure at baseline were indeed specific to exposure at baseline. For instance, if there is a positive relation between $PM_{2.5}$ exposure at earlier points in development, $PM_{2.5}$ levels at baseline may be serving as a proxy for exposure during these earlier developmental stages. However, future ABCD study data releases will include estimates of $PM_{2.5}$ exposure across the entirety of participants' lives, providing an opportunity to directly address this issue. Second, there is a wide range of potential confounders of the association between $PM_{2.5}$ and behavior that were not accounted for in the current analysis. Although the authors controlled for neighborhood socioeconomic deprivation, this approach did not address all potential confounders such as additional air pollutants, noise pollution, access to green space, crime, structural racism, and more. As such, follow-up work is needed to disentangle effects of $PM_{2.5}$ from other confounding environmental variables, including understanding how multiple environmental variables may interact to compound impacts of $PM_{2.5}$ exposure on mental health. For instance, Karamanos et al. found moderating effects of ethnicity and racism on associations between exposure and symptoms, with larger associations in specific ethnic groups when compared with others. A third limitation is the reliance on parental report measures of internalizing and externalizing symptoms. Although it is standard practice to use parent reports on youth mental health symptoms, there are several potential pitfalls to this approach, including difficulties in parents' ability to recognize certain symptoms in youth,[83] as well as the potential for parent's psychopathology to distort how they perceive and ultimately report their child's internalizing and externalizing symptoms.[84] We addressed the latter concern through post hoc analyses that included informant total mental health problems as a covariate. However, we acknowledge that additional research is needed to understand how effects of exposure on internalizing and externalizing symptoms may differ according to whether symptoms are measured through parent or self-report, and whether there are unique effects of exposure depending on whether exposure occurs during youth or in adulthood. Fourth, though relatively high resolution for an area the size of the United States, the spatial resolution of the $PM_{2.5}$ estimates are not ideal for estimating precise levels of exposure, particularly in urban areas where there can be large differences in actual exposure over relatively short distances. In addition, the use of only residential home addresses does not account for the fact that many of the participants likely spent a significant amount of time during the measured exposure period at some other location or moved during the exposure period. As such, the degree to which the estimated exposures in the current report reflect actual exposure is unclear, but this is a common limitation of research into environmental exposures more broadly. Fifth, due to limitations in the curated ABCD dataset, we were unable to evaluate alternative thresholds besides $35\ \mu g/m^3$. Critically, future sensitivity analyses are needed to determine the degree to which lower thresholds may also be associated with alterations in internalizing and externalizing symptom trajectories. Finally, when comparing participants who were excluded from all analyses due to missing or incomplete $PM_{2.5}$ exposure data, we found evidence of selection that may limit the generalizability of the current findings. Specifically, excluded participants showed a higher degree of ADI and higher levels of $PM_{2.5}$ exposure, variables which have been previously linked to higher levels of psychopathology,[15,85] and we believe that this selection may weakly bias our findings by reducing the estimated associations between exposure and internalizing and externalizing trajectories.

Conclusions

The current study concluded that the number of days of $PM_{2.5}$ exposure above US EPA standards during late childhood was associated with higher concurrent levels of internalizing symptoms across females and males, even after considering effects of other temporal patterns of exposure. Notably, this association remained when accounting for parental psychopathology, suggesting $PM_{2.5}$ exposure may have specific impacts on youth distinct from impacts on their parents. Finally, results suggested a weak but notable sex difference in the association between $PM_{2.5}$ exposure and externalizing symptoms. These findings underscore the importance of considering environmental pollutants as a potential causal mechanism increasing risk for psychopathology across the lifespan, while demonstrating the utility of both dimensional models of psychopathology and alternative measures of air pollution exposure in comparison with traditional temporal average measures.

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Perfluoroalkyl Substances (PFAS) Affect Inflammation in Lung Cells and Tissues

Julie Dragon [1], Michael Hoaglund [1], Appala Raju Badireddy [1], Greylin Nielsen [2], Jennifer Schlezinger [2] and Arti Shukla [1,*]

[1] Department of Pathology and Laboratory Medicine, Larner College of Medicine, University of Vermont, Burlington, VT 05405, USA; julie.dragon@med.uvm.edu (J.D.); mike.s.hoaglund@gsk.com (M.H.); raju.badireddy@uvm.edu (A.R.B.); nielseng@bu.edu (G.N.); jschlezi@bu.edu (J.S.)

[2] Department of Environmental Health, School of Public Health, Boston University, Boston, MA 02118, USA

* Correspondence: arti.shukla@med.uvm.edu; Tel.: +802-656-8253; Fax: +802-656-8892

Abstract: Adverse lung outcomes from exposure to per-and polyfluoroalkyl substances (PFAS) are known; however, the mechanism of action is poorly understood. To explore this, human bronchial epithelial cells were grown and exposed to varied concentrations of short-chain (perfluorobutanoic acid, perflurobutane sulfonic acid and GenX) or long-chain (PFOA and perfluorooctane sulfonic acid (PFOS)) PFAS, alone or in a mixture to identify cytotoxic concentrations. Non-cytotoxic concentrations of PFAS from this experiment were selected to assess NLRP3 inflammasome activation and priming. We found that PFOA and PFOS alone or in a mixture primed and activated the inflammasome compared with vehicle control. Atomic force microscopy showed that PFOA but not PFOS significantly altered the membrane properties of cells. RNA sequencing was performed on the lungs of mice that had consumed PFOA in drinking water for 14 weeks. Wild type (WT), PPARα knock-out (KO) and humanized PPARα (KI) were exposed to PFOA. We found that multiple inflammation- and immune-related genes were affected. Taken together, our study demonstrated that PFAS exposure could alter lung biology in a significant manner and may contribute to asthma/airway hyper-responsiveness.

Keywords: PFAS; lung; inflammasome; inflammation

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1. Introduction

Per- and polyfluroalkyl substances (PFAS) are a large suite of industrial chemicals used in many commercial products (e.g., fabric, cookware and food container coatings), and in aqueous film-forming foams used in firefighting [1–3]. Chemically, these are fluorinated carbon chains that have different functional groups, high chemical and thermal stability [4] and surfactant-like properties [5–7]. Their extensive use and persistence have led to PFAS becoming ubiquitous environmental contaminants. PFAS from industrial sources and consumer product use are increasingly detected in air, water, soil, and indoor environments [1,8–12] and are capable of long-distance transport [13–15]. PFAS, particularly the long-chained forms, bio-accumulate with the highest concentrations detected in the liver and blood. PFAS are also known to reach distal organs (e.g., bone and lung) after oral exposure [16–19]. PFAS are implicated in developmental, metabolic, autoimmune, reproductive and kidney disorders as well as cancer, type 1 diabetes and celiac disease [20–25]. While long-chain (≥C8) PFAS have been phased out of production in the U.S., alternative PFAS (e.g., GenX) have taken their place. Significant and ubiquitous body burdens of both legacy and alternative PFAS in Americans are evident [26], which demands more data on the adverse health effects of diverse PFAS.

Systemic, as well as inhaled, PFAS target the lung and are reported to modify lung surfactant function and pro-inflammatory responses [17,27–32]. An association between PFAS, asthma, airway hyper-responsiveness (AHR) and inflammation has previously been reported [33–36]. Many studies have identified a positive association between exposure to

PFAS and asthma-related outcomes in children [8,37] with some inconsistencies [9,38]. A recent study of 675 adolescents in Norway suggests that total PFAS serum concentrations are associated with the occurrence of asthma, while total perfluorooctane sulfonic acid (PFOS), linear PFOS, and linear perfluorohexane sulfonate (PFHxS) double the odds of asthma [39]. A study of 743 children showed a correlation between recurrent respiratory tract infection (RTI) and perfluorobutane sulfonic acid (PFBS) [40]. PFOS and perfluorooctanoic acid (PFOA) accumulate in lung epithelial cells by associating with phospholipids [41]. The literature clearly illustrates the impact of PFAS on lung diseases; however, the mechanistic studies are still limited and need further exploration.

Considering that PFAS act as surfactants and immune modulators [42], we proposed the hypothesis (model) that PFAS exposure would alter lung-cell membrane permeability resulting in NOD-like receptor (NLR) and apoptosis-associated speck-like protein 3 (ASC/PYCARD) (NLRP3) inflammasome activation and pro-inflammatory cytokine upregulation leading to inflammation, asthma or AHR. Using human bronchial lung epithelial cells (BEAS2B), mouse models and PFAS of diverse structures, we demonstrate that PFAS alone or in a mixture can have an immunomodulatory effects on lungs, which may be responsible for the observed lung pathogenesis.

2. Results

2.1. PFOA Significantly Altered Membrane Properties in BEAS2B Cells

Atomic force microscopy (AFM) performed on PFOS/PFOA exposed BEAS2B cells showed that PFOA exposure significantly altered the plasticity, force ratio and elastic modulus of cells compared to DMSO control (Table 1). PFOS did not have a significant effect on membrane properties.

Table 1. PFAS alters BEAS-2B cell membrane properties as measured by atomic force microscopy (AFM). (SEM-standard error of mean).

Treatment	Plasticity			Force Ratio			Elastic Modulus (Pa)		
	Mean	SEM	n	Mean	SEM	n	Mean	SEM	n
DMSO	0.276	0.0217	89	5.299	0.4668	95	521,803	41,398	97
PFOS	0.238	0.0158	96	5.013	0.2219	95	602,628	38,920	100
PFOA	0.305	0.0801	95	2.921	0.2770	95	699,743	159,913	96

2.2. PFOA Activates NLRP3 Inflammasome in BEAS2B Cells

BEAS2B cells were exposed to a range of concentrations of PFOA (1–1000 µM) for 24 h, and cell survival was measured by MTS Assay compared to DMSO control. Higher concentrations of PFOA caused significant cell death (Figure 1A). A range of concentrations of PFOA were then tested to see the effects on NLRP3 activation and priming. Figure 1B shows the release of caspase-1 and HMGB1 in the media at all concentrations of PFOA tested; however, significance was only reached at the highest concentration, suggesting that the activation of NLRP3 was a response to PFOA exposure. Increases in steady-state levels of *NLRP3*, *IL-6* and *IL-5* mRNAs (Figure 1C) demonstrated the effect of PFOA on NLRP3 priming and pro-inflammatory/allergic cytokine upregulation. A decreasing trend observed in steady-state mRNA levels of E-cadherin (*CDH1*) by PFOA could indicate a possible role for PFOA in epithelial-to-mesenchymal transition (EMT) (Figure 1C).

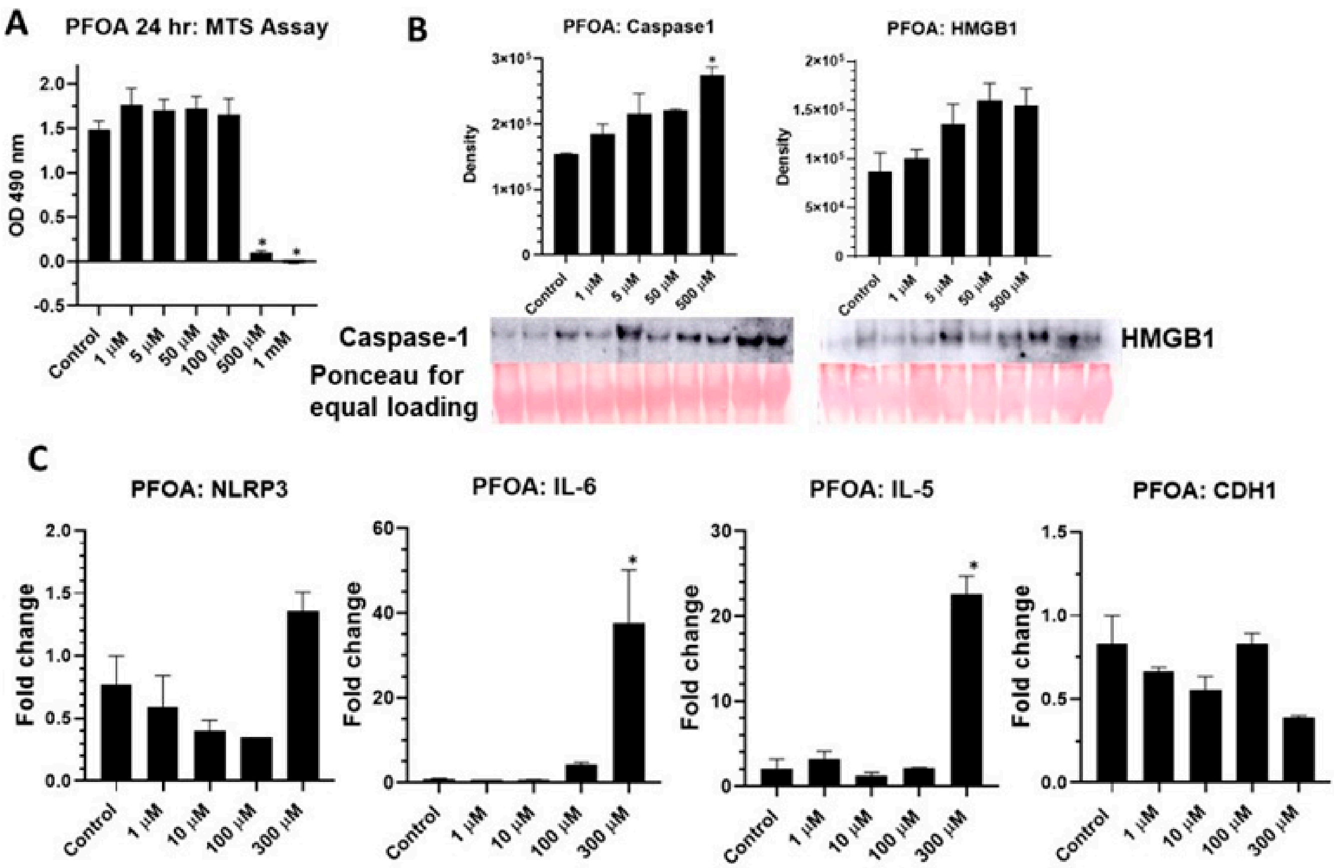

Figure 1. PFOA activates inflammasomes in BEAS2B cells. (**A**) PFOA-attenuated cell viability at 24 h at higher doses as measured by MTS Assay ($n = 6$, * $p \leq 0.05$ compared to control). (**B**) PFOA-caused inflammasome activation as measured by caspase-1 and HMGB1 secretion in media by immunoblotting. Ponceau stain was used as an equal loading control ($n = 2$/group, * $p \leq 0.05$ compared to control). Bar graph represents quantitation of immunoblots. (**C**) PFOA-caused increasedsteady-state mRNA levels of NLRP3 inflammasome, pro-inflammatory cytokine IL-6, allergy related cytokine IL-5 and decreased levels of CDH1, a marker of EMT as measured by qRTPCR normalized to hprt ($n = 2$, * $p \leq 0.05$ compared to control). Equal volume of DMSO was used in control in all experiments.

2.3. PFOS Activates NLRP3 Inflammasome in BEAS2B Cells

BEAS2B cells were exposed to a range of concentrations of PFOS (1–500 µM) for 24 h, and cell survival was measured by MTS Assay compared to DMSO control. The effect of DMSO (≤0.01%) alone on cell viability was also measured and found to have had no significant effect (Figure 2A). Higher concentrations of PFOS caused significant cell death (Figure 2A). A range of concentrations of PFOS were then tested to determine the effects on NLRP3 activation and priming. Figure 2B shows the release of caspase-1 and HMGB1 in the media at a high concentration of PFOS; quantitation by density assessment showed a significant effect (Figure 2B). Increases in steady-state mRNA levels of *NLRP3*, *IL-6* and *IL-5* (Figure 2C) demonstrated the effect of PFOS on NLRP3 priming and pro-inflammatory/allergic cytokine levels. A significant decrease observed in steady-state mRNA levels of *CDH1* by PFOS indicated a possible role for PFOS in initiating the EMT process (Figure 2C).

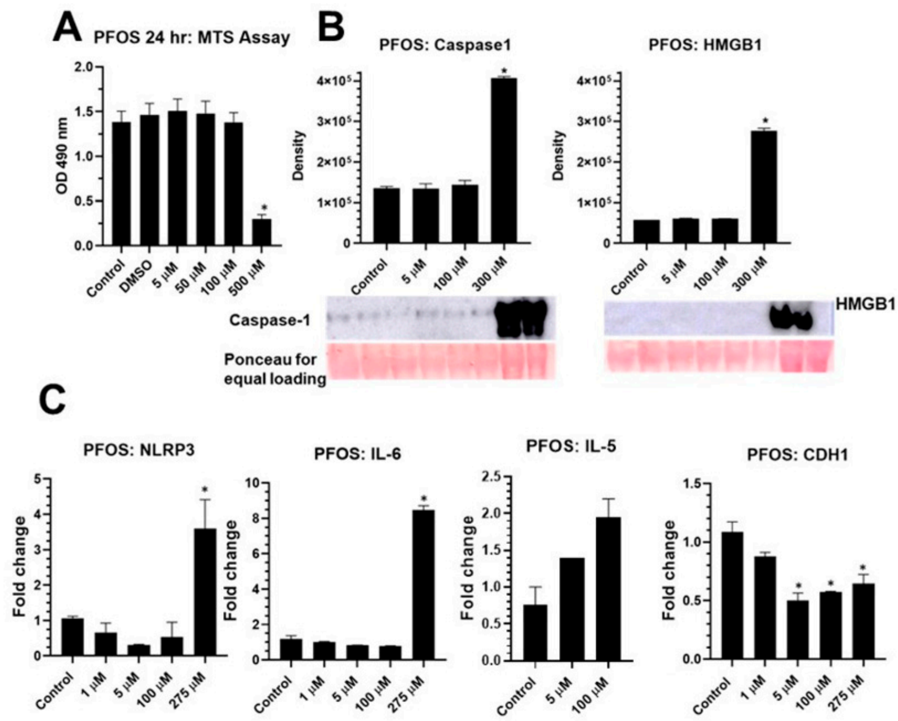

Figure 2. PFOS activates inflammasome in BEAS2B cells. (**A**) PFOS-attenuated cell viability at 24 h at higher doses as measured by MTS Assay (n = 6, * $p \leq 0.05$ compared to control). (**B**) PFOS-caused inflammasome activation as measured by caspase-1 and HMGB1 secretion in media assessed by immunoblotting. Ponceau stain was used as an equal loading control (n = 2/group, * $p \leq 0.05$ compared to control). Bar graphs represent quantitation of immunoblots (**C**). PFOS caused an increase in steady-state mRNA levels of NLRP3 inflammasome, pro-inflammatory cytokines IL-5 and 6 and decreased levels of CDH1, a marker for EMT as measured by qRTPCR (n = 2, * $p \leq 0.05$ compared to control). Equal volume of DMSO was used in control in all experiments.

2.4. Effect of Short Chain and a Mixture of Long and Short Chain PFAS on BEAS2B Cell Viability

As long-chain PFAS (PFOA, PFOS) are being replaced by short-chain PFAS (PFBA, PFBS, GenX) and the fact that the human population is exposed to a mixture of PFAS [25], we conducted experiments with short-chain PFAS as well as with a mixture of PFAS. As presented in Figure 3, the short-chain PFBA and GenX had no significant effect on cell viability. However, PFBS induced a significant increase in viability in a dose-dependent manner. The mixture of all five PFAS at low concentrations also increased viability, but the highest concentration reduced viability (Figure 3). This was an interesting observation. Because an MTS assay measures mitochondrial activity, it is possible that PFBS did not increase the proliferation/growth of the cell but simply the metabolism via mitochondrial activity.

2.5. PFAS Mixture Activates NLRP3 Inflammasome and Pro-Inflammatory Cytokines in Lung Epithelial Cells

A mixture of 5 PFAS (short and long chain) caused significant increases in caspase-1 and HMGB1 release in media, a measure of NLRP3 activation (Figure 4A). The mixture also resulted in increased steady-state mRNA levels of *NLRP3*, *IL-6*, *IL-5*, and *IL-8*, demonstrating its effect on NLRP3 priming and pro-inflammatory signals in BEAS2B cells (Figure 4B). The steady-state mRNA levels of proliferation related gene, PCNA-interacting partner (*PARPBP*) also increased (Figure 4B), which may have played a role in the observed increased viability with some short-chain PFAS as presented earlier. The EMT marker *CDH1* was again downregulated by PFAS mixture as was seen before with individual PFAS (Figure 4B), confirming that EMT plays a significant role in PFAS-induced lung pathogenesis.

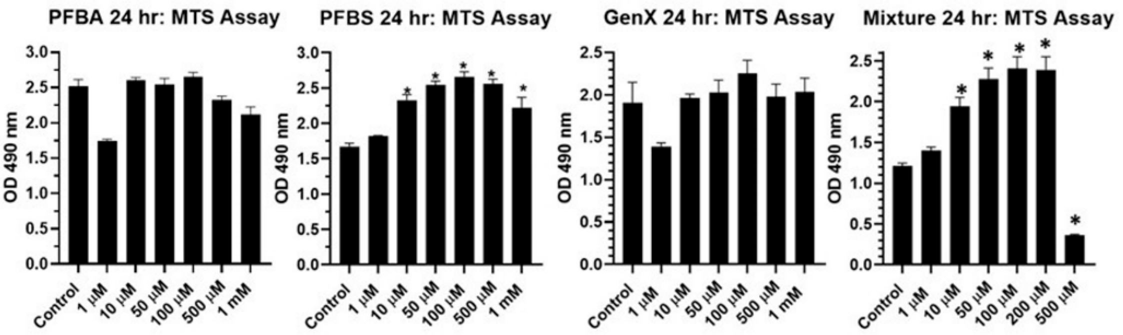

Figure 3. Effect of individual short-chain (PFBA, PFBS, GenX) or long- and short-chain mixture (PFOA, PFOS, PFBA, PFBS and GenX) on BEAS2B cell viability as measured by MTS Assay. * $p \leq 0.05$ compared to control (n = 6/group).

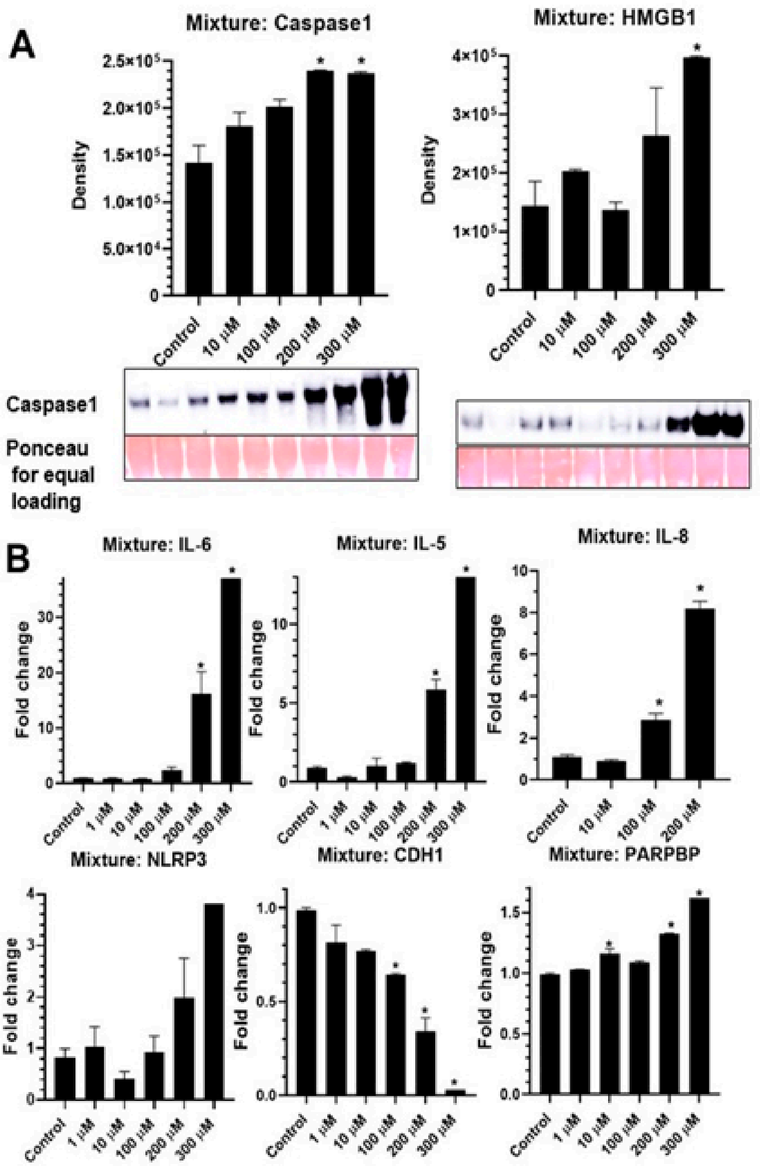

Figure 4. PFAS mixture causes inflammasome activation in BEAS2B cells as depicted by caspase-1 and HMGB1 release in media (**A**). An increase in steady-state mRNA levels of *NLRP3*, *IL-6*, *IL-5* and *PARPBP* and decrease in *CDH1* levels were caused by mixture (PFOA, PFOS, PFBA, PFBS and GenX) exposure (**B**). * $p \leq 0.05$ compared to control. (n = 2/group).

2.6. In Vivo Studies

The concentrations of PFOA in treated drinking water were 1.4 and 6.2 mg/L. Based on average daily consumption (0.21 mL/g mouse/day), the daily exposures were approximately 0.3 and 1.2 mg/kg/day. This resulted in serum concentrations of 29 ± 8 and 107 ± 15 µg/mL, respectively (n = 3–6). Male and female mice did not show significant differences in serum levels of PFOA after 14 weeks of consumption.

2.7. RNA Seq-Gene Expression on Mouse Lung Tissues Exposed to PFOA

WT mice lungs exposed to a high concentration of PFOA in water showed alterations in 62 protein coding genes (Table 2, FDR < 0.2, $p > 0.05$, and 2× fold change) 59 of which are depicted.

Table 2. Differentially expressed protein-coding genes from the lungs of wild type (WT) mice exposed to PFOA compared to those exposed to vehicle (V) based on an FDR < 0.05, p-value < 0.05, and 2× fold change cut off. Due to the limited number of available vehicle-treated lungs, several genes including *Bpifa1*, *Ccdc40*, *Hp* and *Stmnd1*, artifactually passed these thresholds despite weak support and validation on independent samples.

Ensembl	Chr	Total Counts	p-Value	FDR (Step-Up)	Fold Change
Bpifa1	2	946	5.29×10^{-9}	9.88×10^{-5}	2.36×10^{6}
Ighg2c	12	232	1.34×10^{-4}	9.61×10^{-2}	9.80×10^{1}
Hist1h2br	13	85	9.02×10^{-4}	1.87×10^{-1}	7.89×10^{1}
Ighg2b	12	234	6.84×10^{-4}	1.75×10^{-1}	1.46×10^{1}
Ncr1	7	551	8.33×10^{-4}	1.87×10^{-1}	9.14×10^{0}
Ccl5	11	663	2.69×10^{-4}	1.32×10^{-1}	5.59×10^{0}
I830077J02Rik	3	371	9.65×10^{-5}	7.36×10^{-2}	5.18×10^{0}
Plac8	5	745	7.30×10^{-4}	1.75×10^{-1}	3.86×10^{0}
Cd27	6	453	3.25×10^{-4}	1.38×10^{-1}	3.32×10^{0}
Cd226	18	873	2.47×10^{-4}	1.32×10^{-1}	3.30×10^{0}
Il27ra	8	647	6.11×10^{-4}	1.70×10^{-1}	2.65×10^{0}
Lrtm2	6	1051	2.07×10^{-4}	1.21×10^{-1}	2.41×10^{0}
Prkcq	2	1757	2.81×10^{-7}	2.62×10^{-3}	2.38×10^{0}
Nlrc5	8	3571	1.09×10^{-3}	1.96×10^{-1}	2.01×10^{0}
Kin	2	2205	6.73×10^{-4}	1.75×10^{-1}	-2.03×10^{0}
Lmod1	1	6101	1.19×10^{-3}	2.00×10^{-1}	-2.04×10^{0}
5330417C22Rik	3	12,012	8.49×10^{-6}	2.54×10^{-2}	-2.04×10^{0}
Kif7	7	1439	4.81×10^{-4}	1.66×10^{-1}	-2.07×10^{0}
Cyp2f2	7	142,500	5.99×10^{-4}	1.70×10^{-1}	-2.07×10^{0}
Inhbb	1	2105	9.52×10^{-6}	2.54×10^{-2}	-2.08×10^{0}
Rnf186	4	1163	8.24×10^{-4}	1.87×10^{-1}	-2.10×10^{0}
Hp	8	44,707	2.96×10^{-4}	1.38×10^{-1}	-2.14×10^{0}
Lrrc10b	19	1435	5.51×10^{-4}	1.70×10^{-1}	-2.15×10^{0}
Cckar	5	3927	7.17×10^{-5}	6.38×10^{-2}	-2.18×10^{0}

Table 2. *Cont.*

Ensembl	Chr	Total Counts	p-Value	FDR (Step-Up)	Fold Change
Hmgcll1	9	1103	3.40×10^{-4}	1.38×10^{-1}	-2.24×10^{0}
Mns1	9	4942	6.98×10^{-4}	1.75×10^{-1}	-2.24×10^{0}
Drc3	11	2063	1.19×10^{-3}	2.00×10^{-1}	-2.26×10^{0}
Ttc12	9	2140	4.64×10^{-5}	5.30×10^{-2}	-2.27×10^{0}
Aldh1a7	19	9082	1.30×10^{-5}	2.70×10^{-2}	-2.28×10^{0}
Foxj1	11	4375	1.10×10^{-3}	1.96×10^{-1}	-2.30×10^{0}
Rbp4	19	1647	3.00×10^{-5}	4.54×10^{-2}	-2.35×10^{0}
Ccdc189	7	1386	6.25×10^{-5}	5.83×10^{-2}	-2.35×10^{0}
Pcp4l1	1	3787	1.92×10^{-4}	1.17×10^{-1}	-2.39×10^{0}
Lrrc23	6	2829	5.69×10^{-4}	1.70×10^{-1}	-2.40×10^{0}
Ak7	12	5344	8.81×10^{-4}	1.87×10^{-1}	-2.42×10^{0}
Tcea3	4	1315	9.63×10^{-4}	1.88×10^{-1}	-2.43×10^{0}
Scgb1a1	19	910,638	5.78×10^{-6}	2.54×10^{-2}	-2.52×10^{0}
Ccdc40	11	6721	5.28×10^{-4}	1.70×10^{-1}	-2.53×10^{0}
Tyro3	2	1570	2.54×10^{-5}	4.32×10^{-2}	-2.55×10^{0}
Ccdc65	15	945	1.10×10^{-3}	1.96×10^{-1}	-2.56×10^{0}
Cep126	9	3598	9.01×10^{-4}	1.87×10^{-1}	-2.56×10^{0}
Calml4	9	1519	3.79×10^{-4}	1.42×10^{-1}	-2.58×10^{0}
Klc3	7	956	5.11×10^{-5}	5.30×10^{-2}	-2.59×10^{0}
Stk33	7	1254	3.48×10^{-4}	1.38×10^{-1}	-2.59×10^{0}
Rsph4a	10	4311	3.38×10^{-4}	1.38×10^{-1}	-2.65×10^{0}
Ace2	X	1782	5.94×10^{-5}	5.83×10^{-2}	-2.69×10^{0}
Saxo2	7	1942	5.28×10^{-4}	1.70×10^{-1}	-2.71×10^{0}
Spag6l	16	2335	3.38×10^{-4}	1.38×10^{-1}	-2.72×10^{0}
Nek5	8	1539	4.64×10^{-5}	5.30×10^{-2}	-2.77×10^{0}
Ppp1r36	12	987	6.87×10^{-4}	1.75×10^{-1}	-2.81×10^{0}
Dcdc2a	13	1097	6.02×10^{-4}	1.70×10^{-1}	-2.81×10^{0}
Cfap52	11	1362	5.18×10^{-4}	1.70×10^{-1}	-2.98×10^{0}
Tekt4	17	984	2.81×10^{-4}	1.35×10^{-1}	-3.12×10^{0}
Mlf1	3	1739	1.03×10^{-3}	1.92×10^{-1}	-3.13×10^{0}
Six1	12	935	1.03×10^{-3}	1.92×10^{-1}	-3.45×10^{0}
Stmnd1	13	1442	6.27×10^{-4}	1.70×10^{-1}	-3.54×10^{0}
Itih2	2	466	1.59×10^{-4}	1.06×10^{-1}	-3.71×10^{0}
Retnla	16	2736	7.31×10^{-6}	2.54×10^{-2}	-5.01×10^{0}
Pcsk1	13	218	9.91×10^{-4}	1.91×10^{-1}	-5.06×10^{0}
Zmynd12	4	172	5.76×10^{-4}	1.70×10^{-1}	-6.57×10^{0}
Tex26	5	147	9.66×10^{-4}	1.88×10^{-1}	-8.53×10^{0}
Gm3417	17	384	1.20×10^{-5}	2.70×10^{-2}	-2.31×10^{1}

In Figure 5A. it should be noted that only one WT vehicle sample could not be included in these analyses due to RNA quality issues and weak sequencing results. Gene-set enrichment analysis identified a number of cytokines and immunity-related genes enriched due to exposure to PFOA. Gene-set enrichment analysis of the differentially expressing genes (DEG) for this comparison showed that *Ccl5*, *Tyro3*, *Hp*, *Ak7*, *Cd27*, *Prkcq* and *Scgb1a1* were the key players in GO: 0050727 “regulation of inflammatory response” (Figure 5B, $p > 0.016$, Table 3). Genes involved in this enrichment cluster are represented in Figure 5C as a heatmap.

Table 3. Gene ontological enrichment analysis filtered by the keywords “inflammatory” and “inflammation”.

Gene Set	Description	Enrichment Score	*p*-Value	Genes in List	Genes not in List
GO: 0050727	regulation of inflammatory response	4.14199	0.0158912	4	286
GO: 0050728	negative regulation of inflammatory response	1.06038	0.346326	1	126
GO: 0050729	positive regulation of inflammatory response	2.98854	0.0503611	2	106
GO: 0002437	inflammatory response to antigenic stimulus	2.52479	0.0800755	1	24
GO: 0002526	acute inflammatory response	1.81842	0.162283	1	52
GO: 0002673	regulation of acute inflammatory response	4.23522	0.0144766	2	53
GO: 0002675	positive regulation of acute inflammatory response	5.54591	0.00390341	2	26
GO: 0002861	regulation of inflammatory response to antigenic stimulus	2.41631	0.0892499	1	27
GO: 0002863	positive regulation of inflammatory response to antigenic stimulus	3.01936	0.0488324	1	14
GO: 0002864	regulation of acute inflammatory response to antigenic stimulus	2.95645	0.0520031	1	15
GO: 0002866	positive regulation of acute inflammatory response to antigenic stimulus	3.32299	0.0360447	1	10
GO: 0006954	inflammatory response	5.10092	0.00609113	5	344

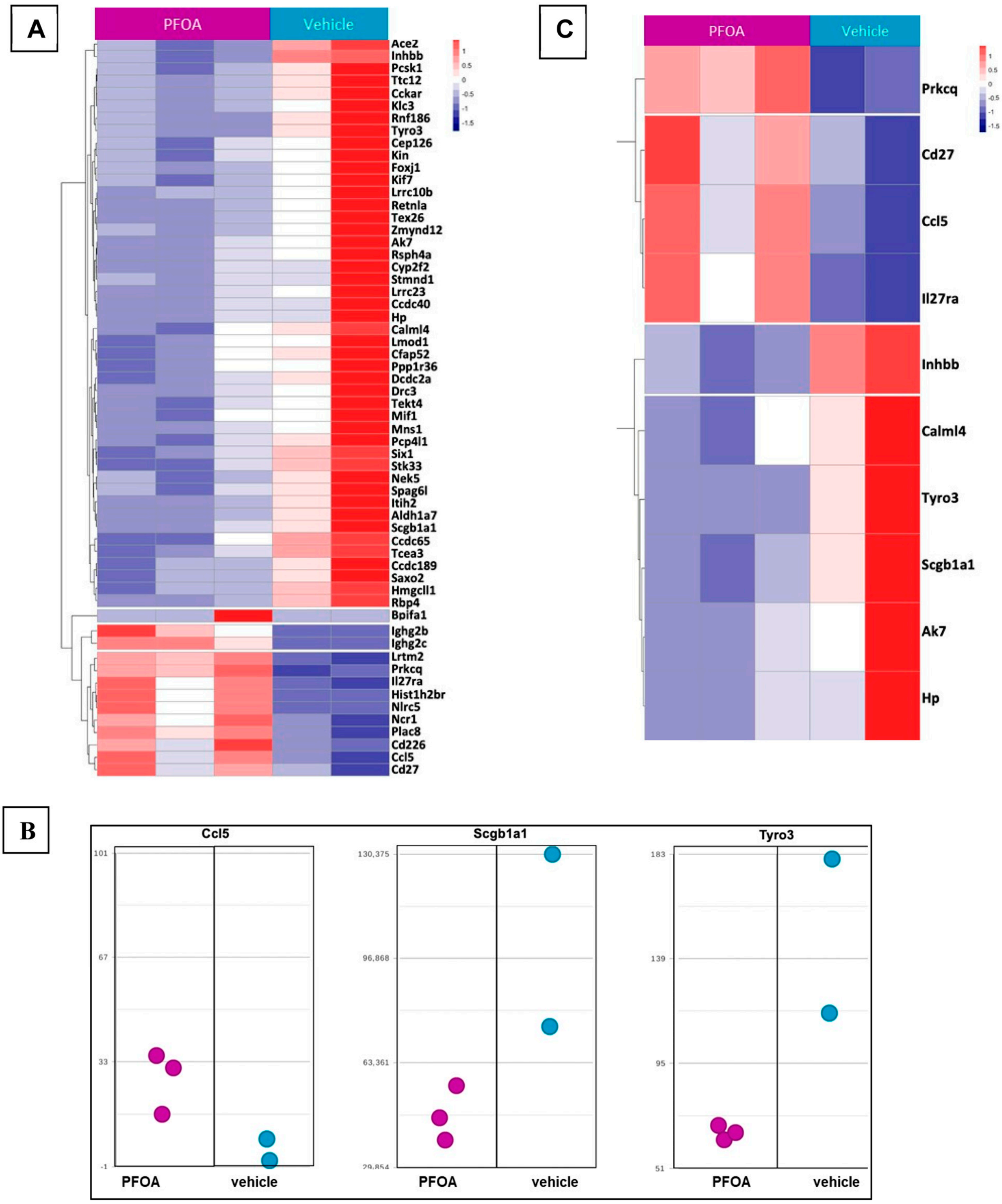

Figure 5. (**A**) Heat map showing effect of administering PFOA-treated drinking water (6.2 µg/mL) on mice for 14 weeks in differential gene expression in lungs compared to vehicle group (V) as measured by Next Gen Sequencing (NGS). (**B**) Dot plots of the key players from GO: 0050727 "regulation of inflammatory response" from the DEG set. (**C**) Heatmap of the raw counts for the GO: 0050727 "regulation of inflammatory response" and other inflammatory gene sets.

The knock-out of mouse PPARα (KO) altered 71 protein-coding genes while human PPARα (KI) affected a single protein-coding gene in response to PFOA consumption (FDR < 0.2, $p > 0.05$, and 2× fold change, see Supplemental Table S1). The combined analyses of the abovementioned 3 genes (*Ccl5*, *Tyro3*, *Scgb1a1*) in 6 groups repeated the findings in WT mice, whereas KO or KI had no significant effect on these genes (Figure 6A). The other top differentially expressed genes in combined analyses were *Col1α1*, *Gas7*, *Klf2*, *Lair1*, *Lrg1*, *Mfsd2a*, *Mylip*, *Scd1*, *Slfn4*, *Slfn1*, *Ms4a6c*, *Ripk3*, *Nlrp3*, *Aim2*. The comparison of gene expression in the three genotypes (WT, KO, KI) with and without PFOA can be seen in Figure 6B. The differences in expression patterns across genotypes suggested different roles for PPARα in controlling gene expression in the lung and warrants detailed investigation.

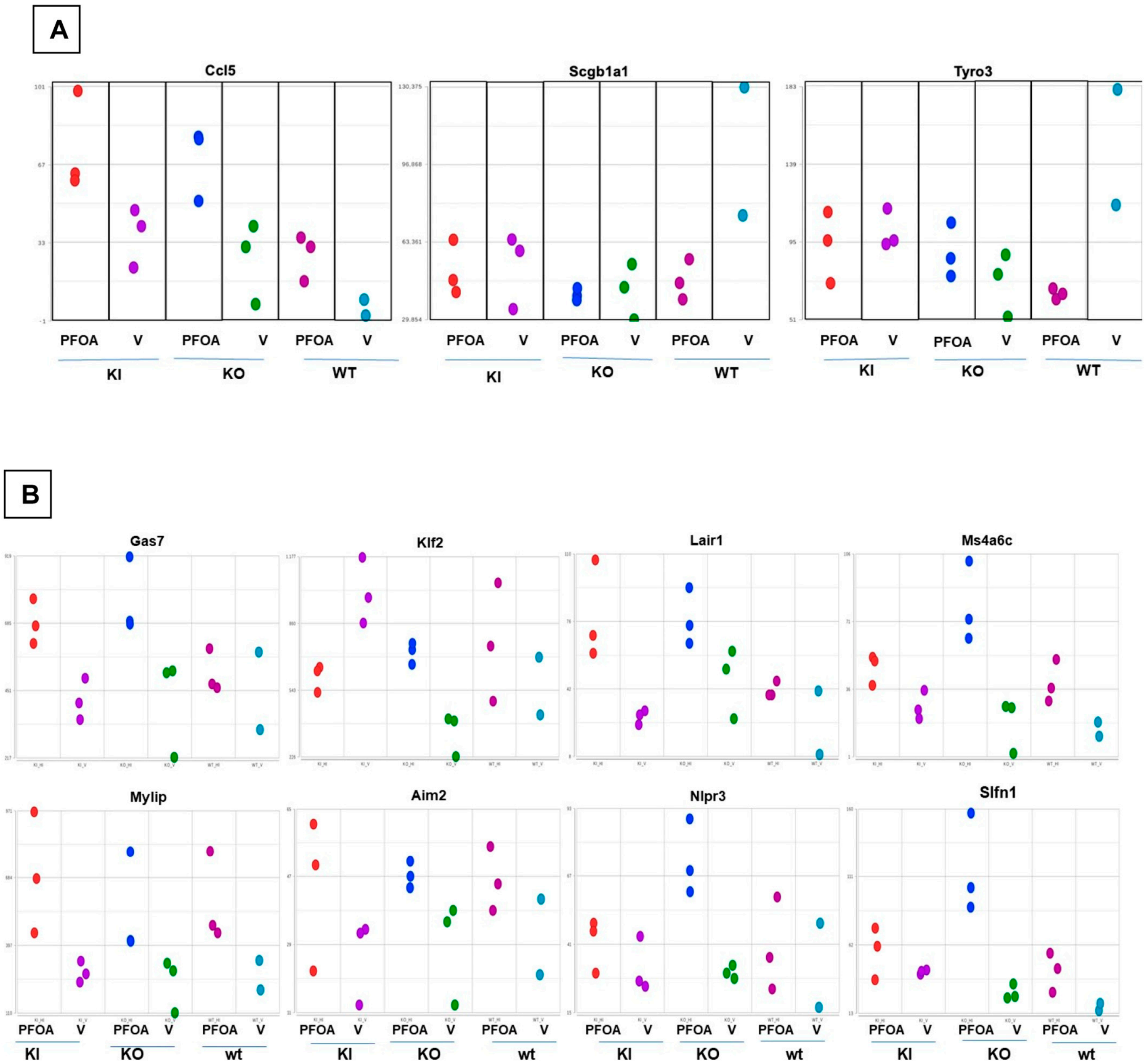

Figure 6. Gene analysis across all genotypes (WT, KI, KO) with and without PFOA. (**A**). Dot plots of the key players from GO: 0050727 "regulation of inflammatory response" from the DEG set, including the PPARα knock-out and knock-in (KO & KI respectively). (**B**). Dot plots of differentially expressed genes in KO and KI in response to PFOA or Vehicle, (V). (n = 3), (WT = wild type; KI = expression of hPPARα; KO = deletion of PPARα).

3. Discussion

PFAS exposure by air, water or food is a significant public health problem [25] associated with asthma and AHR in a number of human cases and in animal studies. It is important to understand the mechanism(s) of PFAS-induced lung pathogeneses such as asthma/AHR so that biomarkers or therapeutic targets can be identified. Our research here is a step in this direction.

Inflammasomes are considered to play an important role in asthma and allergic diseases as evidenced from population, mouse-model and cell-based studies [43–46]. Inflammasomes, multi-protein platforms comprised of nucleotide-binding oligomerization domains, control the activation of the cysteinyl aspartate protease, caspase-1 and the cleavage of pro-IL-1β, which enables the release of the active mature IL-1β cytokine [47] along with IL-18 and HMGB1 [48]. *NLRP3* is the most studied inflammasome and is known to be activated by various particles/fibers including asbestos [47,48]. A growing number of studies have demonstrated the association of NLRP3 and PFAS in gastric cells [29] and rodent models of obesity and lung development [30,31]. Our experience with lung pollutants, the inflammasome field and the published literature led us to hypothesize that PFAS, being a surfactant in nature, could alter cell-membrane permeability, leading to potassium efflux and inflammasome activation. Consistent with the findings of Sorli et al. [27], we demonstrated the alteration of the membrane properties of BEAS2B cells by PFOA. Subsequent activation of NLRP3, as measured by caspase-1 and HMGB1 release in the medium, occurred following exposure to PFOA, PFOS and 5 PFAS mixture (long and short chain). Increased steady-state mRNA levels of pro-inflammatory and -allergic cytokines signified a role for PFAS in lung inflammation and pathogenesis. A recent comprehensive study by Wang et al. [28], using in vitro macrophages and in vivo mouse models indicated the role of another inflammasome, AIM2, in PFOS-induced inflammatory responses but no involvement of NLRP3 in the process. The discrepancy in the outcome could be attributed to the use of different cell types (epithelial vs. macrophage) to test the effects of PFOS or differences in the effects of structurally distinct PFAS.

The viability assessment of BEAS2B cells in response to different doses of PFAS projected an interesting picture. Both long-chain PFAS, PFOA and PFOS had no effect on viability up to a concentration of 100 μM; however, higher concentrations produced significant cell death. NLRP3 activation and priming also were significantly increased at higher concentrations, which suggested that cells were undergoing pyroptosis (inflammasome-dependent inflammatory cell death). Of the short-chain PFAS, PFBA had no effect on cell viability at any concentration; however, PFBS significantly increased viability and GenX showed an increasing trend. Similarly, PFBS has recently been reported to increase cell viability in trophoblasts as well [49]. Furthermore, it is possible that both PFBS and GenX did not increase the viability or growth of cells but only their metabolic activity because the MTS Assay used here for cell viability measures mitochondrial activity.

As the human population is exposed to a mixture of PFAS, it is important to assess the role of a mixture of short- and long-chain PFAS on biological cell pathways [25]. Our 5 PFAS mixture had a significant effect on NLRP3 activation and priming in BEAS2B cells. Pro-inflammatory (IL-6, IL-8) and pro-allergic (IL-5) cytokines were also upregulated. E-cadherin (CDH1), a marker for EMT was downregulated both by PFOA and PFOS alone as well as in a PFAS mixture. EMT is considered an important initial step for many respiratory diseases including asthma and fibrosis [50,51].

PFOA consumption in drinking water is a relevant model for PFOA exposure that mimics real-life situations. Our model mimicked high human-relevant PFAS exposure (range 0.01–92.03 μg/mL serum). Here we showed that chronic exposure to PFOA increased serum levels of PFOA and altered the lung gene-expression profile in mice expressing wildtype PPARα. Many of these genes are involved in immunity/inflammation pathways, suggesting that systemic PFOA exposure can alter lung gene expression, which may lead to lung pathogenesis. We focused on 3 genes (out of 10), *Ccl5*, *Tyro3*, and *Scgb1a1*, which were significantly altered by PFOA exposure in the WT group. These genes are the key players in GO: 0050727 "regulation of inflammatory response". C–C motif chemokine ligand 5 (CCL5) is a pro-inflammatory chemokine known to be involved in respiratory infection and diseases including lung cancer [52–54]. The secretoglobulins (SCGB) are highly abundant in the respiratory system and regulate immunoregulatory and anti-inflammatory process of airway diseases. Their downregulation by PFOA (Figure 5B) can stimulate disease process in lungs [55]. Tyro 3 is a component of the TAM receptor (family of receptor tyrosine kinases) along with Axl and MerTK. TAM plays important roles in efferocytosis and balancing the immune response and inflammation [56]. In different immune cells, TAM can prevent superfluous immune reactions and dampen the inflammatory response. Decreased levels of Tyro 3 in mouse lung by PFOA indicated a possible mechanism by which PFOA could regulate the lung's immune/inflammatory system. A recent study by Phelps et al. [57] using zebrafish and human neutrophils demonstrated that legacy and that emerging PFAS can suppress the neutrophil respiratory burst, thereby suppressing the immune function.

Interestingly, we saw increased expression of two inflammasome-related genes, *Nlrp3* and *Aim2*, in response to PFOA exposure in the mouse lung. It corroborated our in vitro data that one possible mechanism of lung inflammation and pathogenesis by PFAS was inflammasomes. Similarly, Wang et al. showed that in vivo exposure to IP-injected PFOS resulted in Aim2-dependent inflammation. Detailed studies are required with lung specific transgenic models to understand the role of different inflammasomes in PFAS-induced lung pathologies. The following were all upregulated or had an upregulation trend in PFOA-consuming mice lungs compared to vehicle-fed mice: *Klf*2 (kruppel-like factor 2), a transcription factor involved in type I pneumocyte differentiation; *Mfsd2a* (major facilitator superfamily domain containing 2a), known to maintain pulmonary surfactant homeostasis; *Mylip* (myosin-regulated light-chain interacting protein) involved in protein catabolic process and possibly as a tumor suppressor in lung cancer; and *Slfn4 & 1* (schlafen 4 and 1), *Ms4a6c*, involved in immune cell regulation, cell cycle arrest and receptor signaling pathways,

Although it is a very preliminary finding from a limited sample size, PFOA consumed through water was found to affect the lung immune/inflammatory environment, which may play a significant role in lung pathogenesis, asthma and AHR. Downward trends in the PFOA-exposed mice group were also observed in genes such as, *Col1α1* (collagen type1α1), *Gas 7* (growth arrest specific 7) and *Scd* 1 (stearoyl-coenzyme A desaturase 1); however, their significance is yet to be determined.

One of the strongest responses to PFAS exposure is lipid disruption [25,58], which can be mediated by peroxisome proliferator activated receptor α (PPARα) and acts in a species-specific manner. Therefore, we compared PFOA-modulated gene expression profiles in lung tissues from PPARα null (KO) and hPPARα (KI) mice to that in WT mice. No significant effect of PPARα manipulation (KI, KO) was observed for *Ccl5*, *Lair1*, *Mylip* and *Aim2*, all of which appeared to be induced in the lung by PFOA. However, the PFOA-induced reduction of *Tyro3* and *Scgb1a1* expression appeared only to occur in the WT mice. In contrast, *Gas7*, *Ms4a6c*, *Nlrp3* and *Slfn1* showed greater induction by PFOA in the absence of PPARα. *Klf2*, which showed an upward trend in response to PFOA in WT and KO mice, was reduced by PFOA in KI mice. These different patterns suggested that PFOA may have multiple molecular targets in the lung as has been shown for the liver [59].

In conclusion, our study demonstrated that PFAS can dysregulate lung inflammasome/inflammation/immune pathways via membrane permeability alterations which may be responsible for the PFAS-associated respiratory diseases reported (Figure 7). Both short- and long-chain PFAS alone as well as in mixture were shown to affect lung biological responses. In addition, the number of inflammation- and immunity-related genes in the lungs of mice were altered in response to PFOA-treated drinking water. We acknowledge that there were limitations to our study, such as the use of one type of lung cell line, lack of inclusion of a primary cell line and a limited number of samples for the in vivo study. The high points of our study were testing the effect of both the short- and long-chain PFAS and the mixture of PFAS in the in vitro study and using a human-relevant mouse model that allowed us to compare the effects between mice expressing mouse or human PPARα and PPARα-null mice. The role of PPARα in PFOA-induced lung gene expression may not be as significant as in the liver or adipose tissue where lipid metabolism takes place; however, the results here support the need for further investigation of the mechanistic underpinning of PFAS-induced effects on lung health. More studies are required to pinpoint the role of inflammasome/inflammation in PFAS-induced lung responses using transgenic, lung-specific animal models.

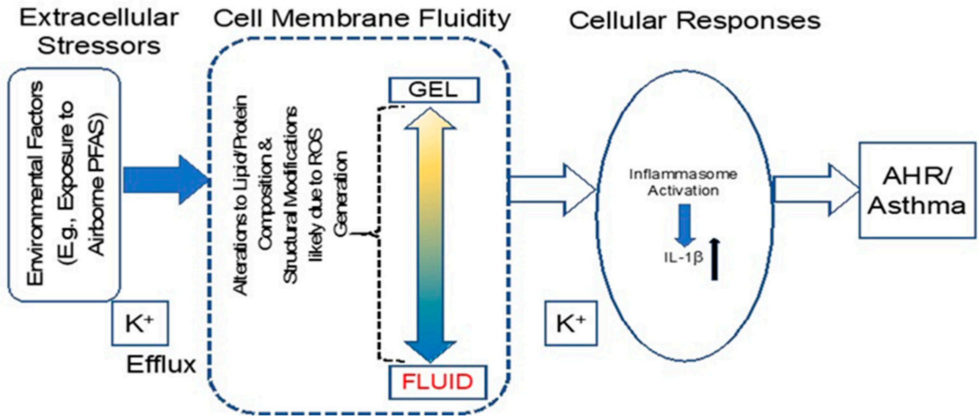

Figure 7. PFAS can alter lung epithelial cell membrane fluidity/permeability, K+ efflux, reactive oxygen species (ROS) generation, which may lead to inflammasome activation, pro inflammatory cytokine (IL-1β, IL-18, IL-33) release and airway hyper-responsiveness (AHR)/asthma.

4. Materials and Methods

Cell culture and treatments: Immortalized BEAS2B cells from ATCC [60,61] were cultured following protocols previously published [11,60,61]. PFAS proposed in this study were purchased from commercial vendors (Sigma-Aldrich, Burlington, MA, USA). Cells were exposed to long-chain (PFOA, PFOS), short-chain PFBS, perfluorobutanoic acid (PFBA), replacement chemical for PFOA (GenX), or mixture (all 5) PFAS for 24 h at predetermined concentrations.

Atomic force microscopy (AFM) was performed on BEAS2B grown on special glass dishes, exposed to PFOA/PFOS or vehicle (DMSO) for 24 h. Alteration in membrane properties (plasticity, elastic modulus and force ratio) were measured (n = 89–100 measurements/dish). Cells grown on glass bottom dishes were analyzed using AM–FM AFM (Asylum Research MFP-3 D BIO (MIC, UVM)] to quantify the fluidity of cellular membranes) [62,63].

PFAS effects on cell viability by MTS Assay: Dose-response analyses were conducted to assess the viability of the cell line following exposure to a range of PFAS individually as well as in mixture. Stock solutions of PFAS in DMSO were diluted in 0.5% fetal bovine serum (FBS) containing a culture medium for cell exposure (24 h). Cells were exposed to a broader range of concentrations to cover the range of the human body burden (0.01–92.03 µg/mL) [64]. The same volume of DMSO was used as a vehicle control ($\leq$0.01%).

The effects of PFAS were seen in NLRP3 priming (mRNA levels), NLRP3 activation (caspase-1 and HMGB1 secretion in medium), cytokine mRNA expression (*IL-5* and *IL-6*) and EMT marker mRNA expression (E-cadherin, *CDH1*). Lung epithelial cells were exposed to PFOA, PFOS or mixture of 5 PFAS (1:1:1:1:1) for 24 h with a range of selected concentrations.

Priming of inflammasome *NLRP3*, *AIM2*, *PYCARD*, *IL-1β*, *gasderminD*: This was assessed on extracted RNA by qRTPCR with assay-on-demand (AOD) primer and probe mixture from Applied Biosystems [48,51,60] normalized to housekeeping gene *HPRT*.

Activation of inflammasome: A conditioned medium was collected from dishes after 24 h of treatment and high-mobility group box 1 (HMGB1), and caspase-1p20 secretion by

Western blot analysis was assessed as previously reported [48,51]. Ponceau stain was used to demonstrate equal loading.

Statistical analyses: We used three or more determinations per group per time point, and experiments were replicated three times. GraphPad Prism 8 (GraphPad Software, La Jolla, CA, USA) was used. Analysis of variance (ANOVA) was used to evaluate the results from each experiment, followed by a Tukey's post-hoc test to assess the combined results from replicate experiments. The latter analysis included an experiment as a random effect to test for differences between experiments and treatment by experimental interactions. The Student–Newman–Keuls procedure was used to adjust for multiple pairwise comparisons between groups ($p \leq 0.05$ was considered statistically significant).

In vivo exposure: PFOA-exposed and control mouse lungs (frozen) were obtained from Dr. Jennifer Schlezinger (BU), who had previously demonstrated the effect of PFOA-treated drinking water in mice using different models [59,65]. Perfluorooctanoic acid, PFOA (cat. #171468, 95% pure) came from Sigma-Aldrich (St. Louis, MO, USA). All animal studies were approved by the Institutional Animal Care and Use Committee at Boston University and performed in an American Association for the Accreditation of Laboratory Animal Care accredited facility (Animal Welfare Assurance Number: A3316-01). Male and female, humanized PPARα (KI) and PPARα null (KO) mice were generated from mouse PPARα null, and human PPARα heterozygous breeding pairs (generously provided by Dr. Frank Gonzalez, NCI) [66]. Sv/129 wildtype (WT) mice were purchased from Jackson labs, Bar Harbor, ME (stock #002448). At 6 weeks of age, mice were provided a custom diet based on the "What we eat in America (NHANES 2015/2016)" analysis for what adults eat (Research Diets, New Brunswick, NJ, USA) [67]. The diet contained 47% carbohydrate, 37% fat, and 16% protein, as a % energy intake. Vehicle and treatment water were prepared from NERL High Purity Water. A concentrated stock solution of PFOA (1×10^{-2} M) was prepared in NERL water and then diluted in NERL water containing 0.5% sucrose. Mice were administered vehicle (0.5% sucrose) drinking water or PFOA (1.4 (low) and 6.2 (high) μg/mL) drinking water *ad libitum* for 14 weeks. Vehicle water was prepared with 0.5% sucrose, which ensures consumption. Treatment water was prepared with vehicle water and PFOA stocks dissolved in water. Treatment was for 14 weeks. At the time of harvest, lungs were removed and snap frozen in liquid nitrogen and transported to UVM in dry ice. Serum PFOA concentrations were determined by LC-MS/MS according to method MLA-110 (EPA Method 537 Modified) (SGS AXYS Analytical Services Ltd., Sidney, British Columbia, CA, USA).

Next Gen Sequencing (RNA Seq) on mouse lungs: Lung tissue RNA extraction, quantification, quality analyses, library preparation, sequencing and data analyses was performed by the Vermont Integrative Genomics Resource (VIGR), UVM. Libraries were sequenced across four lanes of a high-capacity flow cell on the Illumina HiSeq 1500. De-multiplex reads had poorer quality bases trimmed from the 3′ end (phred score < 20), and the trimmed reads (avg. quality > 38.1, avg. length 80 bp, avg. GC ~53.4%) were aligned to the mouse reference genome mm10 using the STAR 2.6 aligner in Partek® Flow®. Aligned reads were then quantified using an expectation–maximization model and translated to genes. Those that had fewer than 20 counts were then filtered, leaving 19,366 high-count genes. Differential gene expression was evaluated using the algorithm in DESeq2 v3.5 base on median ratio normalization, and the negative binomial distribution of the gene signal. Gene-set enrichment analysis and pathway enrichment analysis were performed against the KEGG gene sets and pathways databases.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/ijms24108539/s1.

Author Contributions: A.S.: acquired funding, conceptualized the study, designed and performed experiments, analyzed data, wrote and revised the manuscript; J.D., analyzed sequencing data and made tables and figures for the paper, reviewed manuscript; M.H., performed experiments; A.R.B., supplied PFAS, helped with AFM experiments and reviewed the manuscript; J.S. and G.N., performed animal experiments and shipped lungs to UVM, reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: No human studies. All animal studies were approved by the Institutional Animal Care and Use Committee at Boston University and performed in an American Association for the Accreditation of Laboratory Animal Care accredited facility (Animal Welfare Assurance Number: A3316-01).

Informed Consent Statement: Not applicable.

Data Availability Statement: We have submitted NGS data to NCBI. The GEO number is GSE231602.

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From: Preeta & Hari Srinivasan <preetahari2017@gmail.com>
Sent: Monday, February 17, 2025 10:04 PM
To: CouncilDistrict5@howardcountymd.gov; CouncilDistrict1@howardcountymd.gov; CouncilDistrict2@howardcountymd.gov; CouncilDistrict3@howardcountymd.gov; Rigby, Christiana; CouncilDistrict4@howardcountymd.gov; Yungmann, David
Cc: Jung, Debra
Subject: Fwd: UPDATED Testimony FOR CB11-2025 - Preeta Srinivasan
Attachments: NRDC Chemical-Recycling-Greenwashing-Incineration.pdf; Benzene exposure in children.pdf; Enclosure- WR Grace Reg. Interpretation Signed.pdf

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Good evening Howard County Council Members,

I hope you are all doing well. As a resident of the Cedar Creek neighborhood (7941 Lawndale Circle) with two young children, **I wanted to encourage each one of you to vote FOR CB11-2025 to protect our children, community, and environment**. Below is the testimony I sent to the general Council Mail address that I will be delivering tomorrow, along with sources for information stated in the testimony. I have also included my husband's testimony which was sent to the same email address.

I thank you all for giving us residents the opportunity to testify in support of CB11-2025 tomorrow, especially Deb Jung for filing this bill and supporting its passage.

Best,
Preeta Srinivasan
7941 Lawndale Cir, Columbia, MD 21044

---------- Forwarded message ---------
From: **Preeta & Hari Srinivasan** <preetahari2017@gmail.com>
Date: Sun, Feb 16, 2025 at 11:31 PM
Subject: UPDATED Testimony FOR CB11-2025 - Preeta Srinivasan
To: <councilmail@howardcountymd.gov>

Hello - I have updated my testimony for CB11-2025 and wanted to share the revised version. I have re-attached my source documents and in addition, have shared the link to, and full text of, a very informative article titled "Garbage In, Toxics Out: They Promised 'Advanced Recyling' for Plastics and Delivered Toxic Waste" that I believe every council member needs to read and consider. Thank you.
—-

Hello, my name is Preeta Srinivasan and I live in Cedar Creek. Our house was built in 2022, and the proposed facility is under 800 feet from our house. I am a mother of a 5-year-old and a 2-

year-old, and it’s for their sake that I’m standing up to support CB11-2025 and preserve clean air for our community.

In addition to being a mother, I’m an investment analyst, so I am always weighing benefit versus risk. **It’s very clear to me that the risks - to our families and to the surrounding area - of letting R&D like Grace’s plastic recycling project move forward, outweigh the benefits**. **Here are the facts I’m weighing**. Grace claims pyrolysis is not incineration, but the EPA has literally informed MDE in writing that Grace’s pilot plant meets the definition of an incinerator. Investigations and studies have concluded that pyrolysis carries similar or worse risks as traditional incineration, without the purported environmental benefits. **Everyone in this room needs to read a September 2023 article in the Intercept titled “Garbage In, Toxics Out: They Promised ‘Advanced Recycling’ for Plastics and Delivered Toxic Waste.” It discusses an advanced recycling company called Braven Environmental which gave similar reassurances that Grace is giving to us today, and was subsequently found to be polluting the local community around their facility in Zebulon, North Carolina, *and* to have violated several terms of their original air quality permit. Do you all want to take the risk that Grace, who is literally engaged in joint research with Braven Environmental, might do the same?** Benzene, which Braven contaminated the water and air with in North Carolina, is listed in Grace’s project application as a toxic air pollutant for this project, and there are studies showing significant increased health risks, including cancer risk, for children exposed to benzene. Children are vulnerable to any air pollution because they breathe in more air for their size, and their immune systems and lungs are still developing. Air pollution also has documented impacts on terrestrial and aquatic ecosystems. So the large amount of protected forest area within Cedar Creek itself, the Middle Patuxent River (which our community backs right up to), and the Robinson Nature Center (which sits immediately to the east of our community and Grace) could also be at risk.

I think it's also important to consider how past history, even spanning back decades, affects the risk/benefit calculus. While I am someone who always tries to believe in others' good intentions, **I would respectfully contend that Grace's past and recent history of proven and alleged environmental harm** – from the asbestos claims that triggered their Chapter 11 bankruptcy years ago, to an active lawsuit from Baltimore City surrounding contamination and pollution – **objectively increases the potential risk for our community. It warrants erring on the side of caution to protect our families and the environment around us.**

In conclusion, I believe passing CB11-2025 is the absolute best risk-adjusted decision that Howard County can make. Thank you for your time.

—-

https://theintercept.com/2023/09/28/braven-plastic-recycling-toxic-waste/

GARBAGE IN, TOXICS OUT

They Promised "Advanced Recycling" for Plastics and Delivered Toxic Waste

Plastic pyrolysis equipment at the Braven Environmental facility in Zebulon, N.C. on Sept. 17, 2023. Photo: Schuyler Mitchell/The Intercept

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Schuyler Mitchell
September 28 2023, 6:00 a.m.
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Co-published in partnership with The Assemblyand Carolina Public Press.

HEAD SOUTH ON state Highway 96, past a stretch of soybean crops and tobacco fields, and you'll arrive in Zebulon, North Carolina, population 8,665. There, on a quiet stretch of Industrial Drive, sits a nondescript commercial building. It's easy to miss; the name on the front door is barely legible. But atop that humble three-acre lot lies a leading solution to the global plastic pollution crisis — well, according to the plastic industry.

The facility is home to the 24-hours-a-day, 7-days-a-week operations of Braven Environmental, a company that says it can recycle nearly 90 percent of plastic waste through a form of chemical recycling called pyrolysis. Traditional recycling is able to process only about 8.7 percent of America's plastic waste; pyrolysis uses high temperatures and low-oxygen conditions to break down the remaining plastics, like films and Styrofoam, ideally turning them into feedstock oil for new plastic production.

The American Chemistry Council, the country's leading petrochemical industry trade group, claims that chemical recycling will create a "circular economy" for the bulk of the world's plastic, diverting it from oceans and landfills. Plastic giants have gone so far as to dub the process "advanced recycling," but environmentalists say this is a misnomer because the majority of the plastic processed at such facilities is not recycled at all. In fact, researchers have found that the process uses more energy and has a worse overall environmental impact than virgin plastic production. Numerous companies have tried and failed to prove that chemical recycling is commercially viable.

Despite these challenges, lawmakers nationwide are now embracing the technology, thanks to a massive lobbying push from the ACC and other petrochemical groups. As of September, 24 states have passed industry-backed bills that reclassify chemical recycling as manufacturing. The change effectively deregulates the process, since manufacturing facilities tend to face less stringent guidelines than waste incinerators.

As one of only seven commercial facilities currently operating in the United States, Braven Environmental is at the vanguard of the growing chemical recycling boom. An Intercept investigation, however, found numerous issues at its Zebulon facility.

WE'RE INDEPENDENT OF CORPORATE INTERESTS — AND POWERED BY MEMBERS. JOIN US.

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A review of meeting minutes, permit applications, and compliance documents reveals that Braven misled the public about the risks of its pyrolysis operation and has potentially endangered human health and the environment through "significant noncompliance" with hazardous waste management regulations. While the ACC has touted Braven as a sustainable success story, documents also show that much of the company's pyrolysis oil was not converted into useful plastic or fuel — it was disposed of as highly toxic waste.

"Chemical recycling is really a greenwashing technique for burning up a bunch of petrochemicals in a new way, and it's releasing tons of air pollutants into the environment," said Alexis Luckey, executive director of Toxic Free NC, in an interview. "What we're talking about is incinerating carcinogens and neurotoxicants in a community."

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On Sept. 26, 2022, inspectors visited the Braven site and photographed vapor rising from an open dumpster filled with waste char, a potentially hazardous byproduct of the plastic pyrolysis process.

Photo: N.C. DEQ Division of Hazardous Waste Management Compliance Evaluation Inspection

“Hazardous Items, We Have None”

On April 8, 2019, the Zebulon Board of Commissioners held a joint public hearing with the town planning board to gather community feedback on several proposed construction projects. One of the developments on the docket was from a company called Golden Renewable Energy, based in Yonkers, New York.

Golden Renewable — which changed its name to Braven Environmental in the North Carolina business registry in 2021 — was requesting a special use permit to “locate a refinery and the storage of flammable liquids” on a parcel of land zoned for heavy industry.

According to minutes from the hearing, Meade Bradshaw, former assistant planning director for Zebulon, explained that Braven must show the proposed development “will not materially endanger the public health, safety, or welfare” in order to be granted a special use permit. In response, Ross Sloane, Braven’s business development director, made a series of promises to this effect, painting the company as a safe, family-run operation.

“We’ve never had an incidence in an operation that’s been operating up in New York now for seven years,” Sloane said. “My entire family operates the machine, so I don’t want to lose sleep.”

While Sloane pointed to Braven’s operations in Yonkers as evidence of the company’s safety record, The Intercept’s review of New York State Department of Environmental Conservation records found no indication that the company’s facility in Yonkers has ever been legally permitted to conduct plastic pyrolysis activities.

An air quality permit completed on February 22, 2013, states that the facility’s function was the conversion of vegetable oil to biofuels — a far cry from advanced thermal decomposition of plastic waste. In July 2014, inspectors from the DEC visited the facility and observed plastic waste being accepted and processed without authorization. The company agreed to resolve the violations, pay civil fines, and apply for a modified permit to accept recycled plastics, but the permit was never completed. DEC staff inspected the site again in 2021 and confirmed that Golden Renewable had moved its processing equipment out of state. DEC public records did not contain any additional permit information, and the Yonkers operation is Braven's only other facility.

Public hearing meeting minutes also show Sloane told the town that Braven does not handle any hazardous materials. "Any kind of material trash, landfill items, hazardous items, we have none," he said. "We do not contain any kind of hazardous materials. We have nothing that goes into a drain. … It's all biodegradable."

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Stormwater outfall and riprap in front of Braven's facility on Sep. 17, 2023.

Photo: Schuyler Mitchell/The Intercept

This turned out to be false. According to the Environmental Protection Agency's Resource Conservation and Recovery Act database, Braven's Zebulon facility generated and shipped 9.6 tons of hazardous ignitable waste and benzene in 2021 alone. In March of that year, Braven registered with the EPA as a large quantity generator: a facility that generates at least 1,000 kilograms per month of hazardous waste.

One list of warnings in a Braven air permit application reads like a toxicologist's worst nightmare: The pyrolysis oil may cause cancer and genetic defects, as well as damage to organs, fertility, and unborn children. Other hazards included being "extremely flammable" and "very toxic to aquatic life" with "long lasting effects."

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Matt Sledge

Stephanie Hall, a parent of students at a nearby K-12 charter school, voiced concerns about air emissions during the hearing in Zebulon. She pointed out that the Braven lot would be adjacent to a community college and a public housing community, as well as only 780 feet from the charter school.

Sloane offered reassurance that Braven would "have no smells or emissions that are emitted to the air." But when a planning board member asked for more information, he backtracked.

"It's not a zero-emission process," he clarified. "We do have an emission of CO2. It's the exact same CO2 that comes through in your gas logs at your home."

In response to The Intercept's request for comment, Michael Moreno, Braven's co-founder and chief commercial officer, wrote, "Braven strives to operate its Zebulon facility safely, responsibly and in compliance with its permits and regulatory requirements. Any discrepancies found are proactively resolved with the agencies involved."

Braven's special use permit applicationnotes that the facility will have an exhaust stack but still characterizes the operation as a "closed loop process where all by products are fully contained without being discharged into the atmosphere."
An emissions test report prepared for Braven in March 2020 contradicts this claim, revealing that, in addition to CO2, the company's plastic pyrolysis emits air pollutants such as carbon monoxide, nitrogen oxides, sulfur dioxide, and particulate matter. The report also found that Braven would emit an estimated 5.14 tons of volatile organic compounds per year. It did not specify which VOCs were present, though known human carcinogens like benzene and styrene are commonly found in emissions from petrochemical operations. On the day that I visited the Braven facility and adjacent lots, a faint acrid scent — like burning plastic — was detectable as far as 700 feet away.

> On the day that I visited the Braven facility and adjacent lots, a faint acrid scent — like burning plastic — was detectable as far as 700 feet away.

Certain industrial facilities must annually report their chemical emissions for inclusion in the EPA's Toxics Release Inventory. Since pyrolysis facilities are classified by the EPA as waste incinerators, they're required to meet Clean Air Act guidelines but are excluded from TRI reporting requirements. This makes it difficult to assess the full health risks that Braven and other plastic pyrolysis units could pose to surrounding communities. In April, more than 300 environmental and public health organizations filed a petition with the EPA for the inclusion of waste incinerators in the database.

Ilona Jaspers, director of the Center for Environmental Medicine, Asthma, and Lung Biology at the University of North Carolina School of Medicine, has studied emissions generated from the burning of plastic waste. She called the TRI's lack of pyrolysis and waste incineration data "a giant loophole."

"I am all for finding good ways to make plastics into something usable, but the danger of generating air toxics in the process is considerable," she said. "When we looked at the list of chemicals generated in the emissions of the plastics, a lot of it is not good. It's kind of terrifying what gets generated when you burn plastics."

In addition to air pollutants, residents raised the risk of potential water contamination. Hall, a professional engineer with a background in water resources, noted during the public meeting in Zebulon that the building slated to house Braven's operations was built in 1994, so the lot would not have established stormwater control measures to treat any potential runoff. "You may want to include some sort of sand filter or proprietary stormwater device to help with any incidental spills," she suggested, since the lot lies near a Federal Emergency Management Agency floodplain.

"When that industrial park was developed, there were no regulations for stormwater control," Bradshaw, the former assistant planning director, told The Intercept. "Because they're just occupying an existing building … from a site standpoint, it did not need to meet current regulations. But the commissioners, as part of the special use permit, could've made that a condition if they wanted to."

At a subsequent session, the planning board unanimously recommended denial of the permit, based on "lack of evidence and testimony" showing Braven would not endanger public health and safety. But the planning board's decision was "just a recommendation," Bradshaw noted, and did not dictate the final decision. The Board of Commissioners unanimously voted to approve the special use permit on May 6, 2019, under the sole condition that masonry screening be conducted around the fuel tanks.

Braven was up and running by March 2020. Four months in, one major company had already bet big on the nascent operation's long-term success: To further its "corporate responsibility" goals, Sonoco agreed to deliver its waste plastics to Braven for the next 20 years.

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On Sept. 26, 2022, inspectors visited the Braven site and photographed gallons of pyrolysis oil. “These containers were open and were not marked with the words ‘hazardous waste,’ an indication of the hazards of the contents or an accumulation start date,” inspectors wrote.

Photo: N.C. DEQ Division of Hazardous Waste Management Compliance Evaluation Inspection

Significant Noncomplier

As part of an unannounced hazardous waste compliance inspection, an environmental specialist from the North Carolina Department of Environmental Quality, or DEQ, visited Braven’s Zebulon facility on September 26, 2022. The details of the resulting compliance report paint an alarming picture of a business operating in stark contrast to the health and safety promises made to Zebulon residents three years prior.

Inspectors cited Braven for numerous regulatory violations, including accumulating more than 400 containers of hazardous waste without a permit over the course of two years, as well as failing to “manage waste material in a manner to prevent it from discharging to the ground and storm drain system.”

The report details one incident in April 2022, when Braven sent 31,080 gallons of hazardous waste to a rented warehouse facility about one mile down the road. The transfer was conducted by a local trucking company, not a licensed hazardous waste transporter, and the warehouse was not permitted to receive such waste. The containers, which contained toxic chemicals like toluene and ethylbenzene, were then disposed of by a waste management service, though the transportation manifests for the disposal contained numerous inaccuracies.

The report also states that Braven generates light, medium, and heavy cut oils through plastic pyrolysis but has been unable to find a buyer for the heavy cut oils. As a result, the oil accumulated in a tank until it was eventually discarded as hazardous waste — twice. “The facility has been unable to demonstrate that it has been or can be legitimately used or recycled,” inspectors wrote.

> “It’s an open question for a number of these facilities what it is they’re actually producing and what it’s used for.”

“There’s very little actual monitoring data from these facilities that are doing plastic pyrolysis,” Veena Singla, a senior scientist at the Natural Resources Defense Council, told The Intercept. “It’s an open question for a number of these facilities what it is they’re actually producing and what it’s used for.”

Even Braven’s purportedly recyclable products pose substantial risks. In June 2021, Braven announced a “long-term agreement” to supply pyrolysis-derived oils to Chevron Phillips Chemical. The press release did not state outright what the oil will be used as feedstock for, stating only that it will help Chevron “achieve its circularity goals.” However, ProPublica reported in February that one Chevron refinery in Mississippi is turning pyrolysis oil into jet fuel; according to EPA documents, air pollution from the fuel production process could subject nearby residents to a colossal 1 in 4 cancer risk.

The Intercept confirmed that some of the pyrolysis oil at this Chevron facility is indeed supplied by Braven: The chemical name and unique registry number listed in an EPA record obtained by ProPublica matches the details of Braven’s pyrolysis oils found in a North Carolina air quality permit exemption application. Additionally, in July 2022, the EPA published notice in the Federal Register of several new pyrolysis oils manufactured by Braven, including the same one on the EPA record.

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A public housing community less than 400 feet away from the back of Braven Environmental's lot.

Photo: Schuyler Mitchell/The Intercept

Some residents within one mile of Braven were already at an increased risk for environmental carcinogens before the business moved in: One nearby census tract has worse particulate matter and ozone exposure, hazardous waste proximity, and air toxics cancer risk than over 90 percent of the country.

During the town hearing, Sloane had emphasized Braven's "proactive" safety features; the special use permit application promised "daily inspections." The compliance investigation, however, noted numerous deficiencies in emergency preparedness, including the absence of a fire extinguisher in the main room where containers of flammable waste were accumulating, some of which were left open and unlabeled.

According to the report, Braven staff admitted that personnel had not conducted weekly inspections, and they were unable to provide documentation that an engineer's certification had been completed for a hazardous waste tank. Neither safety data sheets for the pyrolysis oils nor an emergency contingency plan had been completed with all required information, and the plan had not been distributed to local emergency authorities.

Additionally, inspectors observed during the visit that oil-contaminated stormwater was being pumped from a containment pit into a storage tote, but the connecting hose was leaking and "dark staining was evident" on the paved area between the pit and the storm drain.

Christopher Serrati, Braven's manager of operations, told inspectors at the time that the concrete surrounding the storm drain had been "power washed in the past to remove staining." The report noted an absorbent sock had been placed around the storm drain, and dark staining was present on soil adjacent to the property's stormwater outfall, indicating hazardous waste may have been discharged to the ground.

Following an assessment period, the North Carolina DEQ cited Braven as a "significant noncomplier" and issued the company an "initial imminent and substantial endangerment order" on April 28, 2023. Braven has not received any state or federal penalties.

“This is an ongoing state lead enforcement matter, and EPA is currently not involved. EPA cannot further comment regarding the facility’s compliance or enforcement activities,” wrote an EPA spokesperson.

As part of a spill remediation plan, the DEQ required that Braven test both stormwater and soil from the contamination sites. Four of the contaminated stormwater samples tested positive for high concentrations of benzene, according to a report submitted to the agency in January. The report notes, however, that Braven believes the high benzene levels can be attributed to oils that were left in the sampling totes.

Top/Left: Braven Environmental received a special use permit to store flammable liquids on Industrial Drive in Zebulon, N.C. Bottom/Right: Birds sit atop a water tower in downtown Zebulon, N.C. Photos: Schuyler Mitchell/The Intercept

“In the past, all waste including dike water was shipped as hazardous waste and therefore, our crew did not realize the new operations and they inadvertently used the old empty oil totes for dike stormwater storage,” wrote Braven. The report states that going forward, “Braven will use only clean totes to store dike stormwater, if any, to avoid any potential hazardous waste conditions for the stormwater totes.” Braven has also installed an oil/water separator for stormwater discharge.

However, Braven’s claim that contaminated stormwater had previously been disposed of as hazardous waste appears to contradict notes in the initial compliance investigation. “Records dated April 2022 documenting shipment of rainwater … were provided after the inspection and document the material was previously disposed of as non-hazardous,” inspectors wrote.

Singla, of the Natural Resources Defense Council, called the storm drain discharge a “big concern.”

“We know that when there’s spills or leaks from industrial facilities, benzene can contaminate surface water, groundwater especially,” Singla said. “If there’s any built environment over that groundwater, the benzene can migrate up through the soil into indoor spaces and then contaminate the air, and people can be exposed that way.”

Related

How the Plastics Industry Is Fighting to Keep Polluting the World

Another report submitted by Braven in June notes “site-specific groundwater investigations have not been conducted,” though a contractor completed a reconnaissance survey of potential “wells, springs, surface-water intakes, and sources of potable water” within 1,500 feet of the facility and did not observe any apparent water supply wells. The contractor said it also contacted the county for more information on potential water sources in the area but did not receive a response.

In late August, a new remedial action oversight report was posted to the DEQ’s public records database. A state chemist’s review of Braven’s soil samples found “evidence of elevated hexavalent chromium and arsenic” in the site’s underlying soil. The state’s report attributes these findings to “a release of waste,” since the results were above the levels found in background samples. Both arsenic and chromium are consideredoccupational carcinogens by the Centers for Disease Control and Prevention.

The state offered Braven two remediation options: complete additional sampling and remove the contaminated soil, or close the impacted areas as a landfill. According to Melody Foote, a public information officer from the DEQ's Division of Waste Management, Braven completed the additional sampling in late September. The DEQ is waiting for the sampling results and findings report, which is expected in three to four weeks.

Zebulon Commissioner Shannon Baxter called the noncompliance report "extremely disturbing" and noted that the public hearing testimony given in 2019 "appears to be in conflict with how Braven is actually operating." Baxter was previously a member of the planning board and recommended denial of Braven's permit in 2019. She noted that her views should not be interpreted as representative of the entire Board of Commissioners.

"I had my concerns as a member of the Planning Board, which is why we voted to recommend denial of the Special Use Permit," Baxter wrote in a message to The Intercept. "Now, as a Commissioner, I am troubled about how these violations will affect the safety of our Community, especially the students attending school down the road from the Braven facility."

To help protect your privacy, Microsoft Office prevented automatic download of this picture from the Internet.

A community garden sits outside of East Wake Academy, a K-12 charter school located down the road from Braven Environmental.

Photo: Schuyler Mitchell/The Intercept

Aggressive Expansion

A troubled record hasn't deterred the petrochemical industry from throwing its weight behind Braven in recent months. The company has announced three major executive hires since April, including a chief operating officer, development director, and president and CEO. Heath DePriest, the new COO, previously served in leadership positions at Phillips 66, a petroleum company. A press release notesthat CEO and President Jim Simon held roles at the refinery subsidiary of Koch Industries.

In June, Braven announced a new "strategic framework agreement" with another Koch Industries subsidiary, Koch Project Solutions, to "support Braven's aggressive expansion plans." The press release cited a new project to be built in the Gulf Coast region, which will allegedly produce 50 million gallons of pyrolysis oil per year.

Braven's past expansion plans, however, have not materialized. In 2020, the company was the subject of a number of splashy headlines for its plans to invest $32 million in Cumberland County, Virginia, a rural region west of Richmond. Promising the creation of more than 80 new jobs, the project marked the first economic development opportunity for the county since 2009. Braven was slated to break ground in late 2021, but the year quietly came and went, until a sole public update arrived via an article in a Cumberland County newspaper: "Braven No Longer Coming." The article, published in January 2022, did not explain why Braven had pulled out, and the company declined to comment at the time.

Braven has also been the subject of several legal actions. In 2015, sisters Joan Prentice Andrews and Jane Prentice Goff filed a lawsuit against Golden Renewable in New York, which also named four executives, including co-founders Moreno and Nicholas Canosa, as defendants. The suit claims that the sisters had collectively invested a total of $650,000 in Golden Renewable's "bio-energy business" after Canosa had given the false impression that the company was "imminently signing a contract" to sell its biofuels to the Pentagon. The suit's charges included wire fraud, mail fraud, and violations under the Racketeer Influenced and Corrupt Organizations Act. The case was settled out of court and voluntarily dismissed less than one month after the defendants were summoned.

The following year, a New York court ruled that Golden Renewable owed a different plaintiff over $10,000 in a civil debt lawsuit. The company was also released from a New York state tax warrant in 2018 after paying an outstanding balance of $16,522. In January 2020, Moreno was released from another New York tax warrant along with his wife, totaling over $300,000. After stepping down as Braven's CEO in April, Canosa remains on the company's board of managers. Moreno currently still serves as Braven's chief commercial officer.

To help protect your privacy, Microsoft Office prevented automatic download of this picture from the Internet.

Plastic trash hangs in a tree near Braven Environmental in Zebulon, N.C.

Photo: Schuyler Mitchell/The Intercept

In April, Braven announced it had completed a financing round led by institutional investors Fortistar, Arosa Capital, and Avenue Capital, where Moreno also serves as senior managing director. While Fortistar and Arosa have investments in the energy sector, Avenue backs businesses in financial distress — or as it calls them, "good companies with bad balance sheets."

But any bad balance sheets that Braven might have are unlikely to dissuade the numerous major petrochemical companies now banking on chemical recycling. Last year marked the ACC's highest lobbying spend on record, up to nearly $20 million. That same year, the group shelled out more than $265,000 for Facebook and Twitter ads focused on promoting chemical recycling. One ACC ad effort included the sponsorship of a promotional video specifically for Braven, which features Canosa and Moreno alongside the ACC's associate director of plastics sustainability.

Dow, Shell, and Chevron have all invested in developing their own plastic pyrolysis technology, while Exxon Mobil launchedone of the largest chemical recycling plants in North America earlier this year, the first of 13 facilities it says it will launch by the end of 2026. Worldwide, the advanced recycling market is projected to grow by 3,233 percent in less than a decade, from $270 million in 2022 to more than $9 billion by 2031.

As chemical recycling spreads, we know from existing studies that the facilities are most likely to harm communities that are already vulnerable and marginalized.

> "We found that these facilities are commonly sited in places where the surrounding community is disproportionately low income, or disproportionately people of color, or both."

"We found that these facilities are commonly sited in places where the surrounding community is disproportionately low income, or disproportionately people of color, or both," said Singla, who authored a reportfor the Natural Resources Defense Council on the environmental justice impact of chemical recycling.

Meanwhile, North Carolina could soon become the 25th state to take up the reclassification of chemical recycling. In April, three Republican state Senators introduced Senate Bill 725, which would amend the state's waste management laws to explicitly note "solid waste management does not include advanced recycling."

Braven, the only advanced recycling facility in North Carolina, was already exempt from obtaining a solid waste permit, according to Foote, the public information officer. Foote told The Intercept that since Braven processes "recovered material" — defined in state laws as "material that has known recycling potential, can be feasibly recycled, and has been diverted or removed from the solid waste stream" — it is not regulated as "solid waste."

There has been one recent development that could slow chemical recycling down. In June, the EPA unveiled new proposed rules under the Toxic Substances Control Act that would establish reporting requirements for 18 substances derived from plastic pyrolysis. The agency would require companies to submit their chemical feedstocks for review so the agency can screen them for "impurities," including PFAS, dioxins, heavy metals, bisphenols, and flame retardants.

The public comment period ended on August 19. The EPA is currently reviewing responses and is targeting early next year for follow-up action, according to a spokesperson.

The ACC, American Petroleum Institute, and Dow were among those who submitted comments urging the EPA to withdraw the proposed new rules.

"The ACC would welcome the opportunity to meet with EPA leadership to clarify misconceptions about advanced recycling," the ACC wrote, "and invite Agency officials to an advanced recycling facility for a first-hand sense of their operations."

In response to The Intercept's request for comment, Ross Eisenberg, president of America's Plastic Makers from the ACC's Plastics Division, wrote in a statement, "Progress towards a circular economy can only be achieved with smart, cohesive approaches that avoid inconsistent and conflicting approaches by regulators. … ACC remains committed to working with EPA as a constructive stakeholder in the development of effective, practical, and responsible policies."

Braven already appears to be pulling from the ACC's playbook in its efforts to curry favor with state lawmakers. Democrat Deborah Ross, who represents the North Carolina congressional district that includes Zebulon, made a trip to Braven's facility on August 25.

"I enjoyed meeting and learning from Braven's innovative leaders and employees this morning in Zebulon," Ross is quoted as saying in a Braven press release. "I look forward to applying the insights and information I gained during my visit to the important discussions in Congress about advanced recycling technologies."

The Intercept emailed the compliance report to Ross's office and asked whether Braven had mentioned the inspection and ongoing remediation efforts before, during, or after the representative's visit.

"Congresswoman Ross does her best to accommodate invitations she receives from constituents and visits dozens of businesses in her district every year — these tours and constituent meetings should never be interpreted as expressing support for any particular company's policy positions or business practices," wrote a spokesperson. "She was not aware of this investigation before touring Braven, nor was it discussed during or after her visit. As a vocal supporter of environmental protections, she takes these allegations seriously and strongly supports NC DEQ's work to hold companies in our state accountable for harmful waste or activities that threaten our people and our environment."

---------- Forwarded message ---------
From: **Hari Srinivasan** <hari9870@gmail.com>
Date: Sun, Feb 16, 2025 at 2:08 PM
Subject: Testimony FOR CB11-2025 - Hari Srinivasan
To: <councilmail@howardcountymd.gov>

Please see below for my testimony in support of CB11-2025 along with sources.

—

Hello, my name is Hari Srinivasan and I live in the Cedar Creek Community. Our house was built in 2022, and the proposed facility is under 270 yards from our house. I am a father of a 5-year-old and a 2-year-old, and I am here in support of CB11-2025. This is of the utmost importance to ensure the health and safety of our community members, particularly the many young children who live here.

Matters of health are personal for me. My father was diagnosed with Parkinson's Disease more than two decades ago. His condition steadily worsened over time. Earlier last year, after experiencing a significant progression in his symptoms, several of his bodily functions began to break down, he was placed on a ventilator for several days, moved into hospice, and passed away in June.

Now, some of you may ask what this has to do with the current research facility. The true cause of Parkinson's is unknown, but without any known genetic factors or any family history, we believe that one possible explanation for his disease was some kind of environmental exposure.

I hope that no community members will get Parkinson's because of this research facility. However, the Grace docket does state that the pilot plant will expose the surrounding area to nitrogen dioxide and volatile organic compounds. And there have been multiple studies linking Parkinson’s disease risk to higher levels of NO2 and VOCs. So you can understand how even the possibility of environmental exposure is a concern for my family.

The truth is: no one can guarantee that long-term exposure from this facility won't cause unwanted health consequences to our families who are forced to be around it day after day, year after year.

I'm not averse to data and statistics — in fact, I'm a data scientist, and so my entire job is predicated on looking at data, probability, and statistics. The data shows us that plastic incineration can emit particulate matter, VOCs, PFAS, dioxins, and more which are linked to cancer, respiratory issues, neurological and development delays, and preterm birth just to name a few. When it comes to matters of health and wellbeing as dire as this, if there is even a small probability of something going wrong, then we need to take as much caution as we possibly can.

I ask the people in this room: If you found out that a company near your house was thinking of building a plastic recycling facility, would you be comfortable with that? Also for those in the audience that work for Grace, would you really be here supporting this project if you didn’t work for Grace?

Finally, does Grace really want to be the reason why a lot of members of a nearby neighborhood start putting up “for sale” signs up on their yards?

Because a lot of us are actually thinking of doing this if the project happens.How will the media cover this? How will people view Grace after this?

To the council - Please do the right thing for the community and the children that live there and not what a billion dollar company wishes.

—

SOURCES

Nitrogen dioxide and Parkinson’s disease risk:

https://jamanetwork.com/journals/jamaneurology/fullarticle/2780249
(https://jamanetwork.com/journals/jamaneurology/fullarticle/2780249)

(“In this cohort study including a nationally representative cohort from a metropolitan city in South Korea (n = 78 830), a statistically significant association was found between exposure to NO2, especially at high levels, and incidence of PD.”)
https://pubmed.ncbi.nlm.nih.gov/26151951/ (https://pubmed.ncbi.nlm.nih.gov/26151951/)

(“In a case-control study of 1,696 Parkinson's disease (PD) patients identified from Danish hospital registries and diagnosed 1996-2009 and 1,800 population controls matched by sex and year of birth, we assessed long-term traffic-related air pollutant exposures (represented by nitrogen dioxide;

NO2)…Our findings raise concerns about potential effects of air pollution from traffic and other sources on the risk of PD, particularly in populations with high or increasing exposures.")

VOCs: (note that we are not saying the Grace project VOCs are the exact same VOCs studied here, but underscores the necessity of caution)

https://jamanetwork.com/journals/jamaneurology/fullarticle/2805037
(https://jamanetwork.com/journals/jamaneurology/fullarticle/2805037)

("In one of the best-documented large-scale contaminations in US history, the drinking water supplied to residents of Marine Corps Base Camp Lejeune in North
Carolina was contaminated with TCE, PCE, and several other volatile organic compounds (VOCs) from approximately 1953 until 1987…Risk of PD was 70% higher in Camp Lejeune veterans")

NRDC

FEBRUARY 2022
IB: 22-02-A

ISSUE BRIEF

RECYCLING LIES:

"CHEMICAL RECYCLING" OF PLASTIC IS JUST GREENWASHING INCINERATION

Plastic waste is everywhere in the modern world. An estimated 242 million metric tons of it is generated globally every year, polluting our cities and clogging the oceans, and the United States is one of the top generators.[1] However, America recycles only about 8.7 percent of its plastic waste.[2] This small percentage is recycled by mechanical means: sorted by type, cleaned, shredded, and then processed into plastic pellets used to generate new products. The other 90 percent or so is incinerated or landfilled or ends up in the environment.[3]

As public concern grows about mountains of plastic trash, the plastics industry is promoting technologies that it misleadingly calls "chemical recycling" (also known as advanced recycling, molecular recycling, and chemical conversion) and touts as a solution to the plastic crisis. But it is a false solution.

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A bulldozer pushes a pile of waste, including plastic trash.

For more information, please contact:
Veena Singla
vsingla@nrdc.org

www.nrdc.org
www.facebook.com/NRDC.org
www.twitter.com/NRDC

The term "chemical recycling" encompasses many processes that fall into two categories: plastic-to-fuel and plastic-to-chemical components. Plastic-to-fuel conversion is done using pyrolysis or gasification, both of which use heat and chemical processes to break plastic waste down into products that are turned into fuels (see "Terminology" text box).[4] Plastic-to-chemical components uses treatments such as heat and solvents to create feedstocks that proponents claim can be further processed into other chemicals or new plastics.[5] Methods used include solvent-based processes and depolymerization (see "Terminology"); proponents claim pyrolysis and gasification can also be used to convert plastic waste to chemical components. Both categories of "chemical recycling" are fraught with health, environmental, social, and economic concerns (Table 1).

TERMINOLOGY

Pyrolysis: Categorized as a type of "thermal depolymerization." Uses high temperatures and low-oxygen conditions to thermally degrade plastic. The primary product is a liquid/oil that can be refined into fuels or further processed to create chemicals or plastic.[6]

Gasification: Categorized as a type of "thermal depolymerization." Uses high temperatures with air or steam to degrade plastic. The primary product is a gas called "synthesis gas" (or "syngas") that can be processed into fuels or chemicals.[7]

Solvent-based processes: Also called solvent-based purification or recycling. Uses solvents and other chemicals to dissolve plastics and separate polymers from other components. Recovered polymers must be further processed to create new plastics.[8]

Chemical depolymerization: Uses thermal and chemical reactions to break the plastic polymer chain into individual units (monomers). The monomers are recovered and purified and can be made into new plastic. The process is currently applicable only to certain types of plastic. It is distinct from solvent-based processes because the polymers are broken down.[9]

TABLE 1: ISSUES BOTH SHARED AND UNIQUE TO DIFFERENT "CHEMICAL RECYCLING" TECHNOLOGIES
Pyrolysis and gasification can be used to convert plastic to fuel, while proponents claim that pyrolysis, gasification, solvent-based processes, and chemical depolymerization can be used to convert plastic to chemical components.

Issue	Pyrolysis, gasification	Solvent-based processes, chemical depolymerization
Generates large quantity of hazardous waste	X	X
Stores or releases hazardous chemicals on site	X	X
May be sited in low-income communities or communities of color	X	X
May encounter difficulty scaling up[10]	X	X
May produce contaminated end products[11]	X	X
Creates fuels whose burning generates the same harmful air pollutants as burning fossil fuels[12]	X	
Has large carbon footprint[13]	X	?
Requires ongoing virgin plastic production, with its associated harms	X	X
May cause fires at plants due to high heat	X	
Exists primarily at the lab or pilot scale		X

Producing fuel from plastic waste does not qualify as recycling by international standards.[14] Additionally, it requires continued plastic inputs to create fuels that, just like typical fossil fuels, produce harmful air pollution and greenhouse gases when burned; thus, plastic-to-fuel is incompatible with circular-economy or zero-carbon goals.[15] Previous analyses have found that plastic-to-chemical components "recycling" is barely present on a commercial scale in the United States; plastic-to-fuel processes are more common.[16]

To understand more about "chemical recycling" facilities in this country that are operational or may become operational, we reviewed reports to generate an initial list of facilities. We then narrowed that list to facilities about which we could find information in one or more U.S. Environmental Protection Agency (EPA) databases, environmental permit information, and/or other relevant information (see Appendix).[17] While a lack of information and transparency on these facilities made it difficult to determine their operational status or capacity, we found eight that met these criteria, most of which fall into the plastic-to-fuel category (Figure 1). We also found that numerous facilities had opened and then shut down a short time later, consistent with what we had learned from previous reports.[18]

FIGURE 1: CHEMICAL RECYCLING FACILITIES WE IDENTIFIED IN THE UNITED STATES. THE MAJORITY ARE PLASTIC-TO-FUEL

*Though Agilyx states it produces material that is used to make new plastic, data indicate that a high volume of its outputs are burned (more below).[19]

Our review of the eight selected "chemical recycling" facilities in the United States revealed that:

- the majority of facilities are not recycling any plastic;
- the facilities generate large quantities of hazardous waste;
- they release hazardous air pollutants; and
- they are often sited in communities that are disproportionately low income, people of color, or both.

Given these issues, "chemical recycling" cannot be the solution to our plastic problem—no matter how the plastic industry tries to spin it.

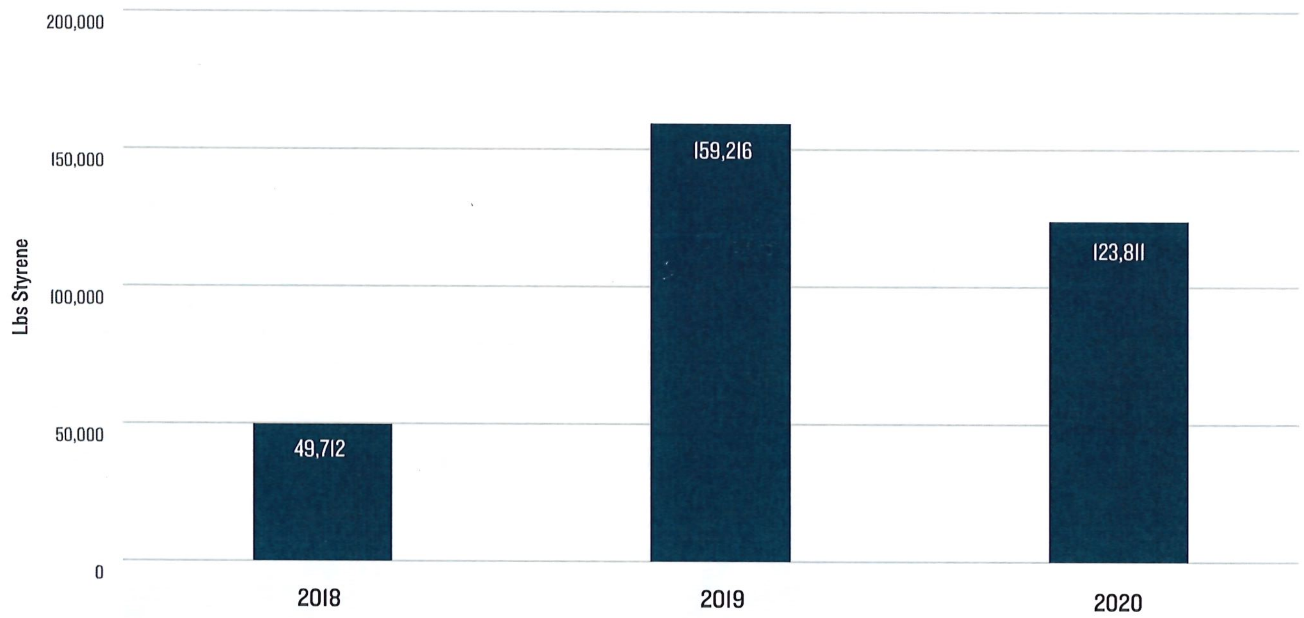
MOST "CHEMICAL RECYCLING" FACILITIES IN THE UNITED STATES ARE NOT RECYCLING ANY PLASTIC.

"Chemical recycling" most often creates materials that are burned—not turned into new plastic—and thus is not recycling at all.

Agilyx, a polystyrene pyrolysis plant in Tigard, Oregon, is held up by industry as a prime example of commercial-scale "chemical recycling." In theory, Agilyx takes waste polystyrene, a common type of plastic, and uses pyrolysis to turn it back into styrene, which is then used to make new polystyrene.[20] However, this facility in fact produces a large volume of styrene that is shipped off site to be burned instead of being converted into new plastic. Since 2018, Agilyx has shipped hundreds of thousands of pounds of styrene across the country to be burned (Figure 2).[21]

FIGURE 2: STYRENE SENT OFF SITE BY AGILYX TO BE BURNED, 2018–20

This amount has nearly tripled from 2018 to 2019. 2018 is the the first year in which the company focused on polystyrene.[22] Agilyx reported this styrene as sent to "energy recovery," which is the term used when an incinerator converts heat from the burning of waste materials into electricity; this is still incineration. In 2020, Agilyx reported implementing pollution prevention measures for onsite styrene releases.



Burning, or incineration, of chemicals and wastes has major climate, public health, and environmental justice impacts. Even if incinerators can convert some amount of the released heat into electricity (called "energy recovery"), the process still emits more greenhouse gases than fossil fuel-fired power plants and releases harmful air pollution and toxic chemicals.[23] Moreover, incineration sites are disproportionately located in communities where more than 25 percent of people identify as a racial minority, live below the federal poverty level, or both.[24]

Agilyx is not an outlier in this regard; since most facilities are creating fuel rather than new plastic, the outputs of all their intensive processing will ultimately be burned.

BOTH PLASTIC-TO-FUEL AND PLASTIC-TO-CHEMICAL COMPONENTS "CHEMICAL RECYCLING" FACILITIES GENERATE HAZARDOUS AIR POLLUTANTS AND LARGE QUANTITIES OF HAZARDOUS WASTE.

Nearly 500,000 pounds of hazardous waste were reported in 2019 from one "chemical recycling" facility alone.

Data from the EPA shows that Agilyx generated nearly 500,000 pounds of hazardous waste in 2019 alone, sending most of it off site to be burned (Table 2). This waste consisted primarily of benzene, along with other toxics such as lead, cadmium, and chromium (Table 2).[25]

TABLE 2: BURNING HAZARDOUS WASTE FROM AGILYX IN 2019

Agilyx sent hazardous waste to six locations across the United States for disposal.[26] The disposal methods all involve burning, though they may be called "incineration," "energy recovery," or "fuel blending"; the latter refers to mixing the hazardous waste with commercial fuel that is burned to power incinerators or cement kilns.

Where was hazardous waste disposed of?	Chemicals sent to this location	Total pounds sent (2019)
Tacoma, WA	Ignitable waste, benzene, and corrosive waste	353,292
Henderson, CO	Ignitable waste, benzene, barium, cadmium, chromium, lead, and selenium	66,190
Hannibal, MO	Ignitable waste, corrosive waste, cadmium, chromium, benzene, and 1,2-dichloroethane	64,122
Kimball, NE	Ignitable waste, corrosive waste, cadmium, chromium, benzene, and vinyl chloride	990
Arlington, OR	Benzene and 1,2-dichloroethane	66
East Chicago, IN	Ignitable waste and benzene	30
		Total: 484,690

Hazardous waste generation does not appear to be limited to pyrolysis facilities like Agilyx. PureCycle Technologies in Ohio states it will perform plastic-to-chemical components "chemical recycling" with solvent-based purification, employing solvents strong enough to break plastic waste down into its chemical components and separate it from contaminants.[27] PureCycle is registered as a large-quantity hazardous waste generator, meaning it plans to generate more than 2,200 pounds of hazardous waste per month in total.[28] We do not currently have details on the exact contents of PureCycle's hazardous waste, though permits indicate the facility plans to store toxic metals and solvents at its Hanging Rock, OH site, which is located in a community that is disproportionately low-income (Table 4).[29]

Hazardous waste and air pollutants generated by "chemical recycling" facilities are toxic chemicals that can cause cancer, harm the developing fetus, damage the reproductive system, and lead to other serious health problems.

The chemicals in the hazardous waste generated by Agilyx are toxic—many are carcinogens and/or neurotoxicants (Table 3). Much of this waste is benzene, a known cancer-causing chemical that can also be harmful to reproduction and the developing fetus.[30]

State-level permit data for Agilyx, Alterra Energy, Braven Environmental, Brightmark, Nexus Fuels, and PureCycle Technologies indicate that "chemical recycling" facilities release or are permitted to release hazardous air pollutants (HAPs), chemicals known or suspected to cause cancer or other serious health effects like birth defects (Table 3).[31] These chemicals are released directly from "chemical recycling" facilities as a by-product of the production process and can impact people living in proximity to the facility (Table 4).

TABLE 3: HEALTH HAZARDS OF CHEMICALS GENERATED BY "CHEMICAL RECYCLING" FACILITIES
(1) Health hazards of chemicals sent off site as hazardous waste by Agilyx and (2) hazardous air pollutants (HAPs) listed in Agilyx's Air Toxics Emissions Inventory and in air permits for Agilyx, Alterra Energy, Braven Environmental, Brightmark, Nexus Fuels, and PureCycle Technologies.[32] Data on hazard traits from California Safer Consumer Products Candidate Chemicals list.[33]

Chemical	Carcinogen	Reproductive toxicant	Developmental toxicant	Neurotoxicant	Persistent	Bioaccumulative	Liver toxicant	Cardiovascular toxicant	Respiratory toxicant	Kidney toxicant	Skin toxicant	Eye toxicant
(1) Hazardous waste sent offsite by Agilyx												
Lead	X	X	X	X	X	X	X	X		X		
Cadmium	X	X	X	X	X	X			X	X		
Selenium			X	X	X	X	X	X	X		X	
Benzene	X	X	X	X			X	X	X			
1,2-dichloroethane	X			X			X	X		X	X	
Chromium	X											
Vinyl chloride	X			X					X			
Barium				X			X	X				
(2) Hazardous air pollutants (HAPs) associated with multiple facilities												
Styrene	X	X	X	X			X					X
Benzene	X	X	X	X			X	X	X			
Toluene			X	X			X	X	X	X		X
Mercury	X			X	X	X	X	X	X		X	
Arsenic	X		X	X			X	X	X		X	
Dioxins	X	X			X	X	X				X	
Ethyl benzene	X		X	X			X		X	X		X
Xylenes			X	X			X		X	X		X
Naphthalene	X			X	X	X	X		X			X
Acetaldehyde	X								X		X	X
Formaldehyde	X						X		X			X
Hydrochloric acid									X		X	X
Methanol			X	X								
Hexane		X		X								

Moreover, according to EPA data, both Agilyx and Nexus were out of compliance with relevant HAP or hazardous waste regulations at least once during the past three years. Agilyx was in violation during 8 out of 12 quarters, with violations relating to pre-transport storage of hazardous waste and record-keeping, while Nexus's violation concerned the release of hazardous air pollutants.[34]

"CHEMICAL RECYCLING" FACILITIES ARE LOCATED IN COMMUNITIES THAT ARE DISPROPORTIONATELY LOW INCOME, PEOPLE OF COLOR, OR BOTH.

Communities of color already disproportionately bear the burden of health risks from plastics manufacturing, a process that releases highly toxic chemicals, because these facilities are often located in their neighborhoods.[35] There is a similar pattern of unequal impacts when it comes to "chemical recycling" facilities (Table 4). Of the eight facilities researched, six are in communities that are disproportionately Black or brown, and five are in communities where a disproportionate percentage of households have an income below $25,000, relative to national averages.[36] A combined total of about 380,000 people currently live within three miles of the eight facilities and could be impacted by their toxic emissions.

TABLE 4: DEMOGRAPHIC ANALYSIS OF COMMUNITIES WITHIN A THREE-MILE RADIUS OF IDENTIFIED "CHEMICAL RECYCLING" FACILITIES
Seven of the eight plants are in communities that are disproportionately low income, people of color, or both.[37] Orange highlights indicate where the percentage of people of color or percentage of people with a yearly household income below $25,000 was greater than the national average.
*Represents population of all census block groups intersecting with the three-mile buffer around the facility.

Facility	Agilyx	Alterra	Aquafil	Braven	Brightmark	New Hope	Nexus Fuels	PureCycle	U.S. Average
Location of facility	Tigard, OR	Akron, OH	Phoenix, AZ	Eagle Rock, NC	Ashley, IN	Tyler, TX	Atlanta, GA	Hanging Rock, OH	
Population within 3-mile radius of facility*	119,130	63,396	97,114	13,072	2,499	38,275	50,100	3,602	
Percentage with household income below $25,000	15%	31%	38%	17%	17%	37%	29%	29%	20%
Hispanic or Latino	10%	2%	79%	14%	2%	41%	13%	2%	18%
Non-Hispanic or Latino									
White alone	77%	70%	12%	60%	96%	26%	8%	91%	61%
Asian/ Pacific Islander	7%	2%	1%	0%	0%	0%	1%	0%	5.6%
Black or African American alone	2%	21%	5%	23%	0%	31%	77%	4%	12%
American Indian	>1%	>1%	2%	0%	0%	0%	>1%	0%	>1%
Other/multiracial	4%	4%	1%	2%	1%	1%	1%	4%	2.4%

POLICY RECOMMENDATIONS

Overall, it is clear that all forms of "chemical recycling" are plagued with problems and do not represent a solution to the plastic waste crisis. We need policies that reduce plastic production and waste, promote greater transparency about "chemical recycling," ensure the protection of environmental justice communities that are disproportionately impacted by these facilities, and do not greenwash the plastic-to-fuel processes as recycling.

Ensure comprehensive regulatory safeguards. Maintain health protections, and do not exempt "chemical recycling" facilities from solid waste permitting and regulations.

Multiple states have recently introduced or passed legislation to change the classification of "chemical recycling" plants so they are no longer considered solid waste facilities—and thus would be subject to weaker regulations related to reporting air and water pollution as well as waste.[38] However, because "chemical recycling" facilities handle discarded plastic waste, they should be treated and regulated as solid waste facilities. These facilities are expected to generate hazardous air pollutants and large quantities of hazardous waste—information that would not be public if the facilities were exempt from reporting requirements.

Additionally, two of the eight plants we researched had fires on site within their first year of operation: Fires occurred at New Hope Energy in Tyler, Texas, in May 2020 and at Brightmark in Ashley, Indiana, in May 2021.[39] Such accidents indicate that safety laws need to be enforced more, not less, at "chemical recycling" facilities to protect workers and nearby communities. Classifying "chemical recycling" facilities as solid waste facilities is necessary to ensure transparency and data access and to protect environmental and human health, particularly in the overburdened communities where these facilities are often located.

Maintain robust recycling definitions and standards that continue to exclude plastic-to-fuel processes.

Using pyrolysis and gasification to convert plastic into fuel should not be considered recycling, and recycling standards must continue to exclude such processes. Plastic-to-fuel is not considered recycling by ISO standards, the EU Environmental Commission, the Ellen MacArthur Foundation, and many other groups.[40]

Despite the fact that plastic-to-fuel does not recycle plastic, the industry continues to strongly support it.[41] This is likely because plastic-to-fuel creates a mirage of "recycling" to assuage public concerns about increased plastic use and waste but does not disrupt new plastic production. This paves the way for continued profits and the expansion of plastic production facilities.[42] Ensuring that plastic-to-fuel remains excluded from official definitions of recycling will make it difficult for plastic manufacturers to succeed in this greenwashing.

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Reusable and refillable products are key to reducing plastic waste. Zylaa, 10, filling a water bottle in the kitchen sink at her home in Washington, DC.

Invest taxpayer dollars in real solutions that reduce plastic production and waste. Do not support federal loan guarantees for "chemical recycling" facilities.

The plastics industry is attempting to secure federal loan guarantees for "chemical recycling" facilities, but this cannot be allowed. Supporting "chemical recycling" facilities with taxpayer dollars is unconscionable given the hazardous chemicals stored on site, the large amounts of hazardous waste generated, and the potential to disproportionately impact environmental justice communities. The current administration has prioritized advancing environmental justice and economic opportunities for disadvantaged communities and investing in these facilities runs directly counter to those commitments. Instead, real solutions include:

- eliminating problematic and unnecessary plastics, such as single-use plastics;
- innovating and scaling up reuse and refill models;[43]
- creating nontoxic materials to replace fossil fuel–derived plastics; and
- scaling up proven mechanical recycling or composting solutions.

The world is drowning in plastic, and we need to turn off the tap. "Chemical recycling" is a false solution that doesn't halt the deluge of plastic waste and creates new harms—it's a toxic distraction.

APPENDIX

TABLE AI: DATA SOURCES IDENTIFIED FOR EACH FACILITY
ECHO = Enforcement and Compliance History Online; TRI = Toxics Release Inventory; RCRA = Resource Conservation and Recovery Act.

Facility	Permit Data	ECHO Data	TRI Data	RCRA Data	Other Evidence re. Operational Status	EJScreen Analysis[44]	Address Used for EJScreen Analysis
Agilyx	X[45]	X[46]	X[47]	X[48]		X	13240 SW Wall Street, Tigard, OR, 97223
Nexus Fuels	X[49]	X[50]				X	500 Waterfront Dr. SW, Atlanta, GA 30336
Alterra Energy	X[51]	X[52]				X	1200 E Waterloo Rd., Akron, OH 44306
Brightmark	X[53]					X	3240 W 800 S, Ashley, IN 46705
Braven Environmental	X[54]					X	517 Industrial Dr., Eagle Rock, NC 27591
PureCycle	X[55]			X[56]		X	1125 County Rd. 1-A, Hanging Rock, OH
New Hope Energy	X[57]					X	1775 Duncan St., Tyler, TX 75702
Aquafil					X[58]	X	3555 W. Washington St., Phoenix, AZ 85009

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Health Risks Associated With Benzene Exposure in Children: A Systematic Review

Mark A. D'Andrea, MD, FACRO[1] and G. Kesava Reddy, PhD, MHA[1]

Abstract

Currently, there is a paucity of studies evaluating the adverse health effects of benzene exposure in children or clinical findings of those children who have been exposed. However, emerging studies show that benzene exposure can cause deleterious health effects in children. The objective of this study was to evaluate and summarize published studies on the adverse health effects of benzene exposure in children. More than 77 articles were examined and only the articles that dealt with adverse health effects on pediatric populations were included in the study. The evaluation of those studies provided current understanding of the health effects of benzene exposure in children. Findings from the currently available studies reveal that benzene exposure is associated with abnormalities in hematologic, hepatic, respiratory, and pulmonary functions in children. Published studies clearly support the need for further assessment of the potential adverse effects of benzene exposure in children, and clinical and laboratory findings of these children.

Keywords

benzene poisoning, blood disorders, chemical exposure, health impact, hematological toxicity, hepatotoxicity, Illness symptoms, pediatric populations, psychological effects, respiratory function.

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Introduction

Benzene is a clear colorless flammable solvent with an almost sweet yet gasoline-like odor that easily volatilizes into vapors in air. It is a natural component of both crude and refined petroleum and is formed as a result of the incomplete combustion of fossil fuels such as petroleum products and coal.[1] Benzene ranks in the top 20 most abundantly produced chemicals in the United States.[2] It is a commercially important intermediate of many chemicals manufactured in the industry. In addition, benzene is the most widely used chemical in the synthesis of various polymers, resins, and synthetic fibers. More than 98% of the benzene produced is derived from the petrochemical and petroleum refining industries.[3] The major sources of most of the ambient benzene is from petroleum refineries, emissions from coal and oil combustion, motor vehicle exhaust, evaporation from gasoline service stations, industrial solvents, and hazardous waste sites. Benzene is also a major component of tobacco smoke.[4] As a volatile organic compound, it is one of the main contributors to air pollutants in the environment.[5,6] It is found in the environment as a contaminant from both human activities and natural processes.[7,8]

Environmental benzene exposure is an important health concern. It has been clearly established that human exposure to benzene leads not only to hematologic cancers[9,10] but also to a wide range of adverse noncancerous effects including functional aberration of respiratory, nervous, immune, hematological, hepatic, renal, cardiovascular, and reproductive systems.[5,11-15] Additionally, benzene exposure can affect both B-cell and T-cell proliferation, reduce the host resistance to infection, and produce chromosomal aberrations.[16] These deleterious health effects of benzene exposure have been very well established, especially in adults. However, there is a paucity of investigations evaluating the clinical findings and adverse health effects of

[1]University Cancer and Diagnostic Centers, Houston, TX, USA

Corresponding Author:
G. Kesava Reddy, University Cancer and Diagnostic Centers, 12811 Beamer Road, Houston, TX 77089, USA.
Email: kreddy_usa@yahoo.com

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benzene exposure in children. Although the literature on the health consequences of benzene in children is scant, emerging studies show that benzene exposure can cause deleterious health effects in children. Moreover, epidemiological evidence suggests that environmental benzene exposure is potentially a major cause of childhood leukemia and other hematologic cancers.[17-20]

Children at various developmental stages have unique physical risk factors when exposed to environmental toxins including benzene due to their levels of mobility, oxygen consumption, hormonal production, and overall growth. In addition, the toxicodynamic processes that determine exposure, absorption, metabolism, excretion, and tissue vulnerability are all age related.[21] Moreover, children have a higher unit body weight exposure to benzene or other toxins than adults because of their heightened activity patterns and different ventilation tidal volumes and frequencies. Furthermore, children are more susceptible to leukemogenesis because their hematopoietic cell populations are differentiating and undergoing maturation. The incomplete metabolic systems, immature host defenses, high rates of infection by respiratory pathogens, and activity patterns make children more vulnerable to the toxic effects of benzene exposure.[22,23] The physiology, immature enzyme systems, and clearance mechanisms play a critical role in determining the susceptibility of children to toxins.[21-24] In particular, the pharmacokinetics of benzene differ widely between children and adults due to children's incomplete metabolic systems, rapid tissue regeneration, immature host defenses, activity patterns, and high rates of infection by respiratory pathogens.[22,23] Thus, children are more susceptible to the effects of environmental toxic pollutants. However, the susceptibility to benzene may vary due to its effect that arises, in part, from genetic variations in its metabolism, DNA repair, genomic stability, and immune function.

The precise mechanism of benzene-induced toxicity is not completely understood but it is believed that there are multiple mechanisms of action involved in benzene toxicity (Figure 1).[25-27] More specifically, the toxic effects of benzene are believed to arise from its metabolites such as benzene oxide, phenol, benzoquinone, muconaldehydes, hydroquinone, and catechol. Following absorption, benzene is metabolized by cytochrome P450 in the liver resulting in the production of its metabolites phenol, catechol, hydroquinone, and benzene oxide.[26] These metabolites undergo further metabolism in the bone marrow to form a benzoquinone. Numerous studies have shown that many of these benzene metabolites are directly responsible for both its cytotoxic and genotoxic effects.[28-30] In the bone marrow, formation of benzoquinone from the metabolism of benzene produces myelotoxicity due to its high reactivity to form adducts with proteins and DNA.[26,31] These protein and DNA adducts interfere with the cellular functions and cause damage in the hematopoietic cells in addition to chromosomal aberration, oxidative stress, gene expression alteration, error-prone DNA repair, epigenetic regulation, apoptosis, and disruption of tumor surveillance.[32] The generation of free radicals leading to oxidative stress, immune system dysfunction, and decreased immune surveillance has been described as the possible mechanisms underlying benzene-induced toxicity.[33]

Given the importance of the toxicity of benzene, this review article provides summaries of the current scientific knowledge and understanding of the clinical findings and health consequences of benzene exposure among children. Specifically, this article summarizes the quantitative changes in hematological and hepatic functions in addition to qualitative changes among somatic symptom in children exposed to benzene.

Methods

We sought all published studies, primarily in the peer-reviewed literature using electronic databases such as MEDLINE via PubMed and Google Scholar. The combinations of the keyword "benzene exposure" with any of the association to the following terms was used for the search in the database search: children, pediatrics, adverse health effects, blood disorders, chemical exposure, hematological toxicity, hepatotoxicity, illness symptoms, psychological effects, and respiratory function. We also searched reference lists in those publications that we obtained in an attempt to find additional relevant publications. Nonindexed journals were manually searched. The search was restricted to English-language articles. Abstracts that had been published in English were also included in this study.

Results

Figure 2 shows the steps involved in the selection process of the published articles for the study. On reviewing the articles' titles, abstracts, and full text content of the study, most of the articles were excluded. The main reasons for exclusion were that they were either nonquantitative, nonanalytical, or lacked clinical data. Articles with clinical data were reviewed, and the information that related to the health effects of benzene exposure in children was assessed and summarized in this review article (Table 1).

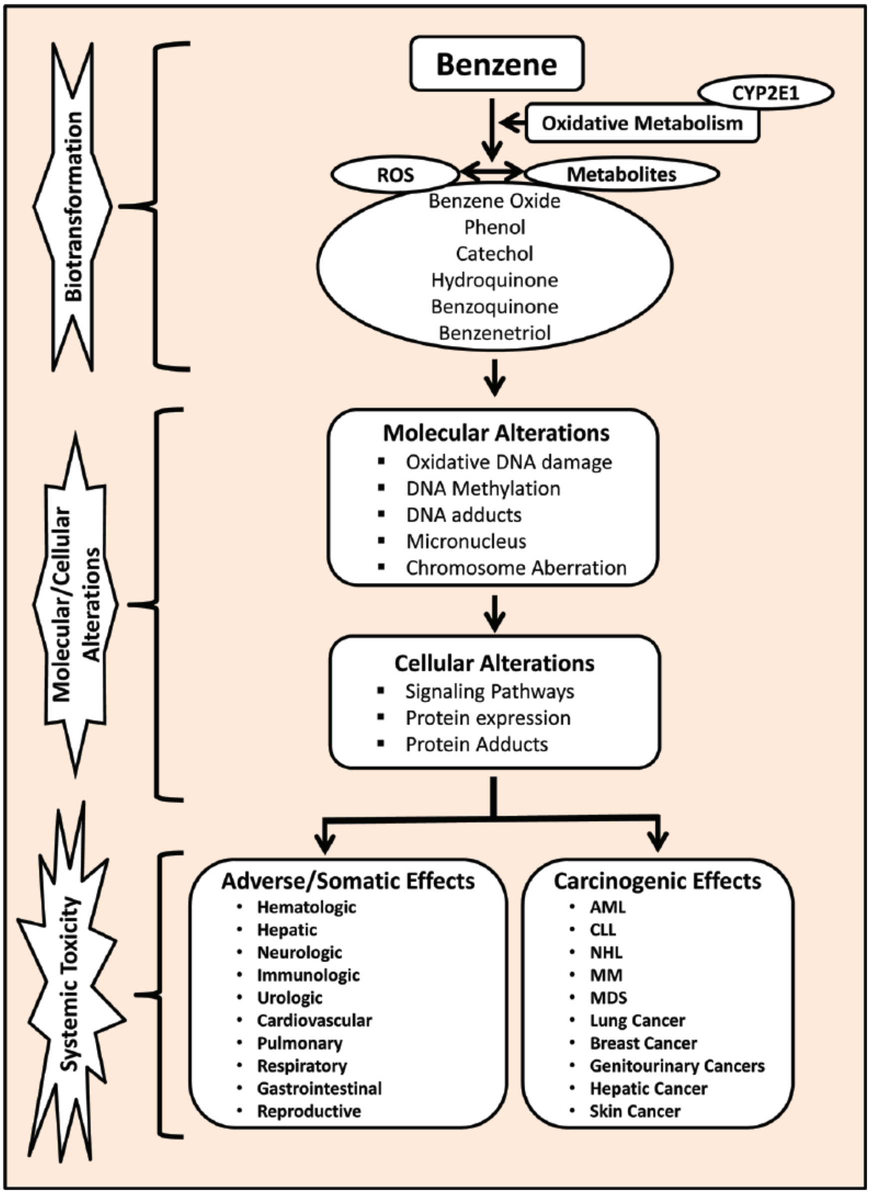

Figure 1. A schematic illustration of benzene metabolism, its mechanisms of toxicity, and its toxic effects in humans. Abbreviations: AML, acute myeloid leukemia; CLL, chronic lymphocytic leukemia; CYP2E1, cytochrome P450 2E1; MDS, myelodysplastic syndrome; MM, multiple myeloma; NHL, non-hodgkin lymphoma; ROS, reactive oxygen species.

Hematological Effects of the Benzene Exposure in Children

A cohort study by Lee and coauthors[34] assessed the hematological changes in children living near the petrochemical estate region in Ulsan, Korea, who were environmentally exposed to volatile organic compounds containing low levels of benzene. This study included a total of 192 children between the ages of 8 and 11 years who were living in close proximity to a petrochemical estate region or suburban region of Ulsan, Korea. The exposed group was composed of 48 boys and 49 girls who lived near the petrochemical estate region and went to an elementary school located near the petrochemical estate. The unexposed group was composed of 46 boys and 49 girls who had lived in the suburban region 10 miles from the petrochemical estate region. Both unexposed and benzene-exposed groups

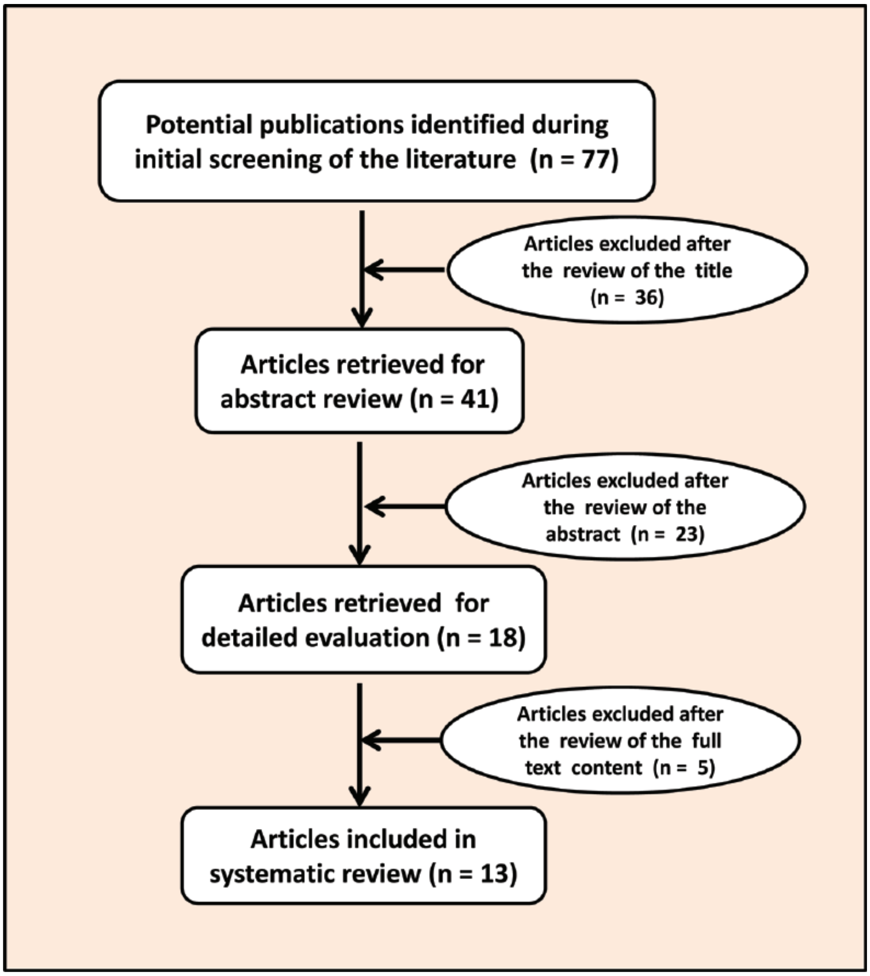

Figure 2. A flow chart illustrating the selection of articles for the study.

had similar age and sex distributions. Hematological assessment revealed that the total white blood cell (WBC) counts and absolute lymphocytes counts of 11-year-old children living near the petrochemical estate region were significantly lower than those of children living in the suburban region (P = .009, P = .032, respectively). Although the 8-year-old children living near the petrochemical estate region had decreased WBC counts and absolute lymphocytes counts compared with those living in the suburban region, they did not reach statistical significance. The red blood cell (RBC) counts and hemoglobin levels of the 8-year-old exposed children were significantly lower than those of the unexposed children (P < .001, P < .001, respectively). A similar, but not statistically significant, trend was seen in the parameters in the 11-year-old exposed and unexposed groups. Whereas the platelet counts were significantly decreased in both 8- and 11-year-old exposed children compared with unexposed children (P = −.001, P = −.001, respectively). A follow-up assessment at 3 and 6 months after the initial evaluation yielded similar differences but there were not consistent findings in the exposed and unexposed groups of the 8- and 11-year-old children.

The generalized linear model analysis of variance for the complete blood count values showed that the region where the exposure took place was a significant independent variable for the total WBC counts, RBC counts, and platelet counts (P = .007, P = .004, and P = .036, respectively), and the children's sex was a significant independent variable for the RBC counts (P = .001). Similarly, age was a significant independent variable for the total WBC counts, absolute lymphocyte counts, and platelet counts (P < .001, P = .004, and P = .005, respectively). Overall, the study findings showed that environmental exposure to volatile organic compounds containing

Table 1. Summary of Studies on the Effect of Benzene Exposure Among Children.

Location of Study	Study Design	Children's Age	Sample Size	Observed Clinical Health Effects	Reference
Ulsan, Korea	Cohort	8-11 years	192 (97 benzene exposed and 95 control) children	Reduced WBC, RBC, platelets, and lymphocytes counts, decreased hemoglobin in benzene-exposed children compared with unexposed children	Lee et al (2002)[34]
Texas City, TX	Cohort	8-11 years	312 (157 benzene exposed and 155 control) children	Reduced WBC counts, increased platelet counts, elevated creatinine levels, and increased liver enzymes such as ALP, AST, and ALT in benzene-exposed children compared with unexposed children	D'Andrea and Reddy (2013)[35]
Texas City, TX	Cohort	8-11 years	899 (641 benzene exposed and 258 control) children	Reduced WBC counts, increased platelet counts, decreased hemoglobin, hematocrit, and BUN levels, and increased liver enzymes such as ALP, AST, and ALT in benzene-exposed children compared with unexposed children	D'Andrea and Reddy (2016)[36]
Kanawha County, WV	Cohort	7-8 years	7796 children	Increased incidence of chronic respiratory symptoms in children attending schools located in a close proximity to chemical industries. Significant trends were observed for asthma-related responses such as a physician's diagnosis of asthma, persistent wheezing, and attacks of shortness of breath with wheezing in school children enrolled within a close proximity to chemical plants regions than those in the nonindustrial region.	Ware et al (1993)[37]
La Plata, Argentina	Cohort	6-12 years	1 191 (282 living close to the petrochemical plants, 270 exposed to heavy traffic, and 639 living in nonpolluted areas)	Significantly elevated asthma and respiratory symptoms including wheezing, cough, dyspnea, and rhinitis, and reduced lung function in children living near the petrochemical plant compared with those living in nonpolluted areas	Wichmann et al (2009)[38]
Rio Grande do Norte, Brazil	Cross-sectional	0-14 years	209 children	Higher incidence of respiratory symptoms in children exposed to petrochemicals	Moraes et al (2010)[39]
El Paso, TX	Panel study	6-12 years	36 children	Increased Asthma Control Questionnaire score in children exposed to traffic pollution with benzene, toluene, and other toxins	Zora et al (2013)[40]
Asturias, Gipuzkoa, Sabadell, and Valencia, Spain	Cohort	12-18 months	2199 infants	Increased respiratory tract infections	Aguilera et al (2013)[41]
Los Angeles, CA	Panel study	10-16 years	21 children	Increased asthma and lung function among the children exposed to benzene	Delfino et al (2003)[42]
Viseu, Portugal	Panel study	6-8 years	51 children	Deteriorated lung function in children exposed to benzene	Martins et al (2012)[43]
Texas City, TX	Cohort	8-11 years	312 (157 benzene exposed and 155 control) children	Upper respiratory (67%), neurological symptoms (57%), diarrhea (25%), cough (24%), dermatological (24%), nausea/vomiting (21%), gastrointestinal (12%), wheezing (9%), chest pain (6%), vision (6%), painful joints (6%), and urinary irritation (3%)	D'Andrea and Reddy (2016)[44]

Abbreviations: WBC, white blood cells; RBC, red blood cells; ALP, alkaline phosphatase; AST, aspartate aminotransferase; ALT, alanine aminotransferase; BUN, blood urea nitrogen.

low levels of benzene was associated clinically with a higher prevalence of hematological abnormalities in children living near the petrochemical estate region.

A pilot study by D'Andrea and Reddy[35] evaluated the hematological function in children who were less than 17 years old and exposed to benzene following British Petroleum's (BP) flaring incident in Texas City, Texas. A total of 312 children were included in the study. Of the 312 children, 157 were exposed to benzene and 155 were not exposed to benzene. Both unexposed and benzene-exposed groups had similar age and sex distributions. Clinically, hematologic analysis showed that WBC counts were significantly decreased in benzene-exposed children compared with the unexposed children ($P = .022$). Conversely, the platelet counts were increased significantly in the benzene-exposed group compared with the unexposed group ($P = .005$). Similarly, the serum creatinine levels were significantly increased in the benzene-exposed children compared with the unexposed children ($P = .000$). However, no significant alterations were observed in the mean hemoglobin or hematocrit or blood urea nitrogen levels between the benzene exposed and unexposed children. The results of this pilot study indicated that environmental exposure to benzene is associated clinically with altered hematological profiles in those children who were exposed to the benzene from the flaring incident at the BP refinery facility in Texas City, Texas.

A later larger cohort study by the same authors assessed the hematological changes in children exposed to benzene following the flaring incident.[36] A total of 899 children aged <17 years were included in the study. Of the 899 children, 258 were unexposed and 641 were exposed to benzene. The mean age of the unexposed and exposed children was 10.5 and 9.5 years, respectively. Among the unexposed children, there were 57% male and 43% female children. In the benzene-exposed group, there were 52% males and 48% females.

Hematological analysis indicated that those children exposed to benzene had significantly decreased mean WBC counts compared with the unexposed children ($P = .001$). Conversely, the mean platelet counts in the benzene-exposed group were significantly higher when compared with the unexposed children group ($P = .001$). Whereas the mean hemoglobin levels decreased significantly in the benzene-exposed group compared with the unexposed group ($P = .001$). Similarly, the percentage of hematocrit decreased significantly among the benzene-exposed children compared with the unexposed children ($P = .001$). Blood urea nitrogen was also found to be reduced significantly in benzene-exposed group compared with the unexposed group ($P = .001$). However, no significant differences were noted in the serum creatinine levels between the benzene exposed and unexposed groups. Furthermore, subanalysis indicated that, regardless of age or gender, significant alterations in the hematological profiles were seen in those children exposed to benzene. Overall, the findings of the hematological profiles confirmed the pilot study findings indicating that children who have been exposed to benzene have significantly increased health risks compared with unexposed children.

Effect of Benzene Exposure on Hepatic Function in Children

Currently, there are no published studies in literature that evaluated the clinical effect of benzene exposure on the liver function in children except 2 recent reports published by the authors.[35,36] The initial pilot study included 157 benzene-exposed and 155 unexposed children and assessed their liver function enzymes such as alkaline phosphatase (ALP), aspartate aminotransferase (AST), and alanine aminotransferase (ALT). The study findings revealed that benzene-exposed children had clinically significantly higher levels of ALP ($P = .04$), AST ($P = .015$), and ALT ($P = .005$) compared with the unexposed children.

Subsequently, the larger cohort study[36] assessed the liver function enzymes in 641 benzene-exposed children and compared with the 258 unexposed children. Serum ALP, AST, and ALT levels were reported to be increased significantly in children exposed to benzene compared with the unexposed children ($P = .001$). Furthermore, subgroup analysis indicated that, regardless of age or gender, significant alterations in hepatic enzymes were seen in children exposed to benzene. Overall, the findings of the hepatic profiles confirmed the pilot study findings indicating that children who have been exposed to benzene have significantly increased health risks compared with unexposed children.

Benzene Exposure and Illness Symptom Profiles in Children

Among all, respiratory illness symptoms are the most often studied health complaints in children exposed to benzene or petrochemicals/urban traffic pollutants. Upper respiratory symptoms were the most (67%) frequently reported, followed by neurological symptoms (57%), diarrhea (25%), and cough (24%). Logistic regression analysis indicated that neurological symptoms ($R^2 = 0.75$), chest pain ($R^2 = 0.64$), joint pain ($R^2 = 0.57$), and vision difficulty ($R^2 = 0.54$) were positively associated with increasing age. Other studies have shown that asthma symptoms such as those related to wheezing, cough, and shortness of breath or chest tightness were the most frequently reported respiratory illness symptoms in benzene-exposed children. A study by Ware and co-investigators[37] evaluated respiratory and irritant health effects of ambient volatile organic compounds in 7796 children attending 74 elementary schools located in chemical industry regions. The findings indicated that exposure to volatile organic compounds from chemical manufacturing plants were associated with an increased incidence of chronic respiratory symptoms in children attending schools located in a close proximity to chemical industries. Significant trends were observed for asthma-related responses such as a physician's diagnosis of asthma, persistent wheezing, and attacks of shortness of breath with wheezing in school children enrolled within a close proximity to regions containing chemical plants than those in the nonindustrial regions.

Similar findings were reported in a study by Wichmann et al[38] that assessed the effects of exposure to petrochemical pollution on the respiratory health of children aged 6 to 12 years living close to petrochemical plants (n = 282) and compared them with those living in a region with exposure to heavy traffic (n = 270) or in relatively non-polluted areas (n = 639) in La Plata, Argentina. The findings showed that children living near the petrochemical plant had significantly elevated asthma and respiratory symptoms (wheezing, cough, dyspnea, and rhinitis) and significantly reduced lung functions than those living in nonpolluted regions ($P < .001$). Moraes and coworkers[39] investigated the health impacts of living near petrochemical plants by assessing respiratory illnesses in 209 Brazilian children. The results from this study revealed that respiratory symptoms were found to be increased in children among communities in the vicinity of a petrochemical complex particularly those living downwind from the plant.

A panel study conducted by Zora et al[40] assessed the associations between urban air pollution of benzene and pediatric asthma control using an Asthma Control Questionnaire (ACQ) score in 2 elementary schools located in high- and low-traffic areas of El Paso, Texas. Eligibility criteria included age of the children between 6 and 12 years, a physician diagnosis of asthma, no other lung disease or major illness, a nonsmoking household, and residence proximal to their school. Data were reported for 36 of the 38 children who completed the protocol. The study found that benzene levels in the air of a school located in the high-traffic area ranged from 0.2 to 2.4 μg/m^3. Although no significant associations between benzene and other pollutants with an increase in ACQ score were found, an increase in ACQ score was related with an increase in benzene levels among children inhaling corticosteroids daily. Aguilera et al[41] investigated the association of air pollution exposure during pregnancy and respiratory illnesses, ear infections, and eczema during the first 12 to 18 months of life in a Spanish birth cohort of 2199 infants. These authors observed that during the second trimester of pregnancy, an increase in 1.0 μg/m^3 of benzene exposure was associated with an increased risk of lower respiratory tract infections in those infants.

In a panel study, Delfino et al[42] examined the longitudinal relationship of the daily asthma severity among asthmatic children exposed to volatile organic compounds such as benzene. The study included 21 asthmatic children between 10 and 16 years of age. The study revealed that increased mean concentrations of benzene (5.7 μg/m^3) levels were associated with increased asthma and poor lung function among the children. Martins and coauthors[43] evaluated the relationship between air polluted by benzene exposure and airway changes in a group of wheezing children. The investigators included a total of 51 wheezing children with a mean age of 7.3 years from Viseu, Portugal. Benzene levels were monitored for 4 weeks, and using a dispersion model, personal exposure was determined based on time-activity patterns according to the estimations. These authors reported that an increase in 10.0 μg/m^3 of benzene exposure was associated with deteriorated lung function-related outcomes in wheezing children.

In a pilot study, we investigated the clinical presentation of the illness symptoms experienced by children who were exposed to benzene following a flaring incident at the BP refinery in Texas City, Texas.[35] The study included a total of 157 children who were exposed to benzene. Among the illness symptoms, neurological symptoms such as unsteady gait, memory loss, and headaches were the most (80%) frequently reported symptoms in children exposed to benzene. Upper respiratory symptoms were reported by 48% of the benzene-exposed children followed by cough (48%), nausea/vomiting (43%), dermatological (36%), shortness of breath (32%), wheezing (27%), dizziness (22%), chest pain (15%), painful joints (15%), and weight loss (13%). To complement these findings, recently we conducted a full-fledged study in 641 children who were exposed to benzene following a flaring incident at the BP refinery in Texas City, Texas.[44] A total of 1790 illness symptoms were observed in 641 children exposed to benzene.

Among all clinically presented illness symptoms, upper respiratory symptoms occurred as the most frequently (67%) followed by neurological symptoms (57%), diarrhea (25%), and cough (24%). Logistic regression analysis indicated that neurological symptoms ($R^2 = 0.75$), chest pain ($R^2 = 0.64$), joint pain ($R^2 = 0.57$), and vision difficulty ($R^2 = 0.54$) were positively associated with increasing age of the children. Overall, the findings revealed that children exposed to benzene experienced range of illness symptoms indicating their vulnerability to increased risks and health complications.

Discussion

The literature reviewed in this article indicates there is a growing interest in evaluating the clinical and health consequences of benzene exposure among children. The literature on both clinical and health effects of benzene exposure in children is scarce, and studies evaluating the hematological, hepatic, and respiratory effects of benzene exposure are starting to emerge based on established biological mechanisms of benzene toxicity. Overview of the findings of the studies included in this review indicates that benzene exposure among children was clinically associated with alterations in hematologic, hepatic, and respiratory functions. In addition, benzene exposure was associated with the clinical presentation of several illness symptoms in children.

Clinical evidence further suggests that hemotoxicity is the major effect and is unique to benzene. Exposure to benzene causes bone marrow injury resulting in hemotoxicity leading to changes in WBCs, platelets, hemoglobin, hematocrit, and other blood cells formation. Multiple mechanisms including alterations in the expression of numerous genes and proteins, DNA methylation patterns, and RNA profiles appear to play an important role in benzene-induced hemotoxicity in exposed children.[27]

Although several studies have investigated the effect of benzene exposure on the hematological changes in adults, only a handful of studies published so far have evaluated the clinical changes in the hematological functions among children following their exposure to benzene.[34-36] The findings of these studies demonstrate that children exposed to benzene experienced significantly reduced hematological indices compared with those unexposed children. However, conflicting findings in platelet counts were observed in benzene-exposed children. Our recently published studies demonstrated significantly elevated platelet counts in children who were exposed to benzene compared with unexposed children.[35,36] However, in the study reported by Lee and associates,[34] significantly decreased platelet counts were observed in children exposed to benzene compared with unexposed children. Although the discrepancies in the platelet counts in benzene-exposed children currently cannot be explained, Ceresa and coworkers[45] previously found that thrombocytopenia was not a constant finding in most of the adult subjects who were exposed to benzene. Nevertheless, additional studies are warranted to clarify the effect of benzene exposure on the platelet counts in children.

The liver is the principal organ of xenobiotic metabolism, and hence, it is very important to monitor its function in people exposed to benzene or other toxins. It is well known that phosphatases, aminotransferases, and dehydrogenases are important enzymes in the biological processes. They are involved in the detoxification, metabolism, and biosynthesis of energetic macromolecules for different essential functions. Any interference in these enzymes leads to biochemical impairment and changes in the tissue and cellular function. Thus, the measurement of these liver enzyme such as ALP, AST, and ALT are routinely assessed as indicators for hepatic dysfunction and damage.[46,47] In normal conditions, these enzymes are confined to the cells but are released into circulating blood when there is necrosis or injury. Despite its importance, until recently, there were no published studies available in the literature evaluating the effect of benzene exposure on the hepatic function in children. The 2 recent studies reported by the authors[35,36] revealed that the serum levels of ALP, AST, and ALT were found to be elevated among those children who were exposed to benzene indicating hepatic abnormalities in these children. The increase in the levels of these liver enzymes in their serum suggests the impairment of the hepatic function in children exposed to benzene.

Studies assessing the somatic or clinically presenting illness symptoms such as respiratory, neurological, gastrointestinal, and other symptoms in children exposed to benzene were also limited in the published literature. However, evidence from available studies suggests that benzene exposure is associated clinically with sickness symptoms in children. The most common clinical presentations of the illness symptoms include neurological, respiratory, shortness of breath, wheezing, dizziness, chest pain, and painful joints.

Conclusions

Together, studies evaluating the clinical changes in the hematologic, cardiac, hepatic, renal, and other vital organ functions in children who were exposed to benzene are sparse. We have yet to learn and understand the full extent of all the adverse effects that benzene exposure has on pediatric populations. Findings from the currently available studies reveal that benzene exposure is associated with clinical abnormalities in the hematologic, hepatic, respiratory, and pulmonary functions in children. The hematological abnormalities were characterized by changes in RBC, WBC, absolute lymphocytes, platelets, hemoglobin, hematocrit, and creatinine in benzene-exposed children. Similarly, the hepatic abnormalities were characterized by elevated levels of ALP, AST, and ALT enzymes in the serum of the children exposed to benzene. Few studies have evaluated the somatic or illness symptoms such as respiratory, neurological, gastrointestinal, and other symptoms in children exposed to benzene. These findings indicate that exposure to benzene may lead to clinically detectable detrimental health effects in children. However, to fully understand the importance and nature of these effects, further longitudinal and mechanistic studies on the health effects of benzene exposure in children are warranted.

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Author Contributions

MAD: Contributed to design; contributed to acquisition; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
GKR: Contributed to conception and design; contributed to acquisition; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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ORCID iD

G. Kesava Reddy https://orcid.org/0000-0002-1936-6972

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REGION 3
PHILADELPHIA, PA 19103

January 8, 2025

VIA ELECTRONIC MAIL
RETURN RECEIPT REQUESTED

Ms. Suna Yi Sariscak
Manager
Maryland Department of the Environment
Air Quality Permits Program
Air and Radiation Administration
1800 Washington Blvd,
Baltimore, MD 21230

RE: Applicability Determination Request - OSWI Rule and Proposed Pilot Plant in Maryland

Dear Ms. Sariscak:

We have received your December 13th, 2024 letter requesting an Applicability Determination for W.R. Grace & Co.-Conn and applicability of 40 CFR Part 60, Subpart EEEE - Standards of Performance for Other Solid Waste Incineration (OSWI).

Background

The December 13th letter and supplemental application describe a proposed Research and Development lab to be constructed by W.R. Grace & Co.-Conn ("Grace"). The proposed R&D facility intends to construct a catalytic pyrolysis unit, for the purposes of:

> …researching the scaling up of an innovative process to convert 1kg/hr of plastics back to their original components. The reactor in this proposed process will use a catalyst and heat in the form of steam to carry out this reaction. The Product from the reactor is a vapor. The vapor is sent via pipe to a condenser. The vapor that is liquified in the condenser is the product, which is then stored in drums. The drums are sent off site for disposal once data is collected. Non condensables from the condenser are sent via pipe to an electric flameless thermal oxidizer to control any VOC that may be present in the gas stream.

Furthermore, two phases will occur in which phase 1 will utilized virgin plastic as feedstock and if the project is determined to be "technologically feasible" and "commercially viable" phase 2 will consist of

processing recycled plastics. It's stated that Grace "cannot directly process plastic waste" and will need to source cleaned, pelletized recycled plastics.

Determination

Subpart EEEE has three applicability requirements, which are:

(a) Your incineration unit is a new incineration unit as defined in § 60.2886.
(b) Your incineration unit is an [Other Solid Waste Incinerator] OSWI unit as defined in § 60.2977 or an air curtain incinerator subject to this subpart as described in § 60.2888(b). Other solid waste incineration units are very small municipal waste combustion units and institutional waste incineration units as defined in § 60.2977.
(c) Your incineration unit is not excluded under § 60.2887.

The proposed catalytic pyrolysis unit, when constructed would be "new" as defined in §60.2886, which is defined to mean having a construction date after December 9, 2004. Additionally, the unit would meet the definition of an Other Solid Waste Incinerator, as OSWI expressly includes pyrolysis units. Despite the first two applicability requirements being satiated, the proposed catalytic pyrolysis unit would meet an exemption under § 60.2887.

§ 60.2887 states that "Your unit is excluded if it burns samples of materials only for the purpose of chemical or physical analysis." If the catalytic pyrolysis unit is operated for the sole purpose of research, the unit would be exempted from other requirements promulgated in 40 CFR Part 60, Subpart EEEE - Standards of Performance for Other Solid Waste Incineration (OSWI). Please note that rules such as 40 CFR 60 – Standards of Performance for New Stationary Sources do change occasionally, and any future changes to Subpart EEEE should be evaluated.

The EPA's response hereinabove to the request for applicability determination was coordinated with EPA's Office of Enforcement and Compliance Assurance (OECA) and EPA's Office of Air Quality Planning and Standards (OAQPS). EPA's applicability determination is specific to the facts provided in the December 13th, 2024 letter and supplemental application from W.R. Grace & Co.-Conn and any differences in the constructed facility or its operations may invalidate this response. If you have any questions regarding this response, please contact Steve Ott, of the Enforcement and Compliance Assurance Division at (215) 814-2267 or ott.steven@epa.gov.

Sincerely,

Karen Melvin
Director
Enforcement and Compliance Assurance Division

CC:
Cristina Fernandez, EPA Region 3, fernandez.cristina@epa.gov
Kristen Hall, EPA Region 3, hall.kristen@epa.gov
MaryCate Opila, EPA Region 3, opila.marycate@epa.gov
Steve Ott, EPA Region 3, ott.steven@epa.gov

From: Raja Ramadas <ramadas.raja@gmail.com>
Sent: Monday, February 17, 2025 6:52 PM
To: CouncilMail
Subject: I support CB11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Council Members,

My name is Raja Ramadas, I live at 7920 Lawndale Circle, and I support CB11-2025.

You will hear quite a bit on "both sides" of this issue, and when you do I urge you to keep the following in mind. Outcomes follow incentives, and history often rhymes.

W. R. Grace is a for-profit enterprise that is accountable only to its shareholders within the boundaries of the law. Every employee within their reporting structure is accountable to their leadership. Our country is now seeing, daily, just how powerful the profit motive and organizational expectations can be, in many cases even trumping actual self-interest, let alone civic responsibility. I am sure that everyone who is testifying against CB11-2025 believes it when they claim that Grace's research in this pilot plant will be safe and won't hurt our communities. But they need to believe it because incentives matter, even to sober-minded scientists and technical professionals. The simplest explanation for this pilot effort is that Grace is attempting to optimize its process to gain a marketing edge and keep their shareholders happy, with some greenwashing thrown in for good measure. And for this, they want you to risk our health, our children's health.

Just how big is this risk, you may ask? With Grace, their track record is clear. You will hear from several people just how egregiously they have betrayed the trust that communities have placed in them, repeatedly. In the 60 years they have been in Columbia they have managed to pollute the soil, water and air and are still cleaning up their mess under order from the EPA. Their Curtis Bay facility in Baltimore is under litigation; in fact they are under litigation throughout the country. It is clear that Grace views communities as obstacles and penalties as business expenses, ones that they are trying to minimize by opposing common-sense responsible regulations such as CB11-2025. With regulatory budgets crippled across the nation, we can't count on the proverbial "adults in the room" to straighten them out either. The only way we can be sure of protecting our citizens is by stopping this bad idea before it gets off the ground.

I know that right now, given what's happening throughout our country, passing this bill may seem at once insignificant and an uphill battle. Letting it fail would be the cynical choice, and in uncertain times cynicism can seem like pragmatism. The truth is nobody can control the future or out-maneuver chaos, but instead only choose their actions and by doing so define their values and priorities. We are here because we trust you to honor your responsibility towards us as voters and taxpayers, and to choose to do the right thing even when it's hard. Protecting our families and children is obviously the right thing, and I urge you to pass CB11-2025.

Thank you.

From:	Rene Maldonado <rene.maldonado@outlook.com>
Sent:	Monday, February 17, 2025 9:25 AM
To:	councilman@howardcountymd.gov
Cc:	CouncilMail; councilmember@howardcountymd.gov
Subject:	Testimony FOR CB11-2025
Attachments:	Rene Maldonado ZRA Testimony 2-18-25.pdf; Review of Grace's Proposed Plastics Pilot Plant and Risks 2-14-2025.pdf
Follow Up Flag:	Follow up
Flag Status:	Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Attached is a copy of my testimony in favor of bill CB11-2025.

Also enclosed is copy of a review article I wrote on Grace’s pilot plant and risks to our community.

Thanks.

René Maldonado
314-223-3117

From: Rita Patel <patel210@yahoo.com>
Sent: Monday, February 17, 2025 5:41 PM
To: CouncilMail
Subject: CB11-2025 - Testimony in Support
Attachments: WR Grace_Rita Patel.docx

Follow Up Flag: Follow up
Flag Status: Flagged

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To Whom It May Concern:

Please see attached testimony in support of CB11-2025 (2/18/2025 at 7pm).

Thanks,

Rita Patel
7639 Cross Creek Drive
Columbia, MD 21044

Hello, my name is Rita Patel and I live at 7639 Cross Creek Drive, Columbia MD - approximately 70 meters or approximately 230 feet from WR Grace in the Cedar Creek neighborhood. I want to thank you for allowing me to share my thoughts on the Pilot Plant for hard to recycle plastics that WR Grace has put in a permit for. Research has shown that chemical recycling of plastics results in incineration emissions of some highly carcinogenic chemicals that are not safe at any level.

I have lived in Howard County for nearly 30 years and when I was looking to purchase a home I was attracted to Cedar Creek because of the Nature Trail that was going to be built to Robison's Nature Center passing the WR Grace facility - I really love to run and walk outdoors and now I fear that the toxic emissions, fires, and explosions will be an issue and I will not be able to do what I intended to do when I bought my home in October of 2021.

I also have elderly parents who are 79 and 67 and come to visit me regularly to take walks around the neighborhood and I fear for their health if we breathe in the highly toxic emissions from this proposed pilot plant. POSSIBLY A REPEAT…MAY NEED TO STATE THAT I AGREE WITH OTHERS THAT HAVE STATED THIS POINT

There are many children and people with autoimmune illnesses in the neighborhood too and this proposed pilot plant, and the hazardous emissions, possible fires and explosions will negatively impact their health and wellbeing. POSSIBLY A REPEAT…MAY NEED TO STATE THAT I AGREE WITH OTHERS THAT HAVE STATED THIS POINT

As an attorney, I know it is important to advocate for issues that are in the interest of public health. Therefore, I am advocating in support of the ZRA, which is coded as ZRA CB11-2025 that states an Act amending the Howard County Zoning Regulation add Research and Development lab use to the Planned Employment Center Zoning district prohibiting such research and development uses that involve commercial plastic pellets or feedstock, which produces flue gas.

Thank you.

From: Sam Schmitz <sschmitz@momscleanairforce.org>
Sent: Monday, February 17, 2025 11:01 AM
To: CouncilMail
Subject: February 18th Testimony
Attachments: CB11-2025 Testimony Feb 19.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

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Hello – here is my testimony on behalf of Moms Clean Air Force for tomorrow's hearing.

Sam Schmitz (she/her)
Project Manager, DC Events & Policy
847-436-7759

MOMS
clean air
FORCE

From: Sara Dwyer <dwyer.sarak@gmail.com>
Sent: Monday, February 17, 2025 4:18 PM
To: CouncilMail
Subject: 2/18 copy of Testimony

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

2/18 copy of Testimony

Good evening, fellow Howard county community members.

My name is Sara Dwyer, and I live in Cedar Creek, just a short distance from the W.R Grace property. I appreciate the chance to speak tonight because this decision affects all of us who call this community home.

At the heart of this issue is a simple question: Is this the right place for a pilot program? Even with advanced technology, there is always a risk—especially in a pilot program, where things are still being tested. Families, children, and seniors live here. The idea that even a small amount of toxic pollution could drift into our neighborhoods is not something we should take lightly.

This isn't just about what's in the air today—it's about long-term impacts. What happens if something doesn't go as planned? If pollution levels go higher than expected or if there's an accident, what's the plan? And more importantly, who takes responsibility? Promises of safety don't mean much unless there's a clear way to hold someone accountable.

Columbia has always been known as a place that values people and the environment. That's why so many of us chose to live here. If this facility moves forward, it raises a bigger question: What kind of projects will follow? Approving this sets a precedent—one that could open the door for more industry moving into residential areas. Once that door is open, it's hard to close.

I understand the need for innovation, and I support research that helps us find better ways to handle waste. But that research should happen in a location that doesn't put families at risk. There are better places for this work—industrial zones that don't border neighborhoods.

This decision is about more than zoning—it's about what kind of community we want to be. I urge you to take a step back and ask if this is truly the best location for this facility. If there's even a small chance that it could harm the people who live here, then it's not worth the risk.

Thank you for your time.

Sent from my iPhone

From: Sara Noonan <saracnoonan@gmail.com>
Sent: Monday, February 17, 2025 3:24 PM
To: CouncilDistrict1@howardcountymd.gov; CouncilMail; CouncilDistrict5@howardcountymd.gov; CouncilDistrict4@howardcountymd.gov; CouncilDistrict2@howardcountymd.gov; CouncilDistrict3@howardcountymd.gov; Williams, China
Subject: Cedar Creek Resident for CB11-2025

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

To Members of the County Council,

My name is Sara Morrell, and I am a resident of the Cedar Creek community, just 70 meters from WR Grace's proposed pilot project. My family moved in to the neighborhood in June of 2023, with the intention of providing a safe, healthy home for my daughter. I was raised in Howard County, attended Reservoir High School, and moved back home to start my own family here. Three months after moving in to our new home, my 4-month-old daughter was diagnosed with a rare interstitial lung disease. She required 24/7 supplemental oxygen and a feeding tube, as her lungs were severely damaged and could not fill with air properly. Today, she is 1.5 years old, has made some improvements but still requires supplemental oxygen to breathe like a normal child.

I chose to raise my daughter here, in this neighborhood, because I believed it would be a place where she could thrive, and alongside alike growing families. However, WR Grace's proposed project threatens not only my child's lung health, leading to increased morbidity and mortality but also the well-being of all children and families in our community. According to our pulmonologist at Johns Hopkins, the emissions from this proposed facility would likely exacerbate my daughter's lung disease. This is extremely concerning since the project is set to be an ongoing, 16-hour-per-day operation, five days a week, for years to come with no definitive end in sight.

Let me also address the troubling issue of WR Grace's claims of "green" initiatives. They have repeatedly dismissed community concerns, calling the public "misinformed" to undermine legitimate worries. But let's be clear: the proposed project is an incineration process, as labeled by the EPA, which Grace refuses to admit. This process, under the disguise of "advanced recycling", will release dangerous emissions and air pollutants into our neighborhood.

Braven Environmental who has partnered with WR Grace in Zebulon, North Carolina serves as a cautionary tale and a similar situation with what we are dealing with here in Columbia, MD. Braven Environmental misled the public, claiming essentially zero emissions and no risks, only to have the reality be far from what was promised.

During a 2019 public hearing, Braven's representatives assured the community that their operations would not endanger public health, asserting, "We do not contain any kind of hazardous materials." Contrary to this claim, the facility generated and shipped 9.6 tons of hazardous ignitable waste and benzene in 2021 alone. Additionally, emissions tests revealed the release of pollutants such as carbon monoxide, nitrogen oxides, sulfur dioxide, and volatile organic compounds, including known carcinogens like benzene and styrene.

We cannot afford to repeat the same mistakes here. As a parent, I cannot stand idly by and allow my child—and all of the other children in this community—to be put at risk by an operation that prioritizes corporate profit over public health.

W.R. Grace promotes that this as a solution to plastic waste, yet it is clear that this process does not live up to the hype. Incineration uses more energy and has a worse overall environmental impact than virgin plastic production. This is not about recycling; it's about burning petrochemicals in a new way, releasing carcinogens and neurotoxicants into our air. The Braven facility in Zebulon, for example, has already shown the dangers of such operations.

What makes this even more troubling is that pyrolysis facilities, classified by the EPA as waste incinerators, are not required to report their emissions under the Toxics Release Inventory, making it difficult to assess THE TRUE risks they pose to the surrounding communities.

This is also not just an environmental issue—it is a zoning issue. WR Grace's facility is far too close to residential homes and protected forestland. This dangerous research project in PEC zoning does not belong here, it belongs in M2 zoning (lab scale or not) and the potential harm it could inflict on our families and children is too great to ignore. We urge the County Council to stand with us residents and stop this project. Protect our children, protect what makes Howard County so great, and protect the health of future generations.

Thank you for your time, we urge you to pass CB11-2025. We need your help now more than ever.

Sincerely,
Sara Morrell

Resident, Cedar Creek Community

From: s3nthl <s3nthl@gmail.com>
Sent: Monday, February 17, 2025 7:21 PM
To: CouncilMail
Subject: Testimony in Support of CB11-2025

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Sir/Madam

My name is Senthil Achari, and I live at 7715 Cross Creek Drive in the Cedar Creek neighborhood. I am writing to express my strong support for CB11-2025.

As a father of three, I am deeply concerned about the health and safety of my children and our community due to the potential impact of the proposed facility. Protecting the air quality in our neighborhood is essential, and I urge you to pass this bill to ensure a safe and clean environment for all residents.

Thank you for your time and consideration.

Best regards,

Senthil Achari

From: Shamieka Preston <snixon2993@gmail.com>
Sent: Monday, February 17, 2025 1:19 PM
To: CouncilMail
Subject: Fwd: Submission in support of CB11-2025
Attachments: 25-01482-R03-PAO Walsh.pdf; Enclosure- OSWI Applicability Detemination Request Letter.pdf; Environmental Health Risks and Housing Values Evidence from 1,600 Toxic Plant Openings and Closings.pdf; Enclosure- WR Grace Reg. Interpretation Signed.pdf; Pyrolysisunits-defined.png; Stop Grace Member Petition_combinedMaster.pdf; Grace_email_testimony preston.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

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Dear Howard County Council members,
Please see the attached pdf entitled, "Grace_email_testimony_preston" for my documented testimony **in support of CB11-2025**. My reasons, as detailed in the document, are as follows:

1. The EPA and MDE have designated WR Grace's pilot plant as a pyrolysis incinerator
2. Community members are concerned about the WR Grace pilot plant project
3. An NIH study showed that health risks increase within 1 mile of toxic air emissions
4. WR Grace plans to emit toxic air emissions for most of the day, for more than half of the year, for an unknown number of years
5. WR Grace continues to contradict themselves in their documentation. We don't know what to believe and we don't trust them with our safety.
6. WR Grace has a history of causing harm to communities
7. Recent changes to federal funding will impact MDE's ability to monitor air pollution including from WR Grace's pilot plant

It is for all of these stated reasons that I demand that no company—present or future—should be allowed to operate a pyrolysis incinerator or similar technology involving "commercial plastic pellets or feedstock which produces flue gas and requires a permit from the state of Maryland" near residential homes. There should be no loopholes, no exceptions, and no grandfathering in for any company in Howard County.

I implore you, as the officials whom we elected to keep our communities safe, to do the right thing and approve CB11-2025. This measure will ensure that Howard County families stay safe from air pollution, fires, explosions hazards and pilot plants that lack community support and offer little to the adjacent communities.

The reference materials are attached, they include:

1. "Pyrolysisunits-defined.png" - EPA's working definition of Pyrolysis Units from the Other Solid Waste Incinerators (OSWI): New Source Performance Standards (NSPS) and Emission Guidelines (EG) for Existing Sources
2. "Enclosure- WR Grace Reg. Interpretation Signed.pdf", " 25-01482-R03-PAO Walsh.pdf", "Enclosure- OSWI Applicability Detemination Request Letter.pdf" - EPA and MDE applicability determination classifying the WR Grace pilot project as a new pyrolysis incinerator
3. "Stop Grace Member Petition_combinedMaster.pdf" - 700+ community members signatures on a petition to "respectfully petition our local and state officials as well as our county and state agencies to block W.R. Grace from constructing and operating the proposed pilot plant."
4. "Environmental Health Risks and Housing Values Evidence from 1,600 Toxic Plant Openings and Closings.pdf" - NIH Study of the impact of air emissions to people living near industrial plants

Please let me know if you have questions.

Shamieka Preston, Cedar Creek resident

REGION 3 ADMINISTRATOR
PHILADELPHIA, PA 19103

February 12, 2025

VIA ELECTRONIC MAIL

Councilwoman Liz Walsh
Howard County Council Chair
George Howard Building
3430 Court House Drive
Ellicott City, Maryland 21043-4392
CouncilDistrict1@HowardCountyMD.gov

Dear Ms. Walsh:

Thank you for your January 10, 2025, electronic correspondence to the U.S. Environmental Protection Agency (EPA) Region 3 concerning W.R. Grace's proposed research and development pilot project in Columbia, MD. The authority to issue Clean Air Act permits in Maryland, including the W.R. Grace draft permit, has been delegated to Maryland Department of the Environment (MDE), and MDE will make a final determination regarding the issuance of a permit modification for the facility. The EPA and MDE are coordinating regarding questions related to Clean Air Act applicable requirements for the W.R. Grace pilot project. This coordination includes determining the applicability of Solid Waste Incineration Rules under Clean Air Act Section 129.

On December 13, 2024, MDE submitted an applicability determination request to the EPA regarding the applicability of the 40 CFR Part 60, Subpart EEEE Standards of Performance for Other Solid Waste Incineration Units (OSWI Rule) to the project. The EPA issued a determination on January 8, 2025 that the proposed project meets an exemption in the OSWI Rule for units operated for the sole purpose of research. These letters are attached to this correspondence.

The EPA reviewed the draft permit, and the EPA is working with MDE throughout the state permitting process to ensure comprehensive oversight and effective action. The EPA intends to review the final permit once MDE makes a final permit determination. MDE maintains an email list of interested parties, and MDE will notify anyone who signs up for the email list of the final permit decision.

If you have any questions, please do not hesitate to contact me, or have your staff contact Cristina

Fernández, Director, Air and Radiation Division, Four Penn Center, 1600 John F. Kennedy Boulevard, Philadelphia, Pennsylvania 19103 at 215-814-2178 or Fernandez.Cristina@epa.gov.

Sincerely,

Catherine A. Libertz
Acting Regional Administrator

ENCLOSURES
1. OSWI Applicability Determination Request Letter
2. WR Grace Reg. Interpretation Signed

cc: Mary Laituri, mlaituri@howardcountymd.gov
Anwer Hasan, anwerhasan@hotmail.com
saracnoonan@gmail.com
aidan.morrell@hhmhotels.com
CouncilDistrict1@howardcountymd.gov

Maryland
Department of
the Environment

Wes Moore, Governor
Aruna Miller, Lt. Governor

Serena McIlwain, Secretary
Suzanne E. Dorsey, Deputy Secretary

SENT VIA E-MAIL CORRESPONDENCE

December 13, 2024

Ms. Karen Melvin, Director
EPA Region 3
Enforcement and Compliance Assurance Division
melvin.karen@epa.gov

Ms. Cristina Fernandez, Director
EPA Region 3
Air and Radiation Division
fernandez.cristina@epa.gov

Dear Director Melvin and Director Fernandez:

I am writing to you on behalf of the Maryland Department of the Environment's Air and Radiation Administration (ARA) to request an applicability determination regarding a proposed pilot plant to be located in Howard County, Maryland and the Standards of Performance for Other Solid Waste Incineration (OSWI) Units for Which Construction is Commenced After December 9, 2004, or for Which Modification or Reconstruction is Commenced on or After June 16, 2006 at 40 CFR 60, Subpart EEEE.

Background
On September 21, 2023 W.R. Grace & Co.-Conn ("Grace") submitted an air quality application for a permit to construct a new pilot plant in Howard County, MD. The pilot plant will be used to research the scaling up of an innovative process to convert 1 kg/hr of plastics back to their original components. The reactor in this proposed process will use a catalyst and heat in the form of steam to carry out this reaction. The product from the reactor is a vapor. The vapor is sent via pipe to a condenser. The vapor that is liquified in the condenser is the product, which is then stored in drums. The drums are sent off site for disposal once data is collected. Non-condensables from the condenser are sent via pipe to an electric flameless thermal oxidizer to control any VOC that may be present in the gas stream.

The project will have two phases of testing. In the first phase, the feed will consist of virgin plastic pellets from commercial suppliers. Grace plans to use a variety of types of pellets to assess the potential reaction products from different types of plastics. In addition, Grace may also add non-hazardous materials, such as calcium carbonate, to test the impact of these materials on the reaction output. If the results of the first phase indicate that the process is technologically feasible and commercially viable, Grace hopes to conduct a second phase of the project to test recycled plastics. The pilot plant can not directly process plastic waste. During the second phase of the project, Grace will need to clean and pelletize recycled plastic or purchase cleaned, pelletized recycled plastic.

The process in the pilot plant reactor is a catalytic chemical conversion, or catalytic pyrolysis. 40 CFR, Part 60, Subpart EEEE includes pyrolysis units as OSWI units by definition. The reactor in the proposed Grace pilot plant would be subject to the requirements of 40 CFR 60, Subpart EEEE as a pyrolysis unit unless otherwise exempt.

<u>Laboratory Analysis Unit Exemption</u>
40 CFR §60.2887 lists combustion units that are exempt from Subpart EEEE. Specifically, §60.2887(j) states the following:

"Laboratory Analysis Units. Your unit is excluded if it burns samples of materials only for the purpose of chemical or physical analysis."

Grace's proposed pilot plant only serves to gather and analyze data for research. There is no product being manufactured for sale from this operation. This is further detailed in the air quality permit to construct application, enclosed as Appendix A, and supplemental letter submitted by Grace, enclosed as Appendix B. ARA requests a determination from EPA regarding whether the proposed pilot plant's pyrolysis unit is exempt from 40 CFR 60, Subpart EEEE as a laboratory analysis unit.

Furthermore, Grace's proposed pilot plant will use both virgin plastic pellets and recycled plastic pellets as raw materials for their process. 40 CFR 60, Subpart EEEE applies to OSWI units if the units combust municipal solid waste. Virgin pellets are not solid waste, and as such the first phase of the project is exempt from the requirements of 40 CFR 60, Subpart EEEE. If the pilot plant's pyrolysis unit is not exempt from Subpart EEEE as a laboratory analysis unit, it is necessary to determine if the pellets used in the second phase of the project meet the definition of municipal solid waste.

<u>Non-Solid Waste Exemption</u>
In order to determine if the pellets originating from recycled material meet the definition of municipal solid waste, a review of the RCRA rules for Non-Hazardous Secondary Materials (NHSM) is required. Although many EPA guidelines refer to the use of NHSM as fuel, this does not directly apply to the Grace pilot plant. The recycled pellets will be used as an <u>ingredient</u>, not a fuel, in the proposed process.

Examining 40 CFR §241.3, *Standards and procedures for identification of non-hazardous secondary materials that are solid wastes when used as fuels or ingredients in combustion units,* §241.3(b)(3) states that NHSM used as an ingredient in a combustion unit that meet the legitimacy criteria of §241.3(d)(2), listed below, are not solid wastes when combusted.

"Legitimacy criteria for non-hazardous secondary materials used as an ingredient in combustion units include the following:

(i) The non-hazardous secondary material must be managed as a valuable commodity based on the following factors:

(A) The storage of the non-hazardous secondary material prior to use must not exceed reasonable time frames;

(B) Where there is an analogous ingredient, the non-hazardous secondary material must be managed in a manner consistent with the analogous ingredient or otherwise be adequately contained to prevent releases to the environment;

(C) If there is no analogous ingredient, the non-hazardous secondary material must be adequately contained to prevent releases to the environment;

(ii) The non-hazardous secondary material must provide a useful contribution to the production or manufacturing process. The non-hazardous secondary material provides a useful contribution if it contributes a valuable ingredient to the product or intermediate or is an effective substitute for a commercial product.

(iii) The non-hazardous secondary material must be used to produce a valuable product or intermediate. The product or intermediate is valuable if:

(A) The non-hazardous secondary material is sold to a third party, or

(B) The non-hazardous secondary material is used as an effective substitute for a commercial product or as an ingredient or intermediate in an industrial process.

(iv) The non-hazardous secondary material must result in products that contain contaminants at levels that are comparable in concentration to or lower than those found in traditional products that are manufactured without the non-hazardous secondary material."

Although the pellets originated from recycled materials, they are cleaned and re-processed to be used as a feedstock. The pellets have not been discarded or abandoned in a landfill and are expected to be processed in the pilot plant in a reasonable amount of time. The pellets from recycled material will be handled in the same way as the analogous virgin plastic pellets. The pellets will be used as the primary ingredient of the proposed process, providing an essential and useful contribution as a research feedstock.

The process intends to reduce the pellets to the original components of plastic and would only contain contaminants comparable to those found in traditional plastic. If the pilot plant's pyrolysis unit is not exempt from Subpart EEEE as a laboratory analysis unit, ARA requests a determination from EPA regarding whether the recycled plastic pellets used in proposed pilot plant's pyrolysis unit qualify as a NHSM used as an ingredient and therefore, not subject to the requirements of 40 CFR 60, Subpart EEEE.

Thank you for your consideration of this request. Should you have any questions regarding this letter, please contact me at 410-537-4129 or by email at suna.sariscak@maryland.gov.

Sincerely,

Suna Yi Sariscak

Suna Yi Sariscak, Manager
Air Quality Permits Program
Air and Radiation Administration

cc: Kris Hall, Chief Air Section, Air and RCRA Branch, Enforcement & Compliance Assurance Division, EPA Region 3

Mary Cate Opila, Air Permits Branch Manager, EPA Region 3

Enclosures

APPENDIX A

W.R. Grace &Co.-CONN
Air Quality Permit to Construct Application
Received September 2023 and
Revised January 2024

GRACE

August 3, 2023

Suna Yi Sariscak, Manager
Air Quality Permits Program
Maryland Department of the Environment
Air and Radiation Management Administration
1800 Washington Boulevard, Suite 720
Baltimore, Maryland 21230-1720
MDE.Submit-AirPermits@maryland.gov

Re: Permit to Construct (PTC) Application to Install Research Pilot Scale Test Catalytic Chemical Conversion of Plastics Process

Dear Ms. Sariscak:

W.R. Grace & Company – Conn. (Grace) is submitting this PTC application to construct a research pilot scale test catalytic chemical conversion of plastics process at the Columbia, Maryland facility. This test process will use Grace's innovative catalyst technology to convert commercially available plastic pellets into potentially usable energy-containing liquids and gas. This test process will evaluate the desired new technologies including catalyst and process conditions as well as resultant liquid/gas properties for research and development purposes only. As presented in the PTC application the reactor gases will be controlled by a very high efficiency electric, flameless thermal oxidizer prior to exhausting to the atmosphere. Atmospheric emissions from this test process will be low.

Enclosed are the completed MDE Forms 5, 5EP, 5T and 6, supporting flow diagram, plot plans and emissions calculations, and a TAP compliance demonstration.

Your prompt attention to our application would be appreciated. Grace would like to request a meeting/call with you in the next few weeks to discuss our planned process and to answer any initial questions you may have on our application. If you need anything additional or have any questions, do not hesitate to contact me at 410-531-4570 or at daniel.resca@grace.com.

Sincerely,

Recoverable Signature

X

Daniel Resca
Project Manager
Signed by: Daniel Resca

Enclosures
Cc:

W. R. Grace & CO.-Conn. Columbia, MD Facility

Application to Install a Research Pilot Scale Test Catalytic Chemical Conversion of Plastics Process

Introduction

W. R. Grace & Co.-Conn.'s (Grace's) research facility located in Columbia, Maryland performs research and development (R&D) activities involving proprietary processes and materials. Grace proposes to install, in Building 30, a pilot-scale test catalytic chemical conversion process (the Project), using Grace's innovative catalyst technology, to convert commercially available plastics pellets into potentially usable energy-containing liquids and gas. This proposed pilot plant will be used to evaluate the desired new technologies including catalyst and process conditions as well as resultant liquid/gas properties for research and development only.

The following comprises the application for a permit-to-construct (PTC) the proposed Project, and includes a project description as well as several attachments, namely:

Attachment 1 Simplified Process Flow Diagram

Attachment 2 List of Key Project Equipment

Attachment 3 Site Plan

Attachment 4 MDE PTC Application Checklist and Forms 5, 5T, 5EP (two) and 6

Attachment 5 Emissions – Calculations, Engineering Estimates and Assumptions

Attachment 6 TAP Compliance Demonstration

Attachment 7 Safety Data Sheet of Example Plastic Feedstock

Attachment 8 Vendor Information for Electric Flameless Thermal Oxidizer

Project Description

The proposed Project will involve four key systems: 1) reaction; 2) product recovery; 3) catalyst circulation/regeneration; and 4) steam generation. Attachment 1 is a simplified process flow diagram of the proposed Project.

The proposed Project is designed to process 1 kg/hr of commercially available plastic pellet feedstock (the benchmark feedstock can be 100% homogeneous polypropylene (PP). However, a typical mixed plastic also can include low density polyethylene (LDPE), high density polyethylene (HDPE), polyethylene terephthalate (PET), polystyrene (PS), polyvinyl chloride (PVC), and others). The plastic feedstock will be manually transferred to a feed system that meters the feedstock into the reaction system. The catalytic chemical conversion reaction occurs at high temperature, in an oxygen-free environment. A catalyst circulation/regeneration system will be used to supply fresh and regenerated catalyst to the reaction system as well as supply heat required for the reaction. The catalytic chemical conversion reaction produces a product vapor comprised of non-condensable gas and condensable liquid. Residual catalyst in the product vapor will be recovered by a process cyclone and returned to the reactors. Then, the product vapor will go through a product recovery system involving vapor condensation and gas/liquid separation. The separated non-condensable gas will go through an electric flameless thermal oxidizer prior to venting to the atmosphere. The separated condensed liquid will be collected in two, 3-gal tanks. The collected liquid will be transferred, daily, to 55-gal drums in the warehouse, and ultimately shipped to a 3rd party waste treatment facility.

Spent catalyst from the reaction system will go through a steam stripper, then transferred with N_2 gas to the top of the catalyst regenerator. Combustion air will be introduced to the regenerator to burn off the spent catalyst coke. The regenerator is designed to provide excess air sufficient for complete combustion. Hot, regenerated catalyst is withdrawn from the regenerator and transferred, through risers, back to the reaction system with steam and N_2 gas. As mentioned above, the hot regenerated catalyst provides the heat for the reaction. Electric heating at the regenerator, the transfer lines to the risers, and the risers will heat the catalyst transferred from the regenerator to the reaction system and will be the prime source of heat during process startup. Regenerator hot combustion flue gas will be treated prior to venting to the atmosphere. The flue gas will go through a knock-out filter pot (to remove residual catalyst) and a gas/liquid separator (to remove water and cool the gas).

Steam used in the proposed process will be produced by electric steam generating units.

Being a pilot scale test installation for research and development there will be handling of samples of gas and liquid products, feedstock and catalyst for testing/analysis all at bench scale.

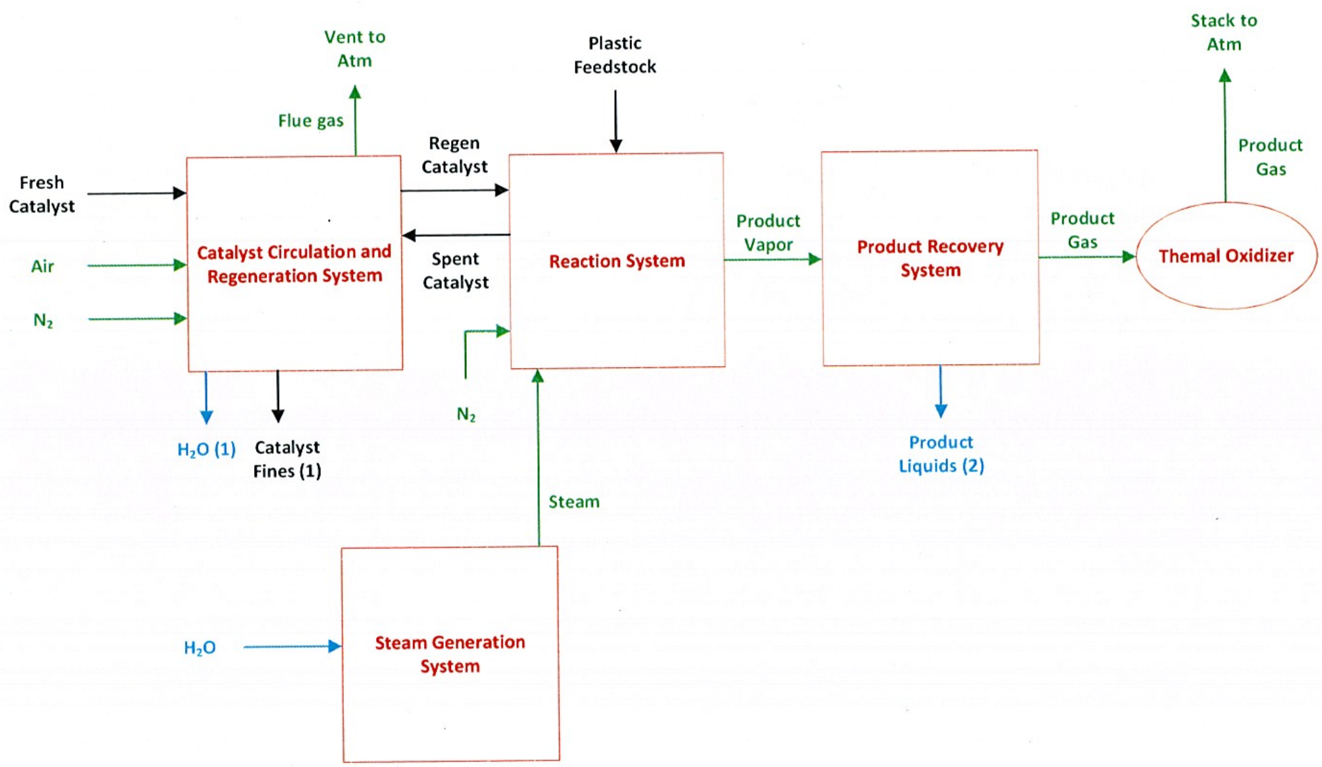
Attachment 2 lists the key process equipment proposed for the Project.

The proposed installation is scheduled to operate over two shifts on a given workday, with start-up activities, continuous reactor operation, shut-down activities and regular maintenance all occurring over 16 hours. Yearly operation is expected to be less than or equal to 4000 hr/yr.

ATTACHMENT 1

Simplified Process Flow Diagram

Simplified Process Flow Diagram for Proposed Research Pilot Scale Test Catalytic Chemical Conversion Process



Notes:
(1) Non-hazardous waste disposal
(2) Transfer to 3rd party treatment facility

ATTACHMENT 2

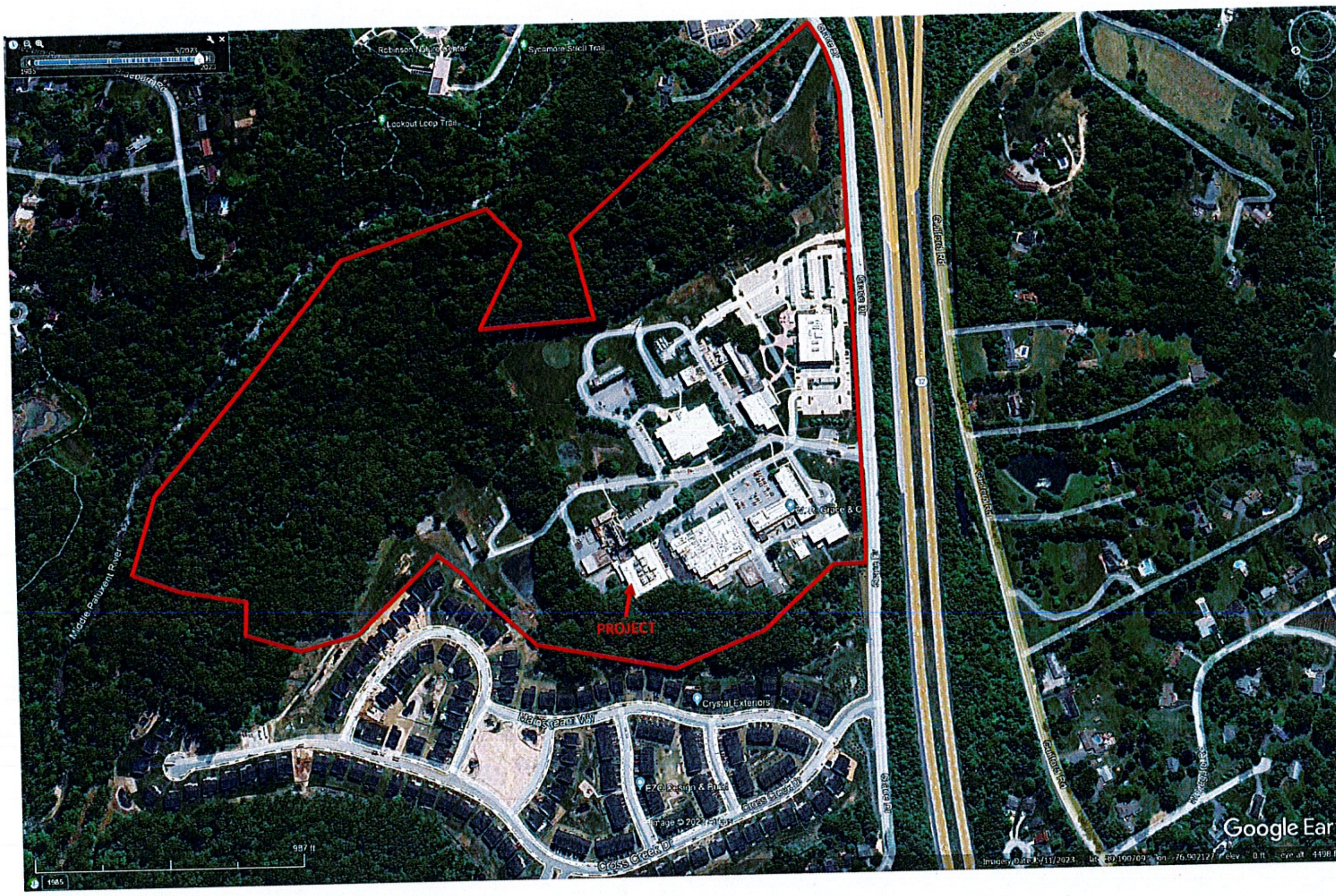
List of Key Project Equipment

List of Key Equipment for Planned Project

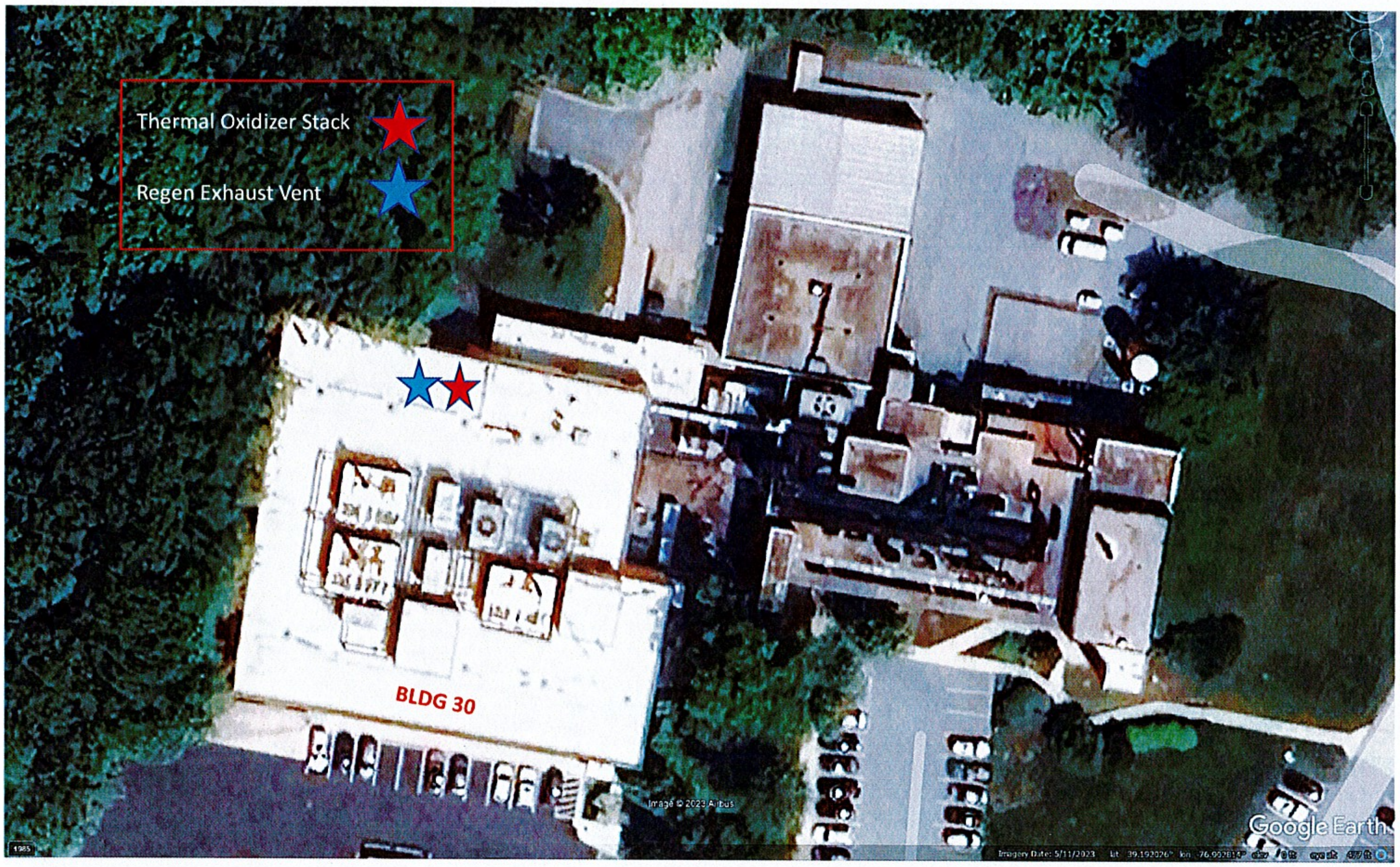
- Reactors and risers
- Reactor gas cyclone
- Reactor gas stabilization column
- Electric flameless thermal oxidizer
- Spent catalyst stripper
- Spent catalyst regenerator
- Steam generators
- Associated hoppers, vessels/tanks, heat exchangers, coolers, electric heating units, conveyance systems, piping, analyzers and instrumentation

ATTACHMENT 3

Site Plan



PROJECT
Lookout Loop Trail
Sycamore Scroll Trail
Crystal Exteriors
Cross Creek Dr
Google Earth


Thermal Oxidizer Stack
Regen Exhaust Vent
BLDG 30
Image © 2023 Airbus
Google Earth

ATTACHMENT 4

MDE PTC Application Checklist and Forms 5, 5T, 5EP (two) and 6

AIR QUALITY PERMIT TO CONSTRUCT APPLICATION CHECKLIST

OWNER OF EQUIPMENT/PROCESS	
COMPANY NAME:	W.R. Grace & Co. - Conn
COMPANY ADDRESS:	7500 Grace Drive, Columbia, MD 21044
LOCATION OF EQUIPMENT/PROCESS	
PREMISES NAME:	W.R. Grace Corporate Headquarters
PREMISES ADDRESS:	7500 Grace Drive, Columbia, MD 21044
CONTACT INFORMATION FOR THIS PERMIT APPLICATION	
CONTACT NAME:	Dan Resca
JOB TITLE:	Project Manager, Columbia
PHONE NUMBER:	410-531-4570
EMAIL ADDRESS:	daniel.resca@grace.com
DESCRIPTION OF EQUIPMENT OR PROCESS	
Catalytic Chemical Conversion of Plastics R&D Process	

Application is hereby made to the Department of the Environment for a Permit to Construct for the following equipment or process as required by the State of Maryland Air Quality Regulation, COMAR 26.11.02.09.

<u>Check each item that you have submitted as part of your application package.</u>

- ☒ Application package cover letter describing the proposed project
- ☒ Complete application forms (Note the number of forms included or NA if not applicable.)

No. 1	Form 5	No. ____	Form 11
No. 1	Form 5T	No. ____	Form 41
No. 2	Form 5EP	No. ____	Form 42
No. 1	Form 6	No. ____	Form 44
No. ____	Form 10		

- ☒ Vendor/manufacturer specifications/guarantees
- ☒ Evidence of Workman's Compensation Insurance
- ☒ Process flow diagrams with emission points
- ☒ Site plan including the location of the proposed source and property boundary
- ☒ Material balance data and all emissions calculations
- ☒ Material Safety Data Sheets (MSDS) or equivalent information for materials processed and manufactured.
- ☐ Certificate of Public Convenience and Necessity (CPCN) waiver documentation from the Public Service Commission [(1)]
- ☐ Documentation that the proposed installation complies with local zoning and land use requirements [(2)]

[(1)] Required for emergency and non-emergency generators installed on or after October 1, 2001 and rated at 2001 kW or more.

[(2)] Required for applications subject to Expanded Public Participation Requirements.

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APPLICATION FOR FUEL BURNING EQUIPMENT

Information Regarding Public Outreach

For Air Quality Permit to Construct applications subject to public review, applicants should consider the following information in the initial stages of preparing a permit application.

If you are not sure at the time you are applying for a permit whether public review of your application is required or for information on steps you can take to engage the surrounding community where your planned project will be located, please contact the Air Quality Permits Program at 410-537-3225 and seek their advice.

Communicating and engaging the local community as early as possible in your planning and development process is an important aspect of your project and should be considered a priority. Environmental Justice or "EJ" is a movement to inform, involve, and engage communities impacted by potential and planned environmental projects by affording citizens opportunities to learn about projects and discuss any concerns regarding impacts.

Although some permit applications are subject to a formal public review process prescribed by statute, the Department strongly encourages you to engage neighboring communities separate from and well ahead of the formal permitting process. Sharing your plans by way of community meetings, informational outreach at local gatherings or through local faith-based organizations can initiate a rewarding and productive dialogue that will reduce anxiety and establish a permanent link with your neighbors in the community.

All parties benefit when there is good communication. The Department can assist applicants in developing an outreach plan that fits the needs of both the company and the public.

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APPLICATION FOR PROCESSING/MANUFACTURING EQUIPMENT

Permit to Construct ☑ Registration Update ☐ Initial Registration ☐

1A. Owner of Equipment/Company Name
W.R. Grace & Company - Conn.

Mailing Address
7500 Grace Drive
Street Address
Columbia | Maryland | 21044
City | State | Zip

Telephone Number
(410) 531-8300

Signature
[signature]

Matt Meixell, Facilities Site Manager — 8/4/2023
Print Name and Title — Date

DO NOT WRITE IN THIS BLOCK
2. REGISTRATION NUMBER

County No. (1-2)	Premises No. (3-6)	Registration Class (7)	Equipment No. (8-11)	Data Year (12-13)	Application Date

1B. Equipment Location and Telephone Number (if different from above)
Same as above
Street Number and Street Name

City/Town | State | Zip | ( ) Telephone Number

Premises Name (if different from above)

3. Status (A= New, B= Modification to Existing Equipment, C= Existing Equipment)

Status (15)	New Construction Begun (MM/YY) (16-19)	New Construction Completed (MM/YY) (20-23)	Existing Initial Operation (MM/YY) (20-23)
A	0 1 2 4	0 8 2 4	

4. Describe this Equipment: Make, Model, Features, Manufacturer (include Maximum Hourly Input Rate, etc.)
Research-scale catalytic chemical conversion of plastics process for Research & Development

5. Workmen's Compensation Coverage 792878903 (Binder/Policy Number) — 11/15/2023 (Expiration Date)
Company Zurich American Insurance Company

NOTE: Before a Permit to Construct may be issued by the Department, the applicant must provide the Department with proof of worker's compensation coverage as required under Section 1-202 of the Worker's Compensation Act.

6A. Number of Pieces of Identical Equipment Units to be Registered/Permitted at this Time See Attach 2

6B. Number of Stack/Emission Points Associated with this Equipment 2

7. Person Installing this Equipment (if different from Number 1 on Page 1)

Name______________________ Title______________________

Company______________________

Mailing Address/Street______________________

City/Town______________________ State______________________ Telephone (______) ______________________

8. Major Activity, Product or Service of Company at this Location

Research & Development

9. Control Devices Associated with this Equipment

None ☐ 24-0

Simple/Multiple Cyclone	Spray/Adsorb Tower	Venturi Scrubber	Carbon Adsorber	Electrostatic Precipitator	Baghouse	Thermal/Catalytic Afterburner	Dry Scrubber
☐	☐	☐	☐	☐	☐	☐	☐
24-1	24-2	24-3	24-4	24-5	24-6	24-7	24-8

Other

☑ Describe Electric flameless thermal oxidizer

24-9

10. Annual Fuel Consumption for this Equipment

OIL-1000 GALLONS	SULFUR %	GRADE	NATURAL GAS-1000 FT^3	LP GAS-100 GALLONS	GRADE
26-31	32-33	34	35-41	42-45	

COAL-TONS	SULFUR %	ASH%	WOOD-TONS	MOISTURE %
46-52	53-55	56-58	59-63	64-65

OTHER FUELS ______ (Specify Type) ☐ 66-1 ANNUAL AMOUNT CONSUMED ______ (Specify Units of Measure)

OTHER FUEL ______ (Specify Type) ☐ 66-2 ANNUAL AMOUNT CONSUMED ______ (Specify Units of Measure)

1= Coke 2= COG 3=BFG 4=Other

11. Operating Schedule (for this Equipment)

Continuous Operation	Batch Process	Hours per Batch	Batch per Week	Hours per Day	Days Per Week	Days per Year
☐	☑	1 6		1 6		2 5 0
67-1	67-2	68-69		70-71	72	73-75

Seasonal Variation in Operation:

No Variation	Winter Percent	Spring Percent	Summer Percent	Fall Percent	(Total Seasons= 100%)
☑					
76	77-78	79-80	81-82	83-84	

12. **Equivalent Stack Innformation- is Exhaust through Doors, Windows, etc. Only?** (Y/N) N
See Form 5EP
85

If not, then	Height Avove Ground (FT)	Inside Diameter at Top	Exit Temperature (°F)	Exit Velocity (FT/SEC)
	86-88	89-91	92-95	96-98

NOTE: See Attach 1 and Attach 3

Attach a block diagram of process/process line, indicating new equipment as reported on this form and all existing equipment, including control devices and emission points.

13. Input Materials (for this equipment only)
Is any of this data to be considered confidential? N (Y or N)

NAME	CAS NO. (IF APPLICABLE)	INPUT RATE PER HOUR	UNITS	PER YEAR	UNITS
1. Commercial plastic pellet feedstock		1000	g	4000	kg
2. Catalyst					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
TOTAL					

14. Output Materials (for this equipment)
Process/Product Stream

NAME	CAS NO. (IF APPLICABLE)	OUTPUT RATE PER HOUR	UNITS	PER YEAR	UNITS
1. Gas stream (H2. CO2 C4 hydrocarbons)		647	g	2588	kg
2. Liquid stream (C5+ organic, H2O, HCl)		320	g	1280	kg
3. Char		33	g	132	kg
4.					
5.					
6.					
7.					
8.					
9.					
TOTAL					

15. Waste Streams- Solid and Liquid

NAME	CAS NO. (IF APPLICABLE)	OUTPUT RATE PER HOUR	UNITS	PER YEAR	UNITS
1. Liquid stream (C5+ organic, H2O HC)		320	g	1280	kg
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
TOTAL					

16. Total Stack Emissions (for this equipment only) in Pounds Per Operating Day

Particulate Matter	Oxides of Sulfur	Oxides of Nitrogen
0.000	0.000	0.011
99-104	105-110	111-116

Carbon Monoxide	Volatile Organic Compounds	PM-10
0.002	0.218	0.000
177-122	123-128	129-134

17. Total Fugitive Emissions (for this equipment only) in Pounds Per Operating Day

Particulate Matter	Oxides of Sulfur	Oxides of Nitrogen
135-139	140-144	145-149

Carbon Monoxide	Volatile Organic Compounds	PM-10
150-154	155-159	160-164

Method Used to Determine Emissions **(1= Estimate 2= Emission Factor 3= Stack Test 4= Other)**

TSP	SOX	NOX	CO	VOC	PM10
4	4	4	4	4	4
165	166	167	168	169	170

AIR AND RADIATION MANAGEMENT ADMINISTRATION USE ONLY

18. Date Rec'd. Local ______ **Date Rec'd. State** ______ **Return to Local Jurisdiction** Date______ By______

Reviewed by Local Jurisdiction Date______ By______

Reviewed by State Date______ By______

19. Inventory Date

Month/Year	Equipment Code	SCC Code
171-174	175-177	178-185

20.

Annual Operating Rate	Maximum Design Hourly Rate	Permit to Operate Month	Transaction Date (MM/DD/YR)
186-192	193-199	200-201	202-207

Staff Code	VOC Code	SIP Code	Regulation Code	Confidentiality
208-210	211 212	213 214	215-218	219

Point Description	Action
220-238	239

A: Add
C: Change

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FORM 5EP: Emission Point Data

Complete one (1) Form 5EP for EACH emission point (stack or fugitive emissions) related to the proposed installation.

Applicant Name: W.R. Grace & Company - Conn.

1. Emission Point Identification Name/Number

List the applicant assigned name/number for this emission point and use this value on the attached required plot plan:
TO Stack

2. Emission Point Description

Describe the emission point including all associated equipment and control devices:
Reactor output gas stream controlled by thermal oxidizer

3. Emissions Schedule for the Emission Point

Continuous or Intermittent (C/I)?	I	**Seasonal Variation** Check box if none: ☒ Otherwise estimate seasonal variation:	
Minutes per hour:	60	Winter Percent	
Hours per day:	16	Spring Percent	
Days per week:	5	Summer Percent	
Weeks per year:	50	Fall Percent	

4. Emission Point Information

Height above ground (ft):	59'-1"	Length and width dimensions at top of rectangular stack (ft):	Length:		Width:
Height above structures (ft):	30'-5"				
Exit temperature (°F):	1600	Inside diameter at top of round stack (ft):			0.833
Exit velocity (ft/min):	200.4	Distance from emission point to nearest property line (ft):			280
Exhaust gas volumetric flow rate (acfm):	109.3	Building dimensions if emission point is located on building (ft)	Height 28'-8"	Length 163'	Width 144'

5. Control Devices Associated with the Emission Point

Identify each control device associated with the emission point and indicate the number of devices. ***A Form 6 is also required for each control device***. If none check none:

- ☐ None
- ☐ Baghouse No. ______
- ☐ Cyclone No. ______
- ☐ Elec. Precipitator (ESP) No. ______
- ☐ Dust Suppression System No. ______
- ☐ Venturi Scrubber No. ______
- ☐ Spray Tower/Packed Bed No. ______
- ☐ Carbon Adsorber No. ______
  - ☐ Cartridge/Canister
  - ☐ Regenerative
- ☐ Thermal Oxidizer No. ______
  - ☐ Regenerative
- ☐ Catalytic Oxidizer No. ______
- ☐ Nitrogen Oxides Reduction No. ______
  - ☐ Selective ☐ Non-Selective
  - ☐ Catalytic ☐ Non-Catalytic
- ☒ Other No. ______
  Specify: Electric Flameless Thermal Oxidizer

FORM 5EP: Emission Point Data

6. Estimated Emissions from the Emission Point

Criteria Pollutants	At Design Capacity (lb/hr)	At Projected Operations		
		(lb/hr)	(lb/day)	(ton/yr)
Particulate Matter (filterable as PM10)		0.000	0.000	0.000
Particulate Matter (filterable as PM2.5)		0.000	0.000	0.000
Particulate Matter (condensables)				
Volatile Organic Compounds (VOC)		0.014	0.218	0.027
Oxides of Sulfur (SOx)				
Oxides of Nitrogen (NOx)				
Carbon Monoxide (CO)				
Lead (Pb)				
Greenhouse Gases (GHG)	**At Design Capacity (lb/hr)**	**At Projected Operations**		
		(lb/hr)	**(lb/day)**	**(ton/yr)**
Carbon Dioxide (CO_2)		4.31	68.90	8.61
Methane (CH_4)		0.000	0.001	0.000
Nitrous Oxide (N_2O)				
Hydrofluorocarbons (HFCs)				
Perfluorocarbons (PFCs)				
Sulfur Hexafluoride (SF6)				
Total GHG (as CO_2e)		4.31	68.93	8.62
List individual federal Hazardous Air Pollutants (HAP) below:	**At Design Capacity (lb/hr)**	**At Projected Operations**		
		(lb/hr)	**(lb/day)**	**(ton/yr)**
1,3-Butadiene		0.000	0.001	0.000

(Attach additional sheets as necessary.)

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FORM 5EP: Emission Point Data

Complete one (1) Form 5EP for EACH emission point (stack or fugitive emissions) related to the proposed installation.

Applicant Name: W.R. Grace & Company - Conn.

1. Emission Point Identification Name/Number

List the applicant assigned name/number for this emission point and use this value on the attached required plot plan:
TO Stack

2. Emission Point Description

Describe the emission point including all associated equipment and control devices:
Reactor output gas stream controlled by thermal oxidizer

3. Emissions Schedule for the Emission Point

Continuous or Intermittent (C/I)?	I	**Seasonal Variation** Check box if none: ☒ Otherwise estimate seasonal variation:	
Minutes per hour:	60	Winter Percent	
Hours per day:	16	Spring Percent	
Days per week:	5	Summer Percent	
Weeks per year:	50	Fall Percent	

4. Emission Point Information

Height above ground (ft):	59'-1"	Length and width dimensions at top of rectangular stack (ft):		Length:	Width:
Height above structures (ft):	30'-5"				
Exit temperature (ºF):	1600	Inside diameter at top of round stack (ft):			0.833
Exit velocity (ft/min):	200.4	Distance from emission point to nearest property line (ft):			280
Exhaust gas volumetric flow rate (acfm):	109.3	Building dimensions if emission point is located on building (ft)	Height 28'-8"	Length 163'	Width 144'

5. Control Devices Associated with the Emission Point

Identify each control device associated with the emission point and indicate the number of devices. ***A Form 6 is also required for each control device***. If none check none:

☐ None

☐ Baghouse No. ______

☐ Cyclone No. ______

☐ Elec. Precipitator (ESP) No. ______

☐ Dust Suppression System No. ______

☐ Venturi Scrubber No. ______

☐ Spray Tower/Packed Bed No. ______

☐ Carbon Adsorber No. ______

- ☐ Cartridge/Canister
- ☐ Regenerative

☐ Thermal Oxidizer No. ______

- ☐ Regenerative

☐ Catalytic Oxidizer No. ______

☐ Nitrogen Oxides Reduction No. ______

- ☐ Selective ☐ Non-Selective
- ☐ Catalytic ☐ Non-Catalytic

☒ Other No. ______
Specify: Electric Flameless Thermal Oxidizer

1/12/24 Replaced per Jan 11, 2024 Email from D. Resca to S. Nash KN

FORM 5EP: Emission Point Data

6. Estimated Emissions from the Emission Point

Criteria Pollutants	At Design Capacity (lb/hr)	At Projected Operations		
		(lb/hr)	(lb/day)	(ton/yr)
Particulate Matter (filterable as PM10)		0.000	0.000	0.000
Particulate Matter (filterable as PM2.5)		0.000	0.000	0.000
Particulate Matter (condensables)				
Volatile Organic Compounds (VOC)		0.014	0.218	0.027
Oxides of Sulfur (SOx)				
Oxides of Nitrogen (NOx)				
Carbon Monoxide (CO)				
Lead (Pb)				

Greenhouse Gases (GHG)	At Design Capacity (lb/hr)	At Projected Operations		
		(lb/hr)	(lb/day)	(ton/yr)
Carbon Dioxide (CO_2)		4.31	68.90	136.61
Methane (CH_4)		0.000	0.001	0.000
Nitrous Oxide (N_2O)				
Hydrofluorocarbons (HFCs)				
Perfluorocarbons (PFCs)				
Sulfur Hexafluoride (SF6)				
Total GHG (as CO_2e)		4.31	68.93	136.61

List individual federal Hazardous Air Pollutants (HAP) below:	At Design Capacity (lb/hr)	At Projected Operations		
		(lb/hr)	(lb/day)	(ton/yr)
1,3-Butadiene		0.000	0.001	0.000

(Attach additional sheets as necessary.)

1/12/24
Replaced per Jan 11, 2024
email from D. Rescue
to S. Nash ISN

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FORM 5EP: Emission Point Data

Complete one (1) Form 5EP for EACH emission point (stack or fugitive emissions) related to the proposed installation.

Applicant Name: W.R. Grace & Company - Conn.

1. Emission Point Identification Name/Number

List the applicant assigned name/number for this emission point and use this value on the attached required plot plan:
Regen Exhaust Vent

2. Emission Point Description

Describe the emission point including all associated equipment and control devices:
Regenerator flue gas stream

3. Emissions Schedule for the Emission Point

Continuous or Intermittent (C/I)?	I	**Seasonal Variation** Check box if none: ☒ Otherwise estimate seasonal variation:	
Minutes per hour:	60	Winter Percent	
Hours per day:	16	Spring Percent	
Days per week:	5	Summer Percent	
Weeks per year:	50	Fall Percent	

4. Emission Point Information

Height above ground (ft):	39.0	Length and width dimensions at top of rectangular stack (ft):	Length:		Width:
Height above structures (ft):	10.3				
Exit temperature (°F):	80	Inside diameter at top of round stack (ft):			0.833
Exit velocity (ft/min):	1835	Distance from emission point to nearest property line (ft):			280
Exhaust gas volumetric flow rate (acfm):	1000	Building dimensions if emission point is located on building (ft)	Height 28'-8"	Length 163'	Width 144'

5. Control Devices Associated with the Emission Point

Identify each control device associated with the emission point and indicate the number of devices. ***A Form 6 is also required for each control device***. If none check none:

☒ None

☐ Baghouse No. ______

☐ Cyclone No. ______

☐ Elec. Precipitator (ESP) No. ______

☐ Dust Suppression System No. ______

☐ Venturi Scrubber No. ______

☐ Spray Tower/Packed Bed No. ______

☐ Carbon Adsorber No. ______

☐ Cartridge/Canister

☐ Regenerative

☐ Thermal Oxidizer No. ______

☐ Regenerative

☐ Catalytic Oxidizer No. ______

☐ Nitrogen Oxides Reduction No. ______

☐ Selective ☐ Non-Selective

☐ Catalytic ☐ Non-Catalytic

☐ Other No. ______
Specify:

FORM 5EP: Emission Point Data

6. Estimated Emissions from the Emission Point

Criteria Pollutants	At Design Capacity (lb/hr)	At Projected Operations		
		(lb/hr)	(lb/day)	(ton/yr)
Particulate Matter (filterable as PM10)		0.000	0.000	0.000
Particulate Matter (filterable as PM2.5)		0.000	0.000	0.000
Particulate Matter (condensables)				
Volatile Organic Compounds (VOC)				
Oxides of Sulfur (SOx)				
Oxides of Nitrogen (NOx)		0.001	0.011	0.001
Carbon Monoxide (CO)		0.000	0.002	0.000
Lead (Pb)				

Greenhouse Gases (GHG)	At Design Capacity (lb/hr)	At Projected Operations		
		(lb/hr)	(lb/day)	(ton/yr)
Carbon Dioxide (CO_2)		[illegible]	4.019	0.502
Methane (CH_4)				
Nitrous Oxide (N_2O)				
Hydrofluorocarbons (HFCs)				
Perfluorocarbons (PFCs)				
Sulfur Hexafluoride (SF6)				
Total GHG (as CO_2e)		0.251	4.019	0.502

List individual federal Hazardous Air Pollutants (HAP) below:	At Design Capacity (lb/hr)	At Projected Operations		
		(lb/hr)	(lb/day)	(ton/yr)

(Attach additional sheets as necessary.)

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FORM 5T: Toxic Air Pollutant (TAP) Emissions Summary and Compliance Demonstration

Applicant Name: W.R. Grace & Co. - Conn.

Step 1: Quantify premises-wide emissions of Toxic Air Pollutants (TAP) from new and existing installations in accordance with COMAR 26.11.15.04. Attach supporting documentation as necessary.

Toxic Air Pollutant (TAP)	CAS Number	Class I or Class II?	Screening Levels (µg/m³)			Estimated Premises Wide Emissions of TAP: Actual Total Existing TAP Emissions	Projected TAP Emissions from Proposed Installation	Premises Wide Total TAP Emissions	
			1-hour	8-hour	Annual	(lb/hr)	(lb/hr)	(lb/hr)	(lb/yr)
ex. ethanol	*64175*	*II*	*18843*	*3769*	*N/A*	*0.60*	*0.15*	*0.75*	*1500*
ex. benzene	*71432*	*I*	*80*	*16*	*0.13*	*0.5*	*0.75*	*1.00*	*400*
See Attach 5 and Attach 6									

(attach additional sheets as necessary.)

Note: Screening levels can be obtained from the Department's website (http://www.mde.maryland.gov) or by calling the Department.

Step 2: Determine which TAPs are exempt from further review. A TAP that meets either of the following Class I or Class II small quantity emitter exemptions is exempt from further TAP compliance demonstration requirements under Step 3 and Step 4.

Class II TAP Small Quantity Emitter Exemption Requirements (COMAR 26.11.15.03B(3)(a))
A Class II TAP is exempt from Step 3 and Step 4 if the Class II TAP meets the following requirements: Premises wide emissions of the TAP shall not exceed 0.5 pounds per hour, and any applicable 1-hour or 8-hour screening level for the TAP must be greater than 200 µg/m³.

Class I TAP Small Quantity Emitter Exemption Requirements (COMAR 26.11.15.03B(3)(b))
A Class I TAP is exempt from Step 3 and Step 4 if the Class I TAP meets the following requirements: Premises wide emissions of the TAP shall not exceed 0.5 pounds per hour and 350 pounds per year, any applicable 1-hour or 8-hour screening level for the TAP must be greater than 200 µg/m³, and any applicable annual screening level for the TAP must be greater than 1 µg/m³.

If a TAP meets either the Class I or Class II TAP Small Quantity Emitter Exemption Requirements, no further review under Step 3 and Step 4 are required for that specific TAP.

FORM 5T: Toxic Air Pollutant (TAP) Emissions Summary and Compliance Demonstration

Step 3: Best Available Control Technology for Toxics Requirement (T-BACT, COMAR 26.11.15.05)
In the following table, list all TAP emission reduction options considered when determining T-BACT for the proposed installation. The options should be listed in order beginning with the most effective control strategy to the least effective strategy. Attach supporting documentation as necessary.

Target Pollutants	Emission Control Option	% Emission Reduction	Costs		T-BACT Option Selected? (yes/no)
			Capital	Annual Operating	
ex. ethanol and benzene	*Thermal Oxidizer*	*99*	*$50,000*	*$100,000*	*no*
ex. ethanol and benzene	*Low VOC materials*	*80*	*0*	*$100,000*	*yes*
VOC	Electric Flameless TO	99.99			Yes

(attach additional sheets as necessary)

Step 4: Demonstrating Compliance with the Ambient Impact Requirement (COMAR 26.11.15.06)
Each TAP not exempt in Step 2 must be individually evaluated to determine that the emissions of the TAP will not adversely impact public health. The evaluation consists of a series of increasingly non-conservative (and increasingly rigorous) tests. Once a TAP passes a test in the evaluation, no further analysis is required for that TAP. "Demonstrating Compliance with the Ambient Impact Requirement under the Toxic Air Pollutant (TAP) Regulations (COMAR 26.11.15.06)" provides guidance on conducting the evaluation. Summarize your results in the following table. Attach supporting documentation as necessary.

Toxic Air Pollutant (TAP)	CAS Number	Screening Levels ($\mu g/m^3$)			Premises Wide Total TAP Emissions		Allowable Emissions Rate (AER) per COMAR 26.11.16.02A		Off-site Concentrations per Screening Analysis ($\mu g/m^3$)			Compliance Method Used?
		1-hour	8-hour	Annual	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	1-hour	8-hour	Annual	AER or Screen
ex. ethanol	*64175*	*18843*	*3769*	*N/A*	*0.75*	*1500*	*0.89*	*N/A*	*N/A*	*N/A*	*N/A*	*AER*
ex. benzene	*71432*	*80*	*16*	*0.13*	*1.00*	*400*	*0.04*	*36.52*	*1.5*	*1.05*	*0.12*	*Screen*
See Attach 6												

(attach additional sheets as necessary)

If compliance with the ambient impact requirement cannot be met using the allowable emissions rate method or the screening analysis method, refined dispersion modeling techniques may be required. Please consult with the Department's Air Quality Permit Program prior to conducting dispersion modeling methods to demonstrate compliance.

MARYLAND DEPARTMENT OF THE ENVIRONMENT

1800 Washington Blvd ▪ Baltimore, Maryland 21230
(410) 537-3230 ▪ 1-800-633-6101 ▪ www.mde.state.md.us

Air and Radiation Management Administration ▪ Air Quality Permits Program

APPLICATION FOR PERMIT TO CONSTRUCT
GAS CLEANING OR EMISSION CONTROL EQUIPMENT

1. Owner of Installation W.R. Grace & Co. - Conn.	**Telephone No.** (410) 531-4570		**Date of Application** 8/3/23
2. Mailing Address 7500 Grace Drive	**City** Columbia	**Zip Code** 21044	**County** Howard
3. Equipment Location 7500 Grace Drive	**City/Town or P.O.** Columbia, MD		**County** Howard
4. Signature of Owner or Operator	**Title**		**Print or Type Name**

5. Application Type: Alteration ☐ New Construction ☑

6. Date Construction is to Start: 1/24 **Completion Date (Estimate):** 8/24

7. Type of Gas Cleaning or Emission Control Equipment:

Simple Cyclone ☐ Multiple Cyclone ☐ Afterburner ☐ Electrostatic Precipitator ☐

Scrubber ☐ ______ (type) Other ☑ Electric Flameless TO (type)

8. Gas Cleaning Equipment Manufacturer	**Model No.**	**Collection Efficiency (Design Criteria)**
PCC	EFTO25	> 99.99%

9. Type of Equipment which Control Equipment is to Service:
Catalyst Chemical Conversion Reactor System

10. Stack Test to be Conducted:

Yes ☐ No ☑ ______ (Stack Test to be Conducted By) ______ (Date)

11. Cost of Equipment ______

Estimated Erection Cost ______

12. The Following Shall Be Design Criteria:

	INLET		OUTLET	
Gas Flow Rate		ACFM*	109.3	ACFM*
Gas Temperature		°F	1600	°F
Gas Pressure		INCHES W.G.		INCHES W.G.

PRESSURE DROP ________________

Dust Loading		GRAINS/ACFD**		GRAINS/ACFD**
Moisture Content OR		%		%
Wet Bulb Temperature		°F		°F

Liquid Flow Rate ________________ GALLONS/MINUTE
(Wet Scrubber)
(WHEN SCRUBBER LIQUID OTHER THAN WATER INDICATE COMPOSITION OF SCRUBBING MEDIUM IN WEIGHT %)

*= ACTUAL CUBIC FEET PER MINUTE **= ACTUAL CUBIC FEET DRY

WHEN APPLICATION INVOLVES THE REDUCTION OF GASEOUS POLLUTANTS, PROVIDE THE CONCENTRATION OF EACH POLLUTANT IN THE GAS STREAM IN VOLUME PERCENT. INCLUDE THE COMPOSITION OF THE GASES ENTERING THE CLEANING DEVICE AND THE COMPOSITION OF EXHAUSTED GASES BEING DISCHARGED INTO THE ATMOSPHERE. USE AVAILABLE SPACE IN ITEM 15 ON PAGE 3.

13. Particle Size Analysis

Size of Dust Particles Entering Cleaning Unit	% of Total Dust	% to be Collected
0 to 10 Microns		
10 to 44 Microns		
Larger than 44 Microns		

14. For Afterburner Construction Only:

Volume of Contaminated Air ________________ CFM (DO NOT INCLUDE COMBUSTION AIR)

Gas Inlet Temperature ________________ °F

Capacity of Afterburner ________________ BTU/HR

Diameter (or area) of Afterburner Throat ________________

Combustion Chamber ________________ (diameter) ________________ (length) Operating Temperature at Afterburner ______ °F

Retention Time of Gases ________________

15. Show Location of Dust Cleaning Equipment in the System. Draw or Sketch Flow Diagram Showing Emission Path from Source to Exhaust Point to Atmosphere.

See Attach 1

Date Received: Local ______________________ State ______________________

Acknowledgement Date: ______________

By ____

Reviewed By:

Local ____

State ____

Returned to Local:

Date ____________

By ____

Application Returned to Applicant:

Date ____________

By ____

REGISTRATION NUMBER OF ASSOCIATED EQUIPMENT: [ ] [ ][ ][ ][ ]

PREMISES NUMBER: [ ][ ] [ ][ ][ ][ ]

Emission Calculations Revised By ______________________________ Date __________

ATTACHMENT 5

Emissions – Calculations, Engineering Estimates and Assumptions

Table 1. Reactor Product Gas Emissions

Operation 16 hr/dy 4000 hr/yr

Pollutant	CAS	C	VOC?	HAP?	From Reactor (1)		Control Efficiency	Emissions (3)			
					Other C4 Speciation (% Other C4) (4)	Mass (g/hr)	(%)	(lb/hr)	(lb/dy)	(lb/yr)	(tpy)
CO_2						18	0	0.040	0.635	158.733	0.079
PM (5)						0.375	99	0.000	0.000	0.033	0.000
Methane	74-82-8	C1	No	No		3	99	0.000	0.001	0.265	0.000
Ethane	74-84-0	C2	No	No		8	99	0.000	0.003	0.705	0.000
Ethylene	74-85-1	C2	Yes	No		79	99	0.002	0.028	6.967	0.003
Propane	74-98-6	C3	Yes	No		66	99	0.001	0.023	5.820	0.003
Propylene	115-07-1	C3	Yes	No		246	99	0.005	0.087	21.694	0.011
Butane	106-97-8	C4	Yes	No		60	99	0.001	0.021	5.291	0.003
Other C4		C4				167					
Isobutene	115-11-7	C4	Yes	No	36	60.12	99	0.001	0.021	5.302	0.003
1-Butene	106-98-9	C4	Yes	No	20	33.4	99	0.001	0.012	2.945	0.001
t-2-Butene	624-64-6	C4	Yes	No	23	38.41	99	0.001	0.014	3.387	0.002
c-2-Butene	590-18-1	C4	Yes	No	20	33.4	99	0.001	0.012	2.945	0.001
1,3-Butadiene	106-99-0	C4	Yes	Yes	1	1.67	99	0.000	0.001	0.147	0.000
Total VOC			Yes				99	0.014	0.218	54.498	0.027

(1) Based on engineering estimates
(2) For VOC, the proposed electric flameless thermal oxidizer is designed for a VOC control efficiency of greater than 99.99% (i.e., meets requirements of COMAR 26.11.19.30 of at least 90% control overall). For PM, assume 99% particulate control for process cyclone
(3) Assumed 16 hr/dy and 4000 hr/yr operation
(4) Based on typical distribution for catalyitic cracking
(5) Based on regenerator outlet particulate fines equal to 0.3% /dy of catalyst inventory. The catalyst inventory for the regenerator is about 2000 g, and daily operation is 16 hr/dy

Reactor Outlet PM g/hr = 0.3 g PM/dy/100 g catalyst inventory X 2000 g catalyst / 16 hr/dy

(Revised 01/09/2024)

Table 2. Additional Thermal Oxidizer CO_2 Emissions From Controlling Hydrocarbons

Operation	16	hr/dy	4000	hr/yr
TO CE	99	%		
CO_2 MW	44.01	g/mol		

Pollutant	CAS	# of C	MW (g/mol)	TO Inlet Mass Rate (g/hr)	Mass Rate Controlled by TO (g/hr)	Mol Rate Controlled by TO (mol/hr)	Equiv Mol C Rate (mol/hr)	Mass Rate CO_2 (g/hr)	
Methane	74-82-8	1	16.04	3	2.97	0.1851621	0.185162	8.148984	
Ethane	74-84-0	2	30.07	8	7.92	0.2633854	0.526771	23.18319	
Ethylene	74-85-1	2	28.05	79	78.21	2.7882353	5.576471	245.4205	
Propane	74-98-6	3	44.097	66	65.34	1.4817335	4.4452	195.6333	
Propylene	115-07-1	3	42.08	246	243.54	5.7875475	17.36264	764.1299	
Butane	106-97-8	4	58.12	60	59.4	1.0220234	4.088094	179.917	
Isobutene	115-11-7	4	56.11	60.12	59.5188	1.0607521	4.243008	186.7348	
1-Butene	106-98-9	4	56.11	33.4	33.066	0.5893067	2.357227	103.7416	
t-2-Butene	624-64-6	4	56.11	38.41	38.0259	0.6777027	2.710811	119.3028	
c-2-Butene	590-18-1	4	56.11	33.4	33.066	0.5893067	2.357227	103.7416	
1,3-Butadiene	106-99-0	4	54.09	1.67	1.6533	0.0305657	0.122263	5.38079	
				629				1935.334	
								4.266685	lb/hr
								68.26696	lb/dy
								17066.74	lb/yr
								8.53337	tpy

Table 2. Additional Thermal Oxidizer CO_2 Emissions From Controlling Hydrocarbons

Operation	16	hr/dy	4000 hr/yr
TO CE	99	%	
CO_2 MW	44.01	g/mol	

Pollutant	CAS	# of C	MW (g/mol)	TO Inlet Mass Rate (g/hr)	Mass Rate Controlled by TO (g/hr)	Mol Rate Controlled by TO (mol/hr)	Equiv Mol C Rate (mol/hr)	Mass Rate CO_2 (g/hr)	
Methane	74-82-8	1	16.04	3	2.97	0.1851621	0.185162	8.148984	
Ethane	74-84-0	2	30.07	8	7.92	0.2633854	0.526771	23.18319	
Ethylene	74-85-1	2	28.05	79	78.21	2.7882353	5.576471	245.4205	
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Propylene	115-07-1	3	42.08	246	243.54	5.7875475	17.36264	764.1299	
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t-2-Butene	624-64-6	4	56.11	38.41	38.0259	0.6777027	2.710811	119.3028	
c-2-Butene	590-18-1	4	56.11	33.4	33.066	0.5893067	2.357227	103.7416	
1,3-Butadiene	106-99-0	4	54.09	1.67	1.6533	0.0305657	0.122263	5.38079	
				629				1935.334	
								4.266685	lb/hr
								68.26696	lb/dy
								273067.9	lb/yr
								136.5339	tpy

1/12/24 Replaced per Jan 11, 2024 email from D. Rosen to S. Nash / EN

Table 3. Regenerator Flue Gas Emissions

Operation 16 hr/dy 4000 hr/yr

Pollutant	Control Efficiency (1) (%)	Emissions (2) (lb/hr)	(lb/dy)	(tpy)
CO_2 (3)		0.251	4.019	0.502
CO (4)		0.0001	0.0017	0.0002
NO (5) (6)		0.0007	0.0107	0.0013
PM (7)	99	0.0000	0.0001	0.0000

(1) Assume 99% particulate control for process knockout pot
(2) Assume 16 hr/dy and 4000 hr/yr operation
(3) Assume engineering estimate of CO_2 flow rate equal to 33 NL/hr

CO_2 g/hr = 44 g CO_2/mol CO_2 X 58 NL CO_2/hr / 22.4 NL/mol

(4) Assume lean burn (excess oxygen) conditions resulting in 0.01 vol% CO in flue gas (detection limit of CO analyzer) and flue gas flow rate of 377 NL/hr

CO g/hr = 28 g CO/mol CO X 0.01 NL CO/100 NL flue gas X 377 NL flue gas/hr / 22.4 NL/mol

(5) Assume the mass of nitrogen in the composite plastic feedstock is equal to the mass of nitrogen in the fraction of the feedstock that is Nylon, the constituent with the highest nitrogen content. Nylon has a nitrogen content of 12.3 wt% and the fraction of Nylon in the composite feedstaock is less than 2 wt%

N content of feed wt% = (12.3 g N/ 100 g Nylon X 2 g Nylon/ 100 g feed) X 100 = 0.246

(6) Based on 600 ppmv (dry basis) NO in flue gas from Xinjin Zhao et. al., 1997, Nitrogen Chemistry and NOx Control in a Fluid Catalytic Cracking Regenerator (Ind. Eng. Chem. Res., 1997, 36, 11, 4535-4542) for a similar N content feed and lean combustion, and a flue gas flow rate of 377 NL/hr

NO g/hr = 30 g NO/mol NO X 600 NL NO/1000000 NL flue gas X 377 NL flue gas/hr / 22.4 NL/mol

(7) Based on engineering estimate of regenerator outlet particulate fines equal to 0.3% /dy of catalyst inventory. The catalyst inventory for the regenerator is about 1500 g, and daily operation is 16 hr/dy

Regenerator Outlet PM g/hr = 0.3 g PM/100 g catalyst inventory/dy X 1500 g catalyst / 16 hr/dy

ATTACHMENT 6

TAP Compliance Demonstration

TAP Compliance Demonstration

MARYLAND TAP REQUIREMENTS

The proposed Project has the potential to discharge to the atmosphere several non-criteria substances which include Toxic Air Pollutants (TAPs) and, pursuant to COMAR 26.11.15.03 A (1), is subject to the Maryland TAP requirements (under COMAR 26.11.15 and 26.11.16) because the proposed installation is required to obtain a permit to construct (PTC) under COMAR 26.11.02.09.

COMAR 26.11.15.06 requires a demonstration that TAP emissions will not unreasonably endanger human health. Grace is demonstrating compliance with this ambient impact requirement using a screening analysis as specified under COMAR 26.11.15.07. According to COMAR 26.11.16.02 A, such a demonstration is made by showing that TAP emissions from the premises will not cause increases in ambient levels that exceed the applicable risk-based screening level for a Class I TAP and the applicable TLV-/threshold-based screening level for a Class II TAP (MDE Screening Levels).

The proposed Project will be a new installation/source as defined under COMAR 26.11.15.01 B (10). For new installations, COMAR 26.11.15.06 A (1) requires that the total emissions from the premises of each TAP discharged by the new installation be used in demonstrating compliance with the TAP impact requirements. COMAR 26.11.15.06 A (2) does not require the accounting of other premise-wide emissions from existing installations/sources on the existing premises (as defined under COMAR 26.11.15.01 B (7)) for a TAP that is not listed in COMAR 26.11.16.07. Except for 1,3-Butadiene, all TAPs expected to be discharged from the proposed Project (see Table 1 (Attachment 5)) are not listed in COMAR 26.11.16.07. However, several of the registered installations/sources at the existing premises are considered new installations (not existing installations).

EMISSIONS

Proposed Project TAP Emissions

Several non-criteria pollutants are expected to be discharged into the ambient air from the proposed Project's new thermal oxidizer stack (see Table 1 (Attachment 5)). Methane (CAS 74-82-8), ethane (CAS 74-84-0), ethylene (CAS 74-85-1), propane (CAS 74-98-6), and propylene (CAS 115-07-1) are listed as simple asphyxiants under COMAR 26.11.16.08 and are excluded from the definition of Toxic Air Pollutants (TAPs), as defined under COMAR 26.11.15.01 B (20). 1,3-butadiene (CAS 106-99-0) is a Class I TAP while the remaining non-criteria pollutants in Table 1 (Attachment 5) are Class II TAPs.

Other Premise-Wide TAP Emissions

Other new installations on the existing premises discharge a TAP that is expected to be discharged from the proposed Project; namely, butene (CAS 106-98-9).

The Test Polymerization Process (controlled by the existing thermal oxidizer) constructed in 2014 (ARA Registration Number 027-0013-7-0084) and the Test Gas-Phase Polymerization Process constructed in 2017 (ARA Registration Number 027-0013-7-0086) are permitted to emit butene. The maximum combined hourly butene emissions from these two installations is 0.03 lb/hr. For the Test Polymerization Process the maximum hourly butene emissions is expected to be 0.01 lb/hr (based on the supplement to the permit to Construct application (dated November 21, 2014), if butene is used as an additive). For the Test Gas-Phase Polymerization Process the maximum hourly butene emissions is expected to be 0.02 lb/hr (assuming butene from one linear low density polyethylene (LLDPE) batch run is released in one hour].

EXEMPTION FROM TAP REGULATIONS

The anticipated emissions of butane, isobutene (CAS 115-11-7), 1-butene, t-2-butene (CAS 624-64-6), and c-2-butene (CAS 590-18-1) from the premises are exempt from the Maryland TAP regulations (specifically COMAR 26.11.15.05 and COMAR 26.11.15.06) because of the small quantity of discharge from this proposed Project and other permitted installations.

Under COMAR 26.11.15.03 B (3) (a):

> "The emissions of a Class II TAP from a premises are exempt from the requirements of Regulations .05 and .06 of this chapter, if:
>
> (i) The total allowable emissions of the TAP from the premises are 0.5 pound per hour (0.23 kilogram per hour) or less; and
>
> (ii) All applicable TLV-based, threshold-based, or special screening levels for the TAP are greater than 200 micrograms/cubic meter."

After construction of the proposed Project, the maximum hourly emissions of butane from the premises will be about 0.001 lb/hr. This premises value includes the anticipated emissions due to the proposed Project. These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for butane is 23770.96 $\mu g/m^3$ (8-hour). This screening level is well above the minimum set forth in (ii) above.

After construction of the proposed Project, the maximum hourly emissions of isobutene from the premises will be about 0.001 lb/hr. This value includes the anticipated emissions due to the proposed Project. These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for isobutene is 5737.22 $\mu g/m^3$ (8-hour). This screening level is well above the minimum set forth in (ii) above.

After construction of the proposed Project, the maximum hourly emissions of 1-butene (butene) from the premises will be about 0.03 lb/hr (0.001 lb/hr + 0.03 lb/hr). This premises value includes the anticipated emissions due to the proposed Project and the possible emissions due to the Test Polymerization Process and the Test Gas-Phase Polymerization Process (see Other Premise-Wide TAP Emissions above). These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for butane is 5737.22 $\mu g/m^3$ (8-hour). This screening level is well above the minimum set forth in (ii) above.

After construction of the proposed Project, the maximum hourly emissions of t-2-butene from the premises will be about 0.001 lb/hr. This value includes the anticipated emissions due to the proposed Project. These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for isobutene is 5737.22 μg/m³ (8-hour). This screening level is well above the minimum set forth in (ii) above.

After construction of the proposed Project, the maximum hourly emissions of c-2-butene from the premises will be about 0.001 lb/hr. This value includes the anticipated emissions due to the proposed Project. These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for isobutene is 5737.22 μg/m³ (8-hour). This screening level is well above the minimum set forth in (ii) above.

Because the total allowable butane, isobutene, butene, t-2-butene and c-2-butene (Class II TAPs) emissions from the premises are each below 0.5 lb/hr, and the applicable screening levels are well above 200 μg/m³, these emissions qualify for the small-emitter exemption from TAP compliance demonstration requirements.

Under COMAR 26.11.15.03 B (3) (b):

> "The emissions of a Class I TAP from a premises are exempt from the requirements of Regulations .05 and .06 of this chapter, if:
>
> (i) The total allowable emissions of the TAP from the premises are 0.5 pound per hour (0.23 kilogram per hour) or less;
> (ii) The total allowable emissions of the TAP from the premises are 350 pounds per year (159 kilograms per year) or less;
> (iii) All applicable TLV-based, threshold-based, or special screening levels for the TAP are greater than 200 micrograms/cubic meter; and
> (iv) The applicable risk-based screening level is greater than 1 microgram/cubic meter."

Because the risk-based screening level for 1,3-butadiene (i.e., 0.03 μg/m³) is not greater than 1 μg/m³, the 1,3-butadiene emissions do not qualify for the small-emitter exemption from TAP compliance demonstration requirements.

SCREENING ANALYSIS

For the screening analysis, estimates of TAP emissions are compared to the conservative Allowable Emission Rates (AERs) consistent with the Table provided under COMAR 26.11.16.02 A (4) (MDE AER). Compliance with the TAP impact requirements is demonstrated if the TAP emissions are less than the respective AERs.

<u>MDE-Based AER</u>

The AERs given in the Table under COMAR 26.11.16.02 (4), for non-stack or downwash sources, can be generalized as follows:

Short-term (1-hr/8-hr) AER (lb/hr) = SL/279

Long-term (annual) AER (lb/yr) = SL/0.00274

where SL is the applicable MDE Screening Level (μg/m³).

This is based on discussions in "An Example of Demonstrating Compliance with Ambient Impact Requirement. (COMAR 26.11.15.06) – Fact Sheet" on MDE's website.

Screening Compliance Demonstration

Since many of the expected non-criteria pollutants from the proposed Project are not TAPs and of the TAPs 1,3-butadiene (CAS 106-99-0, a Class I TAP) is the only TAP not exempt from the TAP requirements under COMAR 26.11.15.05 and 26.11.05.06, a TAP screening analysis was performed for 1,3-butadiene. The screening analysis presented in Table 4 demonstrates TAP compliance for 1,3-butadiene.

Table 4. TAP Demonstration Screening Analysis

Substance	Substance Alternate Name	CAS Number	MDE TAP (1)	MDE Screenling Level (2) 1-hr	8-hr	Annual	TAP Emissions Project TAP Hourly (3)	Project TAP Annual (3)	Other TAP Hourly (4)	Other TAP Annual	Sitewide TAP Hourly	Sitewide TAP Annual	Small Quantity Exemption (5)	MDE AER (6) 1-hr	8-hr	Annual	Compliance 1-hr	8-hr	Annual
				(μg/m³)	(μg/m³)	(μg/m³)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)		(lb/hr)	(lb/hr)	(lb/yr)			
Methane		74-82-8	No				0.000066	0.264555			0.000066	0.26455493							
Ethane		74-84-0	No				0.0001764	0.70548			0.00017637	0.705479814							
Ethylene		74-85-1	No				0.0017417	6.966613			0.001741653	6.966613168							
Propane		74-98-6	No				0.0014551	5.820208			0.001455052	5.820208469							
Propylene		115-07-1	No				0.0054234	21.6935			0.005423376	21.69350429							
Butane		106-97-8	Class II		23770.9611		0.0013228	5.291099			0.001322775	5.291098608	Yes	0	85.20057742	0		Yes	
Isobutene	Isobutylene	115-11-7	Class II		5737.2188		0.0013254	5.301681			0.00132542	5.301680806	Yes	0	20.56350824	0		Yes	
1-Butene	Butene, isomers	106-98-9	Class II		5737.2188		0.0007363	2.945378	0.03		0.030736345	2.945378225	Yes	0	20.56350824	0		Yes	
t-2-Butene	Butene, isomers	624-64-6	Class II		5737.2188		0.0008468	3.387185			0.000846796	3.387184959	Yes	0	20.56350824	0		Yes	
c-2-Butene	Butene, isomers	590-18-1	Class II		5737.2188		0.0007363	2.945378			0.000736345	2.945378225	Yes	0	20.56350824	0		Yes	
1,3-Butadiene		106-99-0	Class I		44.2454	3.00E-02	0.000037	0.147269			0.000037	0.147268911	No	0	0.158585663	10.94890511		Yes	Yes

(1) COMAR 26.11.15.01 and COMAR 26.11.16.08
(2) MDE's Toxic Air Pollutant Regulations Assistance web page; Screening Levels
(3) See Table 1 (Attachment 5)
(4) Other sitewide emissions: Butene emissions based on PTC application for Gas Phase Polymerization Process submitted on May 26, 2016 (accounting for GPP emissions and RSPP controlled emissions)
(5) COMAR 26.11.15.03 B (3) (a) and (b)
(6) Based on "An Example of Demonstrating Compliance with Ambient Impact Requirement. (COMAR 26.11.15.06 - Fact Sheet" on MDE's website

ATTACHMENT 7

Safety Data Sheet for Example Plastic Feedstock

1 Identification

· **Product identifier**

· **Trade name: polypropylene**

· **Application of the substance / the preparation:**
Product for industrial research and applicability tests.
· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
GRACE
W. R. Grace & Co.-Conn
7500 Grace Drive
Columbia MD 21044
U. S. A.

· **Information department:**
Health and Safety (9 AM to 5 PM-EST) 1-410-531-4000
MSDS.Davison@grace.com

· **Emergency telephone number:**
Chemtrec North America: +1-800-424-9300
Chemtrec International: +1-703-527-3887
Other Emergencies (24hr): +1-410-531-4000

2 Hazard(s) identification

· **Classification of the substance or mixture**
The substance is not classified, according to the Globally Harmonized System (GHS).
· **Label elements**
· **GHS label elements** None
· **Hazard pictograms** None
· **Signal word** None
· **Hazard statements** None
· **Classification system:**

· **NFPA ratings (scale 0 - 4)**

Health = 0
Fire = 1
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

Health = 0
Fire = 1
Reactivity = 0

· **Hazard not otherwise classified**
WARNING: Product dust together with air may develop ignitable and explosive mixtures

3 Composition/information on ingredients

· **Chemical characterization: Substances**

· **Additonal information:**

· **CAS No. and description:**		
9003-07-0	polypropylene	100%

USA

(Contd. on page 2)

(Contd. of page 1)

4 First-aid measures

· **Description of first aid measures**

· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Generally the product does not irritate the skin.
Wash with water.
After contact with the molten product, cool rapidly with cold water.
Do not pull solidified product away from the skin.
Seek medical treatment.
· **After eye contact:**
Flush opened eye with large quantities of running water for at least 30 minutes. If symptoms occur, consult a doctor.

· **After swallowing:** Seek medical attention. Do not induce vomiting.

· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed**
No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Fire-fighting measures

· **Extinguishing media**

· **Suitable extinguishing agents:**
CO_2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **Hazardous combustion products**
In case of fire, the following can be released:
Carbon monoxide and carbon dioxide
· **Advice for firefighters**

· **Protective equipment:**
Do not inhale explosion gases or combustion gases.
Wear personal protective equipment.
Wear respiratory protective device.
· **Additional information**
Collect contaminated fire fighting water separately. It must not enter the sewage system.
Dispose of fire debris and contaminated fire fighting water in accordance with official regulations.
WARNING: Product dust together with air may develop ignitable and explosive mixtures
Prevent formation of dust.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
Remove persons from danger area.
Wear protective clothing.
WARNING: Product dust together with air may develop ignitable and explosive mixtures
Keep away from ignition sources
· **Environmental precautions:**
Do not allow to enter sewers, surface or ground water.
Prevent from spreading (e.g. by damming-in or oil barriers).
· **Methods and material for containment and cleaning up:**
Vacuuming or wet sweeping may be used to avoid dust dispersal.
Vacuuming or wet sweeping may be used to avoid dust dispersal.

(Contd. on page 3)

(Contd. of page 2)

· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.
· **Protective Action Criteria for Chemicals**

· **PAC-1:**	
	5.2 mg/m^3
· **PAC-2:**	
	58 mg/m^3
· **PAC-3:**	
	350 mg/m^3

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Keep away from heat and direct sunlight.
Prevent formation of dust.
Provide suction extractors if dust is formed.
Use appropriate industrial vacuum cleaners or central vacuum systems for dust removal.
Take precautionary measures against static discharges.

· **Information about protection against explosions and fires:**
Dust can combine with air to form an explosive mixture.
When transferring this material into flammable solvents, use proper grounding to avoid static electric sparks.
WARNING: Product dust together with air may develop ignitable and explosive mixtures
When transferring this material, use proper grounding to avoid static electric sparks.
· **Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** No special requirements.

· **Information about storage in one common storage facility:** Store away from foodstuffs.

· **Further information about storage conditions:** None.

8 Exposure controls/personal protection

· **Additional information about design of technical systems:**
Dust control and material handling systems should contain explosion relief vents, an explosion suppression system or other explosion suppression or prevention controls. Ensure that dust-handling systems are designed in a manner to prevent the escape of dust into the work area. Use only appropriately classified electrical equipment and powered industrial trucks.
· **Control parameters**
· **Components with limit values that require monitoring at the workplace:** Not required.
· **Additional information:** Valid lists at time of creation were used as basis.
· **Exposure controls**
· **Personal protective equipment:**

· **General protective and hygienic measures:**
The usual precautionary measures for handling chemicals should be followed.

· **Breathing equipment:**
As appropriate for the employee exposure, use a NIOSH approved respirator and cartridge.

(Contd. on page 4)

Trade name: polypropylene

(Contd. of page 3)

· **Protection of hands:**

Protective gloves

Check protective gloves prior to each use for their proper condition.
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
Nitrile rubber, NBR
Butyl rubber, BR
Strong fabric gloves
Leather gloves
Recommended thickness of the material: ≥ 0.35 mm

· **For the permanent contact gloves made of the following materials are suitable:**
Butyl rubber, BR
Nitrile rubber, NBR

· **Eye protection:**

Safety glasses

· **Body protection:** Protective work clothing

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9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Granulate
Color:	Transparent
· **Odor:**	Odorless
· **Odor threshold:**	Not applicable.
· **pH-value at 20 °C (68 °F):**	7
· **Change in condition**	
Melting point/Melting range:	120-170 °C (248-338 °F)
Boiling point/Boiling range:	Not determined.
· **Flash point:**	Not determined.
· **Flammability (solid, gaseous):**	Not determined.
· **Ignition temperature:**	410 °C (770 °F)
· **Decomposition temperature:**	~250 °C (~482 °F)
· **Auto igniting:**	Product is not self-igniting.

(Contd. on page 5)

(Contd. of page 4)

· **Danger of explosion:**	Danger of dust explosion.
· **Explosion limits:**	
Lower:	Not applicable.
Upper:	Not applicable.
· **Vapor pressure:**	Not applicable.
· **Density at 20 °C (68 °F):**	0.90 - 0.92 g/cm³ (7.5105 - 7.6774 lbs/gal)
· **Bulk density at 20 °C (68 °F):**	0.5 kg/m³
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Insoluble.
· **Coefficient of water/oil distribution:**	Not available.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Other information**	No further relevant information available.

10 Stability and reactivity

· **Reactivity** No further relevant information available.
· **Chemical stability** No decomposition if used and stored according to specifications.
· **Possibility of hazardous reactions**
WARNING: Product dust together with air may develop ignitable and explosive mixtures
As the product is supplied it is not capable of dust explosion; however enrichment with fine dust causes risk of dust explosion.
· **Conditions to avoid**
In case of thermal decomposition caused by smouldering and incomplete combustion toxic fumes may be developed.
· **Incompatible materials:** Protect from contamination.
· **Hazardous decomposition products:**
Carbon monoxide and carbon dioxide
Aldehyde
At temperatures above 250°C, depolymerization and the release of starting monomers can arise.

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11 Toxicological information

· **Information on toxicological effects**

· **Acute toxicity:**

· **Primary irritant effect:**

· **on the skin:** No irritant effect.

· **on the eye:** Irritating effect.
· **Respiratory sensitization** No further relevant information available.
· **Skin sensitization** No further relevant information available.

· **Additional toxicological information:**

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**
3

(Contd. on page 6)

Trade name: polypropylene

(Contd. of page 5)

· **NTP (National Toxicology Program)**
Substance is not listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**
Substance is not listed.

· **CMR effects (carcinogenity, mutagenicity and toxicity for reproduction)**
· **Carcinogenicity** No further relevant information available.
· **Mutagenicity** No further relevant information available.
· **Reproductive toxicity** No further relevant information available.
· **Specific target organ toxicity (single exposure)** No further relevant information available.
· **Specific target organ toxicity (repeated exposure)** No further relevant information available.

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12 Ecological information

· **Toxicity**

· **Aquatic toxicity:** No further relevant information available.

· **Persistence and degradability** No further relevant information available.

· **Behavior in environmental systems:**

· **Bioaccumulative potential** No further relevant information available.
· **Mobility in soil** No further relevant information available.

· **Additional ecological information:**
· **General notes:** Do not allow product to reach ground water, water course or sewage system.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

13 Disposal considerations

· **Precautions for disposal:**

· **Recommendation:**
Disposal must be made according to official regulations.
Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State/provincial and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state/provincial and local requirements.

14 Transport information

· **UN-Number**	
· **DOT, ADR, ADN, IMDG, IATA**	None
· **UN proper shipping name**	
· **DOT, ADR, ADN, IMDG, IATA**	None
· **Transport hazard class(es)**	
· **DOT, ADR, ADN, IMDG, IATA**	
· **Class**	None

(Contd. on page 7)

(Contd. of page 6)

· **Packing group** · **DOT, ADR, IMDG, IATA**	None
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **Transport/Additional information:**	Not dangerous according to the above specifications. GRACE recommendation for air transport: Cargo aircraft only.

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15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**

· **SARA**

· **SARA 302/304**

Substance is not listed.

· **SARA 313**

Substance is not listed.

· **SARA 311/312** Combustible Dust.

· **TSCA (Toxic Substances Control Act):**

ACTIVE

· **Hazardous Air Pollutants**

Substance is not listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for females:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for males:**

Substance is not listed.

· **Chemicals known to cause developmental toxicity:**

Substance is not listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**

Substance is not listed.

· **TLV (Threshold Limit Value established by ACGIH)**

Substance is not listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

Substance is not listed.

· **Canadian DSL**

9003-07-0	polypropylene

· **Canadian NDSL**

Substance is not listed.

(Contd. on page 8)

(Contd. of page 7)

· **European EINECS**
The corresponding monomers are listed in EINECS.

Substance is not listed.

· **Philippines Inventory of Chemicals and Chemical Substances PICCS**
Substance is listed.

· **Inventory of the Existing Chemical Substances manufactured or imported in China IECSC**

9003-07-0	polypropylene

· **Australian Inventory of Chemical Substances AICS**
Substance is listed.

· **Existing and New Chemical Substance List ENCS**
6-402

· **Korean Existing Chemical Inventory KECI**
KE-29389

· **TCSCA (Taiwan)**
Substance is not listed.

· **New Zealand Inventory of Chemicals (NZIoC)**
Substance is listed.

· **Existing Chemical Directory of Thailand (DIW)**
Substance is listed.

· **TCSI - Taiwan Chemical Substance Inventory**
Substance is listed.

· **GHS label elements** None
· **Hazard pictograms** None
· **Signal word** None
· **Hazard statements** None

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16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Department issuing SDS:** GRACE Safety & Health Department
· **Other information:**
Refer to NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, for safe handling

· **Contact:**
SALES OFFICES

USA:
GRACE
W. R. Grace & Co.-Conn
7500 Grace DR
Columbia, MD 21044
Tel: +1 410-531 4000

Europe:
Grace GmbH
In der Hollerhecke 1
D-67545 Worms, Germany
Tel: +49 6241 40300

Asia Pacific:
Grace Products (Singapore) Pte Ltd
230 Orchard Road

(Contd. on page 9)

(Contd. of page 8)

09-232, Faber House
Singapore 238854
Tel: +65 6737 3033
Fax: +65 6737 5826

Grace Trading (Shanghai) Ltd
19th Floor K.Wah Center
1010 Huai Hai Zhong Road
Shanghai, 200031 China
T (电话): +86 21 3325 8288
F (传真): +86 21 5405 1500

W. R. Grace Japan K.K
Kohken New River Bldg 3F
2-21-18, Shinkawa
Chuo-ku, Tokyo 104-0033
JAPAN
Tel: +81 3.3537.6006
Fax: +81 3.3537.6007

· **Other information:**
· **Date of preparation / last revision** 01/08/2021 / 3.1
· **The first date of preparation** 06/06/2006
· **Number of revision times and the latest revision date** 3.2 / 01/08/2021
· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
NIOSH: National Institute for Occupational Safety
OSHA: Occupational Safety & Health
TLV: Threshold Limit Value
PEL: Permissible Exposure Limit
REL: Recommended Exposure Limit
· **Others** No further relevant information available.
· *** Data compared to the previous version altered.**

1 Identification

· **Product identifier**

· **Trade name:** **Polyethylene**

· **Application of the substance / the preparation:** Raw material
· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
GRACE
W. R. Grace & Co.-Conn
7500 Grace Drive
Columbia MD 21044
U. S. A.

· **Information department:**
Health and Safety (9 AM to 5 PM-EST) 1-410-531-4000
MSDS.Davison@grace.com

· **Emergency telephone number:**
Chemtrec North America: +1-800-424-9300
Chemtrec International: +1-703-527-3887
Other Emergencies (24hr): +1-410-531-4000

2 Hazard(s) identification

· **Classification of the substance or mixture**
The substance is not classified, according to the Globally Harmonized System (GHS).
· **Label elements**
· **GHS label elements** None
· **Hazard pictograms** None
· **Signal word** None
· **Hazard statements** None
· **Hazard not otherwise classified** The product is combustible.

3 Composition/information on ingredients

· **Chemical characterization: Substances**

· **Additonal information:**

· **CAS No. and description:**		
9002-88-4	Polyethylene	100%

4 First-aid measures

· **Description of first aid measures**

· **General information:**
Immediately remove contaminated clothing if necessary to prevent direct skin contact.

· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Immediately wash with water at least for 30 minutes and rinse thoroughly.
Seek medical treatment.
· **After eye contact:**
Flush opened eye with large quantities of running water for at least 30 minutes. If symptoms occur, consult a doctor.

· **After swallowing:** Seek medical attention. Do not induce vomiting.

(Contd. on page 2)

· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed**
No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Fire-fighting measures

· **Extinguishing media**

· **Suitable extinguishing agents:**
CO_2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

· **For safety reasons unsuitable extinguishing agents:** Water with full jet
· **Hazardous combustion products**
Carbon monoxide and carbon dioxide
Can form explosive gas-air mixtures.
· **Advice for firefighters**

· **Protective equipment:**
Wear personal protective equipment.
Wear respiratory protective device.
· **Additional information**
Cool receptacles with water spray.
Dispose of fire debris and contaminated fire fighting water in accordance with official regulations.
Heating of container(s) will cause the pressure to rise with risk of bursting.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
Ensure adequate ventilation
Keep away from ignition sources
Wear protective clothing.
Wear respiratory protective device.
· **Environmental precautions:**
Damp down dust with water spray.
Do not allow to enter sewers, surface or ground water.
· **Methods and material for containment and cleaning up:**
Dispose of the collected material according to regulations.
· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.
· **Protective Action Criteria for Chemicals**

· **PAC-1:**
16 mg/m³

· **PAC-2:**
170 mg/m³

· **PAC-3:**
1,000 mg/m³

(Contd. on page 3)

(Contd. of page 2)

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Keep away from heat and direct sunlight.
Any deposit of dust which cannot be avoided must be regularly removed.
Take precautionary measures against static discharges.
No special measures required.

· **Information about protection against explosions and fires:**
WARNING: Product dust together with air may develop ignitable and explosive mixtures
Keep ignition sources away. Do not smoke.
Protect against electrostatic charges.
The product is flammable.
· **Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:**
Use only receptacles specifically permitted for this substance/product.

· **Information about storage in one common storage facility:** Store away from foodstuffs.

· **Further information about storage conditions:** Store in dry conditions.

8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see item 7.
· **Control parameters**
· **Components with limit values that require monitoring at the workplace:** Not required.
· **Additional information:** Valid lists at time of creation were used as basis.
· **Exposure controls**
· **Personal protective equipment:**

· **General protective and hygienic measures:**
The usual precautionary measures for handling chemicals should be followed.
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Do not inhale dust / smoke / mist.
Prevent contact with the eyes and skin.

· **Protection of hands:**
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to lack of information no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

Protective gloves

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

· **Material of gloves**
Recommended thickness of the material: ≥ 0.35 mm
Leather gloves

· **For the permanent contact in work areas without heightened risk of injury (e.g. Laboratory) gloves made of the following material are suitable:**
Leather gloves

(Contd. on page 4)

(Contd. of page 3)

· **For the permanent contact gloves made of the following materials are suitable:**
Leather gloves

· **For the permanent contact of a maximum of 15 minutes gloves made of the following materials are suitable:**
Leather gloves

· **Not suitable are gloves made of the following materials:** Strong fabric gloves

· **Eye protection:**

Safety glasses

· **Body protection:** Protective work clothing

*

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Color:	White
· **Odor:**	Odorless
· **Odor threshold:**	Not applicable.
· **pH-value (50 g/l) at 20 °C (68 °F):**	7
· **Change in condition**	
Melting point/Melting range:	120-135 °C (248-275 °F)
Boiling point/Boiling range:	Not determined.
Drip point:	50-150 °C (122-302 °F) (DIN 51801 & ASTM D 3954-9)
· **Flash point:**	>220 °C (>428 °F) (DIN 51758)
· **Flammability (solid, gaseous):**	Flammable.
· **Ignition temperature:**	>350 °C (>662 °F)
· **Decomposition temperature:**	Not applicable.
· **Auto ignition temperature:**	Product is not self-igniting.
· **Danger of explosion:**	Product is not explosive. However, formation of explosive air/vapor mixtures are possible.
· **Explosion limits:**	
Lower:	Not applicable.
Upper:	Not applicable.
· **Vapor pressure:**	Not applicable.
· **Density at 20 °C (68 °F):**	~0.93 g/cm³ (~7.76085 lbs/gal)
· **Vapor density**	Not determined.
· **Evaporation rate**	Not determined.
· **Solubility in / Miscibility with**	
Water:	Insoluble.
· **Coefficient of water/oil distribution:**	>6 log POW (calculated)

(Contd. on page 5)

Trade name: Polyethylene

(Contd. of page 4)

· **Viscosity:**	
Dynamic at 120 °C (248 °F):	<400 mPas (DIN 53019)
Kinematic:	Not applicable.
· **Other information**	
Particle characteristics	Not determined.

10 Stability and reactivity

· **Reactivity** No further relevant information available.
· **Chemical stability** No decomposition if used and stored according to specifications.
· **Possibility of hazardous reactions**
As the product is supplied it is not capable of dust explosion; however enrichment with fine dust causes risk of dust explosion.
· **Conditions to avoid**
In case of thermal decomposition caused by smouldering and incomplete combustion toxic fumes may be developed.
· **Incompatible materials:** Protect from contamination.
· **Hazardous decomposition products:**
Carbon monoxide and carbon dioxide
Flammable gases/vapors
Hydrocarbons

*
11 Toxicological information

· **Information on toxicological effects**

· **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**		
9002-88-4 Polyethylene		
Oral	LD50	7,950 mg/kg (rat)

· **Primary irritant effect:**

· **on the skin:**		
9002-88-4 Polyethylene		
Irritation of skin	IS	0 (-)

· **on the eye:**		
9002-88-4 Polyethylene		
Irritation of eyes	IS	0 (-)

· **Sensitization:** No sensitizing effects known.
· **Skin sensitization** No further relevant information available.

· **Additional toxicological information:**

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**	
	3

· **NTP (National Toxicology Program)**
Substance is not listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**
Substance is not listed.

(Contd. on page 6)

(Contd. of page 5)

· **CMR effects (carcinogenity, mutagenicity and toxicity for reproduction)**
· **Carcinogenicity** No further relevant information available.
· **Mutagenicity** No further relevant information available.
· **Reproductive toxicity** No further relevant information available.
· **Specific target organ toxicity (single exposure)** No further relevant information available.
· **Specific target organ toxicity (repeated exposure)** No further relevant information available.

*

12 Ecological information

· **Toxicity**

· **Aquatic toxicity:** No further relevant information available.

· **Persistence and degradability** No further relevant information available.
· **Other information:**
Do not allow product to reach sewage system, groundwater and any water course.
By the insolubility in water there is a separation at every filtration and sedimentation process.

· **Behavior in environmental systems:**

· **Bioaccumulative potential**
Due to the distribution coefficient n-octanol/water an accumulation in organisms is possible.
· **Mobility in soil** No further relevant information available.

· **Additional ecological information:**
· **General notes:**
Do not allow product to reach ground water, water course or sewage system.
Not hazardous for water.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

13 Disposal considerations

· **Precautions for disposal:**

· **Recommendation:**
Disposal must be made according to official regulations.
Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State/provincial and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state/ provincial and local requirements.

14 Transport information

· **UN-Number** · **DOT, ADR, ADN, IMDG, IATA**	Not applicable.
· **UN proper shipping name** · **DOT, ADR, ADN, IMDG, IATA**	Not applicable.
· **Transport hazard class(es)** · **DOT, ADR, ADN, IMDG, IATA** · **Class**	Not applicable.

(Contd. on page 7)

(Contd. of page 6)

· **Packing group** · **DOT, ADR, IMDG, IATA**	Not applicable.
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Segregation groups**	-
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **Transport/Additional information:**	Not dangerous according to the above specifications. GRACE recommendation for air transport: Cargo aircraft only.

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**

· **SARA**

· **SARA 302/304**

Substance is not listed.

· **SARA 313**

Substance is not listed.

· **SARA 311/312** Not applicable.

· **TSCA (Toxic Substances Control Act):**

ACTIVE

· **Hazardous Air Pollutants**

Substance is not listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for females:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for males:**

Substance is not listed.

· **Chemicals known to cause developmental toxicity:**

Substance is not listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**

Substance is not listed.

· **TLV (Threshold Limit Value)**

Substance is not listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

Substance is not listed.

· **Canadian DSL**

9002-88-4	Polyethylene

(Contd. on page 8)

(Contd. of page 7)

· **Canadian NDSL**
Substance is not listed.

· **European EINECS**
Substance is not listed.

· **Philippines Inventory of Chemicals and Chemical Substances PICCS**
Substance is listed.

· **Inventory of the Existing Chemical Substances manufactured or imported in China IECSC**

9002-88-4	Polyethylene

· **Australian Inventory of Industrial Chemicals (AIIC)**
Substance is listed.

· **Existing and New Chemical Substance List ENCS**
6-1

· **Korean Existing Chemical Inventory KECI**
KE-28877

· **TCSCA (Taiwan)**
EPEP4A01714252

· **Russian Register of Potentially Hazardous Chemical and Biological Substances (RPOHV)**
№ BT-000548 от 14.07.1995 г.

· **New Zealand Inventory of Chemicals (NZIoC)**
Substance is listed.

· **Existing Chemical Directory of Thailand (DIW)**
Substance is listed.

· **TCSI - Taiwan Chemical Substance Inventory**
Substance is listed.

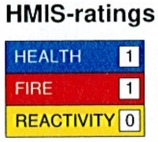
· **Mexican National Inventory of Chemical Substances (INSQ)**
Substance is listed.

· **GHS label elements** None
· **Hazard pictograms** None
· **Signal word** None
· **Hazard statements** None
· **Classification system:**

· **NFPA ratings (scale 0 - 4)**

Health = 1
Fire = 1
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = 1
Fire = 1
Reactivity = 0

* 16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Department issuing SDS:** GRACE Safety & Health Department

(Contd. on page 9)

(Contd. of page 8)

· **Contact:**
SALES OFFICES

USA:
GRACE
W. R. Grace & Co.-Conn
7500 Grace DR
Columbia, MD 21044
Tel: +1 410-531 4000

Europe:
Grace GmbH
In der Hollerhecke 1
D-67545 Worms, Germany
Tel: +49 6241 40300

Asia Pacific:
Grace Products (Singapore) Pte Ltd
230 Orchard Road
09-232, Faber House
Singapore 238854
Tel: +65 6737 3033
Fax: +65 6737 5826

Grace Trading (Shanghai) Ltd
19th Floor K.Wah Center
1010 Huai Hai Zhong Road
Shanghai, 200031 China
T (电话): +86 21 3325 8288
F (传真): +86 21 3325 8245

W. R. Grace Japan K.K
Kohken New River Bldg 3F
2-21-18, Shinkawa
Chuo-ku, Tokyo 104-0033
JAPAN
Tel: +81 3.3537.6006
Fax: +81 3.3537.6007

· **Other information:**
· **Date of preparation / last revision** 03/11/2022 / 3.2
· **The first date of preparation** 05/07/2003
· **Number of revision times and the latest revision date** 3.3 / 03/10/2022
· **Abbreviations and acronyms:**
ADR: Accord relatif au transport international des marchandises dangereuses par route (European Agreement Concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
NIOSH: National Institute for Occupational Safety
OSHA: Occupational Safety & Health
TLV: Threshold Limit Value
PEL: Permissible Exposure Limit
REL: Recommended Exposure Limit
· **Others** No further relevant information available.
· *** Data compared to the previous version altered.**

ATTACHMENT 8

Electric Flameless Thermal Oxidizer Vendor Information

Electric FTO
Flameless Thermal Oxidizer

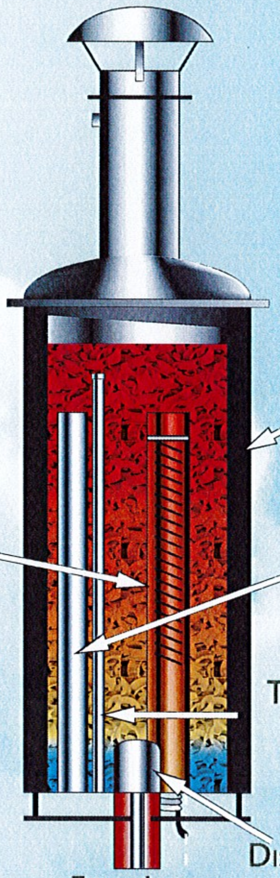
High Destruction Efficiency, Low NOx, Electrically Heated

The *PCC Electric FTO (EFTO)* consistently treats Volatile Organic Compounds (VOCs) in waste gas streams yielding removal efficiencies of 99.9999%. The thermal oxidation is accomplished at 1800°F to avoid production of thermal NOx and to minimize operating costs. Thermal NOx levels are <1 ppmv.

The *PCC Electric FTO* consists of a carbon steel, refractory-lined oxidation vessel. The vessel contains three spiral-wound electric resistance heater elements in 310SS protection tubes surrounded by a bed of randomly packed inert ceramic saddles. The *PCC Electric FTO* is fully automatic and there are no moving parts in the oxidizer. Alternate materials of construction are available as required based on the waste gas composition. A typical system requires 480V 3phase 100 amp, 120V 1 phase 20 amp, and 5 scfm of instrument air at 80 psig.

How the PCC Electric FTO Works

The *PCC EFTO* consists of a vertical, refractory-lined vessel filled with ceramic media. The ceramic media is pre-heated to a calculated temperature through the use of an electric resistance heater. Electrical energy is only required as a supplement to the heat content of the fume and to preheat the ceramic bed during start-up.



The waste gas and air are pre-mixed at the bottom of the vessel and introduced into the unit. The organic compounds found in the waste gas are oxidized and discharged into the atmosphere via a stack extension on the top of the unit.

The *PCC Electric FTO* operates well below the Lower Flammable Limit (LFL), eliminating the possibility of a flame within the system. The fume oxidizes as it passes through the oxidation zone releasing heat, which is transferred into the surrounding ceramic matrix thus maintaining the operating temperature of the bed without the need for supplemental heat via the electric heaters.

Simplicity of Design

The *PCC EFTO's* simplicity of design and portability make it a multi-purpose piece of equipment for multiple low volume gas treatment applications. The *PCC EFTO's* standardized design requires minimal customization. The modular configuration makes it simple to install.

PROCESS COMBUSTION CORPORATION

300 Weyman Road, Suite 400 · Pittsburgh, PA 15236 · (412) 655-0955 · pcc@pcc-group.com · www.pcc-group.com

Call now for a competitive proposal!

January 9, 2024

Susan Nash, Regulatory and Compliance Engineer Sr.
Air and Radiation Administration
Air Quality Permits Program
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230
susan.nash@maryland.gov

W. R. Grace & Co.- Conn. Columbia, MD facility's application for a planned pilot-scale test catalytic chemical conversion process was submitted to MDE on August 7, 2023.

The following is a response to your question, received on January 5, 2024, regarding emissions estimates in our application; namely, "How were the emissions estimates done for both stacks and for all types of pollutants [criteria, GHG, TAPs, etc.}".

Estimated emissions (along with relevant information in footnotes and assumed control efficiencies) for the Thermal Oxidizer (TO) Stack and the Regenerator Exhaust Vent are presented in Tables 1 and 2, for the TO Stack and Table 3, for the Regenerator Exhaust Vent, in Attachment 5 of the application. A summary of the bases and assumptions for the emissions estimates are given below.

For the TO Stack:

- Criteria pollutants
  - VOC based on gaseous hydrocarbon yield (i.e., mass hydrocarbon per mass raw material) and typical distribution of hydrocarbons from catalytic cracking estimated from
    - Bench scale lab testing results
    - Published technical papers of similar reactions
    - Understanding of cracking chemistry of the raw material
    - Mass balance of the system
  - PM estimated from
    - Assumed percentage of outlet particulate fines based on system catalyst inventory
- GHG pollutants
  - CO_2 estimated from
    - Bench scale lab testing results
    - Published technical papers of similar reactions
    - Understanding of cracking chemistry of the raw material
    - Mass balance of the system
    - As a result of the destruction of hydrocarbons in the TO, assumed moles of hydrocarbon carbon input to TO are converted to mass of CO_2 (one mole of carbon to one mole of CO_2)

    - Methane based on gaseous hydrocarbon yield (i.e., mass hydrocarbon per mass raw material) and typical distribution of hydrocarbons from catalytic cracking estimated from
        - Bench scale lab testing results
        - Published technical papers of similar reactions
        - Understanding of cracking chemistry of the raw material
        - Mass balance of the system
- TAPs
    - Six of the speciated VOC pollutants are Class II TAPs. See Criteria Pollutants bullet above for VOC.

For the Regenerator Exhaust Vent:

- All pollutants
    - Based on 20 years of experience on operating regenerators from other similar pilot plants (eg., Davison Circulating Riser (DCR))
- Criteria pollutants
    - CO estimated from
        - Assumed lean burn (excess oxygen) resulting in trace CO at detection limit
    - NO estimated from
        - Published technical paper of similar process (and similar N content of raw feed and lean combustion)
    - PM estimated from
        - Assumed percentage of outlet particulate fines based on system catalyst inventory
- GHG pollutants
    - CO_2 estimated from
        - Carbon balance of coke deposited on spent catalyst

Please contact me with any questions.

Sincerely,

Daniel Resca
Project Manager
W.R. Grace & Co.-Conn
Daniel.resca@grace.com
410-531-4570

HOWARD COUNTY DEPARTMENT OF PLANNING AND ZONING
3430 Court House Drive ■ Ellicott City, Maryland 21043 ■ 410-313-2350
Lynda D. Eisenberg, AICP, Director FAX 410-313-3467

RECEIVED
SEP 24 2024
By

September 13, 2024

To Whom It May Concern:

In September of 2023, WR Grace requested a Zoning Compliance Certificate associated with an application for a research-scale pilot plant for development purposes only at the request of Maryland Department of the Environment (MDE). The zoning compliance certificate was limited to whether this use is permitted at 7500 Grace Drive (Building 30 Lab 120).

A letter was issued to WR Grace and MDE in September of 2023 confirming R&D as an allowable use according to the following:

The property was zoned Residential in the first zoning regulations adopted in 1948 and rezoned as follows:

- 1961: R-40 (Residential, One and Two-Family Detached)
- 1977: R (Rural)
- 1986: PEC (Planned Employment Center) Zoning Board Case No. 814

The research and development laboratory land use was permitted as a matter of right in the PEC zoning district in 1991. This use was legally established in Building 30, as approved through SDP-91-090 in 1991.

The research and development establishments land use was removed as a matter of right use from the PEC zoning district during the 2013 Comprehensive Zoning.

Section 129.0.A of the Howard County Zoning Regulations, states that a nonconforming use is "any lawful existing use, whether of a structure or a tract of land, which does not conform to the use regulations of the zoning district in which it is located, either on the effective date of these Regulations or as a result of any subsequent amendment thereto. Therefore, the research and development activity on the Property is a nonconforming use.

A nonconforming use may be continued subject to the requirements of Section 129.0.B. The proposed research and development lab complies with these requirements.

More recently on August 19, 2024, because of numerous zoning inquiries regarding this site, the Maryland Department of the Environment requested DPZ to again verify the allowance of this use. The Department of Planning and Zoning received a zoning complaint on August 8, 2024, alleging that Engineering and Scientific Research is occurring at the property and is not in conformance with the PEC district. On Monday September 9, 2024, the Chief of Public Service and Zoning Administration along with representatives from the Maryland Department of the Environment and WR Grace visited the site and toured the inside of the facility to investigate possible zoning violations. During this inspection there were no zoning violations observed and no unapproved exterior development evident. WR Grace further supported their nonconforming use status by providing a letter indicating that the building has been used for research and development without cessation since 2013.

Attached is the close out letter indicating no zoning violations found at 7500 Grace Drive (Building 30 Lab 120) along with the WR Grace letter mentioned above.

The Department of Planning and Zoning only has the authority to inspect and validate the zoning and site conditions of the property and is not the issuer of the Air Quality Permit. The Maryland Department of Environment issues the permit and has previously conducted public meetings to receive comments and questions. Further concerns and questions may be directed to MDE's Shannon Heafey. Her contact information is below.

Shannon Heafey, Public Participation Coordinator Air Quality Permits Program, Air and Radiation Administration
Maryland Department of the Environment
1800 Washington Boulevard, Baltimore, Maryland 21230 shannon.heafey@maryland.gov
410-537-4433

Sincerely,

Geoff Goins, Division Chief
Public Service and Zoning Administration

Cc: Lynda Eisenberg, DPZ Director

Docusign Envelope ID: 2F85614F-1F83-4F6E-9132-E331C341BD71

HOWARD COUNTY DEPARTMENT OF PLANNING AND ZONING
3430 Courthouse Drive ■ Ellicott City, Maryland 21043 ■ 410-313-2350

Lynda D. Eisenberg, AICP, Director

www.howardcountymd.gov
FAX 410-313-3391
TDD 410-313-2323

September 13, 2024

Nana Adadey
7252 Mainstream Way
Columbia, MD 21044

RE: Alleged Zoning Violation
7500 Grace Drive
CE-24-107

Ms. Adadey,

In response to your request regarding the above-mentioned property a representative of the Zoning Division inspected the property on September 9, 2024. There were no violations of the Howard County Zoning Regulations or Subdivision and Land Development Regulations found for this property. Since there are no violations, the case is closed.

If you are interested in reviewing the case file for more details, please submit a written request to me at 3430 Court House Drive Ellicott City, MD 21043 or via email to ggoins@howardcountymd.gov.

Thank you for referring this matter to the Division of Public Service and Zoning Administration. If you have any questions concerning this case, please contact Geoff Goins at (410) 313-4350.

Sincerely,

DocuSigned by:

Lynda Eisenberg

Lynda D. Eisenberg, AICP, Director
Department of Planning and Zoning

Any person aggrieved by a decision of the Department of Planning and Zoning ***may file an appeal to the Board of Appeals****. An appeal to this notice must be filed within 30 days of the date of the notice and must state the alleged error or other grounds for the appeal. Instructions and forms for filing an appeal may be obtained from the Department of Planning and Zoning.*

GRACE
Talent | Technology | Trust

RECEIVED
SEP 24 2024
By

Scott K. Purnell
Vice President, R&D
Refining Technologies

T +1 410.531 8203
M +1 443 280 1265
Scott.Purnell@grace.com

W. R. Grace & Co.
7500 Grace Drive
Columbia, MD, USA 21044

September 9, 2024

W. R. Grace Building 30: Use

To Whom it May Concern:

I am writing to confirm that Building 30 on our property at 7500 Grace Drive, Columbia, MD has been in continuous use for research and development (R&D) activities since 2013 without cessation.

Examples of R&D work conducted in this building includes:

- Catalytic performance testing of Grace methanol-to-olefins (MTO) catalysts whereby methanol is reacted with our catalysts at high temperatures and converted to ethylene, propylene and other products. Catalysts are tested for activity, selectivity, and stability and compared against each other and over a range operating conditions.
- Catalytic performance testing of Grace RANEY® hydrogenation catalysts. RANEY catalysts are used in a range of hydrogenation reactions from nitro compounds to amines, carbonyls to alcohols, nitriles to amines, olefins, and acetylenes to saturates. Also, they are widely used in reductive alkylations, reductive aminations and ammonolysis of alcohols. Catalysts are tested for activity, selectivity, and stability and compared against each other and over a range operating conditions.
- Drying and high-temperature heat treatment of Grace Fluid Cracking Catalysts (FCC) and Additives as well as zeolites such as USY and ZSM-5.
- Studies whereby fluidizable catalysts with different particle size distributions and morphologies are studied over a range of air flow rates to compare their fluidization properties.
- Bench-scale sample handling including sample collection, separation, screening, preparation and submission to in-house and third-party analytical laboratories, etc.

If you have any further questions, please do not hesitate to contact me.

Sincerely,

Scott K. Purnell
Vice President, R&D

APPENDIX B
W.R. Grace &Co.-CONN
Letter Dated Oct 10, 2024

Ms. Apple Chapman
Assistant General Counsel
Regulatory & EHS

T +1 410.531.4182
M +1 443.518.0882
apple.chapman@grace.com
W. R. Grace & Co.-Conn.
7500 Grace Drive
Columbia, MD 21044

GRACE
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Suna Yi Sariscak, Manager
Air Quality Permits Program
Maryland Department of the Environment
Air and Radiation Management Administration
1800 Washington Boulevard, Suite 720
Baltimore, Maryland 21230-1720
MDE.Submit-AirPermits@Maryland.gov

October 10, 2024

Sent Via Electronic Mail

Re: Supplemental Information for Permit to Construct Research-Scale Pilot Plant, W.R. Grace & Co., 7500 Grace Drive, Columbia MD
<u>Docket No. 16-23</u>

Dear Ms. Sariscak:

W.R. Grace & Co. – Conn. (Grace) submitted the above-referenced application for a permit to construct in August 2023. We understand that questions have been raised regarding whether the proposed unit is subject to the requirements of NSPS Subpart EEEE, 40 C.F.R. Part 60, Subpart EEEE, which regulates, among other things, small municipal solid waste (MSW) incinerators. We are writing to provide confirmation that the unit is not subject to these requirements for reasons including the following: first, the unit will not process MSW; and second, the unit is exempt as a laboratory analysis unit.

I. Background

<u>Purpose</u>

Grace seeks to permit a pilot-scale project to research a new catalytic chemical process to convert plastics back into their original components. The purpose of this pilot plant is to develop data to assess the technical and economic feasibility of this advanced conversion technology. If successful, the technology could be licensed or sold to refineries and chemical manufacturing facilities to enable more efficient and low-pollution recycling of plastic wastes into useful raw materials and feedstocks.

Currently, plastic waste is often disposed either in landfills or by incineration. The only widely available commercial recycling technology for plastics is mechanical recycling, which involves breaking down the plastic into smaller pieces to be melted and re-used as recycled plastic. Mechanical recycling, however, has a substantial downside: plastic begins to lose its integrity as it is mechanically recycled—especially after multiple cycles. Grace's unique technology, if proven, will provide a new recycling option that is both more environmentally friendly and more commercially desirable: it will use a chemical reaction to break down the plastic into its component parts, such as ethylene, propylene, and butylene. These chemicals are commercially valuable and can be used to manufacture virgin plastic or for other uses.

The specific project that Grace proposes for its Columbia, Maryland R&D facility involves a pilot-scale process, which is several orders of magnitude smaller than a commercial process. The unit is designed to process only small quantities of various types of plastics to test/assess the process solely for research and development purposes.

Process

The process itself is shown in the attached drawing. The process begins by feeding plastic pellets into the unit's reactors along with a heated catalyst, nitrogen, and steam. No oxygen or flame is present in the reaction chamber; instead, heat is required to activate the catalyst and trigger the chemical reaction. This process is known as catalytic chemical conversion, or catalytic pyrolysis. The heated catalyst interacts with the plastic to break it down into its component parts, which at this point are entirely in a gaseous phase. The gas exits the reactor through a cyclone, which captures any small bits of catalyst that may be entrained in the gases and returns them to the reactor. From the cyclone, the gases enter a condenser unit to separate the products into gas and liquid fractions.[1] All liquids appropriate disposal; waste gases are controlled through a thermal oxidizer.

During the process, the catalyst becomes coated with catalytic coke, a soot-type substance that prevents the catalyst from interacting with the plastic feedstock. As a result, the catalyst is sent to a catalyst regenerator in a continuous process. The regenerator is like those used at many industrial catalytic processes and is an integral part of the process. The regenerator

[1] As described in more detail below, this pilot unit will employ a condenser for this stage of the process, but Grace anticipates that a commercial-sized unit would employ one or more distillation processes to separate out the gas and liquid fractions into individual products.

oxidizes the coke, which removes it from the catalyst, and the regenerated catalyst is returned to the reactor.

Contemplated Research Unit

The contemplated unit is specifically designed only for testing purposes. The unit will be different in several ways from a commercial unit.

First, the unit is very small, processing only 1 kg/hr of plastic pellets. Yearly operation is expected to be less than or equal to 4000 hours/year, compared with commercial operations that generally strive for more than 85% annual uptime, or 7400+ hours/year.

Second, the feedstock characteristics will be significantly different from a commercial unit. A commercial unit will likely be fed rough-shredded post-consumer plastics direct from a recycling facility, whereas the pilot process is only capable of feeding clean and carefully pre-sized pelletized plastics. The pilot project will have two phases of feed testing. In the first phase, the feedstock for the unit will comprise virgin plastic pellets bought from commercial suppliers. Grace plans to use a variety of types of pellets to assess the potential reaction products from different types of plastics (numbers 1-7). In addition, Grace may also add non-hazardous materials that are typically used as additives in manufacturing plastics, such as calcium carbonate, so that it may test the impact of these materials on the reaction output.[2]

If the results of the first phase indicate that the process is technologically feasible and commercially viable, Grace hopes to conduct a second phase of the pilot project to test recycled plastics. The unit cannot, however, directly process plastic waste. Rather, it is designed to accept only cleaned, pelletized plastic. Therefore, if and when the site moves to the second phase of the operation, it will need to either clean and pelletize recycled plastic before the plastic is fed to the process, or purchase cleaned, pelletized recycled plastic. This type of pelletized recycled plastic is often commercially sold as feedstock for a variety of manufacturing processes, including highly regulated food contact applications.

Third, we anticipate that a commercially sized process would conduct significant additional processing, including, for example, multiple distillations to separate the individual gaseous and liquid compounds produced by the process, and then use or sell those products as raw materials or feedstocks. The small size of the project here, however, means that it is not economically feasible to further process and sell or re-use the products. Instead, the pilot project

[2] Note that Grace will *not* intentionally add PFAS as part of its testing program.

will use a condenser to separate the vent stream from the reactor into liquid and gaseous components.

Grace will assess both the material yields and the chemical composition of each stream by sending the materials through analytical equipment such as a gas chromatograph. The results of these tests will be used to assess the technical and commercial viability of the operation and assess any environmental and/or commercial implications (*e.g.*, production of either useful or undesirable byproducts when particular types or combinations of materials are processed). After this testing is complete, the liquids will be sent off-site for proper treatment and disposal, and the gases will be sent to a thermal oxidizer with 99.99% combustion efficiency.

II. Applicability of NSPS EEEE

EPA has promulgated a variety of regulations for incinerators. NSPS Subpart EEEE applies to new incineration units that meet the definition of "very small municipal waste combustion units" and that are not otherwise excluded. 40 C.F.R. § 60.2885. A "municipal waste combustion unit" is defined as:

> any setting or equipment that combusts municipal solid waste (as defined in this subpart) including, but not limited to, field-erected, modular, cyclonic burn barrel, and custom-built incineration units (with or without energy recovery) operating with starved or excess air, boilers, furnaces, pyrolysis/combustion units, and air curtain incinerators (except those air curtain incinerators listed in § 60.2888(b))."

40 C.F.R. § 60.2977. "Municipal solid waste" (MSW), in turn, is defined as:

> refuse (and refuse-derived fuel) collected from the general public and from residential, commercial, institutional, and industrial sources consisting of paper, wood, yard wastes, food wastes, plastics, leather, rubber, and other combustible materials and non-combustible materials such as metal, glass and rock, provided that: (1) the term does not include industrial process wastes or medical wastes that are segregated from such other wastes; and (2) an incineration unit shall not be considered to be combusting municipal solid waste for purposes of this subpart if it combusts a fuel feed stream, 30 percent or less of the weight of which is

comprised, in aggregate, of municipal solid waste, as determined by § 60.2887(b).

Id.

Finally, Subpart EEEE excludes "laboratory analysis units," which are defined as units that [burn] samples of materials only for the purpose of chemical or physical analysis." *Id.* § 60.2887(j).

The proposed project does not fall within the scope of Subpart EEEE, for reasons including: (1) the unit does not combust MSW;[3] and (2) the unit is an exempt "laboratory analysis unit."

A. <u>The feedstock is not "municipal solid waste."</u>

As discussed above, phase 1 of the project will use virgin plastic pellets as feedstock. These pellets are commercially available and sold on the market for a number of uses. They are not and cannot be considered to be "refuse" or "refuse-derived fuel" within the meaning of the definition of MSW because they have never been "discarded."

The same holds true for the second phase, which will use cleaned, recycled plastic pellets. In this phase, the material used as feedstock may have begun as a waste material (*i.e.*, it was discarded from any number of residential, commercial, industrial, or institutional sources) in some past iteration, but the cleaned, processed plastic pellets used as feedstock are considered a new product and are no longer waste. Indeed, EPA has determined and courts have held that this feedstock is not a waste[4] and these types of clean, recycled plastic pellets are commercially available from a number of sources and can be used to make a variety of products, including

---

[3] Please note that the catalytic chemical process does not "combust" any materials. While Subpart EEEE does refer to "pyrolysis" units, EPA's focus at the time was on "pyrolysis/combustion" units – *i.e.*, those that use direct application of heat alone to burn/destroy materials, not catalytic chemical units that rely on a catalyst to chemically break down a material into its component parts. *See* 70 Fed. Reg. 74870, 74876-66 (Dec. 16, 2005).

[4] *See* 76 Fed. Reg. 15456, 15537 ("Collected plastic is generally sent to a reclaimer, who will sort, grind, and clean the plastic. The cleaned and sorted plastic is sent to a manufacturer who will use it as feedstock. These are clear examples where discarded materials are processed into legitimate non-waste products."); *Cf. Alternate Fuels, Inc. v. Dir. of Illinois E.P.A.*, 215 Ill. 2d 219, 240 (2004), as modified on denial of reh'g (June 16, 2005) (holding that plastic pesticide containers that were cleaned, shredded into chips, and sold as fuel did not constitute "waste" because the material was a new product that had been returned to the economic stream of commerce).

plastic bottles, piping, decking, or textiles. *See, e.g.*,
https://www.ptonline.com/products/mechanically-recycled-food-contact-hdpe-

We note that Subpart EEEE does apply to "refuse-derived fuel." *See* 40 C.F.R. §§ 60.2977. In this case, however, the pelletized plastic is not a "fuel" at all, because it is not being combusted (or otherwise used) for its heating or energy value.[5] Indeed, the heat required to activate the catalyst, generate steam for the process, and run the thermal oxidizer will be provided by electricity, using the existing electrical service at the Columbia site. In particular, the equipment identified in the permit application will be heated/cooled as follows:

1) Reactors and risers, heated by electric heater, with power provided and controlled by skid-mounted panel.
2) Reactor gas cyclone, heated by electric heater, with power provided and controlled by skid-mounted panel.
3) Reactor gas stabilization column, cooled by heat exchangers with circulating coolants, which are powered and controlled by skid-mounted electric chillers.
4) Electric flameless thermal oxidizer, heated by electric heater, with power provided and controlled by skid-mounted panel.
5) Spent catalyst stripper, heated by electric heater, with power provided and controlled by skid-mounted panel.
6) Spent catalyst regenerator, heated by electric heater, the power is provided and controlled by skid-mounted panel.
7) Steam generators, heated by electric heater, with power provided and controlled by skid-mounted panel.
8) Some associated hoppers, vessels/tanks, conveyance systems, and piping are heat traced by electric heaters, with power provided and controlled by on-skid panel.

Nor are other parts of the process where heat is used – *i.e.*, the thermal oxidizer and the catalyst regeneration unit – subject to Subpart EEEE.

[5] Refuse-derived fuel consists of mixed MSW subject to some basic level of shredding and sorting of non-combustibles. *See* "Energy Recovery from the Combustion of Municipal Solid Waste (MSW)," available at: https://www.epa.gov/smm/energy-recovery-combustion-municipal-solid-waste-msw; *see also* 76 Fed. Reg. 15456, 15537 ("Another example is scrap tires retrieved from waste tire piles that have been shredded/chipped into [tire derived fuel (TDF)] with the wire removed. In this instance, the scrap tires have been sufficiently processed and thus, the TDF would not be considered a solid waste when burned as a fuel. On the other hand, scrap tires from waste tire piles that have been shredded/chipped without the metal wire removed, would not be considered to have been sufficiently processed, and any TDF that is generated in such a fashion would be considered a waste-derived fuel."). Due to the level of sorting, cleaning, and processing required to manufacture them, as well as the variety of their non-fuel uses, the plastic pellets that Grace intends to use are not refuse-derived fuel.

Thermal oxidizer. The pilot plant will use a thermal oxidizer to destroy the gas stream exiting the condenser. As discussed above, this gas stream would normally be considered a "product" (and not a "waste"). In this case, however, the unit is too small to produce the kind of volume necessary for commercial viability; accordingly, the pilot plant will use the thermal oxidizer to destroy the product after it has been analyzed by the gas chromatograph. These kinds of gases, however, are expressly excluded from the definition of MSW, because they are uncontained and segregated from any other waste streams.[6] As such, the thermal oxidizer is not subject to Subpart EEEE; instead, it is treated and permitted as an air pollution control device and will be subject to appropriate emissions limits and monitoring requirements under the permit.

Catalyst regeneration unit. The chemical reaction process leads to the development of coke, or a sooty layer, on the catalyst. Because an effective chemical reaction requires catalyst with a sufficient clean surface area, the catalyst must be treated in a regeneration unit, which uses heat and oxygen to oxidize the coke. The catalyst regeneration unit operates continuously while the process is running to ensure a sufficient supply of clean catalyst.

These types of regeneration processes are used across a variety of industries and are consistently regulated as part of the process, not as a waste management unit.[7] Indeed, if the catalyst could be used only once before being disposed of, this catalytic chemical process would be cost-prohibitive; the regeneration is necessary to make the process commercially viable.[8]

Moreover, the materials heated in the catalyst regeneration unit are not "municipal solid waste" for purposes of Subpart EEEE. Specifically, all such materials are by-products of the on-site industrial/R&D activities. They are not "collected from" multiple off-site sources, as is required if Subpart EEEE is to apply. *See* 40 C.F.R. § 60.2977 (MSW must be "collected from the general public *and* from residential, commercial, institutional, and industrial sources.") (emphasis added).

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[6] *See* 40 C.F.R. § 60.2977 (defining "municipal solid waste" to exclude "industrial process wastes . . . that are segregated from such other wastes," and limiting "solid waste" to "contained gaseous material resulting from industrial . . . activities"); *see also* 70 Fed. Reg. 74870, 74877 ("It is important to note, however, that [thermal oxidizers and flameless thermal oxidizers] often are used to combust uncontained gases (generally from industrial processes) and are not used to dispose of solid waste. Such units would not be subject to the final OSWI rules.").

[7] *See, e.g.*, 40 C.F.R. Part 60, Subpart J (regulating, among other things, fluid catalytic cracking unit catalyst regenerators at refineries); 40 C.F.R. Part 63, Subpart UUU (regulating process vents from catalyst regeneration and reforming processes at refineries).

[8] Once the catalyst is completely spent and can no longer be used effectively in the process, is it considered a "waste" and will be properly disposed of at a permitted waste management facility.

In sum, no part of the pilot plant will combust municipal solid waste as those terms are defined in Subpart EEEE, and therefore the unit is not subject to Subpart EEEE's requirements.

B. The pilot process is an exempt "laboratory analysis unit."

In addition to not processing any MSW, the unit also is exempt from Subpart EEEE as a "laboratory analysis unit." 40 C.F.R. § 60.2887(j). Subpart EEEE expressly excludes units that "[burn][9] samples of materials only for the purpose of chemical or physical analysis."

Grace's pilot project falls squarely within this provision. As discussed above, the sole purpose of the project is to allow Grace to gather and analyze data on the products generated by the proposed catalytic chemical process. In particular, the site intends to weigh the products and evaluate them in a gas chromatograph to assess the composition of the products and the yield and quantity of each potentially useful material.

The unit in question is *not* designed to produce any gases or liquids for sale; indeed, the quantity of material that the unit is capable of processing (1 kg/hr) is so small that attempting to use the unit to manufacture a product for sale would not be commercially viable. Grace will thus receive no immediate economic benefit from this operation; indeed, it will be incurring costs to purchase feedstocks, provide power, and operate the process, without the benefit of generating any revenue. In sum, this pilot project would never be commercially viable as proposed. Accordingly, the pilot project qualifies as a "laboratory analysis unit" that is exempt from regulation under Subpart EEEE.

III. Conclusion

We appreciate the opportunity to address MDE's questions regarding the appropriate regulations to apply to this proposed project, and we hope we have addressed the concerns you raised. We believe that this new process technology will provide a more environmentally beneficial method of managing and re-using plastic wastes, producing more valuable products with lower environmental impacts. But we need to complete this project and conduct the planned testing to determine whether the process can work as efficiently and cost-effectively as we believe it will – and, indeed, to assess whether this process will be at all commercially viable.

[9] As noted above, the process in question does not in fact "burn" anything; rather, it uses a catalytic chemical reaction to break plastic molecules into their individual components.

Thank you for your assistance in ensuring that this project is properly permitted, and please let us know if you have any additional questions or need additional information.

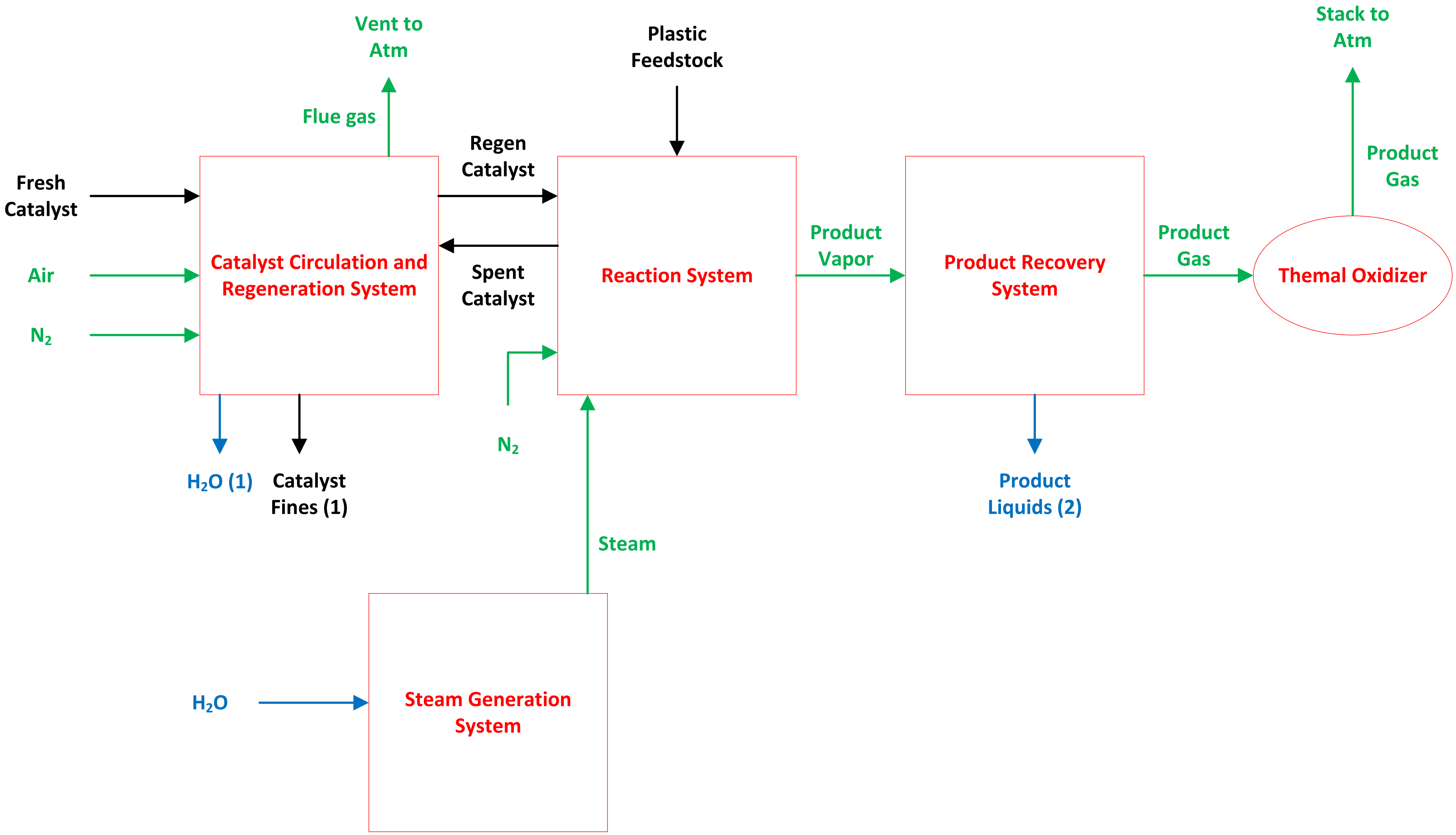
Sincerely,

Ms. Apple Chapman
Assistant General Counsel
Regulatory & EHS

Talent | Technology | Trust™

Attachment

Simplified Process Flow Diagram for Proposed Research Pilot Scale Test Catalytic Chemical Conversion Process



Notes:
(1) Non-hazardous waste disposal
(2) Transfer to 3rd party treatment facility

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Environmental Health Risks and Housing Values: Evidence from 1,600 Toxic Plant Openings and Closings†

Janet Currie,
Department of Economics, Princeton University, 316 Wallace Hall, Princeton, NJ 08540
(jcurrie@princeton.edu)

Lucas Davis,
Haas School of Business, University of California, Berkeley, Berkeley, CA 94720
(ldavis@haas.berkeley.edu)

Michael Greenstone, and
Department of Economics, University of Chicago, 1126 E. 59th Street, Chicago, IL 60637
(mgreenst@uchicago.edu)

Reed Walker
Haas School of Business, University of California, Berkeley, Berkeley, CA 94720
(rwalker@haas.berkeley.edu)

Abstract

Regulatory oversight of toxic emissions from industrial plants and understanding about these emissions' impacts are in their infancy. Applying a research design based on the openings and closings of 1,600 industrial plants to rich data on housing markets and infant health, we find that: toxic air emissions affect air quality only within 1 mile of the plant; plant openings lead to 11 percent declines in housing values within 0.5 mile or a loss of about $4.25 million for these households; and a plant's operation is associated with a roughly 3 percent increase in the probability of low birthweight within 1 mile.

Industrial plants that emit toxic pollutants are ubiquitous in the United States today, and many lie in close proximity to major population centers. These plants emit nearly 4 billion pounds of toxic pollutants in the United States annually, including 80,000 different chemical compounds.[1] Whereas criteria air pollutants like particulate matter have been regulated for decades, regulation of airborne toxic pollutants remains in its infancy. The nascent state of regulation of these emissions is controversial because, on the one hand, most of the chemicals emitted have never undergone any form of toxicity testing (US Department of Health and Human Services 2010)[2], and, on the other hand, they are widely believed to cause cancer, birth defects, and damage to the brain and reproductive systems (Centers for

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†Go to http://dx.doi.org/10.1257/aer.20121656 to visit the article page for additional materials and author disclosure statement(s).

Correspondence to: Reed Walker.

[1]US Government Accountability Office, http://www.gao.gov/highrisk/risks/safety-security/epa_and_toxic_chemicals.php (accessed March 19, 2012).

[2]The Environmental Protection Agency characterizes their risk assessments as "not completely accurate" because "scientists don't have enough information on actual exposure and on how toxic air pollutants harm human cells. The exposure assessment often relies

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Disease Control and Prevention 2009). The unveiling of the Mercury and Air Toxics Standards in December 2011 represents the first time the US government has enforced limits on mercury and other toxic chemicals.

Toxic emissions are one of the reasons why siting industrial plants is so controversial. Policymakers must balance the negative externalities associated with industrial plants with their potential to create jobs, increase local economic activity, and lead to positive economic spillovers (Greenstone, Hornbeck, and Moretti 2010). While negative externalities often generate intense local opposition (e.g., "not in my backyard" or NIMBY movements), there is also frequently intense competition among communities to entice industrial plants to locate within their jurisdictions. If siting decisions are to be made efficiently, it is crucial that policymakers have reliable measures of the different costs and benefits.

This paper represents a first step toward understanding the external costs of industrial plants that emit toxic pollutants in terms of both individuals' willingness to pay to avoid these facilities and population health. In order to address this question, we have assembled an extraordinarily rich dataset on the location and economic activity of industrial plants in five large US states. Our analysis focuses, in particular, on plants that report toxic emissions to the US Environmental Protection Agency's *Toxic Release Inventory*. We link information on these "toxic" plants with administrative data that provides detailed information on the near-universe of housing transactions and birth outcomes in these states. All three datasets provide geographic coordinates, so we are able to perform the analysis with an unusually high degree of spatial detail.

Since the previous literature offers little guidance about how far toxic air pollutants travel, our first contribution is to measure the relationship between toxic emissions and air quality. Using data from pollution monitoring stations and a difference-in-differences estimator, we document that there are significantly higher levels of ambient toxic pollution within one mile of operating plants but no significant effect at further distances. On average, each birth in our sample lies within 1 mile of 1.27 toxic plants, so our results imply that the total amount of exposure could be substantial.

The findings on the distance that toxic air emissions travel guide our research design, which is based on the sharp changes in local amenities that result from more than 1,600 toxic plant openings and closings.[3] Our estimates are based on comparing housing prices and birth outcomes within 0.5 miles or 1 mile of plants with these same outcomes measured 1–2 miles away from plants, after adjustment for all unobserved time-varying factors that are common within 2 miles of the plants.[4] Further, the estimates are based on millions of births and hundreds of thousands of housing transactions.

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on computer models when the amount of pollutant getting from the source(s) to people can't be easily measured. Dose-response relationships often rely on assumptions about the effects of pollutants on cells for converting results of animal experiments at high doses to human exposures at low doses" (EPA 1991).

[3]Our approach is inspired by pioneering studies by C. Arden Pope and collaborators who examined the health effects of opening and closing the Geneva steel mill near Provo, Utah in the late 1980s (Pope 1989; Ransom and Pope 1992; Pope, Schwartz, and Ransom 1992). These studies have been influential largely because the resulting sharp changes in airborne particulates over a short period of time make the empirical analyses transparent and highly credible.

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This research design reveals that housing prices within 0.5 miles of a toxic plant's site decrease by about 11 percent after a plant opens, relative to the period before the plant was constructed. This decline implies an aggregate loss in housing values of approximately $4.25 million for the average plant opening. Housing prices are largely unaffected by a plant closing, relative to the period when the plant was operating, implying that toxic plants continue to negatively affect housing prices after they cease operations. Potential explanations for a plant's lasting effect include persistent visual disamenities, concerns about local contamination, or an expectation that the plant will reopen.

Many toxic pollutants are colorless, odorless, and not well monitored, making them less salient than other negative externalities. Thus, it is valuable to contrast housing prices with health outcomes, which should immediately respond to changes in plant activity. We find that the incidence of low birthweight increases by roughly 3 percent within 1 mile of operating toxic plants, with comparable magnitudes between 0 and 0.5 miles and 0.5 and 1 miles. Like the housing price impacts, the impacts on infant birthweight appear to be highly localized, with no impact beyond one mile.

We believe our study is the first large-scale empirical analysis of the external costs of toxic plants.[5] The availability of 1,600 plant openings and closings allows us to begin to characterize the heterogeneity of effects across plants. In additional results, we stratify plants by size, the amount and toxicity of emissions, and local demographic characteristics and find that the housing price and health impacts are experienced broadly across different types of plants. There is some evidence that housing price responses are stronger in lower income communities, whereas the estimated health effects are relatively uniform across plant and community types.

The rest of the paper proceeds as follows: Section I presents an analytical framework which helps motivate the empirical analysis. Section II discusses the data, and Section III discusses the research design. Sections IV and V outline the econometric specifications and results for housing values and infant health respectively. Finally, Section VI interprets the results, and Section VII concludes.

I. Conceptual Framework for the Incidence of Toxic Plant Openings

To motivate our empirical strategy, we outline a partial equilibrium model of housing incidence in the context of toxic plant externalities.[6] A local economy consists of a continuum of agents of measure one (denoted L) who choose to live in one of two locations $g \in \{N, F\}$; some choose to live near a plant ($g = N$) and others choose to live further away from a plant ($g = F$), but in the same local labor market. Toxic plant activity is assumed to generate local economic benefits for both sets of residents in the form of wage income, w.

[4]There have been attempts to study the health and housing price responses of toxic emissions at the county level (Agarwal, Banternghansa, and Bui 2010; Bui and Mayer 2003; Currie and Schmieder 2009), but counties are too large due to the short transport distances of most airborne toxic pollutants (see Figure 1).

[5]Studies of individual plants include the studies by C. Arden Pope mentioned above, as well as Blomquist (1974), Nelson (1981), and Kiel and McClain (1995). For studies of multiple plants see, e.g., Bui and Mayer (2003) and Davis (2011).

[6]The results from this partial equilibrium exercise generalize into a model of general equilibrium of the sort found in Kline (2010) and Moretti (2011). These models are themselves generalizations of the canonical models of Rosen (1974) and Roback (1982).

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Wages are assumed to be an exogenous function of local productivity and are the same across groups. Residents in each location enjoy location-specific amenities net of any housing costs, A_g, associated with their location. Lastly, each resident i has some idiosyncratic preference for both locations, ϵ_{ig}, representing heterogeneity in the valuation of local amenities. The ϵ_{ig}s are independently and identically distributed across individuals and assumed to possess a continuous multivariate distribution with mean zero.

An individual seeks to maximize utility by choosing over locations

$$U_{ig}=\max\{\nu_N+\varepsilon_{iN},\nu_F+\varepsilon_{iF}\},$$

where ν_g represents mean utility in location g. Individuals will locate in whichever community yields the highest utility. Without heterogeneity in locational preferences, all individuals will locate in the community that offers the highest amenities. With heterogeneity in tastes, individuals in location N will have $\nu_N - \nu_F > \epsilon_{iF} - \epsilon_{iN}$. Define the distribution function $\eta_i \equiv \epsilon_{iF} - \epsilon_{iN}$ by $G(\cdot)$. Then, $L_N \equiv \Pr(\eta_i < \nu_N - \nu_F)$ is the measure of individuals in location N.

Write the total welfare of workers in location N and F as

$$V=E[\max\{\nu_N+\varepsilon_{iN},\nu_F+\varepsilon_{iF}\}]$$

and consider a positive economic shock stemming from a toxic plant opening in the community. We model this shock as a marginal improvement in productivity in the local community, which is assumed to increase wages in both the near and far locations equally. The plant opening, however, creates a negative externality for residents living near the plant through, for example, air pollution and related health effects.

Taking the derivative of workers' welfare with respect to the economic shock associated with a plant opening yields the expression:

$$\frac{dV}{d\theta}=L_F\cdot\frac{\partial w}{\partial\theta}+L_N\cdot\left[\frac{\partial w}{\partial\theta}+\frac{\partial A_N}{\partial\theta}\right]=L\cdot\frac{\partial w}{\partial\theta}+L_N\cdot\frac{\partial A_N}{\partial\theta}, \quad (1)$$

where $d\theta$ represents the marginal effect of a plant opening and $\frac{dV}{dv_g}=L_g$.[7] Equation (1) suggests the incidence of the plant opening may be summarized by two terms. The first term is the total wage effect associated with the plant opening. Since in our empirical application, all residents near or far live within two miles of a plant, we assume that the wage effects are similar for both nearby residents and those a little further from a plant. The second term consists of the non-wage changes in amenities associated with a plant opening for residents

[7]The relationship $\frac{dV}{dv_g}=L_g$ follows directly from assuming that preference heterogeneity is drawn from a Type I Extreme Value distribution (Train 2003). However, this relationship also holds independent of the distribution of the taste heterogeneity. See Busso, Gregory, and Kline (2013).

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near the plant. Since negative plant externalities in the form of noise or air pollution are highly localized, these costs will only accrue to the residents living near the plant.

After the plant opening some "marginal" residents who initially lived near the plant are better off moving further away. However, since workers are assumed to be optimizing with respect to location decisions, a simple envelope result suggests that workers who switch locations in response to a change in local amenities experienced small gains in private utility by doing so.[8] Therefore, the incidence of the plant opening may be approximated simply by the change in prices experienced by the immobile population.[9]

This paper aims to estimate the local disamenities of toxic plant operation, $\frac{\partial A_N}{\partial \theta}$, *holding all other factors fixed*. We do this by comparing residents near a plant to those within the same local labor market who live slightly further away. Since, by assumption, both groups are affected similarly by the productivity shock, the difference- in-differences estimate will approximate $\frac{\partial A_N}{\partial \theta}$. By explicitly controlling for the first component of equation (1) in this way, our estimates will reflect the gross external costs/benefits of a toxic plant opening or closing rather than the net external costs/benefits after accounting for any local economic gains associated with toxic plant production.

II. Data Sources and Summary Statistics

A. The Toxic Release Inventory Data

We identify plants that emit airborne toxic pollutants using the Toxic Release Inventory (TRI), a publicly available database established and maintained by the US Environmental Protection Agency (EPA).[10] The TRI was established by the Emergency Planning, Community Right to Know Act (EPCRA) in 1986, in response to the Bhopal disaster and a series of smaller spills of dangerous chemicals at American Union Carbide plants. Bhopal added urgency to the claim that communities had a "right to know" about hazardous chemicals that were being used or produced in their midst. EPCRA requires manufacturing plants (those in Standard Industrial Classifications 2000 to 3999) with more than 10 full-time employees that either use or produce more than threshold amounts of listed toxic substances to report releases to the EPA.[11]

[8]Although the change in amenities induces changes in behavior, these behavioral responses cannot have a first-order effect on private welfare; if they did, agents would not be optimizing. Alternatively, in this model the marginal migrant is indifferent between location 1 and location 2. Thus, any marginal shift in amenities in location 1 cannot make the agent much better off given the pre-intervention indifference between the two locations. Of course, plant openings and closings might not be marginal changes.

[9]In the case of non-marginal changes in productivity or local amenities, the envelope theorem no longer holds, and taste-based sorting may also have first-order implications for welfare. However, in the case of localized disamenities such as a single plant, Bartik (1987) and Palmquist (1992) show that the slope of the hedonic price function is an approximate measure of the willingness to pay for a non-marginal change. See Greenstone and Gallagher (2008) for a more complete discussion of non-marginal changes in the context of environmental amenities. Equilibrium sorting models may also yield insight into the welfare effects of non-marginal changes in the context of environmental disamenities. See Kuminoff, Smith, and Timmins (2013) for a recent review.

[10]See EPA (2009a) and EPA (2012) for detailed descriptions of the TRI.

[11]Currently, facilities are required to report if they manufactured or processed more than 25,000 pounds of a listed chemical or "otherwise used" 10,000 pounds of a listed chemical. For persistent bio-accumulative toxins, the thresholds are lower. These thresholds have changed periodically over the life of the program. For example, in 1998, EPA added the receipt or disposal of chemical waste to the definition of "otherwise used."

The toxic emissions measures in the TRI have been widely criticized (de Marchi and Hamilton 2006; Koehler and Spengler 2007; Bennear 2008). The emissions data are self-reported, and believed to contain substantial measurement error.[12] Moreover, coverage has expanded over time to include additional industries and chemicals, making comparisons of total emissions levels over time extremely misleading. [13] Finally, because of the minimum thresholds for reporting, plants may go in and out of reporting even if they are continually emitting toxic chemicals. This feature of the TRI introduces additional measurement error, and also makes the TRI poorly suited for identifying plant openings and closings.

The TRI is extremely useful, however, for identifying which US industrial plants emit toxic pollutants. The approach we adopt in this paper is to ignore the self-reported magnitudes and instead exploit variation introduced by plant openings and closings. Using the publicly available TRI data, we create a list of all US “toxic” plants by keeping every plant that ever reported toxic emissions to the TRI in any year. This method sidesteps the problems introduced by changes in reporting requirements because plants end up being classified as “toxic” plants, even if, for example, they are in industries which were not included in the early years of the TRI. We then link this list of toxic plants to establishment-level data from the US Census Bureau to determine the years in which each plant opened (and closed, if applicable).

B. The Longitudinal Business Database

We determine the exact years in which plants open and close using the US Census Bureau’s Longitudinal Business Database (LBD). Started in 1975, the LBD is a longitudinal, establishment-level database of the universe of establishments in the United States.[14] The LBD has been used widely by economists, for example, in studying plant-level employment dynamics (Davis et al. 2010), and is by far the most accurate existing record of US plant activity.

These data must be accessed at a Census Research Data Center under authorization from the Census Bureau. In addition to the year of opening and closing (if applicable) for each plant, these data report mean annual employment and mean annual total salaries.[15] We merge the LBD with a second restricted access Census database called the Standard Statistical Establishment List (SSEL), which contains plant names and addresses for all plants in the LBD. Finally, we merge the LBD/SSEL dataset with the EPA’s TRI database via a name- and address-matching algorithm.[16]

[12]The EPCRA explicitly states that plants need not engage in efforts to measure their emissions. The EPA provides guidance about possible estimation methodologies, but plants estimate their emissions themselves, and estimating methodologies vary between plants and over time. In addition, EPA enforcement of TRI reporting has typically taken the form of ensuring compliance rather than accuracy (de Marchi and Hamilton 2006).

[13]Federal facilities were added in 1994. Mining, electric utilities, hazardous waste treatment and disposal facilities, chemical wholesale distributors, and other additional industrial sectors were added in 1998. Treatment of persistent bio-accumulative toxins was changed in 2000. By the EPA’s own admission, the TRI is not well suited for describing changes in total amounts of toxic releases over time (EPA 2012).

[14]For more information about the LBD, see Davis, Haltiwanger, and Schuh (1998) and Jarmin and Miranda (2002).

[15]The year of a plant opening is left-censored for those plants that were operating on or before 1975.

[16]See Walker (2013) for further details pertaining to the match algorithm.

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C. Housing Values

The housing data for this project includes housing transactions in five large states (Texas, New Jersey, Pennsylvania, Michigan, and Florida). These data report the date, price, mortgage amount, and address of all property sales for these five states from approximately 1998 to 2005.[17] The data also include the exact street address of the property, which allows us to link the housing data with plant level data from the TRI based on the latitude and longitude of the geocoded address (described in more detail below). The main limitation of the housing data is that it contains very little information pertaining to housing unit characteristics.[18] These data include both residential and commercial real estate transactions; we focus only on single-family, residential properties. To limit the influence of outliers and focus on "arms length" transactions, we exclude properties that sold for less than $25,000 or more than $10 million. All housing prices have been adjusted to year 2000 dollars.

D. Vital Statistics Data

Data on infant health comes from vital statistics natality and mortality data for the same five large states: Texas, New Jersey, Pennsylvania, Michigan, and Florida, from 1990 to 2002. Together, these states accounted for 10.9 million births between 1990 and 2002, approximately 37 percent of all US births. The substantial advantage of these restricted-access data is their geographic detail, including the residential address of the mother. This precision is crucial in our context because the health consequences of toxic plants are highly localized.

These data include detailed information about the universe of births and infant deaths in each state. We focus, in particular, on whether the infant is low birthweight defined as birthweight less than 2,500 grams. Low birthweight is not uncommon, affecting about seven percent of the births in our sample. Low birthweight is also one of the most widely used overall indicators of infant health, in part because it has been shown to predict adult well-being.[19] Other birth outcomes that we examine include a continuous measure of birthweight, very low birthweight (defined as birthweight less than 1,500 grams), prematurity (defined as gestation less than 37 weeks), congenital abnormalities, and infant mortality (death in the first year).[20] Focusing on infant health is advantageous, relative to adult outcomes, because infants do not have a long unobserved health history, reducing concerns about time lags between exposure and outcomes.

In addition to these health outcomes, the vital statistics data include a number of important maternal characteristics including age, education, race, and smoking behavior. In the

[17]The transaction records are public due to state information disclosure acts, but the raw data are often housed in PDF images on county websites making them inaccessible for computational analysis on a large scale. We used an external data provider who compiled the information from the county registrar websites into a single dataset. Data availability and temporal coverage varies by county but is fairly consistent between 1998–2005, the years of our housing analysis.

[18]For example, we observe square footage of the housing unit for less than half of the transactions.

[19]Black, Devereux, and Salvanes (2007) use twin and sibling fixed effects models on data for all Norwegian births over a long time period to show that birthweight has a significant effect on height and IQ at age 18, earnings, and education. Using US data from California, Currie and Moretti (2007) find that mothers who were low birthweight have less education at the time they give birth and are more likely to live in a high poverty zip code. They are also more likely to have low birthweight children.

[20]These are all outcomes that have been previously examined in the environment-infant health literature (e.g., Chay and Greenstone 2003; Currie, Neidell, and Schmieder 2009; Currie, Greenstone, and Moretti 2011; and Currie and Walker 2011).

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empirical analyses below we control explicitly for these factors, as well as for month of birth, birth order, and gender of child. In all analyses we exclude multiple births since they are likely to have poor birth outcomes for reasons that have little to do with environmental pollution. We also test whether plant openings and closings have affected these characteristics directly, either by changing the composition of neighborhoods near plants and/or by changing fertility.

The fact that the LBD data is annual, while births are reported monthly raises the question of how to appropriately structure the empirical models for infant health outcomes. We focus the analysis on a data file comprised of births in November, December, January, and February. Births in November and December are merged to LBD data from the same calendar year, while births from January and February are merged to LBD data from the preceding calendar year. The idea is that a baby born January 1, 2002 has not been exposed to any of the toxic plant activity for calendar year 2002, but was exposed to toxic emissions in 9 out of 12 months of 2001. Similarly, a baby born in November 2001 was exposed to toxic emissions for 9 out of 12 months of 2001. This restriction has the additional advantage of limiting the extent to which seasonality in plant activity or birth outcomes affects our findings. The robustness of the results to alternative timing assumptions is explored in the subsequent analysis.

E. Data Linkages and Aggregation

We link plants in the TRI and LBD to the housing and vital statistics, based on the latitude and longitude of the plants, houses, and mother's residence. Specifically, we first create a large dataset consisting of all pairwise combinations of plants and outcome variables (i.e., births and/or housing transactions). We keep outcome and explanatory variables within two miles of a plant. This means that any house or birth observation within two miles of more than one plant will contribute one observation for each plant-outcome pair. For the primary specifications, we collapse the outcome measures into various distance bins surrounding plants in a given year to minimize the computational burden of working with the universe of birth and housing transactions crossed with plants. That is, for each plant-year, we construct the mean of the outcome variable and key covariates for outcomes that occurred within 0 to 0.5, 0.5 to 1.0, 0 to 1.0, and 1.0 to 2.0 miles of a plant. In addition to easing the computational burden, the collapsing of the data accounts for issues pertaining to inference when the identifying variation occurs at a more aggregate level. In supplementary specifications, we analyze subsamples using the underlying microdata.

F. Summary Statistics

Panel A of Table 1 presents summary statistics for the 3,438 plants that form the basis for our analysis. The three columns reflect the sample characteristics for plants that were always open, newly opened, and newly closed within our sample frame respectively. A plant can appear in both columns 2 and 3, and we have about 1,600 total plants that either open or close. In practice, the plants in our sample tend to be long-lived, with a median age of around 17 years.[21] For continuously operating plants, the mean value of plant equipment and structures is $22 million, and mean annual salary and wages is $11.7 million.[22] Mean salary and wages is lower for plants that opened or closed. The table also reports mean annual toxic emissions, which exceeds 17,000 pounds in all three columns. These are the self-reported measures of airborne toxic emissions from the TRI, and are averaged over all non-missing observations (i.e., if a plant does not report to the TRI during a particular year in which we know the plant is operating, we treat this as missing rather than zero).

Panel B of Table 1 describes community characteristics near plants that either opened or closed during our sample period. Statistics are reported separately by distance to the plant and observations are restricted to the two years after a plant opening or the two years before a plant closing. Note that a house or birth can be close to more than one plant, and so the same house or birth can appear in more than one column. Within columns, we have restricted houses and births so that they appear only once in this panel, implicitly giving equal weight to each birth and housing outcome.

Both housing values and maternal characteristics tend to improve with distance from the plant. The average housing value is $124,424 within a half mile of a plant compared to $132,227 for houses between one and two miles away. Similarly, average maternal education rises from 11.93 to 12.22 over the same distance. Rather than rely on equality of levels, our difference-in-differences-style identification strategy relies on the assumption that trends in the unobserved determinants of the outcomes are evolving equally in the 0–1 (or 0–0.5 and 0.5–1.0) and 1–2 mile distance from the plant categories. The subsequent analysis provides graphical evidence supporting the validity of this assumption.

III. The Transport of Airborne Toxic Pollutants as the Basis of a Research Design

Our difference-in-differences strategy compares houses and births in areas “near” a toxic plant to those in areas slightly farther away. While this is a simple idea conceptually, there is little guidance in the literature about how near a household must be to a plant for proximity to affect either housing prices or birth outcomes (or alternatively, about how far toxic emissions are transported). Hence the first step in our analysis is to characterize this relationship empirically. This evidence is of significant independent interest and an important contribution of our paper.

Our approach uses data from monitoring stations about ambient levels of hazardous air pollution. While the EPA has been monitoring criteria air pollutants for four decades, they have only recently begun monitoring hazardous air pollutants (HAPs).[23] The first year of data availability was 1998, and monitors have been gradually added over time. As of 2005, the last year of our sample, there were 84 pollutants being monitored across the 5 states we examine. We investigate the ways in which plant operating status maps into local ambient

[21] Plant age in the LBD is left-censored in 1975 (the first year the plants are observed in the sample). Therefore, the median age of the plants in our sample is likely to be a bit larger.

[22] The capital stock measures come from the Annual Survey of Manufacturers, and are computed using a modified perpetual inventory method (Mohr and Gilbert 1996). Since the ASM is a sample and oversamples large establishments, these statistics are not available for all plant years and reflect statistics for larger plants.

[23] Hazardous air pollutants, also known as toxic air pollutants, are defined by the EPA as “pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects” (EPA 2011). In contrast, criteria air pollutants, are the more commonly found air pollutants that are regulated according to the EPA’s National Ambient Air Quality Standards (NAAQS), such as particulate matter.

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hazardous air pollution in two separate ways. First, we take the eight most monitored pollutants in our data and examine pollutant-by-pollutant heterogeneity in emissions transport as a function of plant operating status and distance between a plant and a monitor. Second, we combine all pollutants into a single summary measure by standardizing each pollutant to have mean zero and standard deviation of one.[24]

We matched the monitoring station data to our data on toxic plants using latitude and longitude, keeping monitor-plant pairs in which the plant had ever reported releasing the monitored pollutant and in which the monitor was less than four miles away from the plant. We then estimate the following linear regression model:

$$\mathrm{Poll}_{\mathrm{jmt}}=\beta_0+\beta_1 1[\mathrm{Plant\ \ Operating}]_{jt}+(1[\mathrm{Plant\ \ Operating}]_{jt}\cdot\mathrm{Distance}_{jm})'\beta_d+\eta_{jm}+\tau_t+\varepsilon_{\mathrm{jmt}}, \quad (2)$$

where the dependent variable is one of the pollution measures described in the previous paragraph for monitor *m* linked to plant *j* in year *t*. The regression includes an indicator variable for whether a plant is operating in a given year, and the interaction between the indicator and a quartic polynomial in the distance between the plant and the monitor.[25], [26] We also include monitor-plant pair fixed effects, η_{jm}, which are collinear with the main effect of the distance polynomial. The inclusion of these fixed effects ensures that identification comes from plant openings and closings. Lastly, we include year fixed effects, τ_t, to control for overall trends in ambient pollution concentrations. The standard errors are two-way clustered on monitor and plant.

Figure 1 plots the marginal effect of an operating plant on hazardous air pollution as a function of distance from the plant for eight of the most widely monitored pollutants. Each panel of Figure 1 presents the pollutant-specific distance gradient, showing how the marginal effect of plant operation fades with distance. Each pollutant has been standardized by subtracting the pollutant-specific mean and dividing by the standard deviation so that the distance gradient may be interpreted as standard deviations from the mean value. Below each graph is a histogram showing the number of monitors in 0.1 mile increments. There is some heterogeneity across pollutants, and in future work it might be possible to take advantage of these differences to disentangle the impacts of specific pollutants. For the most part, however, pollution levels tend to fall exponentially with distance from the plant. In most cases, pollution is only detectable within one mile of a plant.

Figure 2 plots the standardized pollution measure pooling over all 84 pollutants in our sample. Average levels of ambient hazardous air pollution are one standard deviation higher immediately adjacent to an operating plant, and decline exponentially with distance, reaching zero at roughly one mile from a plant. Most previous analyses of the economic

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[24]Note that some pollutants are more toxic or hazardous than others. For the purposes of this particular econometric exercise, we are simply trying to understand if *any* detectible relationship exists between toxic plant activity and ambient levels of hazardous air pollutants, irrespective of the toxicity of a given pollutant.

[25]We have also examined different functional forms for distance and the results are similar. Models using more flexible distance specifications, such as replacing a continuous distance measure with dummy variables for different distance bins yield similar results, but the models are less precisely estimated.

[26]The LBD provides information on the first year and last year that a plant is observed in the data. We define $1[\mathit{Plant\ Operating}]_{jt} = 1$ if year *t* is greater than or equal to the first year the plant is observed in the data and less than or equal to the last year the plant is observed in the data.

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impacts of toxic emissions have used county-level data, making it impossible to measure these highly localized impacts. An important exception is Banzhaf and Walsh (2008), who use block-level aggregates from the 1990 and 2000 censuses for urban areas in California to examine localized changes in average household income.

Documenting this relationship between toxic plant activity and ambient levels of hazardous air pollution helps to motivate our empirical specification. There are several ways for an industrial plant to affect housing values and human health including aesthetics, congestion, and noise. Toxic emissions may be among the channels that have the most distant effects, and the evidence suggests that on average emissions do not reach further than one mile.[27] This finding underscores the importance of performing the analyses that follow using spatial data at a high level of resolution. In most analyses below, we define "near" as within 0.5 or 1 mile of a plant and "far" as one to two miles away. That is, houses and households between one and two miles are used as comparison groups. We also present results using alternative distances. As discussed above, the underlying assumption is that the comparison groups are close enough to experience the wage and productivity effects of the plant. A second assumption is that outcomes in the near and far areas are evolving with similar trends. Under these assumptions, differences in the impact of plant operations reflect the effects of the local disamenities of plant operation.

IV. Housing Values

A. Housing Values: Empirical Strategy

We begin our investigation of the effects of toxic plants on housing values by fitting the following econometric model:

$$\begin{aligned} Y_{\mathrm{jdt}} = & \beta_0 + \beta_1 1[\text{Plant Operating}]_{jt} + \beta_2 1[\text{Near}]_{jd} \\ & + \beta_3 (1[\text{Plant Operating}]_{jt} \times 1[\text{Near}]_{jd}) + \eta_{jd} + \tau_t \\ & + \beta_4 (X1990_{jd} \times T_t) + \varepsilon_{\mathrm{jdt}}, \end{aligned} \quad (3)$$

where Y_{jdt} denotes the natural log of average housing values near plant site *j*, within distance group *d*, in year *t*. For each plant *j*, there are two observations per year. In each plant-year, one observation consists of average housing prices "near" a plant (i.e., within 0.5, 0.5 to 1.0, or 1 mile of the plant). The second observation per plant-year consists of average house prices for houses within 1–2 miles of the plant; this second group provides a counterfactual for housing prices near the plant. The availability of these two groups allows for a difference-in-differences-style estimator.

The variable $1\,[\mathit{Plant\ Operating}]_{jt}$ is an indicator equal to one if a toxic plant *j* is operating in year *t* and zero otherwise. It is equal to one for both distance groups associated with a plant. The indicator $1\,[\mathit{Near}]_{jd}$ is equal to one for observations from the near category, regardless of whether the plant is currently operating. Equation (3) also includes plant-by-distance fixed effects η_{jd} to control for all time-invariant determinants of house prices in a plant-by-

[27]A recent literature also finds that other forms of housing externalities are very localized (see, for example, Linden and Rockoff 2008; Harding, Rosenblatt, and Yao 2009; Rossi-Hansberg, Sarte, and Owens 2010; and Campbell, Giglio, and Pathak 2011).

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distance group, which in practice is collinear with the indicator 1 $[Near]_{jd}$. Additional controls include 1990 census tract characteristics, $X1990_{jd}$, interacted with quadratic time-trends T_t.[28]

Equation (3) also includes time fixed effects, τ_t, to flexibly account for trends in housing values over time. We report specifications that include either state-by-year fixed effects to account for state-level trends in housing prices or plant-by-year fixed effects to account for highly localized trends. The richer specification adds approximately 10,000 fixed effects, one for each plant-year.

The parameter of interest in equation (3) is β_3, the coefficient on the interaction term: $1[Plant\ Operating]_{jt} \times 1\ [Near]_{jd}$. It captures the differential impact of an open plant on locations "near" the plant, relative to those one to two miles away. Given that our models include plant-by-distance fixed effects, η_{jd}, β_3 is identified by changes in the operating status of a plant (i.e., plant openings and closings). The model with plant-by-year and plant-by-distance fixed effects provides an average of the estimates that would be derived from the roughly 1,600 case studies of plant openings and closing that underlie this analysis. Specifically, β_3 is identified by within-year differences in the change in house prices among houses "near" and 1–2 miles from toxic plant openings and closings.

We also estimate a "repeat-sales" model with individual-level, rather than grouped, data. The advantage of this model is that our housing value data contain few housing characteristics, so the estimates of β_3 from equation (3) may confound willingness to pay to avoid a toxic plant with changes in the composition or type of house sold. To distinguish between these two possibilities we focus on a sample of houses that sold more than once between 1998–2005, allowing us to difference out the unobserved time invariant qualities of a house.

We use several versions of the following first differenced specification:

$$\begin{aligned}\Delta Y_{\mathrm{ijt},t-\alpha}=&\beta_1\Delta 1[\text{Plant Operating}]_{jt,t-\alpha}+\beta_2\Delta 1[\text{Near}]_{ij}\\&+\beta_3\Delta(1[\text{Plant Operating}]_{jt,t-\alpha}\times 1[\text{Near}]_{ij})+\Delta\tau_{t,t-\alpha}\\&+\beta_4\Delta(X1990_{jd}\times T_{t,t-\alpha})+\Delta\varepsilon_{jdt,t-\alpha},\end{aligned}\quad (4)$$

where $\Delta\ Y_{ijt,t-\alpha}$ denotes the difference in ln(house price) between sales of house i, near plant site j, in years t and $t-\alpha$. Notice that the time between sales varies across houses so α takes different values across houses. Since houses are in fixed locations, there is no variation in $\Delta 1[Near]_{ij}$ and it is infeasible to obtain estimates of β_2.

The coefficient of interest remains β_3, which captures the variation in housing prices when there is a change in plant operating status for houses "near" sites, relative to the change in housing prices among houses 1–2 miles from the site. It is important to recognize that β_3 does not compare the operating period to either the period before a plant opened or to the period after it closed. Rather, it compares the operating period to a weighted average of

[28]Census tract characteristics were mapped to plant radii using ArcGIS, where the radius characteristics consist of the area weighted averages of census tracts that intersect the distance circle/radius. Results are similar with and without these controls.

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periods before the plant opened and periods after the plant closed that is specific to this sample, so that its external validity may be limited.

Because of these important issues of interpretation, we also estimate an alternative version of equation (4) that allows us to separately identify the effects of plant openings and plant closings. For these models, the variable $1[\mathit{Plant\ Operating}]_{jt}$ is replaced by two separate indicators $1[\mathit{Plant\ Opened}]_{jt}$ and $1\ [\mathit{Plant\ Closed}]_{jt}$. The variable $1\ [\mathit{Plant\ Opened}]_{jt}$ is an indicator equal to zero before the plant opens, and equal to one in all years after the plant opens, even if the plant subsequently closed. The variable $1\ [\mathit{Plant\ Closed}]_{jt}$ is an indicator variable equal to zero before the plant opens and while it is operating, and then equal to one for all years after the plant closes.[29] These indicators are then interacted with $1\ [\mathit{Near}]_{jd}$.

The result is that the $1[\mathit{Plant\ Opened}]_{jt}$ interaction measures the effect on housing prices in near locations, relative to the 1–2 mile locations, during the period that the plant is operating, relative to the period before it opened. Because of the way that the indicators are defined, the interaction with $1[\mathit{Plant\ Closed}]_{jt}$ tests for an additional effect on housing prices in near locations, relative to 1–2 mile locations, after the plant has closed, relative to the period when it was operating; so, the coefficient associated with this interaction provides a direct test of whether plant closings affect housing prices, relative to the period that the plant was operating. We also report on tests of the hypothesis that the parameters associated with the two interactions are equal and of opposite sign, which would be the case if a plant's closing completely reversed the effect of its opening.

Note that housing values reflect both current and expected future amenities. In our setting, these expectations are likely to include valuations of local air pollution, visual disamenities, traffic related to plant activity, and soil and water pollution, as well as expectations about how long the plant will operate and whether it will reopen if it closes. These expectations are, of course, unobservable (see, e.g., Bishop 2012), but it is nevertheless important to keep in mind that housing values reflect the present discounted value of the entire stream of amenities associated with a particular location when interpreting the estimates.

B. Housing Values: Results

We first present event study graphs that motivate the regression analyses that follow. These graphs are derived from the estimation of versions of equation (3) that include plant-by-year fixed effects and allow the coefficients on $1[\mathit{Plant\ Opened}]_{jt} \times [\mathit{Near}]_{jd}$ and $1[\mathit{Plant\ Closed}]_{jt} \times 1[\mathit{Near}]_{jd}$ to vary with event time; here, year zero is the year that the plant's operating status changes (i.e., the year of the plant opening or closing). The figures plot these coefficients and their 95 percent confidence intervals.[30] They provide an opportunity to judge the validity of the difference-in-differences-style approach that is based on the assumption of similar trends in advance of the opening or closing.

[29]Formally, we define $1[\mathit{Plant\ Closed}]_{jt} = 1$ if year t is greater than the last year the plant is observed in the LBD and $1\ [\mathit{Plant\ Opened}]_{jt} = 1$ if year t is greater than or equal to the first year the plant is observed in the LBD.

[30]The available housing price data only allow for the estimation of the coefficients for event years −3 through +5 for plant openings and −5 through +5 for plant closings since plant openings are concentrated in the earlier part of our sample.

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Figure 3 plots event study coefficients from two separate regressions. Panel A of Figure 3 plots event study coefficients for years before/after a plant opening, and panel B plots event time coefficients before/after a plant closing. The plotted coefficients represent the time path of housing values within 0–1 miles from a plant, relative to 1–2 miles from a plant, conditional on plant-by-distance and plant-by-year fixed effects. Both panels support the validity of the design as there is little evidence of differential trends in housing prices between houses 0–1 and 1–2 miles from the plant in the years preceding the opening or the closing. There is clear evidence that plant openings lead to housing price declines in the year that the plant opens. The plant-closing figure provides less decisive evidence, although on average prices rise slightly after the year of a closing.

Table 2 reports baseline estimates for the effect of toxic plants on housing values. Panel A shows least squares estimates from various versions of equation (3), in each case reporting the coefficient and standard error associated with the interaction of $1[\mathit{Plant\ Operating}]_{jt} \times \mathit{Near}_{jd}$. We estimate these models on a balanced panel of plant-by-distance-by-year observations, excluding a subset of plants for which no housing values occurred in a specific distance-by-year cell.[31] Panels B and C report estimates of equation (4), where panel B reports the coefficient and standard error associated with the interaction of $1[\mathit{Plant\ Operating}]_{jt} \times \mathit{Near}_{jd}$, and panel C allows the effects of openings and closings to differ.

In all regressions the comparison group is homes located between one and two miles from the plant, whereas the definition of "near" changes across regressions, as indicated by the column headings. The odd-numbered columns report estimates from specifications that include state-by-year fixed effects and the even-numbered columns report estimates from specifications that use plant-by-year fixed effects (or county-by-year fixed effects in the repeat sales analysis).[32]

The estimates in columns 1 and 2 of panel A show that an operating toxic plant within a half-mile is associated with a 2 to 3 percent decrease in housing values. The point estimates in columns 3 and 4 are smaller in magnitude, suggesting that the effects of plant operations on housing values tend to fade with distance. For example, the point estimate in column 3 suggests that the effect of an operating plant falls to one percent in the half mile to one mile range. The standard errors are large enough, however, that their 95 percent confidence intervals overlap the 95 percent confidence intervals of the estimates in columns 1 and 2. Hence, in columns 5 and 6 we compare the entire zero to one mile area with the one to two mile zone.[33] Not surprisingly given the previous estimates, the overall impact on housing values within one mile is about −1.5 percent.

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[31] Results using an unbalanced panel are similar. Models estimated using plant-by-year fixed effects are estimated in two steps. The first step demeans all regression model variables by plant-by-year. The second step then estimates the model on the remaining covariates using the demeaned data. Given all the fixed effects in these models, it is not surprising that they explain a lot of the variation in housing prices. The R^2s are around 0.7 and 0.9 for models with and without the repeat sales, respectively.

[32] We ran into computational challenges when estimating the full set of plant-by-year fixed effects in the first difference setting, and thus we rely on county-by-year fixed effects as a compromise. This being said, estimates using equation (3) with county-by-year or plant-by-year fixed effects are almost identical.

[33] The column 6 specification is the difference-in-differences analogue to the event-time regression plotted in Figure 2.

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The last two columns of Table 2 report estimates from specifications that restrict observations to within two years of a change in plant operation. In the short-run, prices will do a better job of capturing the full welfare effects because supply is relatively inelastic over short periods of time; over the longer run, the full welfare effects are captured by adjustments in prices and quantities (which are unobservable in our data). This restriction attenuates the point estimates, but the 95 percent confidence intervals overlap those associated with the estimates in columns 5 and 6.

Panels B and C present the repeat sales estimates from fitting equation (4). For the most part, the estimates in panel B are similar to those found in panel A, albeit somewhat smaller in absolute magnitude. The differences between the two panels are consistent with the interpretation that some of the estimated impacts in panel A are driven by less expensive houses selling near to a plant whenever a plant is operating. The disparities between the results in panels A and B are also consistent with greater attenuation due to measurement error in a first difference setting. However, the 95 percent confidence intervals overlap across all estimates, and thus we are not able to make strong conclusions about the difference in magnitudes.

Panel C presents parameter estimates associated with $1[Plant\ Opened]_{jt} \times 1[Near]_{jd}$ and $1[Plant\ Closed]_{jt} \times 1[Near]_{jd}$. Within 0.5 miles, a plant's operation is associated with a 10 percent–11 percent decline in housing prices; these estimates are economically large and statistically significant. There is little evidence of an effect on housing prices between 0.5 and 1.0 miles from the plant. As Figure 3 foreshadowed, plant closings appear to modestly increase housing prices, but this effect is small economically (less than 2 percent, even less than 0.5 miles from a plant) and statistically indistinguishable from zero.

The final row reports the results from a test that the opening and closing coefficients are equal and opposite in sign. This null hypothesis can be rejected in the 0–0.5 mile range. One possible interpretation is that households expect closed plants to reopen. However, we measure closings using the last year that a plant is observed in the LBD. Consequently, our data generally pick up permanent (not temporary) plant closures, though home buyers and sellers may not realize this at the time of the closure.[34] Other potential explanations for a plant's lasting effect include persistent visual disamenities and concerns about local contamination.

Thus far we have concentrated on the average effect of plant openings and closings. We next explore heterogeneity in our baseline estimates by stratifying plants by observable characteristics. Since the housing price impacts are almost entirely concentrated within 0.5 miles of a plant, we focus on housing values within this range.

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[34]We also tested whether plant openings and closings affect the volume of housing transactions. We used the baseline housing regression approach (aggregated at the plant-distance-year level), but replaced mean log(sales price) with the number of houses sold (in logs). While the housing price regressions weight cells by the number of houses sold, we excluded regression weights from this volume regression so as to not weight observations by the outcome variable. The results suggest that the number of transactions decreases when there is an operating toxic plant nearby, especially within 0.5 miles after plants open. It is difficult to draw definitive conclusions, however, because most of the estimates are not statistically significant.

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We group plants into whether the median value of a particular variable (taken over all years of plant operation) is above or below the population median (taken over the plant-level medians). The plant characteristics we explore are plant employment, payroll, stack emissions, fugitive emissions, and total emissions, as well as the mean and maximum toxicity of the chemicals that are released. Plants in the TRI report both stack and fugitive emissions. Stack emissions occur during the normal course of plant operations, and are emitted via a smoke stack or some other form of venting equipment which is, in many cases, fitted with pollution abatement equipment. Because stacks are often extremely high, these emissions tend to be dispersed over a wide geographic area. Fugitive emissions are those that escape from a plant unexpectedly, generally without being treated. These emissions may be more likely to be manifest to households in the form of noxious odors or residues. The toxicity measures were calculated using the EPA's Risk-Screening Environmental Indicators.[35] We also stratify plants based on the characteristics of the nearby communities (i.e., within 2 miles), including the fraction of the population that is college educated, the fraction of the population that is Caucasian, the median housing value surrounding a plant, and median income.

Table 3 reports the results of this exploration. We focus on the baseline first-differences specification, augmenting equation (4) to include an additional interaction term for whether or not a plant is above the median for each of the above listed characteristics. We then estimate the full three-way interaction, allowing for all lower order interaction terms. The estimates indicate that the housing results are fairly homogeneous across various plant types (columns 1–6) but that the negative impacts appear to be concentrated in relatively disadvantaged communities (columns 7–10). If households were aware of the toxicity measures and they were valued (negatively) by households, then one might have expected to see relative toxicity reflected in housing price differentials. A possible explanation for the absence of such a pattern is that households have imperfect information. Given the lack of scientific evidence about the health effects of exposure, such ignorance would not be surprising.

The online Appendix presents estimates from several additional specifications. Appendix Table A2 examines the sensitivity of the baseline estimates to varying sets of controls. The qualitative findings are unchanged across several different approaches. Appendix Table A3 presents estimates of equation (3) that use a comparison group of two to four miles from a plant instead of one to two miles, and the results are similar to the baseline results in Table 2. This is reassuring because it suggests that the results are not driven by patterns in housing prices in the one to two mile zone. Appendix Table A4 presents regressions identical to the baseline estimates of equation (3) except that each regression is estimated using only observations from a single distance bandwidth (e.g., 0 to 0.5 miles, 0.5 to 1 miles, 1 to 1.5 miles, 1.5 to 2.0 miles, etc…) for each plant. Identification in these models comes from differential timing of openings and closings across plants. Estimates from this specification corroborate our baseline findings and choice of comparison group; the effects of plant

[35]Surprisingly little is known about the relative toxicity of different chemicals. Although animal testing is broadly used for evaluating the toxicity of chemical compounds, these studies are of limited relevance for evaluating which chemicals are likely to be most damaging for human health.

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operating status are highly localized, and there seems to be little negative effect of plant openings in areas more than one mile away from a plant.

V. Infant Health

A. Infant Health: Empirical Strategy

The empirical strategy for examining infant health outcomes is very similar to the approach used for housing values. Again, our main focus is on comparing outcomes “near” a plant with outcomes one to two miles away. We estimate models of the form:

$$\begin{aligned}Z_{\mathrm{jdt}}=&\alpha_0+\alpha_1 1[\mathrm{Plant\ \ Operating}]_{jt}+\alpha_2 1[\mathrm{Near}]_{jd}\\&+\alpha_3(1[\mathrm{Plant\ \ Operating}]_{jt}\times 1[\mathrm{Near}]_{jd})+\eta_{jd}+\tau_t\\&+\beta_4(X1990_{jd}\times T_t)+\varepsilon_{\mathrm{jdt}},\end{aligned} \quad (5)$$

where Z_{jdt} denotes the average incidence of low birthweight or another measure of infant health near plant site j, within distance group d, in year t. As before, the specification includes plant-by-distance fixed effects, η_{jd}, year fixed effects τ_t (which in practice are state-by-year or plant-by-year fixed effects), and census controls, $X1990_{jd}$, interacted with quadratic time-trends T_t

As in the housing equations, the coefficient of interest, now denoted α_3, is the differential impact of an operating plant within one mile. We again explore a version of this specification that replaces the $1[\textit{Plant Operating}]_{jt}$ variable with the $1[\textit{Plant Opened}]_{jt}$ and $1[\textit{Plant Closed}]_{jt}$ variables. For this richer specification, we again test whether the coefficients on the interactions of these variables with $1[\textit{Near}]_{jd}$ are equal and opposite in sign. If air toxic emissions are the channel for any infant health effects, then the plausibility of this null is stronger than in the housing price regressions where plant closings may be perceived as temporary and visual disamenities could remain after a closure.

The vital statistics data include a rich set of mother’s characteristics that can be used to control for possible changes in the composition of mothers. However, the identifying variation in our models comes at a much higher level of aggregation; hence, in order to avoid overstating the precision of our estimates and to limit the computational burden of our most stringent specifications we control for mother’s characteristics using a two-step, group-level estimator (Baker and Fortin 2001; Donald and Lang 2007). In the first step, we estimate the relationship between low birthweight (Z_{jdt}) and plant-by-distance by year indicators (g_{jdt}), after controlling for mother’s characteristics (m_{it}):

$$Z_{\mathrm{jdt}}=m_{\mathrm{it}}^{\prime}\theta+g_{\mathrm{jdt}}+\xi_{\mathrm{jdt}}. \quad (6)$$

The vector m_{it} controls for maternal characteristics including indicators for: age categories (19–24, 25–34, and 35+), education categories (< 12, high school, some college, and college or more), race (African American or Hispanic), smoking during pregnancy, month of birth, birth order, and gender of child.[36] The estimated $\widehat{g_{jdt}}$ provides group-level, residualized averages of each specific birth outcome after controlling for the observable characteristics of the mother. These averages are used as the dependent variable in equation (5), instead of Z_{jdt}. In this second step, the equation is weighted by the group-level cell size.[37], [38]

B. Infant Health: Results

We start by presenting event study graphs for the incidence of low birthweight (i.e., an infant born weighing less than 5.5 pounds or 2,500 grams) based on a version of equation (5). The plotted estimates and 95th percentile confidence intervals correspond to the interaction of event-time indicators with $1[Plant\ Opened]_{jt} \times 1[Near]_{jd}$ and $1[Plant\ Closed]_{jt} \times 1[Near]_{jd}$. The specification includes plant-by-distance and plant-by-year fixed effects, as well as the census controls interacted with a quadratic time trend. The birth data cover a longer period than the housing prices data and we can estimate the parameters of interest for all event years from five years before an opening/closing through five years after an opening/closing.

Figure 4 suggests that operating plants raise the incidence of low birthweight. There is little evidence of differential trends in the adjusted incidence of low birthweight between mothers living 0–1 and 1–2 miles away during the years leading up to plant openings or closings, which supports the validity of the design. After plant openings, there is a relative increase in the incidence of low birthweight among mothers living within one mile of a plant. After plant closings, there is some evidence of an opposite effect. Specifically, the incidence of low birthweight within one mile decreases modestly relative to what is observed between one and two miles although the decline is less sharp than in the plant opening panel.

Table 4 presents regression estimates, and is structured similarly to panels B and C of Table 2 which reports the housing price results. We focus on the panel B results, which have a clearer counterfactual and greater external validity. Further, due to the finding that toxic air emissions travel roughly 1 mile on average, we concentrate on the 0–1 mile results.

The final four columns suggest that an operating toxic plant increases the incidence of low birthweight by 0.0024 – 0.0037 percentage points or 3.3 percent–5.1 percent. The effects among infants born to mothers in the 0–0.5 mile and 0.5–1 mile ranges are nearly identical. It is also interesting that the larger estimates come from the restricted sample that only includes births within 2 years of a change in operating status.

The results are less conclusive on the question of whether a plant closing reverses the negative effects of a plant's operation on the incidence of low birthweight. On the one hand, all of the point estimates suggest that low birthweight declines after a plant closing. This decline, however, is only statistically significant at the 95 percent level of confidence in

[36]For a small number of observations there is missing data for one or more of these control variables and we include indicator variables for missing data for each variable.

[37]To limit the computational burden of estimating the first stage of the full sample, the first stage is estimated separately by state. Alternative group-level weights include the inverse of the sampling error on the estimated fixed effects, but since we are estimating state by state, the estimated standard errors are likely to be inefficient (although the group level estimates are still consistent) making this weighting mechanism less attractive. Donald and Lang (2007) present an alternative feasible GLS specification where the weights come from the group level residual and the variance of the group effect. Since all of these weights are proportional and highly correlated, the choice of weights has little effect on the results. We follow Angrist and Lavy (2009), who weight by the group cell size. These models have R^2s of about 0.3.

[38]We obtain similar results from group-level models that convert micro-level covariates into indicator variables and take means within cells.

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column (8), though this specification is perhaps the most reliable one. The null that the coefficients are equal and of opposite sign cannot be rejected in any of the specifications.

Table 5 examines plant heterogeneity, stratifying plants as was done in the housing regressions (i.e., Table 3) using the version of equation (5) that includes plant-by-year fixed effects. There is little evidence of heterogeneity across these cuts of the data, except that there are no effects on low birthweight in areas with above median housing values. It is possible that richer households are better able to take compensatory measures to protect themselves.

We probed the robustness of these results in several ways. The results are qualitatively similar when we vary the set of controls used in our baseline regressions (see online Appendix Table A5), and when we use a comparison group of births that occur two to four miles from a plant, rather than one to two miles (see online Appendix Table A3). The results are also similar when we estimate the regressions separately by distance group (see online Appendix Table A4). These alternate specifications corroborate the main results, again indicating that the effects of plant operating status are highly localized, and providing additional empirical support for the choice of comparison group.

We also tested for changes in the composition of mothers giving birth in online Appendix Table A6. Documenting this type of compositional change is of significant independent interest (see, for example, Cameron and McConnaha 2006; Banzhaf and Walsh 2008; and Currie 2011). Overall, impacts of plant openings and closings on mothers' characteristics are small and generally statistically insignificant, suggesting that the low birthweight estimates are not driven by changes in the composition of mothers who live near plants. If anything, toxic plants appear to be associated with a small *increase* in the socioeconomic status of mothers; if the regressions fail to adequately adjust for these changes, then the measured health effects may modestly understate the true effects.

When assigning plant events to birth outcomes, there is some ambiguity as to whether the plant event occurred before or after a birth because we observe plant operating status just once a year in the LBD. In online Appendix Table A7 we investigate the sensitivity of our results to alternative approaches to timing. Estimates from these alternative specifications are largely consistent with our baseline findings. See the online Appendix for details.

C. Alternative Measures of Infant Health: Results

This section presents estimates for alternative measures of infant health. We begin by examining the influence of toxic plant activity on the birthweight distribution. We first create indicators for births falling within 500-gram birthweight intervals, and we aggregate these outcomes to the plant-by-distance bin by year level. We then use these binned averages as the dependent variable when estimating nine different versions of equation (5), one per bin. The resulting estimates of the parameter associated with $1[\mathit{Plant\ Operating}]_{jt} \times 1[\mathit{Near}]_{jd}$ are plotted in Figure 5. All regressions compare birth outcomes for mothers less than one mile from a plant to those of mothers living one to two miles away, so that these models are comparable to those presented in columns 5 and 6 of Table 4. Figure 5 suggests that when a plant is operating the birthweight distribution is skewed to the left, increasing the likelihood of births below 2,500 grams. Appendix Table A8 reports the regression results that underlie this figure, as well as results that replace the $1[\textit{Plant Operating}]_{jt}$ variable with the $1[\textit{Plant Opened}]_{jt}$ and $1\ [\textit{Plant Closed}]_{jt}$ variables.

Table 6 reports estimates of equation (5) using additional measures of infant health as the dependent variables. These estimates support the hypothesis that toxic plants damage infant health; birthweight decreases and the incidence of prematurity increases. The other birth outcomes are not individually statistically different from zero although this is perhaps unsurprising given that many of these outcomes, such as the incidence of very low birthweight (i.e., an infant born weighing less than 3.3 pounds or 1500 grams) and infant deaths, are an order of magnitude more rare than low birthweight.

In light of this issue of precision, the last two columns show models using a summary index measure of infant health as the dependent variable. We first convert each birth outcome measure so that they all move in the same direction (i.e., an increase is undesirable) and then subtract the mean and divide by the standard deviation of each outcome. We construct our summary measure by taking the mean over the standardized outcomes, weighting by the inverse covariance matrix of the transformed outcomes in order to ensure that outcomes that are highly correlated with each other receive less weight than those that are uncorrelated, and thus represent new information, receive more weight (Hochberg 1988; Kling, Liebman, and Katz 2007; Anderson 2008).[39] An operating plant has a small but statistically significant positive effect on the index, increasing the probability of a bad health outcome by 0.016–0.017 standard deviations.

VI. Interpretation

The estimates in Table 2 indicate that the opening of a toxic plant reduces housing values by roughly 11 percent within 0.5 miles and this effect appears to persist even after the plant ceases operations.[40] As with all of our estimates, this effect is measured relative to homes 1 to 2 miles away. Since the mean housing value within 0.5 miles of a plant is $125,927, this decrement corresponds to about $14,000 for the average house. In our sample, the value of the housing stock within 0.5 miles of a toxic plant is $38.5 million. Multiplying this figure by 11 percent yields a decline in local housing values of about $4.25 million per plant. Although non-negligible, these housing price changes are small compared to the capital cost of new industrial plants; for example, a typical natural gas power plant (620MW) costs about $570 million to build.[41]

It is important to bear in mind that this is an incomplete measure of these plants' total welfare consequences. For example, it misses the effects of increased emissions of criteria pollutants, such as particulates, ozone, and sulfur dioxide, which may harm human health over a much broader geographic area. Further, it does not include any impacts on non-

[39]Alternatively, we have created summary index measures that weight each outcome variable equally, as in Kling, Liebman, and Katz (2007), with little appreciable effect on our results.

[40]Potential explanations for a plant's lasting effect on property values even after it closes include persistent visual disamenities, concerns about local contamination, and an expectation that the plant will reopen.

[41]US Department of Energy, Energy Information Administration. 2013. "Updated Capital Cost Estimates for Utility Scale Electricity Generation Plants." http://www.eia.gov/forecasts/capitalcost/ (accessed May 2012).

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residential property (which could even be positive if there are spillovers in production efficiency).[42] Moreover under our imposed assumption that the economic benefits of plant production accrue equally to homes within two miles of the plant, this estimate reflects an upper bound on the net costs associated with toxic plants. As we have emphasized throughout, these plants have positive as well as negative externalities, bringing jobs to local communities and potentially raising wages and housing prices over a wide area.

An appealing feature of the analysis is that it provides estimates of the effect of toxic plant openings on *both* housing prices and on an important health outcome. It is interesting to compare the estimates from the housing value analysis with a valuation of the low birthweight impacts. The point estimate in Table 4, column 6 implies that an operating toxic plant within one mile reduces the incidence of low birthweight by 0.0024 percentage points or 3.1 percent. There is an average of 67 births within 1 mile of each toxic plant per year. Thus, the estimate implies that there are approximately 0.16 additional low birthweight births per toxic plant per year. Using estimates in the literature, this corresponds to about $5,600 in decreased lifetime earnings per toxic plant per year.[43] This measure is small compared to the estimated value of losses in the housing market but, of course, low birthweight is only one of many potential health consequences of exposure to toxic plants. Further, the finding that housing prices remain depressed after the plant has closed and air toxic emissions have ceased suggests that willingness to pay is comprised of more than health effects in this setting.

VII. Conclusion

Toxic emissions are widely believed to cause birth defects, cancer, and other severe health impacts, yet there is little evidence about their effects on humans. Governments have only recently begun to regulate these emissions. In many respects, this state of affairs resembles the situation that prevailed more than four decades ago when the Clean Air Act compelled the EPA to begin to regulate airborne particulate matter and other criteria air pollutants. This paper represents a first step toward understanding the local external effects of toxic plant production on the health and well-being of local residents.

The application of a research design based on more than 1,600 plant openings and closings matched to extraordinarily detailed, geocoded data yields three primary findings. First, on average, toxic air pollutants affect ambient air quality only within 1 mile of the plants, suggesting that health effects from these emissions should be concentrated in this range. The highly localized range differs substantially from particulate matter emissions, which can affect ambient air quality several hundred miles away from their source. Second, the opening of a plant that emits these pollutants leads to a roughly 11 percent decline in housing prices

[42]The $4.25 million measure does not capture changes to the value of industrial, commercial, or undeveloped property. While some industrial uses may not be substantially affected by toxic plant proximity, commercial property and, perhaps more importantly, the price of undeveloped land may be affected.

[43]Black, Devereux, and Salvanes (2007) estimate that each 1 percent decrease in birthweight decreases expected earnings by about 0.13 percent. Based on our analysis of the distribution of birthweight, the impact appears to be more births 1,000–2,000 grams, compared to about 3,200 grams for the average birth, for a back-of-the-envelope average reduction of about 50 percent. So a low birthweight birth would be associated with approximately 6.5 percent lower lifetime earnings. Isen, Rossin-Slater, and Walker (2014) calculate that the mean present value of lifetime earnings at age zero in the US population is $542,000 (2000$) using a real discount rate of 3 percent (i.e., a 5 percent discount rate with 2 percent wage growth), so this is equivalent to $35,320 per low birthweight birth.

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within 0.5 miles, or a loss of about $4.25 million per operating plant. Housing prices are largely unaffected by a plant closing, implying that toxic plants continue to negatively affect housing prices after they cease operations. Third, the incidence of low birthweight increases by roughly 3 percent within one mile of an operating toxic plant, with comparable magnitudes between 0 and 0.5 miles and 0.5 and 1 miles.

These results underscore opportunities for further research in several areas. We interpret the estimated effects of low birthweight to be a rejection of the null hypothesis that there are no health effects from toxic air emissions. This finding opens the door to seeking creative approaches to testing for longer run health effects on children and adults. It is also possible that toxic air emissions cause households to engage in costly behaviors to protect themselves and documenting these costs would be a contribution (see e.g., Deschenes, Greenstone, and Shapiro 2012).

This paper also raises broader questions around the determinants of housing prices. As computing power increases and more detailed data are accessible, it will be possible to assess the degree to which housing markets fully capture the present discounted value of all present and expected future amenities associated with a particular location. A related and important question is the degree to which health effects are capitalized into housing prices. Finally, we believe that a better understanding of belief formation around local amenities and how these beliefs interact with willingness to pay in the context of local housing markets is a critical area for future research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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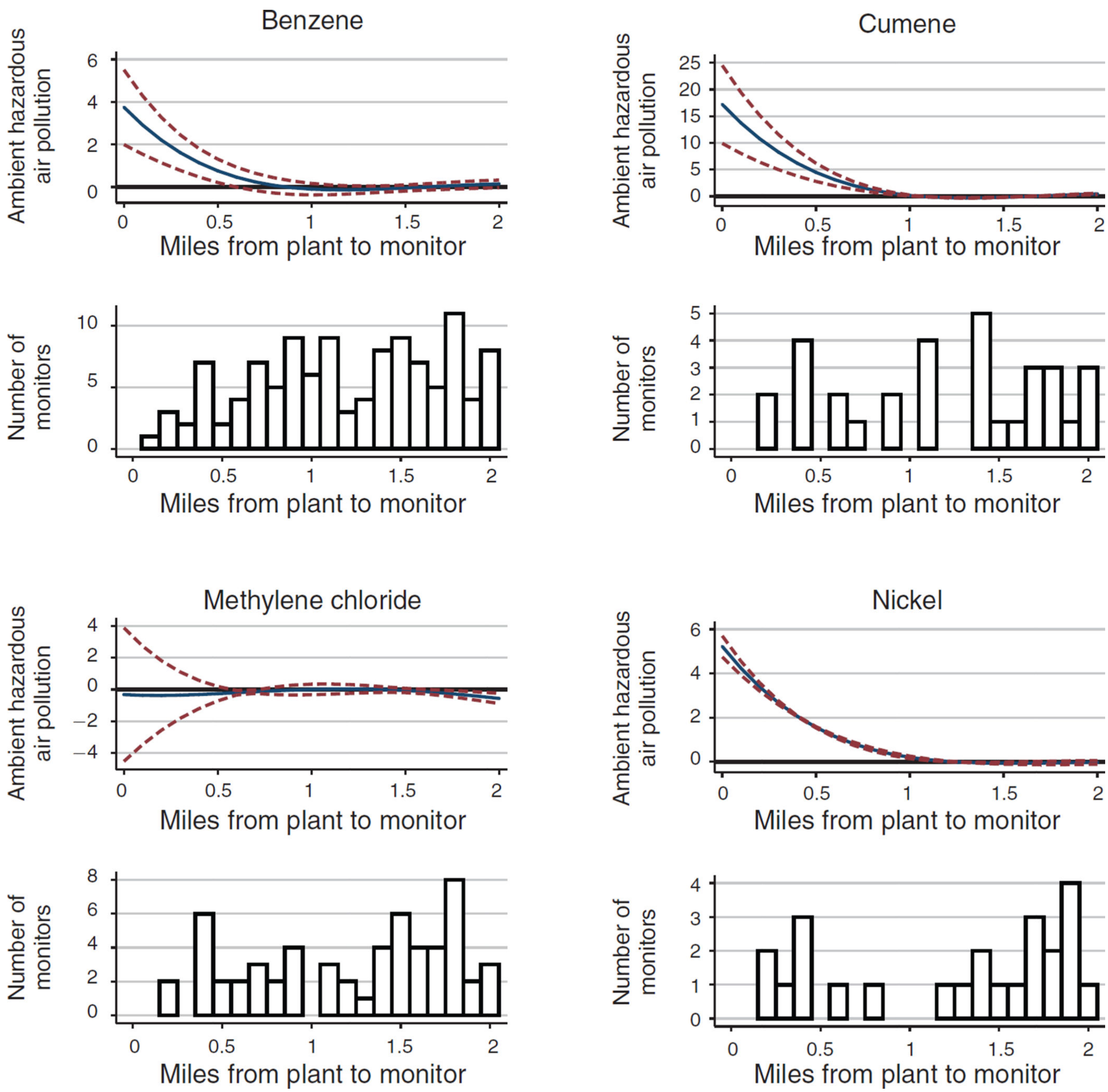

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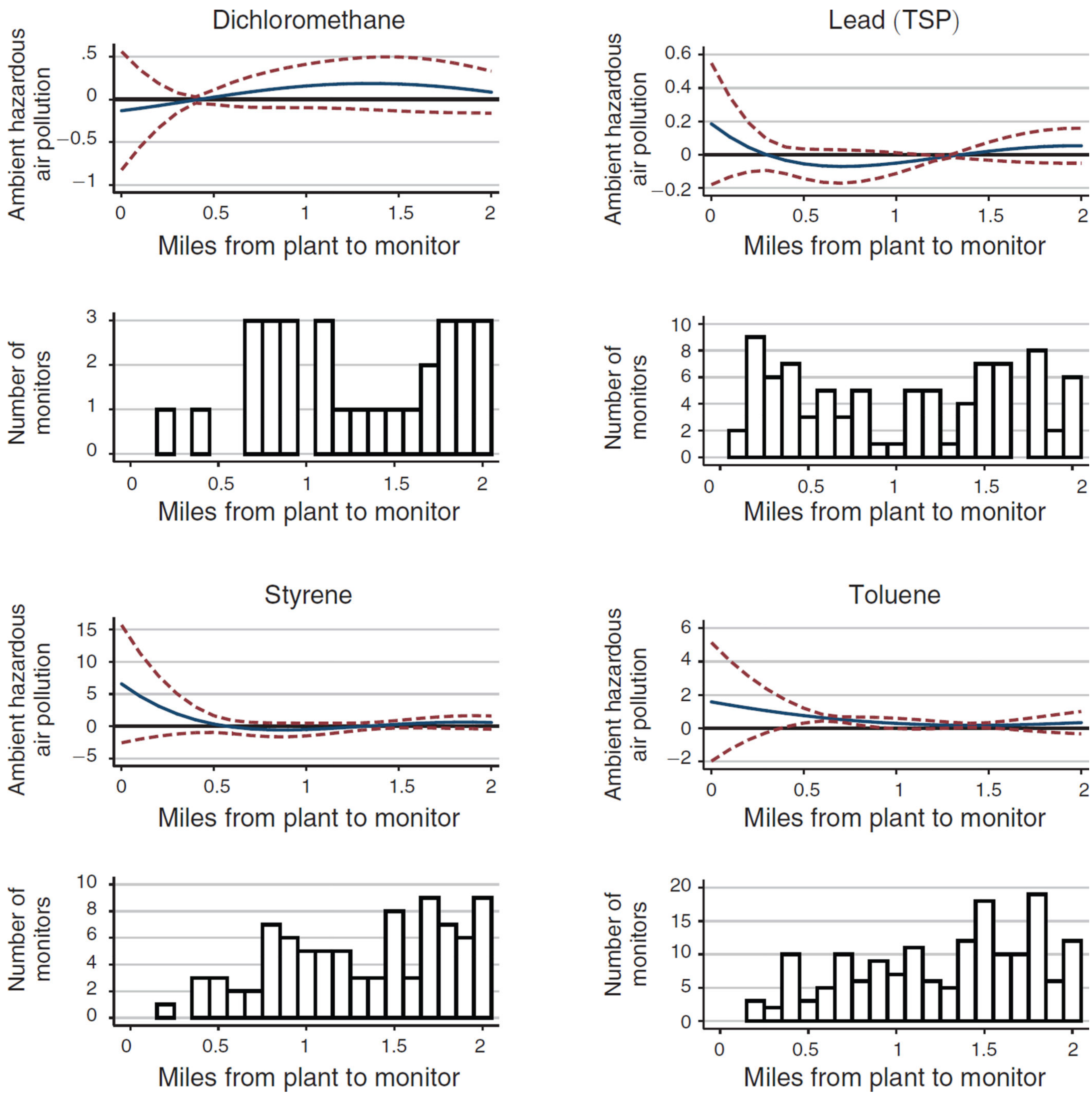

Figure 1. The Effect of Toxic Plants on Ambient Hazardous Air Pollution

Notes: This figure plots marginal effects and ninety-fifth percentile confidence intervals from 8 separate regressions of a single form of ambient hazardous pollution on a quartic in distance to the nearest operating toxic plant. The unit of observation is the monitor-plant pair and all regressions include monitor-plant fixed effects so the distance gradient is identified using plant openings and closings. In the regression sample, each pollutant has been standardized to be mean 0 and standard deviation 1. The distance gradient can therefore be interpreted as standard deviations from the mean value. Standard errors for the regression

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are two-way clustered on plant and monitor, and the pointwise standard errors in the figure are calculated using the delta method. Below each pollutant specific graph is a histogram, representing the number of monitors at various distance bins from the plants in the sample.

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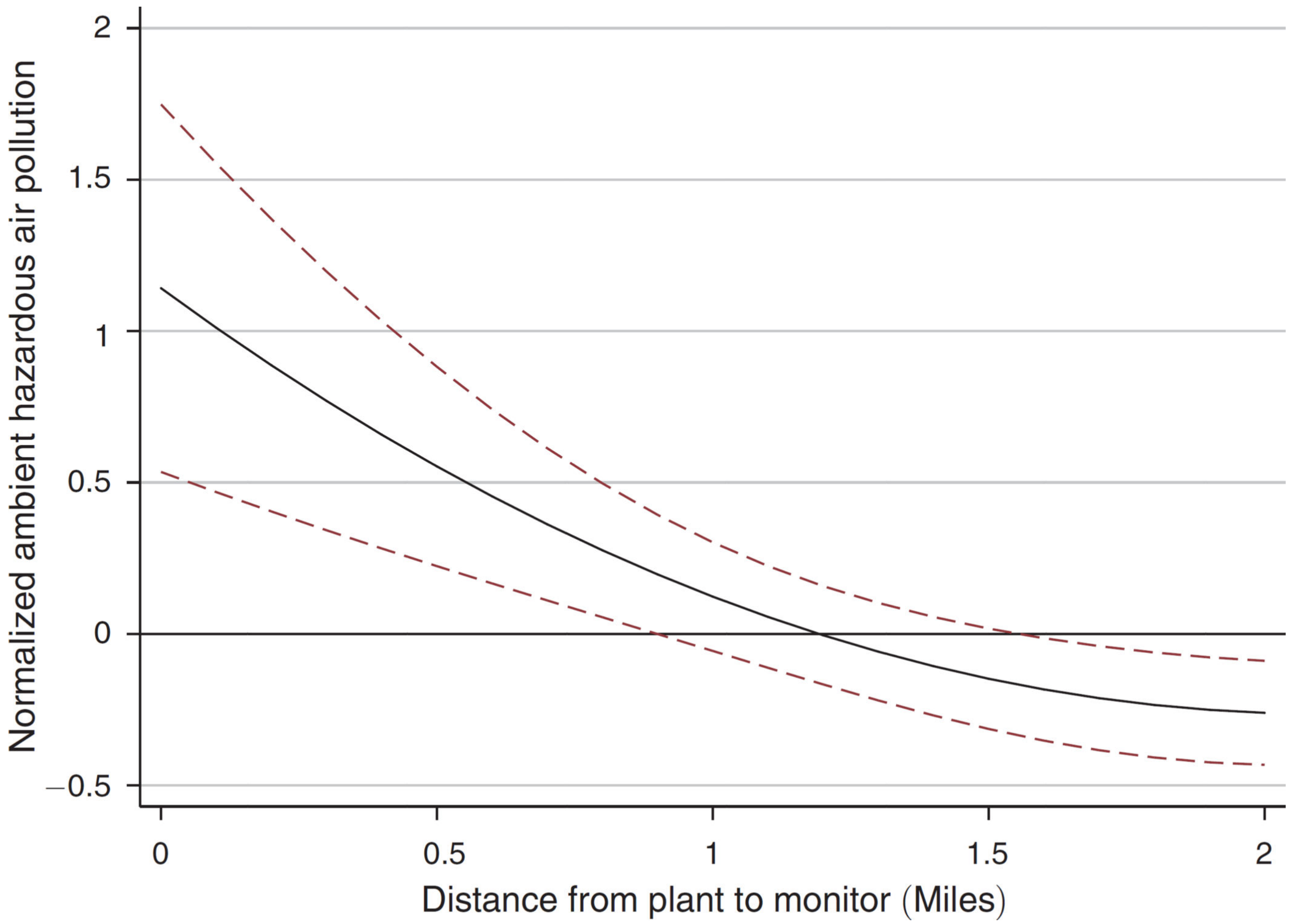

Figure 2. The Effect of Toxic Plants on Ambient Hazardous Air Pollution, All Pollutants

Notes: This figure plots marginal effects and ninety-fifth percentile confidence intervals from a regression of ambient hazardous pollution on a quartic in distance to the nearest operating toxic plant. The unit of observation is the monitor-plant pair and the regression includes monitor- plant fixed effects so the distance gradient is identified using plant openings and closings. In the regression sample, pollutants are pooled, standardizing each pollutant to be mean 0 and standard deviation 1. The distance gradient can therefore be interpreted as standard deviations from the mean value. Standard errors for the regression are two-way clustered on plant and monitor, and the pointwise standard errors in the figure are calculated using the delta method.

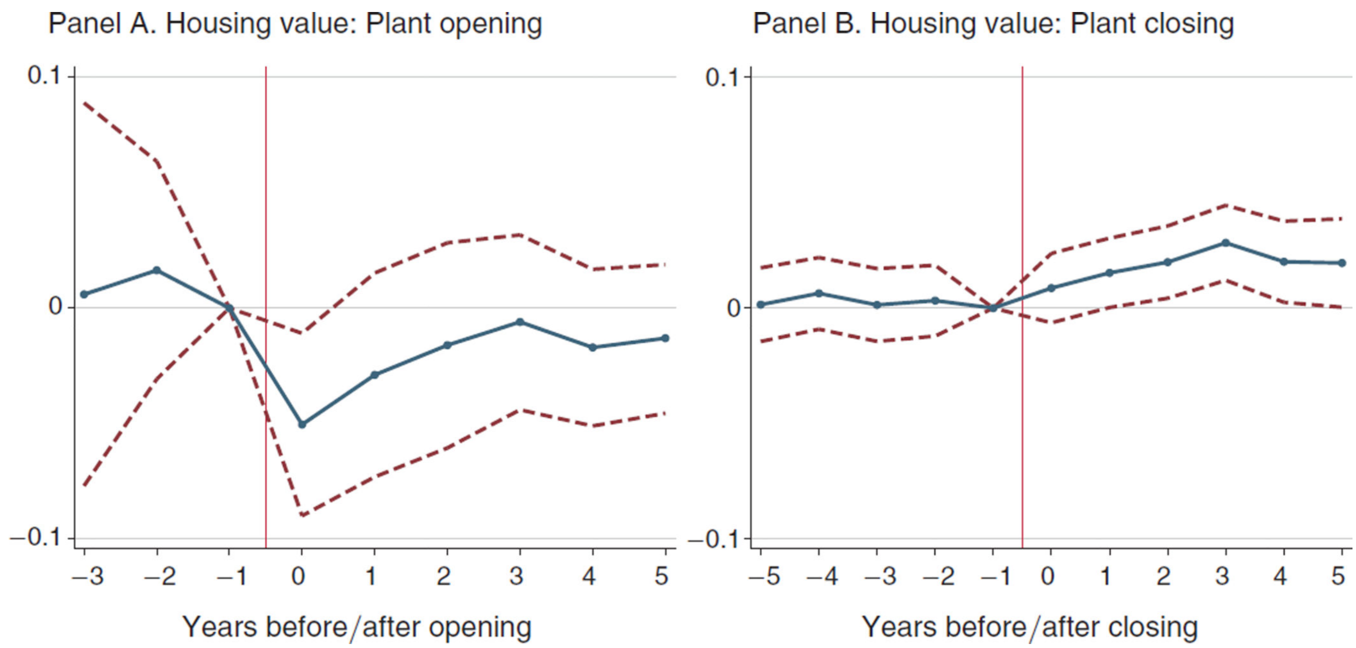

Figure 3. Event Study: The Effect of Toxic Plant Openings and Closings on Local Housing Values

Notes: These are event study plots created by regressing log housing sale price for a plant-by-distance-by-year cell on a full set of event time indicators interacted with an indicator for "near," plant-by-distance fixed effects, plantby- year fixed effects, and census controls (interacted with quadratic trends), weighting by the group-level cell size. Reported are the coefficients for event-time, which plot the time path of housing values "near" relative to "far" before and after a plant opening or closing. "Near" is defined as less than 1 mile between a plant and a house, and "far" is defined as 1–2 miles between a house and plant. The dashed lines represent 95 percent confidence intervals, where standard errors are computed using two-way cluster-robust standard errors, clustering on plant and year. Time is normalized relative to the year that the plant's operating status changes ($\tau = 0$), and the coefficients are normalized to zero in the year prior to a change in operating status ($\tau = -1$). The coefficients corresponding to four or more years before a plant opening are not identified due to the lack of openings in the second half of our sample period and the lack of housing data prior to 1998.

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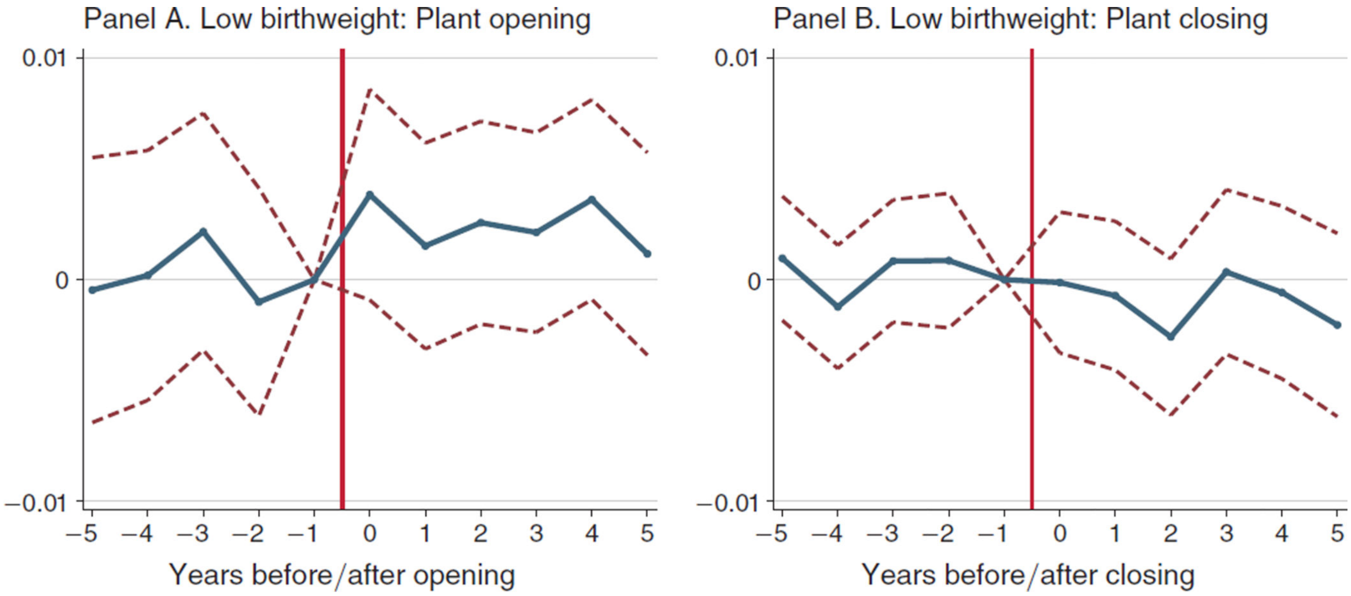

Figure 4. Event Study: The Effect of Toxic Plant Openings and Closings on the Incidence of Low Birthweight

Notes: These are event study plots created by regressing the incidence of low birthweight for a plant-by-distance by year cell on a full set of event time indicators interacted with an indicator for “near,” plant-by-distance fixed effects, plant-by-year fixed effects, and census controls (interacted with quadratic trends), weighting by the group-level cell size. The dependent variable in the regression is the residualized mean incidence of low birthweight for a plant-by-distance-by-year, adjusted for micro-level covariates in a first stage. Reported are the coefficients for event-time, which plot the time path of low birthweight “near” relative to “far” before and after a plant opening or closing. “Near” is defined as less than 1 mile between a plant and a house, and “far” is defined as 1–2 miles between a house and plant. The dashed lines represent 95 percent confidence intervals, where standard errors are computed using two-way cluster-robust standard errors, clustering on plant and year. Time is normalized relative to the year that the plant’s operating status changes ($\tau = 0$), and the coefficients are normalized to zero in the year prior to a change in operating status ($\tau = -1$).

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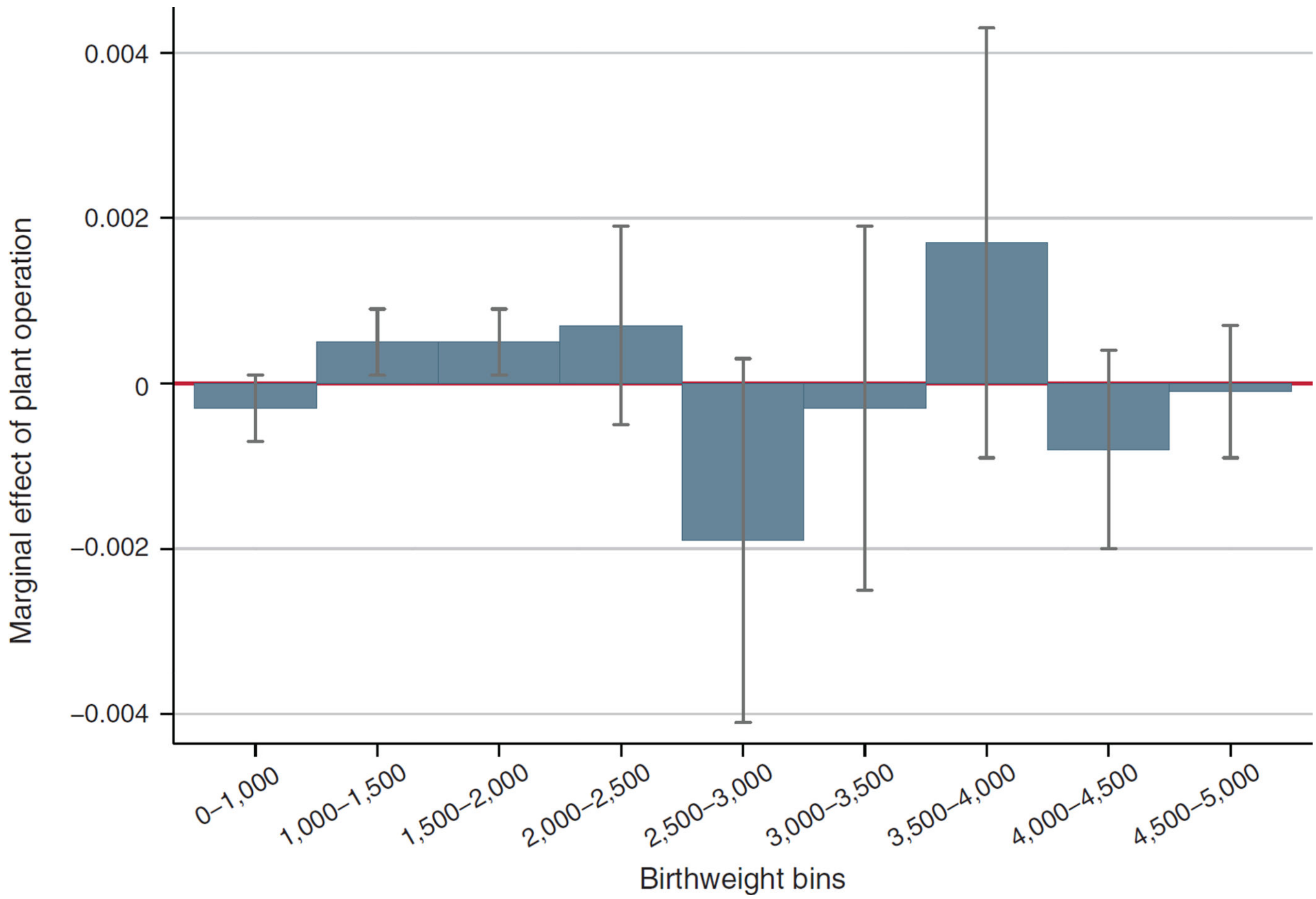

Figure 5. Effect of Plant Operation on the Distribution of Birthweight 0–1 Miles from a Plant

Notes: This figure reports regression coefficients from nine separate regressions. The dependent variable in each regression is an indicator variable for whether a birth falls in a particular birthweight range as indicated on the *x*-axis, and the data have been aggregated to plant-by-distance by year cells. The estimates reflect the effect of plant operation on "near" relative to "far" birth outcomes. All regression estimates control for census tract characteristics (interacted with quadratic trends) and regressions are weighted by the group-level cell size. Multiple births are dropped from regressions. Standard errors are two-way clustered by plant and year, and reported confidence intervals reflect 2 standard errors above and below the estimate.

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Table 1

Characteristics of Toxic Plants and the Surrounding Community

	Open continuously 1990–2002 (1)	Opened between 1990–2002 (2)	Closed between 1990–2002 (3)	
Panel A. Plant characteristics by opening and closing status				
Number of plants	1,846	689	1,062	
Average plant employment (total workers)	224	90	114	
Average plant age (years)	18.6	2.0	16.2	
Mean value of plant equipment (in millions)	\$15.8	\$15.4	\$14.9	
Mean value of plant structures (in millions)	\$6.2	\$5.8	\$5.1	
Mean annual salary and wages (in millions)	\$11.7	\$5.5	\$6.2	
Mean annual toxic emissions (in pounds)	22,016	23,303	17,919	
	$0 < d \leq 0.5$ (1)	$0.5 < d \leq 1$ (2)	$0 < d \leq 1$ (3)	$1 < d \leq 2$ (4)
Panel B. Community characteristics by distance, d, from plants that opened or closed 1990–2002				
Housing characteristics				
Mean housing value	\$124,424	\$126,492	\$125,927	\$132,227
Aggregate housing value (in millions)	\$38.56	\$60.00	\$98.57	\$174.80
Birth and maternal characteristics				
Mother’s education	11.93	12.08	12.05	12.22
Mother’s age	26.33	26.50	26.46	26.70
Proportion teenage mother	0.15	0.15	0.15	0.15
Proportion smoker	0.14	0.13	0.13	0.13
Proportion African American	0.23	0.25	0.25	0.26
Proportion Hispanic	0.32	0.30	0.31	0.29
Proportion white/Caucasian	0.72	0.71	0.71	0.70

Notes: Panel A describes the 3,438 plants in Florida, Michigan, New Jersey, Pennsylvania, and Texas that reported to the Toxic Release Inventory at least one year between 1990 and 2002. In calculating plant characteristics in columns 2 and 3, the sample is restricted to observations in the 2 years after a plant opening or 2 years before a plant closing, and a single plant can appear in both columns. Plant age is right censored, as the year a plant opened is not available for plants opened before 1975 in the Longitudinal Business Database. The value of plant equipment, structures, and salary and wages come from the NBER Productivity Database microdata and is only available for a subset of our data that matches the NBER Productivity Database in a given year. The value of plant equipment and structures is constructed using the perpetual inventory method from investment data (Mohr and Gilbert 1996). All dollar amounts are in 2000 dollars. Panel B statistics describe community characteristics surrounding toxic plants that either opened or closed between 1990 and 2002. Housing sales and births may appear in multiple columns if they are within 2 miles of more than one plant opening or closing, but within each column a house or birth appears only once.

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Table 2

The Effect of Toxic Plants on Local Housing Values

	0–0.5 Miles		0.5–1 Miles		0–1 Miles		0–1 Miles (+/− 2 years)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Estimated effect of plant operation								
1(Plant Operating) × Near	−0.030*** (0.007)	−0.022*** (0.006)	−0.010** (0.005)	−0.012*** (0.004)	−0.015*** (0.005)	−0.014*** (0.004)	−0.009** (0.004)	−0.010*** (0.003)
Observations (plant-distance-year cells)	34,736	34,736	34,736	34,736	34,736	34,736	30,492	30,492
Plant × distance-bin FE	X	X	X	X	X	X	X	X
State × year FE	X		X		X		X	
Plant × year FE		X		X		X		X
Panel B. First difference: Estimated effect of plant operation								
1(Plant Operating) × Near	−0.020** (0.010)	−0.014** (0.007)	−0.008* (0.004)	−0.003 (0.004)	−0.010** (0.005)	−0.005 (0.004)	−0.005 (0.006)	−0.002 (0.005)
Observations	1,114,248	1,114,248	1,305,780	1,305,780	1,375,751	1,375,751	1,196,000	1,196,000
Panel C. First difference: Estimated effect of plant openings and closings								
1(Plant Opening) × Near	−0.096*** (0.036)	−0.107*** (0.034)	−0.007 (0.023)	−0.008 (0.020)	−0.020 (0.022)	−0.022 (0.019)	−0.030 (0.028)	−0.038 (0.025)
1(Plant Closing) × Near	0.017 (0.011)	0.010 (0.009)	0.008 (0.005)	0.003 (0.004)	0.010* (0.006)	0.005 (0.005)	0.005 (0.007)	0.001 (0.005)
H_0: Opening	0.051	0.013	0.968	0.827	0.688	0.438	0.402	0.164
= −Closing (*p*-value)								
Observations	1,114,248	1,114,248	1,305,780	1,305,780	1,375,751	1,375,751	1,196,000	1,196,000
State × year fixed FE	X		X		X		X	
County × year FE		X		X		X		X

Notes: This table reports regression coefficients from 24 separate regressions, 8 per panel, from a sample of 2,171 plants. The dependent variable in all regressions is housing values (in logs). Both the regression sample and the indicator variable "Near" change as one moves across the columns, indicated by the column headings. For example, the specification in columns 1 and 2 examines how group-level average housing values within 0.5 miles of a plant (i.e. "Near") respond to plant operating status, relative to the comparison group. The comparison group in all columns is homes between 1 and 2 miles from a plant. In columns 7 and 8, the sample removes observations more than two years before and after changes in plant activity. In panel A, the data have been aggregated to plant-by-distance-by-year cells and regressions are weighted by the group-level cell size. Panel B reports the same estimates as panel A using the set of houses we observe selling more than once in our sample and estimating in first

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differences. Panel C estimates of the asymmetric effect of plant openings/closings using the first difference specification, including *p*-values from tests that the two coefficients are equal, but of opposite sign. All specifications control for census tract characteristics (interacted with quadratic trends). Standard errors two-way clustered by plant and year are in parentheses.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

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Table 3

The Effect of Toxic Plants on Local Housing Values: Above/Below Median (0–0.5 Miles), First-Difference

	Employment (1)	**Payroll (2)**	**Fugitive emissions (3)**	**Stack emissions (4)**	**Mean toxicity (5)**
1(Plant Operating) × 1(< 0.5 Miles)	−0.005 (0.009)	−0.002 (0.009)	−0.009 (0.006)	−0.008 (0.006)	−0.010 (0.006)
1(Plant Operating) × 1(< 0.5 Miles) × 1(Above Median)	−0.012 (0.012)	−0.017 (0.012)	−0.010 (0.015)	−0.010 (0.014)	−0.006 (0.014)
Observations	1,140,399	1,140,399	1,140,399	1,140,399	1,140,399
	Max toxicity (6)	Fraction college (7)	Fraction white (8)	Housing value (9)	Median income (10)
1(Plant Operating) × 1(< 0.5 Miles)	−0.003 (0.008)	−0.014** (0.007)	−0.016** (0.006)	−0.012 (0.007)	−0.024*** (0.006)
1(Plant Operating) × 1(< 0.5 Miles) × 1(Above Median)	−0.016 (0.013)	0.007 (0.014)	0.014 (0.012)	0.002 (0.012)	0.032*** (0.009)
Observations	1,140,399	1,140,399	1,140,399	1,140,399	1,140,399

Notes: This table reports regression coefficients from 10 separate regressions, where we interact our treatment variable 1(Plant Operating) × 1(< 0.5 Miles) with an indicator for whether the plant/community is above or below the median characteristic indicated in the column heading. The median indicator is equal to 1 if the plant-level median of the column variable (taken over plant operating years) is above or below the sample median value (taken over median plant values). The dependent variable in all regressions is housing values (in logs). All regressions control for county by year fixed effects and census tract characteristics (interacted with quadratic trends), and the model is estimated in first differences. Standard errors are two-way clustered by plant and year.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

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Table 4

The Effect of Toxic Plants on Low Birthweight

	0–0.5 Miles		0.5–1 Miles		0–1 Miles		0–1 Miles (+/− 2 years)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Estimated effect of plant operation								
1(Plant Operating) × Near	0.0010 (0.0010)	0.0012 (0.0012)	0.0014** (0.0006)	0.0015** (0.0006)	0.0013** (0.0006)	0.0014** (0.0007)	0.0021** (0.0009)	0.0026*** (0.0009)
Observations	88,958	88,958	88,958	88,958	88,958	88,958	63,324	63,324
Plant count	3,438	3,438	3,438	3,438	3,438	3,438	3,438	3,438
Panel B. Estimated effect of plant openings and closings								
1(Plant Opened) × Near	0.0025 (0.0019)	0.0022 (0.0018)	0.0024*** (0.0009)	0.0027*** (0.0010)	0.0024** (0.0009)	0.0024*** (0.0008)	0.0031* (0.0017)	0.0037** (0.0017)
1(Plant Closed) × Near	−0.0002 (0.0016)	−0.0007 (0.0016)	−0.0009 (0.0009)	−0.0009 (0.0010)	−0.0007 (0.0009)	−0.0009 (0.0009)	−0.0016 (0.0012)	−0.0021* (0.0013)
H_0: Opening = −Closing (p-value)	0.44	0.56	0.32	0.28	0.22	0.24	0.51	0.48
Observations	88,958	88,958	88,958	88,958	88,958	88,958	63,324	63,324
Plant count	3,438	3,438	3,438	3,438	3,438	3,438	3,438	3,438
Plant × Distance-bin FE	X	X	X	X	X	X	X	X
State × Year FE	X		X		X		X	
Plant × Year FE		X		X		X		X

Notes: This table reports regression coefficients from 16 separate regressions, 8 per panel. The dependent variable in all regressions is the mean incidence of low birthweight where the data have been aggregated to plant by distance by year cells. Cell level averages have been adjusted for maternal characteristics including age, education, race, and smoking behavior, as well as for month of birth, birth order, and gender of child. See text for details. The mean incidence of low birthweight in our sample is 0.07. Both the regression sample and the indicator variable “Near” change as one moves across the columns, indicated by the column headings. For example, the specification in columns 1 and 2 examines how group-level average birth outcomes within 0.5 miles of a plant (i.e. “Near”) respond to plant operating status, relative to the comparison group. The comparison group in all columns is births between 1 and 2 miles from a plant. In columns 7 and 8, the sample removes observations more than two years before and after changes in plant activity. Panel A estimates the effect of plant operating status on local birth outcomes, where 1(Plant Operating) is an indicator variable equal to one for plants that have opened and/or have not yet closed. Panel B estimates the asymmetric effect of plant openings/closings. Panel B reports p-values from tests that the two coefficients are equal in magnitude but of opposite sign. All columns control for census tract characteristics (interacted with quadratic trends) and regressions are weighted by the group-level cell size. Multiple births are dropped from regressions. Standard errors are two-way clustered by plant and year.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

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Table 5

The Effect of Toxic Plants on Low Birthweight: Above/Below Median (*0–1 Miles*)

	Employment (1)	**Payroll (2)**	**Fugitive emissions (3)**	**Stack emissions (4)**	**Mean toxicity (5)**
1(Plant Operating) × 1(< 1 Mile)	0.0016** (0.0007)	0.0012 (0.0007)	0.0010 (0.0007)	0.0008 (0.0007)	0.0013* (0.0007)
1(Plant Operating) × 1(< 1 Mile) × 1(Above Median)	−0.0010 (0.0013)	0.0003 (0.0014)	0.0007 (0.0013)	0.0010 (0.0011)	−0.0001 (0.0017)
Observations	88,958	88,958	88,958	88,958	88,958
	Max toxicity (6)	Fraction college (7)	Fraction white (8)	Housing value (9)	Median income (10)
1(Plant Operating) × 1(< 1 Mile)	0.0006 (0.0007)	0.0007 (0.0007)	0.0010* (0.0005)	0.0028*** (0.0010)	0.0014* (0.0007)
1(Plant Operating) × 1(< 1 Mile) × 1(Above Median)	0.0020 (0.0013)	0.0017 (0.0017)	0.0009 (0.0010)	−0.0028* (0.0017)	−0.0003 (0.0013)
Observations	88,958	88,958	88,958	88,958	88,958

Notes: This table reports regression coefficients from 10 separate regressions, where we interact our treatment variable 1(Plant Operating) × 1(< 1 Mile) with an indicator for whether the plant/community is above or below the median characteristic indicated in the column heading. The median indicator is equal to 1 if the plant-level median of the column variable (taken over plant operating years) is above or below the sample median value (taken over median plant values). The dependent variable in all regressions is the mean incidence of low birthweight, where the data have been aggregated to plant by distance by year cells. Cell level averages have been adjusted for micro covariates, and all regressions control for plant by distance and plant by year fixed effects, as well as census tract characteristics (interacted with quadratic trends). Regressions are weighted by the group-level cell size. Standard errors are two-way clustered by plant and year.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

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Table 6

The Effect of Toxic Plants on Alternative Measures of Infant Health

	Birthweight (grams, in logs) (1)	**Birthweight (grams, in logs) (2)**	**Very low birthweight (3)**	**Very low birthweight (4)**	**Premature (5)**	**Premature (6)**
1(Plant Op) × 1(< 1 Mile)	−0.0011*** (0.0003)	−0.0012*** (0.0004)	0.0001 (0.0002)	0.0001 (0.0001)	0.0009** (0.0004)	0.0009** (0.0005)
Observations	88,958	88,958	88,958	88,958	88,404	88,404
Mean	8.09	8.09	0.0113	0.0113	0.0845	0.0845
Plant × dist-bin FE	X	X	X	X	X	X
State × year FE	X		X		X	
Plant × year FE		X		X		X
	Congenital anomaly (7)	Congenital anomaly (8)	Infant death (9)	Infant death (10)	Summary index (11)	Summary index (12)
1(Plant Op) × 1(< 1 Mile)	−0.0003 (0.0009)	−0.0005 (0.0010)	0.0001 (0.0001)	0.0000 (0.0001)	0.0165** (0.0066)	0.0158** (0.0071)
Observations	88,212	88,212	89,388	89,388	89,388	89,388
Mean	0.0679	0.0679	0.0068	0.0068	−0.0004	−0.0004
Plant × dist-bin FE	X	X	X	X	X	X
State × year FE	X		X		X	
Plant × year FE		X		X		X

Notes: This table reports regression coefficients from 12 separate regressions on a sample of 3,438 plants. The dependent variable is listed in the column heading, and data have been aggregated to plant by distance by year cells. Cell level averages have been adjusted for maternal characteristics. See text for details. The comparison group in all columns is births between 1 and 2 miles from a plant. Columns 11 and 12 present results from a summary index measure of outcomes to address concerns pertaining to inference with a large number of outcomes. Outcomes for the summary index measure include those listed above, in addition to low birthweight, and outcomes are standardized to be mean 0 and standard deviation 1. Before combining, birthweight is multiplied by −1 so that an increase in the summary index measure reflects an increase in adverse health outcomes. All regressions control for tract characteristics (interacted with quadratic trend). Multiple births are dropped from regressions. Regressions are weighted by the group-level cell size. Standard errors are two-way clustered by plant and year.

REGION 3
PHILADELPHIA, PA 19103

January 8, 2025

VIA ELECTRONIC MAIL
RETURN RECEIPT REQUESTED

Ms. Suna Yi Sariscak
Manager
Maryland Department of the Environment
Air Quality Permits Program
Air and Radiation Administration
1800 Washington Blvd,
Baltimore, MD 21230

RE: Applicability Determination Request - OSWI Rule and Proposed Pilot Plant in Maryland

Dear Ms. Sariscak:

We have received your December 13th, 2024 letter requesting an Applicability Determination for W.R. Grace & Co.-Conn and applicability of 40 CFR Part 60, Subpart EEEE - Standards of Performance for Other Solid Waste Incineration (OSWI).

Background

The December 13th letter and supplemental application describe a proposed Research and Development lab to be constructed by W.R. Grace & Co.-Conn ("Grace"). The proposed R&D facility intends to construct a catalytic pyrolysis unit, for the purposes of:

> …researching the scaling up of an innovative process to convert 1kg/hr of plastics back to their original components. The reactor in this proposed process will use a catalyst and heat in the form of steam to carry out this reaction. The Product from the reactor is a vapor. The vapor is sent via pipe to a condenser. The vapor that is liquified in the condenser is the product, which is then stored in drums. The drums are sent off site for disposal once data is collected. Non condensables from the condenser are sent via pipe to an electric flameless thermal oxidizer to control any VOC that may be present in the gas stream.

Furthermore, two phases will occur in which phase 1 will utilized virgin plastic as feedstock and if the project is determined to be "technologically feasible" and "commercially viable" phase 2 will consist of

processing recycled plastics. It's stated that Grace "cannot directly process plastic waste" and will need to source cleaned, pelletized recycled plastics.

Determination

Subpart EEEE has three applicability requirements, which are:

(a) Your incineration unit is a new incineration unit as defined in § 60.2886.
(b) Your incineration unit is an [Other Solid Waste Incinerator] OSWI unit as defined in § 60.2977 or an air curtain incinerator subject to this subpart as described in § 60.2888(b). Other solid waste incineration units are very small municipal waste combustion units and institutional waste incineration units as defined in § 60.2977.
(c) Your incineration unit is not excluded under § 60.2887.

The proposed catalytic pyrolysis unit, when constructed would be "new" as defined in §60.2886, which is defined to mean having a construction date after December 9, 2004. Additionally, the unit would meet the definition of an Other Solid Waste Incinerator, as OSWI expressly includes pyrolysis units. Despite the first two applicability requirements being satiated, the proposed catalytic pyrolysis unit would meet an exemption under § 60.2887.

§ 60.2887 states that "Your unit is excluded if it burns samples of materials only for the purpose of chemical or physical analysis." If the catalytic pyrolysis unit is operated for the sole purpose of research, the unit would be exempted from other requirements promulgated in 40 CFR Part 60, Subpart EEEE - Standards of Performance for Other Solid Waste Incineration (OSWI). Please note that rules such as 40 CFR 60 – Standards of Performance for New Stationary Sources do change occasionally, and any future changes to Subpart EEEE should be evaluated.

The EPA's response hereinabove to the request for applicability determination was coordinated with EPA's Office of Enforcement and Compliance Assurance (OECA) and EPA's Office of Air Quality Planning and Standards (OAQPS). EPA's applicability determination is specific to the facts provided in the December 13th, 2024 letter and supplemental application from W.R. Grace & Co.-Conn and any differences in the constructed facility or its operations may invalidate this response. If you have any questions regarding this response, please contact Steve Ott, of the Enforcement and Compliance Assurance Division at (215) 814-2267 or ott.steven@epa.gov.

Sincerely,

Karen Melvin
Director
Enforcement and Compliance Assurance Division

CC:
Cristina Fernandez, EPA Region 3, fernandez.cristina@epa.gov
Kristen Hall, EPA Region 3, hall.kristen@epa.gov
MaryCate Opila, EPA Region 3, opila.marycate@epa.gov
Steve Ott, EPA Region 3, ott.steven@epa.gov

1. PYROLYSIS UNITS

Pyrolysis is a process where materials are thermally decomposed or rearranged under process conditions where extremely little to no oxygen is present. Pyrolysis, which is also known as devolatilization, is an endothermic process [6] that produces 75-90 percent volatile materials in the form of gaseous and liquid hydrocarbons.[7] Remaining non-volatile materials with high carbon content form a product called char.[8] Pyrolysis relies on intensive heat energy and does not require the presence of oxygen. Pyrolysis units may be used to "crack" or chemically decompose organic materials. Pyrolysis technology vendors use different variations of, and names for, pyrolysis units, including: [9] (1) Thermal pyrolysis/cracking where feedstock is heated at high temperatures (350-900 degrees Celsius (°C)) in the absence of a catalyst; (2) catalytic pyrolysis/cracking where the feedstock is processed using a catalyst; and (3) hydrocracking (sometimes referred to as "hydrogenation") where the feedstock is reacted with hydrogen and a catalyst under moderate temperatures and pressures (*e.g.,* 150-400 °C and 30-100 bar hydrogen). Regardless of the process category, through application of heat, pyrolysis disintegrates the long (print page 50300) hydrocarbon bonds of the incoming feed materials and may generate tars, oils, particulate matter, reduced sulfur and nitrogen compounds, and hazardous air pollutants (HAPs) including polycyclic aromatic hydrocarbons (PAHs).

Stop the W.R. Grace Plastics Burning Project in Howard County, Maryland Petition

Please sign our petition:

I oppose the construction and operation of a pilot plant by W.R. Grace Chemical Company for the purposes of recycling plastics at their Grace Drive facility in Columbia, Maryland. I call on our local and state officials as well as our county and state agencies to take the appropriate steps to block this project as it endangers the health, safety, and well-being of our community residents.

.

The proposed plant will consist of a pyrolysis reactor, an incinerator (aka, a flameless electrical oxidizer), plus supporting structures and equipment. All of this equipment will be located approximately 70 yards away from family homes in a residential neighborhood.

.

The risks to our communities are very significant in terms of toxic air emissions and the catastrophic effect of potential fires and explosions from the reactor and incinerator. According to Grace's permit application to the Maryland Department of the Environment (MDE, Docket number 16-23), the plant will operate for 16 hours a day, 5 days a week, all year round, potentially for several years.

.

Several chemicals will be emitted as volatile organic compounds, the cumulative health effects of these emissions to developing children and to everyone in the community could be severe and are a real concern.

.

In addition, incidents of fires and explosions resulting in injury, death, contamination, and damage to neighboring communities with this type of installation are well-documented in the chemical industry literature. This aspect is particularly concerning to our communities located next to the Grace Chemical facilities.

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Our group has reviewed W.R. Grace's permit application to MDE and expressed our concerns at a public hearing on April 29th, 2024 and in follow-up letter to MDE officials.

.

We also have contacted the Howard County Department
of Planning and Zoning and questioned their decision to approve the proposed expansion
without a review on the basis that the pilot plant will be part of an existing previously approved laboratory. We believe there are significant differences between a research laboratory and a pilot plant of this nature. We believe that a thorough review was required.

Based on these concerns, we respectfully petition our local and state officials as well as our county and state agencies to block W.R. Grace from constructing and operating the proposed pilot plant.

By signing this petition, we will keep you informed of important updates and action steps you can take to stop Grace's proposed plan. You can unsubscribe at any point by responding to an email with the word UNSCUBSCRIBE in that return email.

* Indicates required question

1. Email *

2. I support the petition above. My printed name here represents my support for this petition. Please fill in your full name here. Thank you. *

3. First Name *

4. Last Name *

5. I represent the opinions of: *

Mark only one oval.

- My Family Household (i.e., Multiple Family Member in Household)
- My Self (i.e., Single Person Household or Just Your Self in a Family)

6. If you are representing a Family Household, how many members are in your family?

Mark only one oval.

- 2
- 3
- 4
- 5
- 6 or more
- Prefer not to say.

7. Home Address *

8. Cell Phone Number

9. I live in the following neighborhood: *

Mark only one oval.

- Allview Estates
- Cedar Creek
- Dorsey's Search
- Guilford
- Harper's Choice
- Hickory Ridge
- Kings Contrivance
- Long Reach
- Oakland Mills
- Owen Brown
- River's Edge
- River Hill
- Town Center
- Wild Lake
- Other: ____________________

10. If other above, where do you live?

____

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Google Forms

Stop Grace Member Information

Timestamp	Username	I support the petition above. My printed name here represents my support for this petition. Please fill in your full name here. Thank you.	First Name	Last Name	Home Address	Cell Phone Number	I live in the following neighborhood:	If other above, where do you live?	
2024/08/15 5:42:59 PM EST	bhcohen@gmail.com				12233 Summer Sky Path, Clarksville MD 21044				4108187178
2024/08/15 5:43:58 PM EST	lisalkrausz@comcast.net				6109 Trackless Sea Court				415-717-7065
2024/08/15 7:17:00 PM EST	janw.miller@gmail.com				14460 Triadelphia Mill Rd				301-922-1326
2024/08/15 9:58:59 PM EST	janw.miller@gmail.com				14460 Triadelphia Mill Rd, Dayton MD				301-922-1326
2024/08/15 10:20:11 PM EST	gardengirl0462@gmail.com				8513 Ellicott View Road Ellicott City MD 21043				410-465-9647
2024/08/16 11:39:51 AM EST	sherripowell@verizon.net				11861 Bright Passage	301/758-6451	Hickory Ridge		I affirm and support the statement above.
2024/08/16 1:22:45 PM EST	elizamweih@gmail.com				6449 Mellow Wine Way 21044	4432581030	River Hill		I affirm and support the statement above.
2024/08/16 1:47:34 PM EST	courtney.lacy@gmail.com				6312 Mellow Twilight Court	734-678-5286	River Hill		I affirm and support the statement above.
2024/08/16 2:40:02 PM EST	jrosenthl@yahoo.com				6608 Forest Shade Trail, Clarksville, MD 21029	410-608-1913	River Hill		I affirm and support the statement above.
2024/08/16 3:05:48 PM EST	st2girls@comcast.net				7013 Long View Road	443-277-3186	River's Edge		I affirm and support the statement above.
2024/08/16 3:58:43 PM EST	tkdglenn@gmail.com				6981 Silent Dell Lane	443-745-1054	River's Edge		I affirm and support the statement above.
2024/08/16 7:53:35 PM EST	amanda.heir@gmail.com				6308 victorious song lane Clarksville		River Hill		I affirm and support the statement above.
2024/08/17 11:12:43 AM EST	lisarahwanji4@gmail.com				6445 Quiet Night Ride	4105995331	River Hill		I affirm and support the statement above.
2024/08/17 8:17:29 PM EST	scott_markow@yahoo.com				7124 Morning Light Trail	3016517087	River Hill		I affirm and support the statement above.
2024/08/18 11:17:47 AM EST	ihalkias12@gmail.com				6500 Waving Tree Court Columbia MD 21044	4432269977	River Hill		I affirm and support the statement above.
2024/08/18 12:34:32 PM EST	info@lastinglightwellness.com				6136 Waiting Spring Columbia, MD 21045	4435167740	Long Reach		I affirm and support the statement above.
2024/08/18 1:20:55 PM EST	mark.udey@gmail.com				7341 Wildwood Court, Columbia,MD 21046		Kings Contrivance		
2024/08/18 3:06:27 PM EST	lmkleeman27@gmail.com				7110 Newberry Drive, Columbia MD 21044		River's Edge		I affirm and support the statement above.
2024/08/18 3:46:40 PM EST	bbormel@gmail.com				11824 Chapel Woods Ct Clarksville, MD 21029		Other	Clarksville	I affirm and support the statement above.
2024/08/18 8:36:08 PM EST	saracnoonan@gmail.com				7956 Lawndale Circle Columbia, MD 21044	2405939258	Cedar Creek		I affirm and support the statement above.
2024/08/19 6:20:49 AM EST	shawmd5@comcast.net				7779 Cross creek dr Columbia Md 21044	3017857976	Cedar Creek		I affirm and support the statement above.
2024/08/19 6:15:02 PM EST	monictino@gmail.com				7248 Mainstream Way Columbia		Cedar Creek		I affirm and support the statement above.
2024/08/19 9:07:20 PM EST	aishaahasan@gmail.com				7949 Lawndale Circle	4438120480	Cedar Creek		I affirm and support the statement above.
2024/08/19 11:44:00 PM EST	mariakwon@gmail.com				6937 Crossfield Ct		Other	Clarksville Hunt off of Sanner Rd	I affirm and support the statement above.
2024/08/20 6:19:36 AM EST	dpruitt@nist.gov				5333 Broadwater In Clarksville md	301 503 8070	Other	1.5 miles from river hill	I affirm and support the statement above.
2024/08/20 11:18:31 AM EST	annikaluke@gmail.com				5804 Silent Sun Places	2409386484	River Hill		I affirm and support the statement above.
2024/08/20 11:49:28 AM EST	tfwinc@yahoo.com				6964 Silent Dell Lane		River's Edge		I affirm and support the statement above.
2024/08/20 2:33:38 PM EST	preetahari2017@gmail.com				7941 Lawndale Circle	6096581057	Cedar Creek		I affirm and support the statement above.
2024/08/20 2:56:16 PM EST	preetahari2017@gmail.com				7941 Lawndale Circle	6096581057	Cedar Creek		I affirm and support the statement above.
2024/08/21 10:23:01 PM EST	mmihaela81@gmail.com				7244 mainstream way Columbia 21044 Md	2403637664	Cedar Creek		I affirm and support the statement above.
2024/08/22 3:04:29 PM EST	keostevens@gmail.com	Kathy Stevens	Kathy	Stevens	6553 River Run	410-245-1066	River Hill		
2024/08/22 4:00:25 PM EST	tsullivan@hselderlaw.com	Terry SULLIVAN	Terry	SULLIVAN	7911 Tilghman St	3013107897	River Hill		
2024/08/22 7:41:11 PM EST	anwerhasan@hotmail.com	Anwer Hasan	Anwer	Hasan	7651 cross creek drive Columbia MD 21044	4433241287	Cedar Creek		
2024/08/22 8:09:38 PM EST	debyare@comcast.net	Debbie Yare	Debbie	Yare	6804 Pyramid Way. Columbia	3013188989	Hickory Ridge		
2024/08/22 9:01:54 PM EST	zainqazi@gmail.com	Zain Qazi	Zain	Qazi	7949 Lawndale Cir	5409989176	Cedar Creek		
2024/08/23 1:03:48 AM EST	tssiegel1@gmail.com	Toby Msrtin	Toby	Martin	12014 Triadelphia Road		Ellicott City	Ellicott - close to River Hill & Harper's Choice	
2024/08/23 5:42:40 AM EST	hillarylegrain@hotmail.com	Hillary Legrain	Hillary	Legrain	3820 Championship Drive, Glenwood, MD 21738	7037951824	Cattail Creek Country Club	Cattail Creek Country Club	
2024/08/23 6:29:34 AM EST	tiffanyake@gmail.com	Tiffany Ake	Tiffany	Ake	10947 Eight Bells lane Columbia md 21044	2404766097	Harper's Choice		
2024/08/23 6:32:51 AM EST	inapam829@gmail.com	Ina hersh	Ina	Hersh	10264 Shaker Dr Columbia md 21046	4437569831	Kings Contrivance	I am in between allview and kings contrivance	
2024/08/23 10:17:02 AM EST	hdporton@icloud.com	Harriet Porton	Harriet	Porton	11204 Avalanche Way	4102740443	Hickory Ridge		
2024/08/23 11:59:29 AM EST	tammy.legrys@gmail.com	Tammy LeGrys	Tammy	LeGrys	6558 River Run, Columbia, MD 21044		River Hill		
2024/08/23 12:31:21 PM EST	andrea.chronis@gmail.com	Andrea Chronis-Tuscano	Andrea	Chronis-Tuscano	6521 WAVING TREE CT	202-236-2799	River Hill		
2024/08/23 12:55:30 PM EST	tkdglenn@gmail.com	Glenn Miller	Glenn	Miller	6981 Silent Dell Lane, Columbia, MD 21044	443-745-1054	River's Edge		
2024/08/23 12:59:00 PM EST	christinalambertmba@gmail.com	Christina Lambert	Christina	Lambert	10623 Glen Hannah Dr, Laurel, MD 20723		Leishear Village		
2024/08/23 4:31:49 PM EST	seresnick@verizon.net	Stacie Resnick	Stacie	Resnick	6416 Ripe Apple Lane	4438789522	River Hill		
2024/08/23 8:10:31 PM EST	cjmahoney1@gmail.com	Cara Mahoney	cara	mahoney	7130 Moorland Drive	4107078764	Ashleigh Knolls		
2024/08/24 7:05:04 AM EST	vkwitkowski@gmail.com	Virginia Kwitkowski	Virginia	Kwitkowski	4994 Centaurus Ct, Dayton, MD 21036	2409380324	Dayton	Dayton	
2024/08/24 10:26:07 AM EST	kellip1114@gmail.com	Kelli Passalacqua	Kelli	Passalacqua	12126 Fulton Ridge Drive		Fulton Ridge	Fulton Ridge - Fulton, MD	
2024/08/24 11:01:24 AM EST	scollar67@gmail.com	Robert Scollar	Robert	Scollar	6425 Quiet Night Ride Columbia MD 21044	3017170198	River Hill		
2024/08/24 11:08:16 AM EST	scott_markow@yahoo.com	Scott Markow	Scott	Markow	7124 Morning Light Trail, Columbia MD 21044		River Hill		
2024/08/24 11:15:02 AM EST	timberlane12@verizon.net	John Moore	John	Moore	12750 Scaggsville rd Highland md	443 3249908	Highland	Highland	
2024/08/24 11:27:39 AM EST	jillhartman77@gmail.com	Jill Hartman	Jill	Hartman	6512 Hazel Thicket Drive Columbia MD 21044	4432865654	River Hill	N/A	
2024/08/24 11:37:04 AM EST	ortizimm@gmail.com	Dorothy Ortiz	Dorothy	Ortiz	10962 Trotting Ridge Way, Columbia, MD 21044		Hickory Ridge		
2024/08/24 11:52:08 AM EST	robynbethmiller@gmail.com	Robyn Miller	Robyn	Miller	6384 grateful heart gate Columbia, MD 20144	3019389324	River Hill		
2024/08/24 11:52:35 AM EST	michell.min@gmail.com	Michell Min	Michell	Min	12172 Flowing Water Trail Clarksville MD 21029	443 518 9547	River Hill		
2024/08/24 11:58:05 AM EST	emilychikh@gmail.com	Emily Chikhaoui	Emily	Chikhaoui	5919 trumpet sound court clarksville 21029		River Hill		
2024/08/24 12:13:50 PM EST	jennifer.robin.kulik@gmail.com	Jennifer Kulik	Jennifer	Kulik	6540 Autumn wind cir Clarksville Md 21029	4104048227	River Hill		
2024/08/24 12:15:34 PM EST	bresnick76@verizon.net	Brian Resnick	Brian	Resnick	6416 ripe Apple Lane, columbia, md		River Hill		
2024/08/24 12:45:28 PM EST	mollynich@gmail.com	Molly Nicholl Inglis	Molly	Nicholl	6818 Roslyn Court	4104408137	Guilford	Pointers Run Overlook	
2024/08/24 12:47:12 PM EST	rachel.crosen@umaryland.edu	Rachel Scholnick	Rachel	Scholnick	6317 Morning Time Lane Columbia MD 21044		River Hill		
2024/08/24 1:19:58 PM EST	npilevsky@msn.con	Nicole Pilevsky	Nicole	Pilevsky	6517 Early Lily Row Columbia 21044		River Hill		
2024/08/24 1:39:24 PM EST	laura.seylar@verizon.net	Laura Seylar	Laura	Seylar	6676 Buttonhole Ct		Hickory Ridge		
2024/08/24 1:44:11 PM EST	aishaahasan@gmail.com	Aisha Hasan	Aisha	Hasan	7949 Lawndale Circle Columbia Md 21044		Cedar Creek		
2024/08/24 1:50:21 PM EST	chrisjosey7@gmail.com	Chris Josey	Chris	Josey	6425 grateful heart gate Columbia MD 21044		River Hill		
2024/08/24 1:59:27 PM EST	loriel902@comcast.net	Lorie E. Lana	Lorie	Lana	5380 Green Bridge Road, Dayton MD 21036	410-531-1118	Dayton	Dayton	
2024/08/24 2:18:34 PM EST	lisanichols3@verizon.net	Lisa Nichols	Lisa	Nichols	6308 Silvery Star Path, Columbia, MD 21044	4105300117	River Hill		
2024/08/24 2:20:58 PM EST	sesexton726@gmail.com	Sarah Elise Sexton	Sarah	Sexton	10702 Faulkner Ridge Cir	4435205383	Wild Lake		
2024/08/24 2:26:58 PM EST	finddesign@me.com	Julia V Pogach	Julia	Pogach	6317 Morning Time Lane Columbia Md 21044		River's Edge		
2024/08/24 3:07:06 PM EST	thestarlings@hotmail.com	Melanie Starling	Melanie	Starling	608 Sideling Court	4107073136	Sykesville	Sykesville	
2024/08/24 4:08:23 PM EST	helenann.pappas@gmail.com	Helen Pappas	Helen	Pappas	5646 chamblis Dr	5052031885	River Hill	Clarksville	
2024/08/24 4:54:02 PM EST	hcschwarz@verizon.net	Cathy J Schwarz	Cathy	Schwarz	11668 Dark Fire Way	4102189103	Harper's Choice		
2024/08/24 5:11:31 PM EST	robinsturman5@gmail.com	Robin Sturman	Robin	Sturman	10701 Quarterstaff Road Columbia, Md 21044	443-255-0657	Hickory Ridge		
2024/08/24 5:29:27 PM EST	walter.rowe@gmail.com	Walter Rowe	Walter	Rowe	6313 Mellow Twilight Court	202-355-4123	River Hill		
2024/08/24 5:34:29 PM EST	eac119@gmail.com	Elizabeth Fishman	Elizabeth	Fishman	3013 Quail Hollow terrace	3019287900	In montgomery County	Brookeville Md	
2024/08/24 5:39:36 PM EST	katiefritsch@hotmail.com	Katie Bozarth	Katie	Bozarth	13054 Saint Patricks Ct		Highland, MD	Highland	
2024/08/24 6:07:52 PM EST	dbportnoy@gmail.com	David Portnoy	David	Portnoy	6267 Audubon Drive Columbia Md 21044	8604908993	Hickory Ridge		
2024/08/24 6:28:23 PM EST	marholmes1@gmail.com	Marlene Holmes	Marlene	Holmes	6401 RIVER RUN, Columbia, MD 21044		River Hill		
2024/08/24 6:36:43 PM EST	aj474@yahoo.com	Angela Davis	Angela	Davis	6413 Empty Song Rd	205-246-0481	River Hill		
2024/08/24 6:42:22 PM EST	jspencer@purdue.edu	Jack W. Spencer	Jack	Spencer	4998 Centaurus Court Dayton Maryland	765-490-4717	Dayton	Dayton, Md	
2024/08/24 6:48:31 PM EST	christinayuan33@gmail.com	Christina Yuan	Christina	Yuan	7523 Overview Terrace Columbia MD 21044		Cedar Creek		
2024/08/24 6:53:42 PM EST	julie_pavlovsky@yahoo.com	Julie Pavlovsky	Julie	Pavlovsky	6308 Last Sunbeam Pl columbia Md 21044		River Hill		
2024/08/24 7:09:13 PM EST	barbcosgrove@hotmail.com	Barbara Cosgrove	Barbara	Cosgrove	6508 Early Lily Row, Columbia MD 21044	3016137804	River Hill		
2024/08/24 7:18:20 PM EST	suzthomas@verizon.net	Suzanne Thomas	Suzanne	Thomas	6325 Angel Rose Ct	4104191059	River Hill		
2024/08/24 7:36:24 PM EST	Mhvan2000@gmail.com	Michelle Ho	Michelle	Ho	6118 Tulane Rd, clarksville md 21029	2408932310	River Hill		
2024/08/24 7:39:48 PM EST	bharathimuniswamy@yahoo.com	No	Bharathi	Muniswamy	11729 trotter point ct Clarksville md 21029		Trotter road	On trotter road	
2024/08/24 7:52:48 PM EST	sarah.starsoneck@gmail.com	Sarah Wharton	Sarah	Wharton	12100 Trailing Moss Gate	4108044201	River Hill		
2024/08/24 8:14:09 PM EST	afreelan1189@gmail.com	Alicia Kohler	Alicia	Kohler	6004 Pure Sky Place, Clarksville MD 21029		River Hill		
2024/08/24 8:14:48 PM EST	cathryn_kim@yahoo.com	Cathryn Kim	Cathryn	Kim	12104 Early Lilacs Path		River Hill		
2024/08/24 8:31:09 PM EST	kbernas@netscape.net	Kathryn Bernas	Kathryn	Bernas	12942 Byefield Drive, Highland, MD		Highland	Highland, my kids attended River Hill	
2024/08/24 8:31:52 PM EST	dansteil@verizon.net	Daniel Steil	Daniel	Steil	11878 Simpson Rd, Clarksville, MD 21029-1717, U	14437451393	Simpson Woods	Simpson Woods	
2024/08/24 8:36:38 PM EST	jennydeck22@gmail.com	Jennifer Decker	Jennifer	Decker	10033 Fox Den rd	9144003026	Ellicott city	Work in guilford	
2024/08/24 9:08:52 PM EST	marcgittleman@yahoo.com	Marc Gittleman	Marc	Gittleman	6525 Ocean Shore Ln, Columbia MD 21044		River Hill		
2024/08/24 9:10:52 PM EST	judy.radas42@gmail.com	Judy Radas	Judy	Radas	6726 Mink Hollow Road Highland MD	3018543084	Highland	Highland	
2024/08/24 9:34:22 PM EST	emgodfrey@gmail.com	Emily Godfrey	Emily	Godfrey	3540 Countryside Drive, Glenwood MD		Glenwood	Glenwood	
2024/08/24 9:46:26 PM EST	lweisslora@gmail.com	Lily Weiss-Lora	Lily	Weiss-Lora	6469 Empty Song Rd	410-531-2392	River Hill		
2024/08/24 11:01:06 PM EST	keivan_g@yahoo.com	Keivan Ghoseiri	Keivan	Ghoseiri	5749 Whistling Winds Walk, Clarksville, MD 21029		River Hill		
2024/08/24 11:23:44 PM EST	lehigh.mearns@gmail.com	Lehigh Mearns	Lehigh	Mearns	4321 Buckskin wood dr ellicott city md 21042		Buckskin Lake		
2024/08/25 6:02:49 AM EST	leannebaniqued@yahoo.com	No	Lorena	Baniqued	North Laurel		North Laurel	North Laurel, family member already has lung issues so its a NO	
2024/08/25 6:43:22 AM EST	amerimariam@gmail.com	Mariam Ameri	Mariam	Ameri	7654 Cross Creek Dr Columbia, MD 21044	3012336549	Cedar Creek		
2024/08/25 6:52:54 AM EST	cbattle@zingbycecelia.com	I support the petition above	Cecelia	Battle	5525 Adams Ridge Road Clarksville MD 21029	240-418-4348	Clarksville	Clarksville	
2024/08/25 6:53:49 AM EST	swensonkarin@gmail.com	Karin Swenson	Karin	Swenson	13913 Wayside Drive	2022139913	Clarksville	Near Brighton Dam in Clarksville the city	
2024/08/25 6:54:54 AM EST	alpn02@aol.com	Alan Pine	Alan	Pine	6509 Tender Mist Mews, Columbia MD 21044		River Hill		
2024/08/25 7:16:58 AM EST	painrnumd@yahoo.com	Karen Kaiser	Karen	Kaiser	11819 Far Edge Path	4103027221	Hickory Ridge		
2024/08/25 7:24:55 AM EST	dhaddy11@gmail.com	Danielle Haddy	Danielle	Haddy	6239 Trotter Road		River Hill		
2024/08/25 8:01:41 AM EST	melissasheryl13@gmail.com	Melissa Kay	Melissa	Kay	5308 Nightshade Ct		Glenmont	Glenmont	
2024/08/25 8:06:05 AM EST	lauralcavanaugh@gmail.com	Laura Cavanaugh	Laura	Cavanaugh	6119 minute hand Ct		Hickory Ridge		
2024/08/25 8:49:01 AM EST	sharkulik@comcast.net	Sharon Kulik	Sharon	Kulik	6540 autumn wind circle	410-207-1964	River Hill		
2024/08/25 8:50:25 AM EST	ecsmith257@gmail.com	Erin Anderson	Erin	Anderson	11700 Stonegate Ln Columbia, MD 21044		Hickory Ridge		
2024/08/25 9:16:13 AM EST	wjpow3@gmail.com	William J Powers	William	Powers	6323 Kiteline Court, Columbia, MD 21044	4104872062	Hickory Ridge		
2024/08/25 10:02:16 AM EST	bdibble49@gmail.com	Bridgette dibble	Bridgette	Dibble	6140 Cedar wood drive, Columbia MD		Hickory Ridge		
2024/08/25 10:27:35 AM EST	drquackie@gmail.com	Elise Ng	Elise	Ng	6552 Ballymore Lane, Clarksville, MD 21029		River Hill		
2024/08/25 11:17:51 AM EST	Zakiomar20@gmail.com	Zaki Omar	Zaki	Omar	5414 talon court Clarksville md 21029		Clarksville		
2024/08/25 11:48:05 AM EST	saracnoonan@gmail.com	Sara Morrell	Sara	Morrell	7956 Lawndale Circlr	2405939258	Cedar Creek		
2024/08/25 12:06:49 PM EST	karenholloway48@icloud.com	Karen Holloway	Karen	Holloway	5484 Harris Farm Lane	410 440 4237	Clarksville,MD		
2024/08/25 1:02:13 PM EST	lisamkurr@gmail.com	Lisa Kurr	Lisa	Kurr	6011 Helmsman Way	240-760-0753	River Hill		
2024/08/25 1:12:50 PM EST	d.nassar7@gmail.com	Doha Nassar	Doha	Nassar	Countless Stars Run		River Hill		
2024/08/25 1:28:11 PM EST	stphdoiron@yahoo.com	Stephanie Tyler	Stephanie	Tyler	7111 Moorland Dr	3015377510	Ashleigh Knolls	Clarksville	
2024/08/25 1:28:46 PM EST	rachel.wolven@gmail.com	Rachel Wolven	Rachel	Wolven	7193 Joshua Grayson Drive, jessup MD 20794		jessup	Cedar Villa Heights, Jessup MD	
2024/08/25 1:47:19 PM EST	danielle.cohen3@gmail.com	Danielle Cohen	Danielle	Cohe	12571 Vincents Way, Clarksville MD 21029	4103029010	River Hill		
2024/08/25 2:08:45 PM EST	aabokhari1@gmail.com	Amina Bokhari	Amina	Bokhari	7791 Cross Creek Drive Columbia MD 21044	4437655894	Cedar Creek		
2024/08/25 2:11:32 PM EST	garima.sharma.11@gmail.com	Garima Sharma	Garima	Sharma	7743 Cross Creek Drive, Columbia, MD 21044	2163921196	Cedar Creek		
2024/08/25 2:15:58 PM EST	s.stark.casagrande@gmail.com	Sarah Casagrande	Sarah	Casagrande	11444 iager blvd		Maple lawn	Maple lawn	
2024/08/25 2:17:16 PM EST	agatasmieja@hotmail.com	Agata Anthony	Agata	Anthony	7663 Cross Creek Dr., Columbia, MD 21044	2406393796	Cedar Creek		
2024/08/25 2:21:27 PM EST	aamir084@gmail.com	Aamir Chowdhury	Aamir	Chowdhury	7220 MAINSTREAM WAY	3018873503	Cedar Creek		
2024/08/25 2:34:04 PM EST	rmarravula@gmail.com	Ramya Marravula	Ramya	Marravula	7236 mainstream way	2406883820	Cedar Creek		
2024/08/25 2:50:01 PM EST	eyedoc515@gmail.com	Jacalyn Ely	Jacalyn	Ely	7534 Broadcloth Way Columbia, MD 21046		Kings Contrivance		
2024/08/25 3:02:02 PM EST	hanalah@gmail.com	Hannah Sanderson	Hannah	Sanderson	11453 Iager Blvd	4107339804	Maple lawn	Maple lawn	
2024/08/25 3:15:44 PM EST	nmiller@savills.us	Nicole Miller	Nicole	Miller	12300 Carol Drive, Fulton, MD 20759	3017066572	Fulton Manor	Fulton Manor	
2024/08/25 3:16:19 PM EST	kara.knieriem@gmail.com	Kara Karabias	Kara	Karabias	7675 Cross Creek Drive	8452163759	Cedar Creek		
2024/08/25 3:20:25 PM EST	LIFENETS@HOTMAIL.COM	Vaishali thakkar	Vaishali	Thakkar	6501 Langford ct.	2403249209	Clarksville	Clarksville	
2024/08/25 3:30:28 PM EST	ilysebr@gmail.com	Ilyse Reid	Ilyse	Reid	9558 Angelina cir, columbia Md 21045		Owen Brown		
2024/08/25 3:33:12 PM EST	jmiller4466@gmail.com	Jon Miller	Jon	Miller	6076 Laurel Wreath Way		Town Center		
2024/08/25 3:33:30 PM EST	ereid1215@gmail.com	Elaine Reid	Elaine	Reid	9558 Angelina Circle Columbia		Owen Brown		
2024/08/25 4:32:47 PM EST	mcdiwanji@gmail.com	Maria Diwanji	Maria	Diwanji	7747 CROSS CREEK DRIVE	3015125335	Cedar Creek		
2024/08/25 4:42:52 PM EST	stylenitin@gmail.com	I support this petition.	Nitin	Verma	6500 Kells Court	2403303179	Clarks Glen		
2024/08/25 4:51:17 PM EST	ppossong@gmail.com	H. Karen Jung	Hyonchu	Jung	7763 Cross Creek Dr. Columbia MD 21044		Cedar Creek		
2024/08/25 4:59:39 PM EST	gleithauser@verizon.net	Gail Leithauser	Gail	Leithauser	10606 Millet Seed Hl, Columbia, MD 21044	443-465-9661	Hickory Ridge		
2024/08/25 5:00:15 PM EST	perlpubl@gmail.com	Carla Tevelow	Carla	Tevelow	11170 Chambers Court, Woodstock, MD 21163	410-598-1208	Waverly Woods-Woodstock		
2024/08/25 5:02:37 PM EST	Magnolias2tn@gmail.com	Thanh-Ha Nguyen	Thanh-Ha	Nguyen	7932 Lawndale circle		Cedar Creek	Not applicable	
2024/08/25 5:04:21 PM EST	dbrzezic@yahoo.com	Dena Brzezicki	Dena	Brzezicki	4277 Buckskin Wood Drive Ellicott City MD 21042	4436861246	I run thru River Hill and along Grace Dr	Buckskin Woods	
2024/08/25 5:04:48 PM EST	wcrollow@aol.com	William Rollow	William	Rollow	11884 Bright Passage	4104919801	Hickory Ridge		
2024/08/25 5:07:46 PM EST	tashiasjenkins@gmail.com	Tashia Jenkins	Tashia	Jenkins	7631 Cross Creek Drive Columbia Md 21044	3015381731	Cedar Creek		
2024/08/25 5:54:50 PM EST	mmiller328@hotmail.com	A. Michael Miller	Andrew	Miller	12300 CAROL DRIVE	240-478-8591	Fulton Manor	Fulton, Manor off of Hall Shop Rd.	
2024/08/25 6:28:35 PM EST	srpellet@verizon.net	Scott R Pelletier	Scott	Pelletier	11802 Far Edge Path Columbia MD 21044	4438312202	Clary's Forest	Clary's Forest	
2024/08/25 6:50:55 PM EST	laura.r.hahn.@gmail.com	Laura Hahn	Laura	Hahn	12317 Point Field Drive		Fulton Manor	Fulton Manor	
2024/08/25 7:17:04 PM EST	candice.nager@gmail.com	Candice Kassin Nager	Candice	Nager	7014 Marabou Court Columbia, MD 21044		River's Edge		
2024/08/25 7:20:02 PM EST	kelly.mcculley@hcpss.org	Kelly mcculley	Kelly	Mcculley	1328 broken land pkway		Harper's Choice		
2024/08/25 8:46:21 PM EST	nichollmeg@gmail.com	Meg Snyder	Meg	Snyder	6016 Ascending Moon Path		River Hill		
2024/08/25 8:54:18 PM EST	lakelly000@aol.com	Lisa A Kelly	Lisa	Kelly	6914 Roslyn Court Columbia MD 21044	3017171334	River Hill		
2024/08/25 9:22:12 PM EST	kimstepanuk@gmail.com	Kim Stepanuk	Kim	Stepanuk	7110 Rivers View Ct Columbia MD 21044		River's Edge		
2024/08/25 9:41:52 PM EST	caraleconte@verizon.net	Cara LeConte	Cara	LeConte	12360 Pleasant view dr Fulton MD 20759		Fulton Manor	Fulton Manor	
2024/08/25 10:00:35 PM EST	mkrabbit3@gmail.com	mari Kim	mari	kim	12325 pleasant view drive, Fulton		Fulton Manor	Fulton Manor	
2024/08/25 10:40:48 PM EST	peggynebus@hotmail.com	Peggy Nebus	Peggy	Nebus	5144 Celestial Way		Harper's Choice		
2024/08/25 10:55:10 PM EST	ats999@msn.com	Alan T Seigel	Alan	Seigel	11328 Castlewood Ct, Laurel, MD	2407868046	Reservoir Overlook	Reservoir Overlook	
2024/08/25 11:15:01 PM EST	stephanieweifang@gmail.com	Stephanie Fang	Stephanie	Fang	6400 Morning Time Lane	4103034985	River Hill		
2024/08/25 11:57:12 PM EST	marlenern12@gmail.com	Marlene Buczynski	Marlene	Buczynski	12301 Carol Drive, Fulton, MD. 20759	301-213-7464	Fulton Manor	Fulton Manor	
2024/08/26 5:15:34 AM EST	nsiddiq910@gmail.com	Nusrat Siddique	Nusrat	Siddique	7220 Mainstream Way	4439042372	Cedar Creek		
2024/08/26 6:33:45 AM EST	salky99@gmail.com	Rebecca Salkeld	Rebecca	Salkeld	Fulton, MD		Hunterbrooke		
2024/08/26 7:27:01 AM EST	sandraholtlaw@gmail.com	Sandra Holt	Sandra	Holt	6416 Autumn Sky Way, Columbia 21044	443-878-4406	River Hill		
2024/08/26 7:54:24 AM EST	eddie_4224@hotmail.com	Edward Charles Tanner	Edward	Tanner	6455 South Wind Circle	6099474363	River Hill		
2024/08/26 8:31:10 AM EST	Sidana.Japjit@gmail.com	Japjit Sidana	Japjit	Sidana	6421 Erin Drive, Clarksville		Clarks Glen		
2024/08/26 9:04:56 AM EST	ntabassum@gmail.com	Nazia Tabassum	Nazia	Tabassum	6524 Waving Tree Court, Columbia, MD	917-704-0385	River Hill		
2024/08/26 9:06:01 AM EST	farazrahman@gmail.com	Faraz Rahman	Faraz	Rahman	6524 Waving Tree Court, Columbia, MD	614-208-4238	River Hill		
2024/08/26 9:11:01 AM EST	syedmohdrafi@gmail.com	Rafi Syed	Rafi	Syed	7916 Lawndale Cir, Columbia, MD, 21044	4438100068	Cedar Creek		
2024/08/26 9:56:49 AM EST	Patel210@yahoo.com	Purvita Patel	Purvita	Patel	7639 cross creek drive, Columbia, Md, 21044	4438670428	Cedar Creek		
2024/08/26 9:58:22 AM EST	kpatel2212@aol.com	Kamini Patel	Kamini	Patel	7643 Cross Creek Drive, Columbia, MD 21044	410-440-2294	Cedar Creek		
2024/08/26 10:33:14 AM EST	telpet23@gmail.com	Terri Petzold	Terri	Petzold	9236 Quick Fox Columbia MD 21045		Owen Brown		
2024/08/26 10:35:34 AM EST	aniefeldbatiz@gmail.com	Alisa Niefeld -Batiz	Alisa	Niefeld-Batiz	9466 Farewell Rd	410-215-0047	Hickory Ridge		
2024/08/26 12:00:06 PM EST	katewilliams1127@gmail.com	Kate Williams	Kate	Williams	12375 Pleasant View Drive Fulton, MD 20759		River Hill		
2024/08/26 12:27:50 PM EST	soupmonster@gmail.com	Heather Verron	Heather	Verron	10618 Hunting Lane, Columbia, MD 21044	6319747587	River's Edge		
2024/08/26 12:45:04 PM EST	dave@ashertax.com	David Asher	Margaret	Asher	6300 silvery star path		River Hill		
2024/08/26 12:51:57 PM EST	asudhangi@yahoo.com	Sudhangi Suthrave	Sudhangi	Suthrave	7945 Lawndale Circle	2087241719	Cedar Creek		
2024/08/26 1:01:05 PM EST	francespuente@hotmail.com	Frances Askwith	Frances	Askwith	7925 Lawndale Circle, Columbia MD 21044	3058123858	Cedar Creek		
2024/08/26 2:55:28 PM EST	mstubs@comcast.net	Mary stubs	Mary	Stubs	4435 oakwood overlook ct	240-372-3791	Oakwood overlook ct	Dayton md	
2024/08/26 2:57:02 PM EST	jeffskulik@gmail.com	Jeffrey S. Kulik	Jeff	Kulik	6540 Autumn Wind Circle Clarksville Md 21029	301-518-1316	River Hill		
2024/08/26 3:53:03 PM EST	phenry71@gmail.com	Paula Henry	Paula	Henry	6300 MELLOW TWILIGHT CT, COLUMBIA, MD 21	302-559-2688	River Hill		

2024/08/26 4:20:26 PM EST	cisa38@yahoo.com	Lisa Gouker	Lisa	Gouner	12815 Hall Shop Rd		Highland	Highland
2024/08/26 4:29:52 PM EST	donnashatzer@gmail.com	Donna Shatzer	Donna	Shatzer	6645 mink hollow rd highland Md 20777	2408558222	Highland	Highland
2024/08/26 6:11:41 PM EST	HeidiandMehdy@yahoo.com	Heidi Abdelhady	Heidi	Abdelhady	11517 Manorstone Lane , Columbia MD 21043		Harper's Choice	
2024/08/26 6:51:13 PM EST	scheng465@hotmail.com	Shiowei Cheng	Shiowei	Cheng	3512 Lowlen Court		Plumtree Overlook	
2024/08/26 7:07:18 PM EST	deborah.w.towner@gmail.com	Deborah Wortman Towner	Deborah	Towner	12339 Pleasant View Dr, Fulton, MD 20759	(240) 565 - 3867	Fulton Manor	Fulton Manor
2024/08/26 7:24:49 PM EST	bgrodsky@yahoo.com	Brian Grodsky	Brian	Grodsky	5801 Clipper Lane, #204	734-239-4635	River Hill	
2024/08/26 7:43:12 PM EST	amanda.hatten23@gmail.com	Amanda Hatten	Amanda	Hatten	10829 Vista Road		River's Edge	
2024/08/26 7:45:50 PM EST	joemack962@verizon.net	Joseph Mackrell	Joseph	MacKrell	13454 Long Days Ct	4435319824	Highland	Highland
2024/08/26 8:20:29 PM EST	tony.burns025@gmail.com	Dennis Anthony Burns	dennis	burns	5699 Trotter rd		clarksville md	clarksville md
2024/08/26 8:22:26 PM EST	Greg.perlstein@gmail.com	Greg Perlstein	Greg	Perlstein	6505 Drifting Cloud Mews	8608039135	River Hill	
2024/08/26 8:30:22 PM EST	mona_weinberg@hcpss.org	Mona Weinberg	Mona	Weinberg	6508 Drifting Cloud Mews		River Hill	
2024/08/26 8:35:16 PM EST	berman@afpc.org	Ilan Berman	Ilan	Berman	6520 Hazel Thicket Drive	240-994-8348	River Hill	
2024/08/26 8:43:15 PM EST	hallhandelman@gmail.com	Jacqueline Handelman	Jacqueline	Handelman	5705 Trotter Road Clarksville, MD 21029		River Hill	
2024/08/26 8:57:15 PM EST	hallhandelman@gmail.com	Jacqueline Handelman	Jacqueline	Handelman	5705 Trotter Road Clarksville, MD 21029		River Hill	
2024/08/26 9:24:48 PM EST	jhershmd@verizon.net	Jane Hershey	Jane	Hershey	13454 Long Days court, Highland MD 20777		Allnutt Farms	Allnutt Farms
2024/08/26 9:31:36 PM EST	umurali15@gmail.com	Urmila Murali	Urmila	Murali	6008 Georgetown Ct. Clarksville, MD 21029	443-538-2032	River Hill	
2024/08/27 5:00:33 AM EST	dan.bregman@gmail.com	Daniel Bregman	Daniel	Bregman	14540 Dorsey Mill Rd. Glenwood MD 21738	4439790435	Glenwood	Glenwood
2024/08/27 7:08:39 AM EST	michelev0812@gmail.com	Margaret T Vaughan	Margaret	Vaughan	10308 Winners Circle Way	301 8737705	Hunters Creek	Hunters Creek
2024/08/27 7:10:48 AM EST	karin.m.cantrell@gmail.com	Karin Cantrell	Karin	Cantrell	10392 Derby Drive		Hunters Creek in North Laurel	North Laurel
2024/08/27 7:11:04 AM EST	cheraton@hotmail.com	Cheryle Wharton	Cheryle	Wharton	5653 Harpers Farm Road		Harper's Choice	
2024/08/27 7:17:23 AM EST	ephelpsrealtor@gmail.com	Erin Phelps	Erin	Phelps	14016 Castlebar Dr. Glenwood MD 21738	410-746-1573	Glenwood, MD	Glenwood, MD
2024/08/27 7:41:10 AM EST	scleikin@gmail.com	Sherry Leikin	Sherry	Leikin	10334 Champions Way, Laurel, MD 20723		Hunters Creek, and we have family friends who live in Cedar Creek	
2024/08/27 7:46:23 AM EST	michaelpfau1955@gmail.com	Michael L Pfau	Michael	Pfau	10928 Tompkins Way Woodstock Md 21163	4109773032	Preserve at Waverly Glen	10928 Tompkins way. Woodstock Md. 21163
2024/08/27 8:02:49 AM EST	tipegor@hotmail.com	Swati Kabaria	Swati	Kabaria	12112 Trailing Moss Gate, Clarksville	3013257034	River Hill	
2024/08/27 8:09:22 AM EST	jmleikin@gmail.com	Jeff Leikin	Jeff	Leikin	10334 Champions Way Laurel MD	4438122223	Hunters Creek	Hunters Creek
2024/08/27 8:13:13 AM EST	levine.rebecca@gmail.com	Rebecca Levine	Rebecca	Levine	10304 pimlico pl		Hunters Creek	
2024/08/27 8:27:23 AM EST	jeffhahn@gmail.com	Jeffrey Hahn	Jeff	Hahn	12317 Point Field Dr	4438542836	Fulton Manor	Fulton Manor
2024/08/27 8:37:09 AM EST	mdha34644@gmail.com	Madushini Dharmasena	Madushini	Dharmasena	12379 Pleasant view drive, Fulton	6036671035	Fulton Manor	Fulton Manor
2024/08/27 8:39:33 AM EST	jimwangcmu@gmail.com	Jim Wang	Jim	Wang	8229 Hunterbrooke Ln, Fulton MD 20759	4124782354	Fulton, MD	Fulton, MD
2024/08/27 8:52:41 AM EST	bfb6509@verizon.met	Barbara block	Barbara	Block	6509 ranging hills gate Columbia Md 21044	4102458442	River Hill	
2024/08/27 8:58:18 AM EST	ajspan@yahoo.com	Adam Spanier	Adam	Spanier	6421 River Run, Columbia, MD 21044		River Hill	
2024/08/27 9:19:10 AM EST	kiera.boyle.toledo@gmail.com	Kiera Boyle-Toledo	Kiera	Boyle-Toledo	6309 Angel Rose Ct Columbia MD 21044	9728492025	River Hill	
2024/08/27 9:24:08 AM EST	kavanil@gmail.com	Kavitanjali Kumar	Kavitanjali	Kumar	6308 ANGEL ROSE CT		River Hill	
2024/08/27 9:40:56 AM EST	devlinpatrickjustin@gmail.com	Justin Patrick Devlin	Justin	Devlin	6605 Rising Waves Way	4438787914	River Hill	
2024/08/27 9:43:06 AM EST	betsysee1@gmail.com	Elizabeth (Betsy) Mahaffey See	Betsy	See	12661 Vincents Way Clarksville, MD 21784		River Hill	
2024/08/27 9:50:36 AM EST	paul@cleancuts.com	Paul Perret	Paul	Perret	10300 Pimlico Pl LAurel, MD 20723	4109033375	Hunter's Creek	Hunter's Creek
2024/08/27 9:57:34 AM EST	linshepherd@gmail.com	Leanne Sheriff	Leanne	Sheriff	6329 angel rose court, Columbia nd 21044	2407014476	River Hill	
2024/08/27 10:00:35 AM EST	nora.sudarsan@gmail.com	Nora Sudarsan	Nora	Sudarsan	6320 Angel Rose Court Columbia MD	7726962330	River Hill	
2024/08/27 10:06:12 AM EST	hhuynh3@yahoo.com	Crystal Ngo	Crystal	Ngo	10338 derby dr laurel 20723	2406017659	Hunter creek	Hunter creek
2024/08/27 10:23:32 AM EST	sarah.dwyer9@gmail.com	Sarah Chandler	Sarah	Chandler	6388 Guilford Road, Clarksville, MD 21029		Guilford	
2024/08/27 10:37:28 AM EST	jsmorck@comcast.net	Jeanne SMorck	Jeanne	Morck	12335 Pleasant View Dr		Fulton Manor	
2024/08/27 10:48:41 AM EST	rwallace@bithgroup.com	Robert L. Wallace	Robert	Wallace	6360 Guilford Road		River Hill	
2024/08/27 10:48:52 AM EST	lmccarthy889@gmail.com	Lauren McCarthy	Lauren	McCarthy	6328 Angel Rose Court Columbia, MD 21044		River Hill	
2024/08/27 11:15:31 AM EST	valerieosula@hotmail.com	Valerie Osula	Valerie	Osula	6317 Angel Rose CT		River Hill	
2024/08/27 11:24:57 AM EST	harritye@gmail.com	Eileen Harrity	Eileen	Harrity	5908 Hay boat Court		River Hill	
2024/08/27 11:52:43 AM EST	murali_11@hotmail.com	Murali Kannan	Murali	Kannan	6008 Georgetown Ct Clarksville MD 21029		River Hill	
2024/08/27 11:59:30 AM EST	ctrrbowers@gmail.com	Tina Bowers	Tina	Bowers	6305 Enchanted Key Gate		River Hill	
2024/08/27 11:59:54 AM EST	maryesturm@gmail.com	Mary Ellen Sturm	Mary	Sturm	6845 Sewells Orchard Drive	4435387546	Sewells Orchard	Sewells Orchard
2024/08/27 12:02:06 PM EST	rayferrer@hotmail.com	Raymond Ferrer	Raymond	Ferrer	7909 Lawndale Circle		Cedar Creek	
2024/08/27 12:07:15 PM EST	wildcatscheercoach14@gmail.con	Tammy McCarron	Tammy	McCarron	6445 Muster Ct	5713402432	Centre Ridge	Virginia
2024/08/27 12:13:59 PM EST	rshourbaji3@yahoo.com	Raghid Shourbaji	Raghid	Shourbaji	11825 Clarksville pike Clarksville MD 21029	443-324-4418	River Hill	
2024/08/27 12:19:27 PM EST	kami.patel@aol.com	Kamini patel	Kamini	Patel	7643 cross creek dr	4104402294	Cedar Creek	
2024/08/27 12:20:06 PM EST	judielarry@comcast.net	Judith Klee	Judith	Klee	10101 Governor Warfield Pky #121 Columbia MD 21044		Town Center	
2024/08/27 12:32:45 PM EST	dweinkle@gmail.com	Devi weinkle stephens	Devi	Weinkle stephens	5202 winding star circle Columbia md 21044		Harper's Choice	
2024/08/27 12:41:24 PM EST	maryesturm@gmail.com	Mary Ellen Sturm	Mary	Sturm	6845 Sewells Orchard Drive	4435387546	Sewells Orchard	Sewells Orchard
2024/08/27 12:59:05 PM EST	sdggriego@gmail.com	Sandra Griego	Sandra	Griego	10431 Churchill Way, Laurel 20723		Hunters Creek	
2024/08/27 1:02:41 PM EST	jlinse@hotmail.com	John Linsenmeyer	John	Linsenmeyer	6975 silent Dell lane, Columbia md 21044	443-896-7561	River's Edge	
2024/08/27 1:11:40 PM EST	smnason@yahoo.com	Gem Nason	Gem	Nason	5226 Harpers Farm Road	4103146787	Harper's Choice	
2024/08/27 1:31:52 PM EST	babolimar@gmail.com	Barabara Livieratos	Barabara	Livieratos	3260 Saint Johns Lane		Ellicott City	Ellicott City
2024/08/27 2:14:40 PM EST	behappyhl@gmail.com	Hanna Liu	Hanna	Liu	Scotts Landing Rd., Laurel MD		Cheery Creek	
2024/08/27 2:15:37 PM EST	guohui.wang@hotmail.com	Guohui Wang	Guohui	WANG	6512 tipperary ct, clarksville, md	6266965271	River Hill	
2024/08/27 2:20:00 PM EST	andrewbonic@gmail.com	Andrew Bonic	Andrew	Bonic	Clarksville MD		Enclave at River Hill	
2024/08/27 2:22:15 PM EST	dhitch1111@gmail.com	Diane Hitch	Diane	Hitch	6436 Quiet Night Ride, Columbia, MD 21044		River Hill	
2024/08/27 2:22:53 PM EST	nancywwu@yahoo.com	Nancy wu	Nancy	Wu	10004 culverene Road, Ellicott City, 21042		Ellicott city	
2024/08/27 2:22:55 PM EST	pooh67br@yahoo.com	Yes	Mike	Ren	13150 Deanmar Dr. Highland, MD20777		Highland	Highland
2024/08/27 2:23:06 PM EST	yanming_yin@yahoo.com	Yanming Yin	Yanming	Yin	6537 Ballymore Ln, Clarksville, MD 21029		River Hill	
2024/08/27 2:28:02 PM EST	zhiyu9@gmail.com	zhiyu li	zhiyu	Li	clarksville md 21029		River Hill	
2024/08/27 2:30:25 PM EST	eldl11039597@gmail.com	Rongbo Lu	Rongbo	Lu	4670 Woodland Road Ellicott City MD 21042		Ellicott City	Ellicott City
2024/08/27 2:32:03 PM EST	ygm0324@gmail.com	Gongmei yu	Gongmei	Yu	10213 clubhouse ct Ellicott city md 21042		Dorsey's Search	
2024/08/27 2:33:14 PM EST	jing.jerry@gmail.com	Yuezhou Jing	Yuezhou	Jing	6109 every sail path, Clarksville, md 21029		River Hill	
2024/08/27 2:35:29 PM EST	wenpingl@gmail.com	Wenping Li	Wenping	Li	6533 limerick ct		River Hill	
2024/08/27 2:43:18 PM EST	yayazhang@hotmail.com	Yi Zhang	Yi	Zhang	9679 Oak Hill Dr, Ellicott City, MD 21042	4435839262	Dorsey's Search	
2024/08/27 2:48:35 PM EST	monicadmb@gmail.com	Monica Meier-Beck	Monica	Meier-Beck	6437 Quiet Night Ride, Columbia MD 21044	443-745-6321	River Hill	
2024/08/27 2:52:48 PM EST	zrachbach@gmail.com	Zelda Rachbach	Zelda	Rachbach	10719 Autumn Splendor Drive, Columbia, MD 21044		Hickory Ridge	
2024/08/27 2:55:26 PM EST	realms7@gmail.com	Rebecca Bai	Rebecca	Bai	5665 Harper Farms Rd		Harper's Choice	
2024/08/27 3:05:02 PM EST	rubywang.happy@yahoo.com	Ruby Wang	Ruby	Wang	10129 Bell Inn Ln 21042		Font Hill	Font Hill
2024/08/27 3:16:09 PM EST	liandwu@gmail.com	Yali Li	Yali	Li	7964 Lawndale Cir, Columbia MD 21044	3013859758	Cedar Creek	
2024/08/27 3:17:51 PM EST	zavaglia83@gmail.com	Angela Prescott	Angela	Prescott	10688 Quarterstaff Rd Columbia MD	6094623759	Hickory Ridge	
2024/08/27 3:29:13 PM EST	13372175591vy@gmail.com	yanrong yan	yanrong	Yan	5930 Great Star Dr clarksville MD21029	9097766162	River Hill	
2024/08/27 3:29:41 PM EST	hanyi1990@gmail.com	Yi Han	Yi	Han	2746 Cheekwood Cir, Ellicott City, MD, 21042		Ellicott City	Ellicott City
2024/08/27 3:30:35 PM EST	phoenixqj@gmail.com	Xiaoqing peng	Xiaoqing	Peng	6511 Barley Corn Row, Columbia MD		River Hill	
2024/08/27 3:33:01 PM EST	funfuntogo@gmail.com	Kasau Lai	Kasau	Lai	4720 Woodland Rd, 21042	4077617676	Ellicott City	Ellicott City
2024/08/27 3:35:57 PM EST	ob1us@yahoo.com	Luke Kao	Luke	Kao	11085 Little Patuxent Parkway		Town Center	
2024/08/27 3:42:57 PM EST	zyzfeed@hotmail.com	Yuanzhen Zhang	Yuanzhen	Zhang	12635 Vincents Way		River Hill	
2024/08/27 3:45:39 PM EST	tianjinger@gmail.com	Jing Tian	Jing	Tian	12113 shining stars Ln, Clarksville, MD 21029		River Hill	
2024/08/27 3:48:30 PM EST	haolei777@gmail.com	Lei Hao	Lei	Hao	12120 Shining Stars Lane	410-428-3386	River Hill	
2024/08/27 3:51:22 PM EST	chenjie.huang@gmail.com	Chenjie Huang	Chenjie	Huang	10645 Glen Hannah Dr., Laurel, MD		See below	North Laurel
2024/08/27 3:55:01 PM EST	jinhua62@yahoo.com	Jinhua Wang	Jinhua	Wang	7727 Cross Creek Dr. Columbia MD 21044	9088033828	Cedar Creek	
2024/08/27 4:00:00 PM EST	drwxl2003@yahoo.com	Wei Lu	Wei	Lu	12836 Macbath Farm Lane, Clarksville 21029	4438784098	River Hill	
2024/08/27 4:01:57 PM EST	rdong2500@gmail.com	Subing Zeng	Subing	Zeng	6505 great drum circle, Columbia, me 21044		River Hill	
2024/08/27 4:15:48 PM EST	sl1223@yahoo.com	Sophia Lin	Sophia	Lin	11724 Trotter Crossing Lane	714-809-2463	River Hill	
2024/08/27 4:17:47 PM EST	huawangy@yahoo.com	Hua Wang	Hua	Wang	6904 Sandy Creek Ct, Clarksville MD 21029		River's Edge	
2024/08/27 4:18:46 PM EST	yysang@gmail.com	Yingying Sang	Yingying	Sang	10043 Waterford Drive		Centennial	Centennial
2024/08/27 4:33:44 PM EST	hualili@hotmail.com	Yes	Lily	Hua	12939 Triadelphia Mill Road	3014121064	River Hill	
2024/08/27 4:38:48 PM EST	casey14908@yahoo.com	Chun Chen	Chun	Chen	14908 Michele Dr Glenelg		Glenelg	Glenelg
2024/08/27 4:41:01 PM EST	junzhongpeng@gmail.com	Junzhong Peng	Junzhong	Peng	15429 Maple Ridge Rd, Woodbine, md 21797	4432518227	Woodbine	
2024/08/27 4:48:42 PM EST	xiaominzhi@icloud.com	Minzhi Liu	Minzhi	Liu	6141 Starburn Path	4103008548	Long Reach	
2024/08/27 5:01:48 PM EST	maithilik@aol.com	Maithili Kale	Maithili	Kale	6504 Ocean Shore Ln., Columbia MD 21044	2406768579	River Hill	
2024/08/27 5:03:03 PM EST	gwayne.gibson@verizon.net	Lili Gibson	Lili	Gibson	23 Castlehill ct Lutherville 21093 MD	4438242664	Timonium Lutherville	23 Castlehill CT Lutherville/Timonium 21093
2024/08/27 5:05:27 PM EST	liangy8@yahoo.com	Lynn Liang	Lynn	Liang	3308 Debra Ct, Ellicott City	4104655630	Elliott City	Elliott City
2024/08/27 5:06:04 PM EST	wangzf918@hotmail.com	Zhengfang Wang	Zhengfang	Wang	10102 Colonial Dr., Ellicott City, MD 21042		Centennial	Centennial
2024/08/27 5:19:23 PM EST	zhanjiyu@gmail.com	JIYU ZHAN	JIYU	ZHAN	10109 CARILLON DRIVE ,ELLICOTT CITY MD21042		ELLICOTT CITY	
2024/08/27 5:40:48 PM EST	shuangfeiyan888@gmail.com	Yan Feng	Yan	Feng	9932 Carillon Dr.	4109958280	Dorsey's Search	
2024/08/27 5:47:38 PM EST	logan.jones153@gmail.com	Logan Jones	Logan	Jones	10347 Champions Way	2703139256	Hunters creek	Hunters Creek
2024/08/27 6:06:26 PM EST	yangyu0805@gmail.com	Yang Yu	Yang	Yu	6425 Richardson Farm Ln, Clarksville MD 21029	4432554028	River Hill	
2024/08/27 6:31:36 PM EST	xjwang71@yahoo.com	Xuejiao Wang	Xuejiao	Wang	13838 Wayside Ct, clarksville MD 21029		River Hill	
2024/08/27 6:41:00 PM EST	meifengchen3605@gmail.com	Meifeng chen	Meifeng	Chen	10300 burnside dr ellicott city md 21042	3012561317	Centennial	
2024/08/27 6:46:26 PM EST	huixi181@gmail.com	Stop Grace's proposed the plan	Hui	Shen	14553 Edgewoods Way	4432046618	Glenelg	
2024/08/27 6:59:05 PM EST	dunnbb@verizon.net	Bernadette Dunn	Bernadette	Dunn	6482 South Wind Circle	3016558993	River Hill	
2024/08/27 7:05:44 PM EST	lirong04@yahoo.com	Lirong Zhou	Lirong	Zhou	7320 Sanborn Way, Columbia, MD		Cedar Creek	
2024/08/27 7:13:11 PM EST	karent0823@hotmail.com	Karen Titus	Karen	Titus	5720 western sea run	4433927836	River Hill	
2024/08/27 7:20:27 PM EST	bessie.lewis.adv@gmail.com	Bessie Lewis	Bessie	Lewis	6305 Angel Rose Ct		River Hill	
2024/08/27 7:21:53 PM EST	dong_l_m@yahoo.com	Li Ming Dong	Li Ming	Dong	5800 Clipper Lane Unit 406	4	River Hill	
2024/08/27 7:22:01 PM EST	alingdong@yahoo.com	Aling Dong	Aling	Dong	6408 Galway Dr		River Hill	
2024/08/27 7:26:34 PM EST	jilei0426@gmail.com	lei Ji	Lei	Ji	10070 colonial Dr., Ellicott City	3015439531	Dorsey's Search	
2024/08/27 7:29:16 PM EST	luppia@gmail.com	Nan Zhao	Nan	Zhao	3810 Sand Creek Ct.	6672080037	Paul Mill Road	
2024/08/27 7:37:17 PM EST	jzhengtax@yahoo.com	JING ZHENG	Jing	Zheng	11627 vixens path, Ellicott City, Md 21042	4102077151	River Hill	
2024/08/27 7:42:31 PM EST	xizhengxiong@gmail.com	Opposite	Zhengxiong	Xi	14553 Edgewoods Way Glenelg MD 21737	4436683711	Glenelg	
2024/08/27 7:50:26 PM EST	zspoct55@hotmail.com	2	Spark	Zeng	9633 white acre rd	4437663289	Oakland Mills	
2024/08/27 8:12:15 PM EST	luirealty2000@gmail.com	Ling zheng	Ling	Zheng	5513 Woodenhawk Cir Columbia MD 21044	4109258064	Harper's Choice	
2024/08/27 8:12:59 PM EST	yuexing.li@jhu.edu	YUEXING LI	Yuexing	Li	7731 Cross Creek Drive		Cedar Creek	
2024/08/27 8:26:45 PM EST	laurenjag@hotmail.com	Lauren Jagtiani	Lauren	Jagtiani	6705 Whitegate Road, Clarksville, MD 21029	240-475-3962	Clarksville Ridge	Clarksville Ridge
2024/08/27 8:30:39 PM EST	cylia7600@gmail.com	Wei Zhang	Wei	Zhang	Grovenor Dr		Centennial	
2024/08/27 8:35:32 PM EST	rmsbklynny@gmail.com	Ronny Michael Silver Samet	Ronny	Samet	7845 River Rock Way, Columbia, Maryland 21044	954-673-9095	Simpson Mill	Simpson Mill
2024/08/27 8:38:21 PM EST	lilinchiu20960@gmail.com	Li-Lin Chiu	Li-Lin	Chiu	6512 Langford Ct, Clarksville		Guilford	
2024/08/27 8:45:50 PM EST	nicdeven@gmail.com	Nicole Garrett	Nicole	Garrett	3229 Ramblewood Rd, Ellicott City, MD 21042	410-251-8803	Valley Mede	Ellicott City
2024/08/27 8:57:39 PM EST	triciazhao@gmail.com	Chunsheng Zhao	Chunsheng	Zhao	Ellicott City, MD 21042		Ellicott City	
2024/08/27 9:24:01 PM EST	jh2326@cornell.edu	Jie He	Jie	He	7731 Cross Creek Dr	5623742558	Cedar Creek	
2024/08/27 9:31:44 PM EST	omar.miralikhel@gmail.com	Mohammad Miralikhel	Mohamma	Miralikhel	7841 River Rock Way Columbia MD 21044	2408257821	River Rick Way	River Rock Way
2024/08/27 9:38:44 PM EST	debbiejrubin@gmail.com	Deborah Rubin	Debating rah	Rubin	10627 Millet Seed Hill	443-386-8304	Hickory Ridge	
2024/08/27 9:47:25 PM EST	bibi.foston@gmail.com	Bibi	Bibi	Foston	240 786 5747		North Laurel	North Laurel
2024/08/27 9:55:04 PM EST	miniria@gmail.com	Maria Singletary	Maria	Singletary	7589 weather worn way unit D Columbia Md 2104	2404018972	Kings Contrivance	
2024/08/27 10:09:05 PM EST	watashi315@gmail.com	Michael Ji	Michael	Ji	5681 Columbia Rd. Apt 202 Columbia MD 21044		Harper's Choice	
2024/08/27 10:25:40 PM EST	mvornov@gmail.com	Marina Vornovitsky	Marina	Vornovitsky	6405 Grateful Heart Gate, Columbia, MD 21044		River Hill	
2024/08/27 10:31:47 PM EST	czhou9@yahoo.com	Christine Zhou	Christine	Zhou	14517 Edgewoods Way, Glenelg Maryland 21737	4437663558	Glenelg	Glenelg
2024/08/27 11:17:33 PM EST	nancy042600@yahoo.com	Nancy Zhang	Nancy	Zhang	13300 Long Leaf Dr	4435626653	Clarksville	Clarksville
2024/08/28 1:33:59 AM EST	ymaoy@yahoo.com	Yvonne Mrha	Yvonne	Mrha	14578 Edgewoods way, Glenelg, MD 21737	443-422-9195	Triadelphia	
2024/08/28 1:54:51 AM EST	joelhurewitz@gmail.com	Joel Hurewitz	Joel	Hurewitz	5681 C Harpers Farm Rd Columbia MD 21044		Harper's Choice	
2024/08/28 4:18:51 AM EST	cvrand@verizon.net	VICKI RAND	VICKI	RAND	12150 scaggsville rd	4438124906	Fulton	
2024/08/28 5:59:55 AM EST	alanwayne12000@aol.com	Alan Wayne Idoni	Alan	Idoni	6918 berry wood ct, Columbia Md 21044		Pointers overlook	
2024/08/28 6:02:10 AM EST	junyanfu@yahoo.com	Junyan Fu	Junyan	Fu	9009 Labrador Lane		Dunloggin	Dunloggin area
2024/08/28 6:46:44 AM EST	yi.sheen@gmail.com	Xin Yi	Xin	Yi	10201 Breconshire Road		Burleigh Manor	
2024/08/28 7:04:48 AM EST	bingzh99@gmail.com	Bing Zhang	Bing	Zhang	7107 penny lane		Long Reach	
2024/08/28 7:16:46 AM EST	ferrucci.maria9@gmail.com	María Ferrucci	María	Ferrucci	10904 Harmel Drive Columbia Md 21044		Hickory Ridge	
2024/08/28 7:46:21 AM EST	yic.lee@gmail.com	Calcifer Fan	Calcifer	Fan	11707 Lone Tree Ct		Hickory Ridge	
2024/08/28 7:49:00 AM EST	namika.zaman@gmail.com	Namika Zaman Mahmoodi	Namika	Mahmoodi	2126 Fernglen Way Catonsville MD 21228	410-375-3843	Catonsville	Catonsville MD
2024/08/28 7:52:27 AM EST	wengenchen@yahoo.com	Wengen Chen	Wengen	Chen	3807 sand creek ct, Ellicott city, MD 21042	215-588-0435	Ellicott city	Ellicott city
2024/08/28 8:06:34 AM EST	dwyermk1@gmail.com	Karen & Michael Dwyer	Karen	Dwyer	6644 Towering Oak Path, Columbia		River's Edge	
2024/08/28 8:26:25 AM EST	jerry.j.jiang@gmail.com	Jerry Jiang	Jerry	Jiang	9429 dunloggin rd		Dorsey's Search	
2024/08/28 8:49:16 AM EST	caojianjing@yahoo.com	Jianjing Cao	JIANJING	Cao	9090 Tiber Ridge Ct, Ellicott City, MD		Ellicott City	
2024/08/28 8:50:02 AM EST	amybreebecker@gmail.com	Amy Becker	Amy	Becker	6624 Rising Waves Way, Columbia		River Hill	
2024/08/28 9:18:08 AM EST	vyozwiak@mac.com	Victoria Yozwiak	Victoria	Yozwiak	6514 River Run, Columbia MD 21044		River Hill	
2024/08/28 9:28:33 AM EST	jamielee610@gmail.com	Ja Hyung Lee	Ja Hyung	Lee	6315 Nodding Night Ct	9178819450	River Hill	
2024/08/28 9:37:19 AM EST	allisonp8788@gmail.com	Allison Pihl	Allison	Pihl	7146 Moorland Drive, Clarksville, MD		Ashleigh Knolls	
2024/08/28 9:44:30 AM EST	porcelli.john@gmail.com	John Porcelli	John	Porcelli	7233 Wolverton Ct, Clarksville, MD 21029	6105478079	Ashleigh Knolls	Ashleigh Knolls
2024/08/28 10:11:48 AM EST	sominlee10@gmail.com	Somin Lee	Somin	Lee	6217 Waving Willow Path		River Hill	
2024/08/28 10:17:45 AM EST	hadguhiruy@gmail.com	Hiruy Hadgu	Hiruy	Hadgu	11013 Charles Way, Fulton, MD 20759		Maple Lawn South	Maple Lawn South
2024/08/28 10:28:57 AM EST	jendiamond77@gmail.com	Jennifer Diamond	Jennifer	Diamond	6620 Rising Waves Way, Columbia, MD 21044		River Hill	
2024/08/28 10:47:48 AM EST	sjsoko@gmail.com	Scott H Sokolowski	Scott	Sokolowski	7100 Ramsgate Court	4109055854	Ashleigh Knolls	
2024/08/28 10:53:14 AM EST	markrsmanti@gmail.com	Mark Sormanti	Mark	Sormanti	9801 Diversified Lane	9413305584	Olde Mill	9801 Diversified Lane, Ellicott City
2024/08/28 10:59:14 AM EST	nannyinterviews@gmail.com	Jennifer L Levy	Jennifer	Levy	3935 Walt Ann Dr, Ellicott City, MD 21042	4433985301	Shepards Glen	Shepards Glen
2024/08/28 11:28:04 AM EST	jsessler@kenwoodcare.com	John E Sessler	John	Sessler	12363 Pleasant View Dr	4437457744	Fulton Manor	Fulton Manor
2024/08/28 11:47:23 AM EST	barlly@hotmail.com	Debra Barlly	Debra	Barlly	5093 Durham Rd W		Beaverbrook	Beaverbrook
2024/08/28 12:30:44 PM EST	alans@novobeads.com	Alan Strott	Alan	Strott	7208 Wolverton Ct Clarksville MD 20129	3018075683	Ashleigh Knoll	Ashleigh Knoll
2024/08/28 1:16:28 PM EST	taymoorian@live.com	Danielle Taymoorian	Danielle	Taymoorian	760 Howes Lane	4438124121	Sebring	Sebring
2024/08/28 1:19:11 PM EST	joannezhao@hotmail.com	Joanne Zhao	Joanne	Zhao	8574 Autumn harvest		Wheatfield	Ellicott City
2024/08/28 1:22:33 PM EST	tkhammill2@gmail.com	Kristen Hammill	Kristen	Hammill	6078 Covington Road Columbia, MD 21044	2404628280	Hickory Ridge	
2024/08/28 1:26:18 PM EST	cleo46@msn.com	SONIA TRUESDALE	SONIA	TRUESDALE	10361 Whitewasher Way		Hickory Ridge	
2024/08/28 1:52:25 PM EST	kickballgirl@gmail.com	Virginia Raney	Virginia	Raney	10354 Whitewasher Way		Hickory Ridge	
2024/08/28 2:13:47 PM EST	hackncobra@aol.com	Shelby Willets	Shelby	Willets	13150 Brighton Dam Road		Waterford	Clarksville
2024/08/28 2:20:01 PM EST	grassbiter@gmail.com	Haiwen Ding	Haiwen	Ding	7253 Steamerbell Row, Columbia, MD 21045		Owen Brown	
2024/08/28 3:35:04 PM EST	farazrahman@gmail.com	Faraz Rahman	Faraz	Rahman	6524 Waving Tree Court		River Hill	
2024/08/28 3:39:45 PM EST	zhunt1223@gmail.com	Zarina Hunt	Zarina	Hunt	5414 talon court Clarksville maryland 21029	5712367719	River Hill	
2024/08/28 3:40:32 PM EST	sfreinberg@gmail.com	Scott Freinberg	Scott	Freinberg	5421 Jamesway court		Dunfarmin	
2024/08/28 3:42:48 PM EST	zhunt1223@gmail.com	Zarina Hunt	Zarina	Hunt	5414 talon ct Clarksville MD	5712367719	Ten oaks	
2024/08/28 3:46:22 PM EST	krschwa1@verizon.net	Kurt R. Schwarz	Kurt	Schwarz	7329 Wildwood Court	443-538-2370	Kings Contrivance	

2024/08/28 3:46:37 PM EST	mameri@arheum.com	Mariam Ameri	Mariam	Ameri	7654 Cross Creek Dr	3012336549	Cedar Creek	
2024/08/28 3:48:53 PM EST	Howard@medical-innovations.net	Howard Sturman	Howard	Sturman	10701 Quarterstaff Rd	4103363191	Hickory Ridge	
2024/08/28 3:57:23 PM EST	vic.agrawal@gmail.com	Vic Agrawal	Vic	Agrawal	6308 last sunbeam pl Columbia Md 21044	9176097169	River Hill	
2024/08/28 3:59:23 PM EST	sommershal@gmail.com	Harold Sommers	Harold	Sommers	7513 Red Cravat Ct		Kings Contrivance	
2024/08/28 4:07:26 PM EST	inapam829@gmail.com	Ina Hersh	Ina	Hersh	10264 Shaker drive Columbia MD 21046		Kings Contrivance	
2024/08/28 4:12:32 PM EST	jsimons4k@gmail.com	Judith SImons	Judith	Simons	7124 Chilton Ct, Clarksville, MD 21029	443-742-9755	Ashleigh Knolls	Ashleigh Knolls (Clarksville)
2024/08/28 4:16:28 PM EST	Judy.radas42@gmail.com	Yes, I support the petition above.	Judy	Radas	6726 Mink Hollow Road		Highland	Highland
2024/08/28 4:39:32 PM EST	rlbriggs@comcast.net	Ron Briggs	Ron	Briggs	6429 Empty Song Rd. 21044	443 310 5504	River Hill	
2024/08/28 5:11:16 PM EST	carolyn.parsa@gmail.com	Carolyn Parsa	Carolyn	Parsa	7649 Woodstream Way, Laurel MD 20723		North Laurel	North Laurel, in Howard County
2024/08/28 5:35:35 PM EST	Jleecolumbia@icloud.com	John T Lee	John	Lee	6616 Oxhorn court	443-878-9679	Hickory Ridge	
2024/08/28 5:43:17 PM EST	n8tvnyr122@yahoo.com	Robyn Gold	Robyn	Gold	6506 River Run Columbia MD 21044	3013516253	River Hill	
2024/08/28 5:47:11 PM EST	jkhickey007@gmail.com	Julie Hickey	Julie	Hickey	Silvery Star Path		River Hill	
2024/08/28 6:08:02 PM EST	Irene@mouseketrips.com	Irene Vane	Irene	Vane	7121 Chardon Court Clarksville MD 21029		Ashleigh Knolls	Ashleigh Knolls
2024/08/28 6:29:49 PM EST	nengelberg@gmail.com	Norman Engelberg	Norman	Engelberg	6621 Rising Waves Way	3018016127	River Hill	
2024/08/28 6:33:18 PM EST	jeffgold427@gmail.com	Jeffrey Gold	Jeffrey	Gold	6506 River Run	4105319560	River Hill	
2024/08/28 6:35:47 PM EST	maryandrickjones@verizon.net	Mary Elizabeth Jones	Mary	Jones	6518 South Wind Circle, Columbia, MD 21044	4105319075	River Hill	
2024/08/28 6:41:26 PM EST	keithglo2@gmail.com	Keith Gigliello	Keith	Gigliello	Eight Bells Lane, Columbia, MD 21044		Harper's Choice	
2024/08/28 6:42:33 PM EST	Vvsikora@gmail.com	Valerie V Sikora	Valerie	Sikora	6517 Ocean Shore Lane		River Hill	
2024/08/28 6:49:45 PM EST	Lmarcuse100@gmail.com	Leslie Marcuse	Leslie	Marcuse	6621 Rising Waves Way Columbia 21044		River Hill	
2024/08/28 7:04:59 PM EST	993199556@qq.com	Nian Zhao	Nian	Zhao	14525 Edgewoods way, Glenelg, MD21737	8479025169	Glenelg	
2024/08/28 7:18:10 PM EST	dppatelmd@gmail.com	DHARMESH PATEL	DHARMESH	PATEL	12351 PLEASANT VIEW DR, FULTON, MD 20759		FULTON	FULTON
2024/08/28 7:25:18 PM EST	PunDogg@gmail.com	Puneet Mehrotra	Puneet	Mehrotra	7121 Moorland Dr Clarksville, Md 21029	4126104094	Ashleigh Knolls	Ashleigh Knolls
2024/08/28 7:26:37 PM EST	MMiralikhel@mdot.state.md.us	Bibi Sanam Miralikhel	Bibi Sanam	Miralikhel	7841 River Rock Way	2408257821	Allview Estates	River Rock Way
2024/08/28 7:46:08 PM EST	janw.miller@gmail.com	Janet Miller	Janet	Miller	14460 Triadelphia Mill Rd	301-922-1326	Dayton	Dayton, MD
2024/08/28 8:01:18 PM EST	fuqiang0316@gmail.com	QIANG FU	QIANG	FU	10792 folkestone way, woodstock, MD		woodstock	
2024/08/28 8:02:14 PM EST	hollihamilton8@gmail.com	Holli Hamilton	Holli	Hamilton	10301 Wesleigh Drive, Columbia, MD		Wesleigh Drive	10301 Wesleigh Drive near intersection with Donleigh Drive
2024/08/28 8:04:28 PM EST	regina.coyne@gmail.com	Regina Steuer	Regina	Steuer	6408 empty song rd		River Hill	
2024/08/28 8:12:16 PM EST	jennieyjguo@gmail.com	Jennifer	Jennifer	Guo	3642 Grosvenor Dr, Ellicott City, MD 21042	4434102573	Fonthill Community	Foothill Community
2024/08/28 8:18:52 PM EST	talenier@gmail.com	Tyler Grossi	Tyler	Grossi	6405 Summer Sunrise dr 21044		River Hill	
2024/08/28 8:21:37 PM EST	rakhi12in@yahoo.com	Rakhi De	Rakhi	De	5421 TALON CT CLARKSVILLE MD 21029		River Hill	
2024/08/28 8:21:59 PM EST	janet.tangney@gmail.com	Janet Tangney	Janet	Tangney	6513 folded leaf sq, Columbia Md 21044	4436242453	River Hill	
2024/08/28 8:22:54 PM EST	brenner.sara@gmail.com	Sara Brenner	Sara	Brenner	Brighton Dam Rd		River Hill	
2024/08/28 8:23:19 PM EST	danjenguy@verizon.net	Jennifer Guy	Jennifer	Guy	6417 Onward Trail	443-535-9771	River Hill	
2024/08/28 8:25:35 PM EST	delong6428@gmail.com	Delong liu	Delong	Liu	6428 Richardson farm ln, Clarksville, md 21029		Clsrksville	Clarksville
2024/08/28 8:31:52 PM EST	juliejohnsonyoung@gmail.com	Julia Young	Julia	Young	13155 Brighton Dam Road	2026742885	Waterford in Clarksville	Waterford in Clarksville
2024/08/28 8:56:59 PM EST	brittanyegoldberg@gmail.com	Brittany Goldberg	Brittany	Goldberg	3985 Sharp rd, Glenwood MD 21738	6108123912	Glenwood	Glenwood
2024/08/28 9:16:42 PM EST	salimova.sabina.sh@gmail.com	Sabina Salimova	Sabina	Salimova	5840 Wild Orange Gate	4432555305	River Hill	
2024/08/28 9:31:25 PM EST	donnazhou0214@gmail.com	Donna Zhou	Donna	Zhou	9059 Dunloggin rd, Ellicott City		Ellicott City	Ellicott City
2024/08/28 10:05:55 PM EST	marleibow@verizon.net	Martha Leibowitz	Martha	Leibowitz	6405 Fairest Dream Lane Columbia md 21044	443 812-1372	River Hill	
2024/08/28 10:09:22 PM EST	eebounds@gmail.com	Erin Bounds	Erin	Bounds	7320 Shady Glen Drive Columbia md 21046		Clark’s Crossing (near Kings Contrivan	Clark’s Crossing- off Old Columbia Road near KC Village Center/ a mile from rivers edge ac
2024/08/28 10:55:35 PM EST	eisenbhouse@gmail.com	Linda Eisenberg	Linda	Eisenberg	10417 Blue Arrow Court	4109086904	Hickory Ridge	
2024/08/28 10:57:16 PM EST	peraltea@yahoo.com	Debbie Wang	Debbie	Wang	11332 Castlewood Ct	301-604-8687	Reserved at Rocky Gorge	Laurel
2024/08/28 11:25:52 PM EST	ruthmgoldberg@gmail.com	Ruth Goldberg	Ruth	Goldberg	6542 South Wind Circle	4438122724	River Hill	Pheasant Ridge in River Hill
2024/08/28 11:27:45 PM EST	csbierer@verizon.net	Suzanne Bierer	Suzanne	Bierer	5717 Harper’s Farm RD Columbia MD		Harper's Choice	
2024/08/28 11:33:33 PM EST	jrosenthl@yahoo.com	Julie A. Rosenthal	Julie	Rosenthal	6608 Forest Shade Trail	410-608-1913	River Hill	
2024/08/29 2:58:36 AM EST	Mczhitamu@gmail.com	Miaochan zhi	miaochan	Zhi	12878 lime kiln rd, highland, md,.20777	9795714199	Guilford	
2024/08/29 4:22:37 AM EST	dpatel2589@gmail.com	Dhara Patel	Dhara	Patel	6056 Signal flame ln		River Hill	
2024/08/29 4:24:37 AM EST	TeresaA850@gmail.com	Fred and Teresa Johnston	Fred	Johnston	10362 Whitewasher Way Columbia 21044		Hickory Ridge	
2024/08/29 4:50:49 AM EST	colin@RampartsSecurity.com	Colin Bowers	Colin	Bowers	6305 Enchanted Key Gate	4106603121	River Hill	
2024/08/29 4:51:08 AM EST	sharadamodur@gmail.com	Sharada Modur	Sharada	Modur	6505 Tender Mist Mews	6145796014	River Hill	
2024/08/29 5:27:42 AM EST	mhamet@verizon.net	Melissa Hamet	Melissa	Hamet	6632 Rising Waves Way, Columbia, MD 21044	4437458577	River Hill	
2024/08/29 6:31:32 AM EST	dr.dimple.patel13@gmail.com	Dimple Patel	Dimple	Patel	2133 otter creek circle, Hanover md 21076		Near by	Hanover MD
2024/08/29 6:35:42 AM EST	raymond.ohl@gmail.com	Raymond G. Ohl, IV	Raymond	Ohl	Centaurus Ct, Dayton		Dayton	Dayton
2024/08/29 6:45:15 AM EST	scastner7@gmail.com	Suzanne Castner	Suzanne	Castner	Ellicott City 21043		Ellicott City	
2024/08/29 7:15:06 AM EST	justindaniel@yahoo.com	Justin Daniel	Justin	Daniel	6624 Towering Oak Path, Columbia, MD 21044		River Hill	
2024/08/29 7:40:34 AM EST	markrsmanti@gmail.com	Mark Sormanti	Mark	Sormanti	9801 Diversified Lane	9413305584	Olde Mill	9801 Diversified Lane, Ellicott City
2024/08/29 7:44:53 AM EST	slebo@aol.com	Gail Stovall	Gail	Stovall	6465 Empty Song Road	301-466-5588	River Hill	
2024/08/29 7:49:27 AM EST	christine.hipple@gmail.com	Christine Hipple	Christine	Hipple	11408 Elfstone Way	410-852-5742	Harper's Choice	
2024/08/29 8:28:53 AM EST	carla.joanne@gmail.com	Carla Figueroa	Carla	Figueroa	6515 River Run Columbia MD 21044		River Hill	
2024/08/29 8:36:02 AM EST	dhurbon@mac.com	Damon Hurbon	Damon	Hurbon	6076 Cedar Wood Drive		Cedar Acres	Cedar Acres
2024/08/29 8:38:56 AM EST	sharonthorpe@verizon.net	Sharon Thorpe	Sharon	Thorpe	12256 Summer Sky Path, Clarksville, Maryland	240-381-6888	River Hill	
2024/08/29 8:41:00 AM EST	fultonledo@gmail.com	Natalie Trott	Natalie	Trott	7744 Water Street	443-745-5440	Maple Lawn	Maple Lawn
2024/08/29 8:43:43 AM EST	flyingrooster8@icloud.com	Frances Flannery	Frances	Flannery	5580 Vantage Point Rd. Columbia Md Apt.2		Town Center	
2024/08/29 8:47:57 AM EST	rtrott14@yahoo.com	Rick Trott	Rick	Trott	7744 Water Street Fulton MD 20759		Maple Law	Maple Law
2024/08/29 8:57:38 AM EST	pamela.mellott@gmail.com	Pamela Mellott	Pamela	Mellott	11435 Ellington Street Fulton MD 20759		Maple Lawn	Maple Lawn
2024/08/29 8:58:58 AM EST	katherineyaksich@gmail.com	Katherine Zidarich	Katherine	Zidarich	6105 Eternal Ocean Place		River Hill	
2024/08/29 9:07:25 AM EST	liz.b.kundu@gmail.com	Liz Kundu	Liz	Kundu	7915 Maple Lawn Blvd		Maple Lawn	Maple Lawn
2024/08/29 9:32:52 AM EST	leonard.boyd@gmail.com	Leonard Boyd	Leonard	Boyd	7244 Mainstream Way, Columbia, MD 21044	2404725644	Cedar Creek	
2024/08/29 10:40:05 AM EST	lgraybeal@verizon.net	Lauren Graybeal	Lauren	Graybeal	11216-1 Chase Street, Fulton, MD 20759	3015038899	Maple Lawn	Maple Lawn
2024/08/29 11:37:20 AM EST	caitlin.m.bender@gmail.com	Caitlin Bender	Caitlin	Bender	8302 Spring Blossom Ct, Laurel MD 20723	4438473428	Other Howard County	Other Howard County
2024/08/29 11:56:49 AM EST	sharonfaithmcrae@gmail.com	Sharon McRae	Sharon	McRae	10296 Shaker Dr.	410-615-4631	Kings Contrivance	
2024/08/29 12:36:35 PM EST	mir.wood@gmail.com	Miriam Pokharel-Wood	Miriam	Pokharel-Wood	6318 Dewey Dr, Columbia MD 21066		Hickory Ridge	
2024/08/29 12:47:33 PM EST	kiraelbeyli@hotmail.com	Kira Elbeyli	Kira	Elbeyli	6729 Pyramid Way, Columbia MD 21044		Hickory Ridge	
2024/08/29 1:04:01 PM EST	Vanessa.A.Mims@gmail.com	Vanessa Lin-Mims	Vanessa	Lin-Mims	6776 Pyramid Way, Columbia, MD 21044-4119, USA		Hickory Ridge	
2024/08/29 1:08:21 PM EST	myak@comcast.net	Melanie R. Yaksich	Melanie	Yaksich	6105 Eternal Ocean Place Clarksville, MD 21029	4109083520	River Hill	
2024/08/29 1:20:45 PM EST	klh72384@yahoo.com	Kristin Hartman	Kristin	Hartman	Greatnews Lane		Hickory Ridge	
2024/08/29 1:21:25 PM EST	mikaela.iwaskiw@gmail.com	Mikaela Iwaskiw	Mikaela	Iwaskiw	5436 dogwood Rd Gwynn Oak MD 21207		I don't live in Howard county, but spen	Near Catonsville MD
2024/08/29 1:38:42 PM EST	arbutus126@aol.com	Heidi Hughes	Heidi	Hughes	6784 Athol Ave		Harwood park	
2024/08/29 2:20:38 PM EST	mannapureddy@gmail.com	Yes, it’s a health hazard to the senior citizens, kids and infants.	Madhavi	Annapureddy	6178 Flutie ln		River Hill	
2024/08/29 2:22:52 PM EST	skim2149@gmail.com	Susan Sackel	Susan	Sackel	6138 Flutie lane	443-844-7525	River Hill	
2024/08/29 2:23:49 PM EST	dwang957@gmail.com	Talia Wang	Talia	Wang	6223 Flutie Ln	9207500231	River Hill	
2024/08/29 2:32:48 PM EST	bikdhariwal@yahoo.com	Bik Singh	Bik	Singh	12557 Vincents way Clarksville Md 20129		River Hill	
2024/08/29 2:40:49 PM EST	99godspeed99@gmail.com	Vishal Chhikara	Vishal	Chhikara	6208 Northrop Way Clarksville MD		Enclave at River Hill	
2024/08/29 3:06:08 PM EST	Tripathi.jahnavi@gmail.com	Jahnavi Trivedi	Jahnavi	TRIVEDI	6166 Flutie Lane Clarksville MD 21029	2023671725	Guilford	
2024/08/29 3:33:26 PM EST	fran_may@yahoo.com	Fran May	Fran	May	6048 Winter Grain Path Clarksville	301366-8314	River Hill	
2024/08/29 3:38:10 PM EST	ben.pafe@gmail.com	Ben Pafe	Ben	Pafe	Charmed Days, Laurel, MD		Near savage mill	
2024/08/29 4:52:09 PM EST	kodak1973@yahoo.com	Nick Caputo	Nick	Caputo	10915 Harmel Drive	4109973354	Hickory Ridge	
2024/08/29 6:26:13 PM EST	rthornton4725@gmail.com	Rebecca Thornton	Rebecca	Thornton			Ellicott City	
2024/08/29 7:59:19 PM EST	jzcrich@yahoo.com	Joan Zhang	Joan	Zhang	5912 Trumpet sound ct		River Hill	
2024/08/29 8:02:54 PM EST	thekelleyfamily4@verizon.net	Phyllis A Kelley	Phyllis	Kelley	5709 WHISTLING WINDS WALK	4102924809	River Hill	
2024/08/29 9:40:05 PM EST	keerthi.muthyala@gmail.com	Keerthi Muthyala	KEERTHI	MUTHYALA	6131 Lily Garden	5165082513	Guilford	
2024/08/29 9:55:11 PM EST	mktrossman@gmail.com	Marlene Trossman	Marlene	Trossman	12113 Sunlit Water Way Clarksville MD 21029	4437229579	River Hill	
2024/08/30 5:05:09 AM EST	ningshen99@gmail.com	Ning Shen	Ning	Shen	6436 Swimmer Row Way, Columbia, MD		Guilford	
2024/08/30 6:18:00 AM EST	najlabarton@gmail.com	Najla Barton	Najla	Barton	6130 lily garden, Clarksville, MD 21029	202-409-6425	River Hill	
2024/08/30 7:20:22 AM EST	amy.bracciale@gmail.com	Amy Crouch	Amy	Crouch	10400 Springtwig Ct , Woodstock MD 21163	4432262817	Waverly	Waverly
2024/08/30 8:30:26 AM EST	jakeburdett11@gmail.com	Jake Burdett	Jake	Burdett	4989 Columbia Road, Unit 304	4438335051	Dorsey's Search	
2024/08/30 8:42:11 AM EST	atayee.elaha@gmail.com	Elaha Atayee	Elaha	Atayee	7648 cross creek drive		Cedar Creek	
2024/08/30 8:49:17 AM EST	nawidullah_atayee@icloud.com	Nawid Atayee	Nawid	Atayee	7648 Cross Creek Drive	2065368987	Cedar Creek	
2024/08/30 8:56:24 AM EST	a.bolanos11@gmail.com	Anthony Bolanos	Anthony	Bolanos	6515 river run	8507970788	River Hill	
2024/08/30 9:01:54 AM EST	aynurdemirelfni@gmail.com	Aynur Demirel	Aynur	Demirel	7505 Overview Terrace Columbia MD	4102450400	Cedar Creek	Listed above
2024/08/30 9:11:11 AM EST	nsiddiq910@gmail.com	Nusrat Siddique	Nusrat	Siddique	7220 Mainstream Way	4439042372	Cedar Creek	
2024/08/30 10:37:12 AM EST	wufang3@gmail.com	Fang Wu	Fang	Wu	Shannon Ct, Clarksville, MD21029		River Hill	
2024/08/30 12:33:29 PM EST	lan99ma@gmail.com	Lan Ma	Lan	Ma	8638 Wellford Dr		Centennial Overlook	
2024/08/30 1:16:46 PM EST	javabruin@gmail.com	Richard Clayton	Richard	Clayton	6609 Towering Oak Path	4438120077	River Hill	
2024/08/30 3:20:45 PM EST	lixinzhang@yahoo.com	Lixin Zhang	Lixin	Zhang	6473 empty Song RD Columbia MD	2405933221	River Hill	
2024/08/31 7:23:43 AM EST	laurielyons@gmail.com	Laurie Lyons	Laurie	Lyons	6513 Great Drum Circle		River Hill	
2024/08/31 7:36:18 AM EST	gpengqin@hotmail.com	Jorge Gao	Jorge	Gao	9345 Big River Run		Oakland Mills	
2024/08/31 8:30:12 AM EST	maria_zhang@yahoo.com	Maria zhang	Maria	Zhang	9609 John Randolph court, Ellicott CIty, MD 21042		Ellicott city	
2024/08/31 10:33:22 AM EST	harriszeng@yahoo.com	Harris Haifeng Zeng	Harris	Zeng	10219 Ebb Tide Ln. Laurel, MD 20723		Emerson	Emerson
2024/08/31 9:22:18 PM EST	frostwolfer@gmail.com	Tao Wu	Tao	Wu	9800 Madelaine CT		Ellicott city	Ellicott citu
2024/09/01 9:39:52 AM EST	marilyn8993@gmail.com	Marilyn Mills	Marilyn	Mills	10697 Quarterstaff Rd	4106085952	Hickory Ridge	
2024/09/01 11:54:26 AM EST	rene.maldonado@outlook.com	Rene Maldonado	Rene	Maldonado	7320 Sanborn Way, Columbia MD 21044	314-223-3117	Cedar Creek	
2024/09/01 4:50:48 PM EST	ctupino@gmail.com	Christine Tupino	Christine	Tupino	7703 Cross Creek Drive	3022425608	Cedar Creek	
2024/09/01 5:26:58 PM EST	Laub4@verizon.net	Shelley Laub	Shelley	Laub	10615 Millet Seed Hill	443-538-1316	Hickory Ridge	
2024/09/01 5:29:54 PM EST	kellip1114@gmail.com	Kelli Passalacqua	Kelli	Passalacqua	12126 Fulton Ridge Drive	4108521871	Fulton Ridge	Fulton, MD
2024/09/01 5:37:03 PM EST	vvsessler@comcast.net	Victoria Sessler	Victoria	Sessler	12363 Pleasant View Dr Fulton 20759	4437456115	Fulton	Fulton
2024/09/01 5:42:30 PM EST	dgersuk@gmail.com	Diana Gersuk	Diana	Gersuk	7416 Cherry Tree Drive Clarksville		Hopkins Meade	
2024/09/01 5:52:09 PM EST	arunakharel@hotmail.com	Arundati kharel sigdel	Arundati	Kharel sigdel	7936 lawndale cir columbia MD	4104761678	Cedar Creek	
2024/09/01 7:15:10 PM EST	noahweintraub@verizon.net	Noah Weintraub	Noah	Weintraub	Fulton, Md		Fulton	
2024/09/01 8:26:39 PM EST	robinsturman5@gmail.com	Robin Sturman	Robin	Sturman	10701 Quarterstaff Road	443-255-0657	Hickory Ridge	
2024/09/01 9:41:48 PM EST	kcbloom@verizon.net	Kr	Kristine	BLOOM	10806 Dundee Dr. Columbia, MD 21044	443-745-5677	Hickory Ridge	
2024/09/01 11:32:29 PM EST	suesabenorio@yahoo.com	Sue Sabenorio	Sue	Sabenorio	7783 Cross Creek Drive Columbia MD 21044	4103755032	Cedar Creek	
2024/09/01 11:56:16 PM EST	eriaac@gmail.com	Eric DeMenthon	Eric	DeMenthon	6582 Guilford Rd, Clarksville MD 21029	2403288512	River Hill	
2024/09/02 12:48:16 AM EST	ihalkias12@gmail.com	Irene Halkias	Irene	Halkias	6500 Waving Tree Cr 21044		River Hill	
2024/09/02 12:55:20 AM EST	mikeshare56@gmail.com	David Michael Share	Mike	Share	6405 Misty Top Pass	4102066578	River Hill	
2024/09/02 7:27:37 AM EST	sssmjd@hotmail.com	I support	Scott	Davis	11853 Tall Timber Dr	4105313016	River Hill	
2024/09/02 7:31:17 AM EST	lauraluu_17@hotmail.com	Laura Sullivan	Laura	Sullivan	913 Nichols dr		Laurel	PG county
2024/09/02 7:34:22 AM EST	qbasic92@hotmail.com	Seth Gersuk	Seth	Gersuk	7416 Cherry Tree Dr, Clarksville, MD 21029		Hopkins Meade	Clarksville, near APL
2024/09/02 7:47:09 AM EST	debbiejrubin@gmail.com	Deborah Rubin	Deb	Rubin	10627 Millet Seed Hill Columbia MD 21044	4433868204	Hickory Ridge	
2024/09/02 10:16:30 AM EST	gary.mousigian@gmail.com	Gary M. Mousigian	Gary	Mousigian	6469 River Run, Columbia, MD. 21044	313-671-1155	River Hill	
2024/09/02 10:26:54 AM EST	dennymathew@yahoo.com	Denny Mathew	Denny	Mathew	6405 Empty Song Road	2406205639	River Hill	
2024/09/02 10:41:23 AM EST	zrachbach@gmail.com	Zelda Rachbach	Zelda	Rachbach	10719 Autumn Splendor Drive		Hickory Ridge	
2024/09/02 11:05:03 AM EST	myuncledonald@hotmail.com	Don Mu	Don	Mu	5507 Green Bridge Road, Dayton MD 21036	973-960-4556	Dayton	Dayton
2024/09/02 12:14:14 PM EST	jerry.j.jiang@gmail.com	Jerry Jiang	Jerry	Jiang	9429 dunloggin rd		Dorsey's Search	
2024/09/02 3:55:56 PM EST	anwerhasan@hotmail.com	Anwer Hasan	Anwer	Hasan	7651 Cross Creek Drive	4433241287	Cedar Creek	
2024/09/02 3:57:06 PM EST	roominahasan@gmail.com	ROOMINA HASAN	Roomina	Hasan	7651 Cross Creek Drive	4438120480	Cedar Creek	
2024/09/02 6:01:05 PM EST	lreplus3@gmail.com	Richard Steinberg	Richard	Steinberg	10444 Sternwheel Place		Hickory Ridge	
2024/09/02 7:51:18 PM EST	mu_omarzad@yahoo.com	Mustafa Omarzad	Mustafa	Omarzad	7511 Overview Terr, Columbia MD, 21044	4435092834	Cedar Creek	
2024/09/02 9:02:04 PM EST	dunnbb@verizon.net	Bernadette Dunn	Bernadette	Dunn	6482 South Wind Circle	3016558993	River Hill	
2024/09/02 9:18:18 PM EST	keostevens@gmail.com	Kathy Stevens	Kathy	Stevens	6553 River Run	4102451066	River Hill	
2024/09/02 9:25:45 PM EST	phenry71@gmail.com	Paula Henry	Paula	Henry	6300 MELLOW TWILIGHT CT, Columbia, MD 21044		River Hill	
2024/09/02 9:59:27 PM EST	norapresti@verizon.net	Nora Presti	Nora	Presti	6546 South Wind Circle Columbia MD 21044	410-952-8922	River Hill	
2024/09/02 10:15:36 PM EST	cgkonny@gmail.com	Crystal Konny	Crystal	Konny	11605 Dark Fire Way	3013354870	Clary’s	Clary’s Forest
2024/09/03 12:02:41 AM EST	mikaela_rossman@hotmail.com	Mikaela Rossman Clark	Mikaela	Clark	10634 Glass Tumbler Path, Columbia, MD 21044-4144, USA		Hickory Ridge	
2024/09/03 12:23:57 AM EST	elizamweih@gmail.com	Eliza Weih	Eliza	Weih	Mellow Wine Way		River Hill	
2024/09/03 4:39:33 AM EST	cweih74@yahoo.com	Christopher Weih	Christopher	Weih	6449 Mellow Wine Way	4432581029	River Hill	
2024/09/03 5:05:08 AM EST	awu0226@gmail.com	Annabelle Wu	Annabelle	Wu	7964 lawndale cir	6676780290	Cedar Creek	
2024/09/03 5:13:40 AM EST	leg1247@gmail.com	Laura Grassi	Laura	Grassi	6016 Misty Arch Run		Hickory Ridge	
2024/09/03 5:39:04 AM EST	rakhisingh08@gmail.com	Rakhi Singh	Rakhi	Singh	7711 Cross Creek Drive	3012134295	Cedar Creek	
2024/09/03 8:39:27 AM EST	alicehtsai@yahoo.com	Alice Tsai	Alice	Tsai	3670 Cragsmoor Rd, Ellicott City,MD	4435384896	Font Hill	Font Hill
2024/09/03 12:00:54 PM EST	d4divas@verizon.met	Emily Downs	Emily	Downs	10806 Vista Rd. Columbia Md. 22044		River's Edge	
2024/09/03 12:49:26 PM EST	angel_xu@yahoo.com	Angela Ling	Angela	Ling	6409 Misty Top Pass Columbia MD 21044	4109884638	River Hill	
2024/09/03 5:09:35 PM EST	cherae.jones@icloud.com	Cherae Jones	Cherae	Jones	7612 Cross Creek Drive		Cedar Creek	
2024/09/03 6:19:58 PM EST	wereno@gmail.com	Bita Dayhoff	Bita	Dayhoff	123 don’t want to say columbia Md 21044	4102356785	ML	
2024/09/03 6:59:15 PM EST	davidakrausz@gmail.com	David A. Krausz	David	Krausz	6109 Trackless Sea Court		River Hill	
2024/09/03 8:29:59 PM EST	pearlw.lee@gmail.com	Pearl Lee	Pearl	Lee	6207 Northrop Way Clarksville MD 21029		River Hill	
2024/09/03 8:39:20 PM EST	bpluntz7@gmail.com	Beth Luntz	Beth	Luntz	6513 Kilkenny Ct. 21019	4104560516	Clark’s Glen	Clark’s Glen
2024/09/03 8:46:32 PM EST	Peddishiva@gmail.com	Shivakumar Peddi	Shivakumar	Peddi	6107 Flutie Ln	4102059718	River Hill	
2024/09/03 8:47:51 PM EST	bikdhariwal@yahoo.com	Bik Singh	Bik	Singh	12557 Vincents way Clarksville MD 21029		River Hill	
2024/09/03 9:03:05 PM EST	shugoandliz@gmail.com	Elizabeth Tanaka	Elizabeth	Tanaka	Unsure why you need to know this		Hickory Ridge	
2024/09/03 9:37:03 PM EST	janetmedina@verizon.net	Janet Medina	Janet	Medina	4614 Smokey Wreath Way	4437423994	Dorsey's Search	
2024/09/03 10:07:36 PM EST	dczhoushen@live.com	Jonathan Jou	Jonathan	Jou	12100 Flowing Water Trl., Clarksville MD 21029	2023868808	River Hill	
2024/09/04 12:32:44 AM EST	bgrenn@gmail.com	Bryan S Grenn	Bryan	Grenn	6416 DISTANT MELODY PLACE Columbia Marylai	5858313218	River Hill	
2024/09/04 4:56:20 AM EST	ankita.ahuja@gmail.com	Ankita Chandupatla	Ankita	Chandupatla	12654 Vincents away		River Hill	
2024/09/04 5:00:04 AM EST	taixi65@gmail.com	Luhua Tai	Luhua	Tai	10521 Rossini Lane Ellicott City MD 21042		Turf Valley	
2024/09/04 6:05:57 AM EST	lavner@msn.com	Stephanie Lavner	Stephanie	Lavner	6117 Trackless Sea Ct Clarksville MD 21029	2017042545	River Hill	
2024/09/04 6:06:36 AM EST	ellenbsowry@yahoo.com	Ellen Sowry	Ellen	Sowry	5008 Green Bridge Rd, Dayton, MD 21036	4124803939	Dayton	Dayton
2024/09/04 6:50:10 AM EST	briannagle20@gmail.com	Brian Nagle	Brian	Nagle	6441 Sundown Trail Columbia MD 21044		River Hill	
2024/09/04 7:29:17 AM EST	AlanLLane2@verizon.net	Alan L Lane	Alan	Lane	5920 Great Star Drive, Unit 304, Clarksville, MD 2	443-783-4918	River Hill	
2024/09/04 7:40:20 AM EST	pamela.gutman@gmail.com	Pamela Gutman	Pamela	Gutman	8994 Wetbanks Ct, Columbia, MD 21045		Long Reach	
2024/09/04 7:40:35 AM EST	jack.mcgowan2001@gmail.com	Jack McGowan	Jack	McGowan	4808 Circling Hunter Dr, Columbia MD		Jonestown	Jonestown
2024/09/04 7:57:42 AM EST	gracifer@gmail.com	Grace Chaisson	Grace	Chaisson	10732 McGregor Drive	4438013118	Scot's Glen	Scot's Glen
2024/09/04 7:57:44 AM EST	tbradford313@gmail.com	Teresa Erica Bradford	Teresa	Bradford	11863 Scaggsville Rd Fulton, MD 20759	70	Maple Lawn	
2024/09/04 8:00:39 AM EST	brick@mac.com	Gary Brick	Gary	Brick	13135 Hutchinson Way, Silver Spring, MD 20906		Silver Spring, MD	Silver Spring, MD
2024/09/04 8:15:30 AM EST	shettygirish75@gmail.com	Girish Shetty	Girish	Shetty	6122 flutie lane clarksville md 21029	2812353841	River Hill	
2024/09/04 8:19:43 AM EST	urjita83@gmail.com	Urjita Rami	Urjita	Rami	6119 FLUTIE ln, Clarksville-21029		River Hill	
2024/09/04 8:19:47 AM EST	pnparlette@comcast.net	Nancy Turner Parlette	Nancy	Parlette	6434 South Trotter Rd	4432539761	Pointers Run	Clarksville , Pointers Run
2024/09/04 9:29:25 AM EST	dantheman@daman.com	Dan Gordon	Dan	Gordon	123 Main St		Other	Maryland
2024/09/04 9:52:10 AM EST	rennissmart@gmail.com	Gina Smart	Gina	Smary	4667 Willowgrove Drive	443	Dorsey's Search	

2024/09/04 10:30:11 AM EST	astockbridge@comcast.net	Anne Stockbridge	Anne	Stockbridge	2124 Woodbine Rd	443 615 1176	Lisbon	Lisbon	
2024/09/04 10:50:13 AM EST	miawyatt@verizon.net	Mia Wyatt	Mia	Wyatt	7762 Chatfield Ln	4105300780	Woodland Village	Woodland Village	
2024/09/04 10:55:52 AM EST	8511frederickrd@gmail.com	Carolyn Hughes	Carolyn	Hughes	8511 Frederick Rd		Ellicott City		
2024/09/04 11:38:17 AM EST	svia@umd.edu	Sara Via	Sara	Via	Manor Lane, Ellicott City, MD 21042		Ellicott City	Ellicott City	
2024/09/04 11:48:44 AM EST	jessica.li.eajj@gmail.com	Jessica Li	Jessica	Li	7232 Mainstream Way Columbia MD 21044		Cedar Creek		
2024/09/04 12:09:17 PM EST	sima626@gmail.com	Sima Amin	Sima	Amin	7933 Lawndale Cir		Cedar Creek		
2024/09/04 12:10:32 PM EST	sanket369@gmail.com	Sanket Patel	Sanket	Patel	7933 Lawndale Cir		Cedar Creek		
2024/09/04 12:42:04 PM EST	orgs@cakedasher.bnb4500.net	Barbara Lagas	Barbara	Lagas	8885 Warm Granite Drive		Long Reach		
2024/09/04 12:43:06 PM EST	jbuonato8@gmail.com	SJ Buonato	Sebastian	Buonato	6448 Lochridge Road, Columbia, MD 21044		Braeburn	Braeburn, off of Cedar Lane	
2024/09/04 1:16:22 PM EST	ugur_ates13@hotmail.com	Ugur Ates	Ugur	Ates	7405 Plainview Ter, Columbia, MD 22044	2409070846	Cedar Creek		
2024/09/04 2:32:36 PM EST	roseannandroy@gmail.com	Roseann Taff	Roseann	Taff	11281 Barnsley Way, Marriottsville, Md. 21104		Waverly Woods West	Waverly Wood West	
2024/09/04 5:36:33 PM EST	Jacqiefive@gmail.com	Jacqueline M Bates	Jacqueline	Bates	10826 Braeburn Road	9739752451	Braeburn Community Association	Columbia, across from Hickory Ridge Village Center. Next to Robinson Nature Center. 50 lo	
2024/09/04 7:36:34 PM EST	demack5@comcast.net	Debbi Mack	Debbi	Mack	7888 Savage Guilford Rd., Jessup MD 20794		Kings Contrivance		
2024/09/04 8:18:32 PM EST	janet@schreibmail.com	Janet Schreibstein	Janet	Schreibstein	5204 Woodam Ct -		Beaverbrij	Beaverbrook	
2024/09/04 8:46:27 PM EST	myoung1117@gmail.com	EUNMYOUNG LEE	Eunmyoung	Lee	9824 SNOW BIRD LN		Emerson		
2024/09/04 10:48:40 PM EST	btzy2018@gmail.com	Bing Zhang	Bing	Zhang	6507 River Run, Columbia, Md 21044		River Hill		
2024/09/05 6:02:58 AM EST	jennaballo@gmail.com	Jennifer Aballo	Jennifer	Aballo	6723 Green Mill Way, Columbia, MD 21044		Simpson Mill	Simpson Mill Townhomes	
2024/09/05 11:13:15 AM EST	ss4304@aol.com	Steven Shuman	Steven	Shuman	6608 Gleaming Sand Chase Columbia, MD 21044		River Hill		
2024/09/05 11:25:40 AM EST	dsalva@aol.com	Diane D. Salvatore	Diane	Salvatore	9344 Cross Timbers Court, Laurel, MD 20723	240-354-7379	Settler's Landing	Settler's Landing in Laurel, MD	
2024/09/05 12:17:58 PM EST	maryhepple@verizon.net	Mary Hepple	Mary	Hepple	12006 White Cord Way Columbia MD		Hickory Ridge		
2024/09/05 12:24:53 PM EST	marybean24@verizon.net	Mary Sabella	Mary	Sabella	6452 River Run Columbia MD 21044	443 745-2450	River Hill		
2024/09/05 1:29:30 PM EST	bearcarolina@gmail.com	Melissa Berry-Carolina	Melissa	Berry-Carolina	7107 Kings point Way	4434138287	Kings Contrivance		
2024/09/05 1:52:18 PM EST	indyx86@gmail.com	Eric Miller	Eric	Miller	4906-1 Columbia Road	740-591-1507	Dorsey's Search		
2024/09/05 2:12:36 PM EST	janw.miller@gmail.com	Janet Miller	Janet	Miller	14460 Triadelphia Mill Rd, Dayton, MD	301-922-1326	Dayton	Dayton	
2024/09/05 4:45:41 PM EST	oscse23@gmail.com	Md Osman Gani	Md Osman	Gani	6500 Ranging Hills Gate, Columbia, MD 21044		River Hill		
2024/09/05 5:18:32 PM EST	magicdollkm@gmail.com	Yu Xuan Kimi Liang	Kimi	Liang	6206 Bridget Way, Clarksville, MD 21029	2406887141	Guilford		
2024/09/05 5:34:44 PM EST	anchoevy@gmail.com	Nicole Ma	Nicole	Ma	6190 Flutie ln		River Hill		
2024/09/05 6:55:34 PM EST	svpineo@gmail.com	Stuart Pineo	Stuart	Pineo	8918 Tawes St, Fulton, MD 20759	4107075349	Fulton, MD	Fulton, MD	
2024/09/05 6:59:43 PM EST	chutchi2@yahoo.com	Carol Hutchison. I support the decision to stop this plant and the effects it will have on the neighborhoods.	Carol	Hutchison	5622 Freshaire Lane	4435382407	Harper's Choice		
2024/09/05 7:30:26 PM EST	nicoletvo7@gmail.com	Nicole Shastri	Nicole	Shastri	10218 Sunway terrace, Ellicott City MD	2672105099	Ellicott City		
2024/09/05 9:04:28 PM EST	jtdhanraj@gmail.com	Julie T Dhanraj	Julie	Dhanraj	10354 Derby Dr	3016425149	Hunters Creek	Hunters Creek	
2024/09/05 9:18:38 PM EST	kishor_sigdel@hotmail.com	Kishor sigdel	Kishor	Sigdel	7936 lawndale circle Columbia MD	4109176800	Cedar Creek		
2024/09/05 9:43:08 PM EST	considid@verizon.net	Donna Considine	Donna	Considine	7052 Garden Walk	4107077415	River Hill		
2024/09/06 5:10:44 AM EST	rauerb@gmail.com	Ruth Lynn Auerbach	Ruth	Auerbach	9455 Clocktower Lane, Columbia, MD 21046		Kings Contrivance		
2024/09/06 6:00:46 AM EST	aaronskolnick@gmail.com	Aaron M Skolnick	Aaron	Skolnick	13007 Red Maple Way, Clarksville		Twelve Hills		
2024/09/06 6:03:45 AM EST	ymatties@gmail.com	Ying Matties	Ying	Matties	9982 Cape Ann Dr		Kings Contrivance		
2024/09/06 6:11:57 AM EST	chusblue@gmail.com	Shirley Chu	Shirley	Chu	7241 Mainstream Way, Columbia, MD 21044	9176836064	Cedar Creek		
2024/09/06 7:44:34 AM EST	berghoffhg@gmail.com	Henry berghoff	Henry	Berghoff	12550 Vincents way, Clarksville MD 21029		River Hill		
2024/09/06 8:07:02 AM EST	bethecollins@gmail.com	Elizabeth Collins	Elizabeth	Collins	13014 Highgrove Road, Highland, MD 20777	240-535-1326	Schooley Mill	Schooley Mill (near park)	
2024/09/06 8:16:50 AM EST	tbk81985@verizon.net	Tracee Kramer	Tracee	Kramer	4243 Ten Oaks Rd Dayton MD 21036		Dayton	Dayton Maryland	
2024/09/06 9:12:39 AM EST	bioliumo@hotmail.com	Mo Liu	Mo	Liu	7241 Mainstream Wy, Columbia, MD 21044		Cedar Creek		
2024/09/06 9:41:48 AM EST	ruth_huffman@verizon.net	Ruth Huffman	Ruth	Huffman	12100 hidden waters way 21029	410-707-0915	River Hill		
2024/09/06 9:50:33 AM EST	bethanna_varson@verizon.net	Beth Anna Varson	Beth Anna	Varson	6337 Departed Sunset Lane Columbia, MD 21044	443-801-0434	River Hill		
2024/09/06 9:54:30 AM EST	monica.ennaciri@gmail.com	Monica Ennaciri	Monica	Ennaciri	6461 Empty Song Rd Columbia MD 21044	2405351947	River Hill	Pointers Run - 5 min Walk to Grace	
2024/09/06 11:27:44 AM EST	allisonsmithdennis@gmail.com	Allison Dennis	Allison	Dennis	10179 Owen Brown Road	4109172959	Hickory Ridge		
2024/09/06 2:27:42 PM EST	gganim21@gmail.com	George Ganim	George	Ganim	6405 mellow wine way Columbia Md 21044	2408821281	River Hill		
2024/09/06 2:53:17 PM EST	kingsleylsimons@gmail.com	Kingsley Simons	Kingsley	Simons	7212 Mainstream Way	3013266621	Cedar Creek		
2024/09/06 3:18:45 PM EST	kat@ourrevolutionmd.com	Kathleen Uy	Kathleen	Uy	5014 Whetstone Rd. Columbia, MD 21044	301-728-7956	Wild Lake	*Wilde Lake	
2024/09/06 4:13:46 PM EST	ralove100@gmail.com	Richard Love	Richard	Love	7525 Yellow Bonnet PL	410-381-3621	Kings Contrivance		
2024/09/06 4:36:16 PM EST	b_negahban@yahoo.com	Bahareh Negahban	Bahareh	Negahban	11766 chapel Estates drive Clarksville MD 21029	4432851278	River Hill		
2024/09/06 5:14:20 PM EST	patelpaul@aol.com	Paul patel	Paul	Patel	15146 sapling ridge dr	3016747880	Dayton md	Dayton MD	
2024/09/06 5:31:00 PM EST	KenWard6185@gmail.com	Kenneth Ward	Kenneth	Ward	12488 East Nuggett Court	301-875-6185	Highland Md 20777	Highland md	
2024/09/06 6:07:04 PM EST	a216vcti@gmail.com	Cliff Itwaru	Cliff	Itwaru	14770 Triadelphia Mill Road	4439850787	Dayton	Dayton	
2024/09/06 6:11:00 PM EST	susanbuningh@hotmail.com	Susan B. Buningh	Susan	Buningh	11782 Stonegate Lane, Columbia MD 21044	301-922-0342	Hickory Ridge		
2024/09/06 7:50:15 PM EST	cucusiak@gmail.com	Claire usiak	Claire	Usiak	900 S East Ave	2404098999	Baltimore	Baltimore.	
2024/09/06 8:34:16 PM EST	preet6064@gmail.com	Preet sandhu	Preet	Sandhu	6035 Holland Ct Columbia md 21044		Hickory Ridge		
2024/09/06 8:56:10 PM EST	beth.newman5@gmail.com	Beth Satisky	Beth	Satisky	10560 Hunters Way Laurel MD 20723	2028027275	north laurel	North Laurel	
2024/09/06 8:56:18 PM EST	beth.newman5@gmail.com	Beth Satisky	Beth	Satisky	10560 Hunters Way Laurel MD 20723	2028027275	north laurel	North Laurel	
2024/09/06 9:38:02 PM EST	bkbblankenship@gmail.com	Brooke Blankenship	Brooke	Blankenship	7238 Life Quest Lane, Columbia, MD 21045	4438757228	Owen Brown		
2024/09/07 7:48:27 AM EST	emwink@gmail.com	Emily Winkelstein	Emily	Winkelstein	10750 Bridlerein Terrace		Hickory Ridge		
2024/09/07 7:50:24 AM EST	daljitkdhami@gmail.com	Daljit Soni	Daljit	Soni	12150 Fulton Estates, Fulton, MD	2027146116	Near pindell school road	12150 Fulton estates court	
2024/09/07 7:58:03 AM EST	emagae45@verizon.net	Gina Egel	Gina	Egel	6453 River Run	4102928626	River Hill		
2024/09/07 5:19:38 PM EST	gganim21@gmail.com	George Ganim	George	Ganim	6405 mellow wine way Columbia Md 21044	2408821281	River Hill		
2024/09/07 6:20:34 PM EST	sologirl715@gmail.com	Deb Solomon	Deb	Solomon	12186 Hayland Farm Way		River Hill		
2024/09/08 3:48:28 PM EST	jsaademd@gmail.com	Jawad Saade	Jawad	Saade	6601 gleaming sand columbia MD 21044	3135157457	River Hill		
2024/09/08 5:49:39 PM EST	andiwilliams0809@gmail.com	I support the above petition	Andrea	Estrada	10110 wesleigh Dr		Allview Estates		
2024/09/08 8:53:01 PM EST	jmerti15@gmail.com	Julia Merti	Julia	Merti	6500 Autumn Wind Circle	2029975018	River Hill		
2024/09/09 7:26:18 AM EST	j.garrison52@verizon.net	Kim garrison	Kim	Garrison	6465 sundown trail Columbia 21044	4437455618	River Hill		
2024/09/10 7:57:46 AM EST	mondyz3@yahoo.com	Magdy ebeid	Magdy	Ebeid	6161 flutie Ln Clarksville md 21028	7185107903	River Hill		
2024/09/10 10:39:48 AM EST	krithikak7@gmail.com	Krithika Kesavan	Krithika	Kesavan	7502 overview terrace columbia Maryland	4106622341	Cedar Creek		
2024/09/10 10:39:54 AM EST	jess.reikowsky@gmail.com	Jess Reikowsky	Jessica	Reikowsky	14825 Woodfield lane, Glenelg, md 21737		Glenelg		
2024/09/10 11:23:59 AM EST	debnoon8104@icloud.com	Debbie Noonan	Debbie	Noonan	7956 Lawndale Circle Columbia, Md 21044	3013439412	Cedar Creek		
2024/09/10 11:50:24 AM EST	theharryemail@gmail.com	Nina Harry	Nina	Harry	1040 fairlane road woodbine	240 535 5497	Fairlane farm	Fairlane farm	
2024/09/10 12:04:20 PM EST	neeshapatel14@gmail.com	Neesha Manickam	Neesha	manickam	14052 Gared Drive, Glenwood, MD	4437564182	Byrd Manor	Byrd Manor	
2024/09/10 12:09:17 PM EST	superdupermomma@gmail.com	Laura Tan	Laura	Tan	4333 Maisel Farm Lane		Private road	Beside Buckskin	
2024/09/10 12:14:54 PM EST	jigmaj@hotmail.com	Jigna Majmudar	Jigna	Majmudar	Dayton Md		Castelberry		
2024/09/10 12:25:33 PM EST	bethiew99@yahoo.com	Elizabeth Franks	Elizabeth	Franks	16024 Fields End Ct		Woodbine	Woodbine	
2024/09/10 12:29:31 PM EST	heather.butler0702@yahoo.com	Heather outman	Heather	Outman	st Michaels road		Woodbine	Woodbine	
2024/09/10 12:32:14 PM EST	kbmcnulty@yahoo.com	Kimberly Ford	Kimberly	Ford	14371 Frederick rd Cooksville MD 21723	4433407092	Cooksville	Cooksville md	
2024/09/10 12:38:02 PM EST	gandy.katie@gmail.com	Kathryn E. Gandy	Kathryn	Gandy	3129 West Ivory Road, West Friendship, MD 2179	(410) 913-5185	Fox Valley	Fox Valley neighborhood	
2024/09/10 12:45:50 PM EST	stacibradley75@gmail.com	Staci Bradley	Staci	Bradley	3295 Roscommon Dr, Glenelg, MD 21737	2408880730	Glenelg	Glenelg	
2024/09/10 1:00:14 PM EST	misskristenhill@gmail.com	Kristen Smith	Kristen	Smith	3630 Point Hitch Rd. Glenwood MD 21783		Countryside	Countryside	
2024/09/10 1:41:45 PM EST	bethhiggins4@verizon.net	Beth higgins	Beth	Higgins	1731 cattail meadows dr, Woodbine, md 21797	443-421-0982	Cattail woods	Cattail woods	
2024/09/10 1:58:08 PM EST	jennasunday@gmail.com	Jenna Hammer	Jenna	Hammer	625 Sideling Ct Sykesville MD	4104049193	Gaither	Gaither	
2024/09/10 2:08:55 PM EST	evlanciano@gmail.com	Emily Lanciano	Emily	Lanciano	14108 Burntwoods Rd Glenwood MD 21738	4437450316	Glenwood	Glewood	
2024/09/10 2:08:59 PM EST	nicoleweszka@gmail.com	Nicole Weszka	Nicole	Weszka	3655 Paupers Folly Lane West Friendship MD 217	240-285-8970	Belvedere Estates	Belvedere Estates	
2024/09/10 2:20:07 PM EST	rslebair@gmail.com	Yes	Robert	Lebair	14684 Mustang Path Glenwood Md 21738	4105676625	Glenwood	Glenwood	
2024/09/10 3:31:37 PM EST	cogden636@gmail.com	Catherine Loomis	Catherine	Loomis	14114 Burntwoods Rd		Glenwood	Glenwood	
2024/09/10 3:49:49 PM EST	buckynduke@gmail.com	Sara Schlanger	Sara	Schlanger	3920 Sharp Road, Glenwood, MD 21738		Glenwood	Glenwood	
2024/09/10 4:04:32 PM EST	jennifer@ormond.us	Jennifer Ormond	Jennifer	Ormond	14840 Bushy park Rd		Western HoCo	Western HoCo	
2024/09/10 4:19:36 PM EST	mannik.manokian@gmail.com	Mannik manokian	Mannik	Manokian	13327 ridgewood dr	4435147602	Ridgewood	Ridgewood	
2024/09/10 5:32:17 PM EST	haiyan_c@yahoo.com	Yes	Haiyan	Chen	3982 Old Columbia Pike		Ellicott City	Ellicott City	
2024/09/10 6:22:58 PM EST	krista-kirk@outlook.com	Krista Kirk	Krista	Kirk	15017 Rolling Hills Drive Glenwood, MD 21738	7034593377	Glenwood	Glenwood	
2024/09/10 6:30:45 PM EST	meissneri@yahoo.com	ivy meissner	ivy	meissner	779 chessie crossing way woodbine md 21797	4432869024	woodbine	woodbine	
2024/09/10 6:35:16 PM EST	smitrega@hotmail.com	Susan Lynn Love	Susan	Love	3334 Sharp Road Glenwood MD 21748	410 2457314	Gwenley Estates		
2024/09/10 6:38:03 PM EST	clairedeckert7@aol.com	Claire Reinken	Claire	Reinken	13299 Hunt Rdg, Ellicott City, MD 21042		Hunt Ridge	Western Ellicott Citt	
2024/09/10 7:15:57 PM EST	treeinthemoon@hotmail.com	Mary Lu	Mary	Lu	3625 Cragsmoor Road		Ellicott City		
2024/09/10 8:08:17 PM EST	kathy.broughton79@gmail.com	Kathy Broughton	Kathy	Broughton	14204 Pioneer Circle, Glenelg MD 21737	2403058084	Glenelg	Glenelg	
2024/09/11 4:27:23 AM EST	lroecklein@gmail.com	Leslie Roecklein	Leslie	Roecklein	14581 Edgewoods Way 21737	215-817-5110	Glenelg	Glenelg	
2024/09/11 8:46:36 AM EST	msanderoff@aol.com	Michael Sanderoff	Michael	Sanderoff	6621 Forest Shade Trail, Clarksville, MD, 21029		River Hill		
2024/09/11 8:51:14 AM EST	beth173@verizon.net	Beth Lawson	Beth	Lawson	14820 Cemetery Road, Cooksville, Md 21723	410-952-0355	No neighborhood	Cooksville	
2024/09/11 9:10:49 AM EST	anjaliksandhu@outlook.com	Anjali Sandhu	Anjali	Sandhu	14261 Triadelphia Mill Rd Dayton, MD 21036	3019744070	Dayton	Private Road Dayton MD	
2024/09/11 9:34:03 AM EST	pbascietto@comcast.net	Patricia Bascietto	Patricia	Bascietto	11927 gold needle way Columbia md		Hickory Ridge		
2024/09/11 10:43:01 AM EST	manda.jones87@gmail.com	Amanda Chaves	Amanda	Chaves	4117 ten oaks rd		Dayton	Dayton	
2024/09/11 11:12:47 AM EST	figosharm@gmail.com	Ragaey Ghaleb	Ragaey	Ghaleb	5792 Alderleaf pl, Columbia		Long Reach		
2024/09/11 8:45:12 PM EST	swim2mom@comcast.net	Debra O'Byrne	Debra	O'Byrne	1209 Emmaus Rd Woodbine MD		Walnut Springs	Walnut Springs	
2024/09/12 3:42:46 AM EST	inapam829@gmail.com	Ina hersh	Ina	Hersh	10263 Shaker Dr. Columbia md 21046		Kings Contrivance		
2024/09/12 8:06:26 AM EST	egwinjr@gmail.com	Eric Gwin	Eric	Gwin	14080 Triadelphia rd		Glenelg		
2024/09/12 10:28:25 AM EST	eslacum@gmail.com	Elizabeth Hodnett	Elizabeth	Hodnett	3364 Burton Dr Ellicott City, MD 21042		Westmount	Westmount	
2024/09/12 11:04:29 AM EST	mherold94@gmail.com	Maria Herold	Maria	Herold	5020 lake circle ct, Columbia, MD		Beaverbrook	Beaverbrook	
2024/09/12 11:26:38 AM EST	mbwessal@hotmail.com	Baktash Wessal	Baktash	Wessal	5208 Woodam Ct Columbia md 21045	3016603213	Beaverbrook	Beaverbrook	
2024/09/12 1:57:39 PM EST	lilianregmi@gmail.com	Lilian Regmi	Lilian	Regmi	6803 Green Mill Way, Columbia, MD 21055		Hickory Ridge		
2024/09/12 2:34:05 PM EST	dianeshaver@gmail.com	Diane Shaver	Diane	Shaver	2829 rolling fork way Glenwood md		Mckendree Estates	Glenwood	
2024/09/12 4:54:14 PM EST	circle5064@verizon.net	Maria Alvarez	Maria	Alvare	5064 Lake Circle West, Columbia, MD. 21044		Beaverbrook		
2024/09/12 5:47:17 PM EST	cogdilltracy@gmail.com	Tracy cogdill	Tracy	Cogdill	13705 bold venture drive, Glenelg MD	6097607239	Paddocks, Glenelg	Glenelg.Paddock's neighborhood	
2024/09/12 7:35:50 PM EST	jmorton122@verizon.net	Joan Morton	Joan	Morton	6505 Hazel Thicket Drive, Columbia, Md. 21044	3015094622	River Hill		
2024/09/12 7:38:06 PM EST	esch.amanda@gmail.com	Amanda Salamon	Amanda	Salamon	3447 Huntsmans Run		Western Ellicott City		
2024/09/12 7:42:03 PM EST	rbarlly@gmail.com	Randolph Barlly	Randolph	Barlly	5093 Durham Road west Columbia MD 21044		Beaverbrook	Beaverbrook	
2024/09/13 5:22:13 AM EST	theresabrillant@gmail.com	Theresa Brillant	Theresa	Brillant	Beaverbook Rd Columbia, MD 21044		Beaverbook	Beaverbrook	
2024/09/13 10:37:20 AM EST	kuiyee200@yahoo.com	Yali Mao	Yali	Mao	3934 white rose way		Dorsey's Search		
2024/09/13 12:29:03 PM EST	helenkim37@gmail.com	Helen Kim	Helen	Kim	4085 Roxbury Mill Rd		Glenwood area	Glenwood	
2024/09/13 5:51:25 PM EST	rosemary.call@gmail.com	Rosemary J Duncan	Rosemary	Duncan	6516 Ocean Shore Lane		River Hill		
2024/09/14 10:00:39 AM EST	hylee2716@gmail.com	Haena-Young Lee	Haena-Young	Lee	6513 Kells Ct Clarksville, MD 21029	4105283164	Clark's Glen	Clark's Glen	
2024/09/14 9:23:05 PM EST	Sheila@networkint.com	Sheila BISHOFF	SHEILA	BISHOFF	6440 Richardson Farm Ln Clarksville MD 21029	240-441-4943	Windy Knolls - Clarksville	Richardson Farm Lane - windy knolls	
2024/09/15 12:47:42 PM EST	escapefromli@yahoo.com	Judith S. Thomas	Judith	Thomas	6585 Autumn Wind Circle	202-257-6166	River Hill		
2024/09/24 9:12:30 AM EST	stephanie.kenez@gmail.com	Stephanie Kenez	Stephanie	Kenez	10307 Paddock Place Laurel, MD 20723	2405060755	Hammond		
2024/09/27 11:34:15 PM EST	walkeraj@gmail.com	Andrew J Walker	Andy	Walker	6406 Lochridge Rd	4438449145	Braeburn	Braeburn (Lochridge Rd)	
2024/09/28 9:39:47 AM EST	annie@anniehager.com	Annie Hager	Anne	Hager	6486 River Run, Columbia, MD 21044	443-257-6022	River Hill		
2024/09/28 9:49:39 AM EST	pinghe.yin@gmail.com	Pyunghwa Yoon	Pyunghwa	Yoon	6448 River Run		River Hill		
2024/09/28 10:21:04 AM EST	randall.shore@gmail.com	Randy Shore	Randy	Shore	6421 Distant Melody Pl		River Hill		
2024/09/28 10:30:54 AM EST	mkwoka@gmail.com	Martha Bartlett	Martha	Bartlett	6405 enchanted Solitude place, Columbia md	423.737.5284	Hickory Ridge		
2024/09/28 10:43:39 AM EST	cdonovan2007@yahoo.com	Yes, I support this petition.	Colleen	Donovan	6512 Evensong Mews		River Hill		
2024/09/28 10:53:37 AM EST	brendaandscott@verizon.net	Scott Johnson	Scott	Johnson	6518 River Run	4436919608	River Hill		
2024/09/28 11:42:37 AM EST	sandradee811@gmail.com	Sandy K Cummings	Sandy	Cummings	6613 Rising Waves Way	4109634372	River Hill		
2024/09/28 12:44:16 PM EST	dwyermk1@gmail.com	Karen Dwyer	Karen	Dwyer	6644 Towering Oak Path, Columbia	4108689383	River Hill		
2024/09/28 1:54:34 PM EST	mt06806@gmail.com	Teresa Money	Teresa	Money	6632 Towering Oak Path, Columbia, MD 21044	4437744489	River Hill		
2024/09/28 6:29:34 PM EST	guang_lou@yahoo.com	Guang Lou	Guang	Lou	7021 Jeweled Hand Circle, Columbia, MD 21044		River Hill		
2024/09/28 6:29:45 PM EST	guang_lou@yahoo.com	Guang Lou	Guang	Lou	7021 Jeweled Hand Circle, Columbia, MD 21044		River Hill		
2024/09/29 8:03:43 AM EST	ackergal@comcast.net	Mary Acker	Mary	Acker	6420 Distant Melody Place	410-952-8967	River Hill		
2024/09/30 5:25:24 AM EST	ross.usmani@gmail.com	Ross Usmani	Ross	Usmani	6409 mellow wine way		River Hill		
2024/09/30 9:19:19 PM EST	chaseshari1@gmail.com	Yes	Shari	Chase	6629 towering Oak Path , Columbia, Maryland 210	3015372747	Pointlers run/Riverhill	Pointers run in the Riverhill area. I denounce Grace for doing this and they have not learned	
2024/10/01 1:05:00 PM EST	farroha@hotmail.com	Bassam Farroha	Bassam	Farroha	6429 River Run	4436769420	River Hill		
2024/10/05 1:59:18 PM EST	rcohen0126@aol.com	Rita R. Cohen	Rita	Cohen	6106 Forestvale Court	410-916-5917	Hickory Ridge		
2024/10/08 8:24:35 PM EST	a2c2hubbard@gmail.com	Aron Hubbard	Aron	Hubbard	6410 Liquid Laughter Lane		River Hill		
2024/10/14 8:35:48 PM EST	ongschoolstuff@gmail.com	Stephanie S. Ong	Stephanie	Ong	6500 Evensong Mews, Columbia, MD		River Hill		
2024/10/19 5:26:38 PM EST	sskyedesigns@gmail.com	Shari Skye	Shari	Skye	10309 Derby Dr laurel, MD 20723	3014833512	Hunters Creek / N laurel	Hunters Creek / N laurel	
2024/10/22 10:12:18 AM EST	sec.odell@gmail.com	Shannon E. O'Dell	Shannon	O'Dell	7409 Plainview Terrace	202-699-0194	Cedar Creek		
2024/10/22 7:50:22 PM EST	roulazureick@gmail.com	Roula Zureick	Roula	Zureick	6478 River Run		River Hill		
2024/11/01 3:12:10 PM EST	martha.brucato@gmail.com	Martha Brucato	Martha	Brucato	6513 Ocean Shore Lane		River Hill		
2024/11/05 12:32:25 PM EST	lisalkrausz@comcast.net	Lisa Krausz	Lisa	Krausz	6109 Trackless Sea Court	4157177065	River Hill		
2024/11/05 12:33:02 PM EST	weisslora@gmail.com	Lily Weiss-Lora	Lily	Weiss-Lora	6469 Empty Song Rd	443-538-0788	River Hill		
2024/11/06 6:47:33 PM EST	crdailey3@comcast.net	Christopher T. Dailey	Christopher	Dailey	7678 Cross Creek Drive, Columbia MD 21044		Cedar Creek		
2024/11/07 2:55:28 PM EST	hrm.chitwood@sbcglobal.net	Rhonda Chitwood	Rhonda	Chitwood	6522 River Run, Columbia, MD. 21044	9729784846	River Hill		
2024/11/07 4:35:49 PM EST	hrm.chitwood@sbcglobal.net	Rhonda Chitwood	Rhonda	Chitwood	6522 River Run, Columbia, MD. 21044	9729784846	River Hill		
2024/11/07 7:11:36 PM EST	paul.gionis@protonmail.com	Paul Gionis	Paul	Gionis	7617 Weather Worn Way, Unit D		Kings Contrivance		
2024/11/10 12:24:40 PM EST	sarahpan8569@gmail.com	Sarah Pan	Sarah	Pan	3211 Vanborine Pl		Ellicott City	Ellicott City	
2024/11/10 3:58:43 PM EST	civilpereview@gmail.com	INDRANIL GOSWAMI	Indranil	Goswami	6901 Timber Creek Court Clarksville MD 21029		Clarksville Hunt	Clarksville Hunt	
2024/11/11 4:48:05 PM EST	rsdesilva07@gmail.com	Rukman De Silva	Rukman	De Silva	12379 Pleasant view drive, Fulton, MD 20759	6036671034	Fulton Manor	Off Hallshop Road	
2024/11/12 2:13:07 AM EST	meremcord526@gmail.com	Meredith nowak	Meredith	Nowak	12232 pleasant springs ct Fulton md 20759	6095602624	Highland Reserve		
2024/11/16 7:21:35 PM EST	mariajgf_@hotmail.com	Maria J. Gutierrez	Maria	Gutierrez	5896 Indian Summer Drive, Clarksville, MD 21029	3478400605	River Hill		
2024/11/16 10:30:29 PM EST	nancysolowski@yahoo.com	Nancy Solowski	Nancy	Solowski	6505 Early Lily Row 21044	3145551212	River Hill		
2024/11/16 11:09:58 PM EST	mweedlun@gmail.com	Morag Weedlun	Morag	Weedlun	12217 Ioka Ct Ellicott City, MD	4434130476	Ellicott City near Clarksville/Glenelg	Ellicott City near clarksville/Glenelg	
2024/11/16 11:37:48 PM EST	passes-scat.0a@icloud.com	Jordanna McMillan	Jordanna	McMillan	22100 New Hampshire Ave Brookeville MD		15 mins away	Brookeville MD	
2024/11/17 6:10:52 AM EST	ejherzig@gmail.com	Eric Herzig	Eric	Herzig	12183 Linden Linthicum Ln, Clarksville MD 21029		River Hill		
2024/11/17 7:45:27 AM EST	flike.cecilia@gmail.com	Cecilia Flike Jacobson	Cecilia	Flike Jacobson	13419 Green Hill Court		Highland	Highland	
2024/11/17 2:18:47 PM EST	ellencoop@verizon.net	Ellen Cooper	Ellen	Cooper	10600 Gorman Rd., Laurel, MD 20723		Hammond Village	Hammond Village	
2024/11/17 8:28:51 PM EST	bobbieeves@hotmail.com	Tammy Eves	Tammy	Eves	7510 Sweet Hours Way, Columbia, MD		Kings Contrivance		
2024/11/22 12:20:55 AM EST	hildaflike@gmail.com	Hilda Flike Jacobson	Hilda	Flike Jacobson	13419 Green Hill Court		Highland		
2025/01/07 4:53:46 PM EST	dccop58@aol.com	Steven Salsburg	Steven	Salsburg	5672 April Journey	443-677-3015	Dorsey's Search		
2025/01/26 5:56:57 AM EST	dttotaro@aol.com	dttotaro@aol.com	Tracy	Totaro	12309 Carol Dr	3016746383	Fulton Manor	Fulton Manor	
2025/02/07 12:18:50 PM EST	juliabethlawrence@gmail.com	Julia Lawrence	Julia	Lawrence	5527 Suffield Court		Harper's Choice		
2025/02/07 1:46:10 PM EST	SusanKeach@comcast.net	Susan Keach Sweeney	Susan Keach	Sweeney	6006 Jerrys Drive	4437566231	Hickory Ridge		
2025/02/09 8:38:36 AM EST	hikingboots6@aol.com	MARCIE WEIL	MARCIE	WEIL	10450 waterfowl ter	703-927-9551	Wild Lake		
2025/02/09 11:48:38 AM EST	alexmemory@gmail.com	Alex Memory	Alex	Memory	10478 Waterfowl Terrace, Columbia MD 21044		Wild Lake		
2025/02/09 4:21:57 PM EST	bgrodsky@yahoo.com	Brian Grodsky	Brian	Grodsky	5801 Clipper Ln Unit 204	734-239-4635	River Hill		
2025/02/09 6:38:20 PM EST	arbutus126@aol.com	Heidi Hughes	Heidi	Hughes	6784 Athol Ave		Hardwood park	Elkridge MD	
2025/02/09 11:17:13 PM EST	davidhsteiner@verizon.net	Marjorie Steiner	Marjorie	Steiner	5288 Golden Sky Court. Columbia, MD 21045	410-707-3875	Glenmont	Off 108 between Thunderhill and PhelpsLuck	
2025/02/12 3:13:56 PM EST	debcounts@outlook.com	Debra Counts	Debbie	Counts	11741 Farside Rd		Farside	Farside	

2025/02/12 7:10:17 PM EST	sarahthecooke@hotmail.com	Sarah Cooke	Sarah	Cooke	5054 Durham Rd West, Columbia 21044		Harper's Choice		
2025/02/13 10:24:33 AM EST	a.aleshinguendel@gmail.com	Alexandra Aleshin-Guendel	Alexandra	Aleshin-Guendel	11837 Linden Chapel Road		Chapel Woods		
2025/02/13 10:32:44 AM EST	luciealow@gmail.com	Lucie Low	Lucie	Low	6629 Whitegate Rd, Clarksville		Clarksville Ridge	Clarksville Ridge	
2025/02/13 2:11:28 PM EST	jessraimondi@gmail.com	Jessica Raimondi	Jessica	Raimondi	7901 Olive Branch Lane, Laurel, MD 20723		Wellington Farms	Wellington Farms	
2025/02/13 9:03:15 PM EST	gary.mousigian@gmail.com	Gary Mousigian	Gary	Mousigian	6469 River Run Columbia, MD	313-671-1155	River Hill		
2025/02/13 9:10:50 PM EST	faerieblossom@gmail.com	Mara Lueking	Mara	Lueking	9317 Angelina Circle	3028246144	Owen Brown		

February 16, 2025

Dear Howard County Council members,

My name is Shamieka Preston, my husband, 12-year-old, and 9-year-old have lived in Cedar Creek since 2022.

We moved from California to Columbia due to Howard County's commitment to racial and economic inclusion and the environment.

We left California in part due to years of wildfires affecting our air quality and quality of life. Although we were located hundreds of miles from the wildfires, we were impacted daily during fire season. My husband and I were deeply concerned about the effects of these toxic chemicals on ourselves and our young children. Fast forward to today, we are genuinely concerned about a new, unexpected environmental threat. Our home is 200 feet from the WR Grace facility where they would like to build an "advanced recycling" pilot plant.

I support CB11-2025 for the following reasons:

1. The EPA and MDE have designated WR Grace's pilot plant as a pyrolysis incinerator.[1]

In the attached communications between the Maryland Department of the Environment (MDE) the Environmental Protection Agency (EPA), they have officially defined WR Grace's proposed pilot plant as a *pyrolysis incinerator*. To those who live nearby, this is extremely important and pertinent because Grace has repeatedly stated, in local media, public hearings, and on their website, that their pilot plant is **not** an incinerator.

Although the pilot plant meets the applicability criteria for a pyrolysis incinerator, it does not appear that MDE is intending to regulate it as one.

WR Grace's proposal to build an incinerator on their campus, within 200 feet from homes and backyards with kids and other vulnerable groups, should be of grave concern to local residents, elected officials, and the broader Howard County community. Setting this type of precedent could enable other bad actors to build other hazardous facilities in the name of research. Howard County should not allow any company to build any type of incinerator near homes or outside of manufacturing or industrial zones.

I have spoken to many of the residents who signed petitions, attended hearings, and lent their voices to this cause, we would not have opted to live near WR Grace had we known they intended to build an incinerator (no matter the size nor purpose). My family certainly would not have.

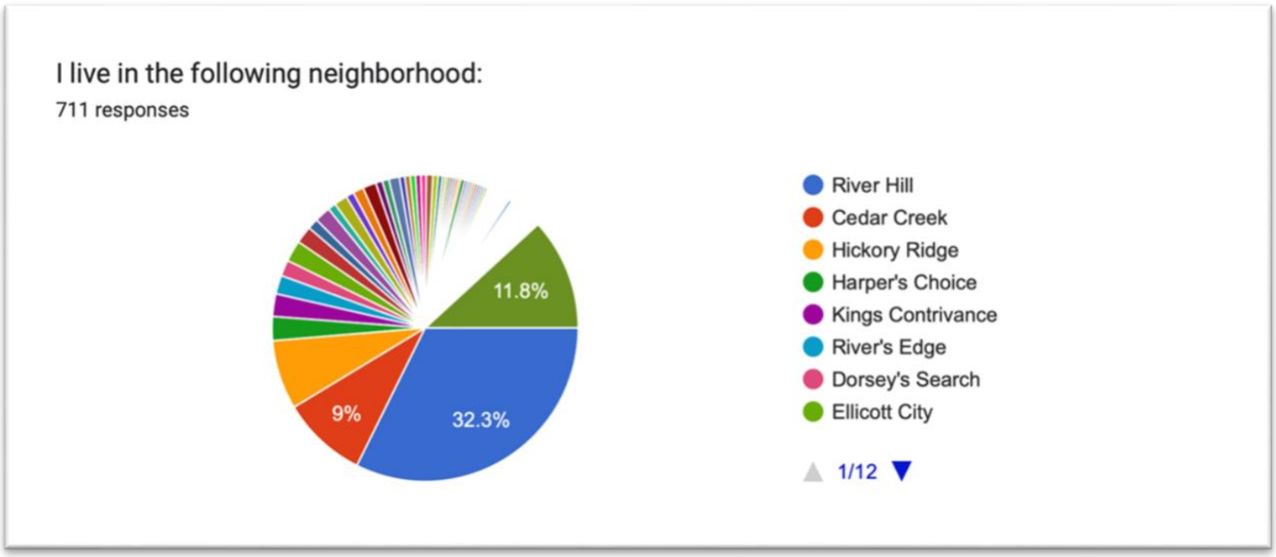
[1] See Attachment "Pyrolysisunits-defined.png"- EPA's working definition of Pyrolysis Units from the Other Solid Waste Incinerators (OSWI): New Source Performance Standards (NSPS) and Emission Guidelines (EG) for Existing Sources

For more details, see attached document named, "Enclosure- WR Grace Reg. Interpretation Signed.pdf", " 25-01482-R03-PAO Walsh.pdf", "Enclosure-OSWI Applicability Detemination Request Letter.pdf"

2. Community members are alarmed by the WR Grace pilot plant project.
The Stop Grace grassroots organization created a petition and collected over 700 names of those who oppose Grace's Pyrolysis Incineration Project. This petition has evolved over time based on growing concern and outreach. Despite the evolution, the message from those who signed is clear and emphatic:

> ***"…RESPECTFULLY PETITION OUR LOCAL AND STATE OFFICIALS AS WELL AS OUR COUNTY AND STATE AGENCIES TO BLOCK W.R. GRACE FROM CONSTRUCTING AND OPERATING THE PROPOSED PILOT PLANT.***

The data extract below demonstrates that the vast majority of respondents live in the communities within a mile of WR Grace (including Cedar Creek, River Hill and Hickory Ridge) with many others neighboring communities within Howard County sharing the same concerns.[2]



3. **An NIH study showed that health risks increase within 1 mile of toxic air emissions**

The majority of the concerned petitioners live closest to the WR Grace Project. According to a 2015 NIH Study[3] of 1,600 industrial plants with toxic air emissions, there are clear impacts to health and housing prices in communities that are within 1 mile of a plant emitting toxic air pollutants. A summary of the study and the findings are as follows:

[2] For more details, see attached document named, "Stop Grace Member Petition_combinedMaster.pdf"

[3] Detailed information can be found in the link and attached document named, "Environmental Health Risks and Housing Values Evidence from 1,600 Toxic Plant Openings and Closings.pdf"

> The application of a research design based on more than 1,600 plant openings and closings matched to extraordinarily detailed, geocoded data yields three primary findings. First, on average, toxic air pollutants affect ambient air quality only within 1 mile of the plants, suggesting that health effects from these emissions should be concentrated in this range. The highly localized range differs substantially from particulate matter emissions, which can affect ambient air quality several hundred miles away from their source. Second, the opening of a plant that emits these pollutants leads to a roughly 11 percent decline in housing prices within 0.5 miles, or a loss of about $4.25 million per operating plant. Housing prices are largely unaffected by a plant closing, implying that toxic plants continue to negatively affect housing prices after they cease operations. Third, the incidence of low birthweight increases by roughly 3 percent within one mile of an operating toxic plant, with comparable magnitudes between 0 and 0.5 miles and 0.5 and 1 miles.

On a personal note, this is one of the most terrifying points for me as a parent and homeowner because my house is approximately 200 feet from Grace's fence line and within line of sight of Building 30, the intended site for the pyrolysis incinerator. My children and my neighbor's children play in our backyards which abut Grace's fence. I am deeply concerned over the potential negative health impacts to my children, visiting relatives, and neighborhood animals (including my 14-month-old dog), waterways, and the broader environment. In addition, wild animals such as deer, foxes and bunnies roam the land between Robinson Nature Center, Cedar Creek, and WR Grace's campus and the Middle Patuxent River runs nearby.

This photo, taken from my front porch on February 14, 2025, is of WR Grace's corporate headquarters located at 7500 Grace Drive, Building 30.

4. WR Grace plans to emit toxic air emissions for most of the day, for more than half of the year, for an unknown number of years.

According to WR Grace's Air and Radiation Administration Application for Permit to Construct Docket #16-23, they will run their incinerator every hour for 16 hours a day, 5 days a week, and for 50 weeks each year. The below is a screen capture of the page in their permit where they outline the projected schedule.

Describe the emission point including all associated equipment and control devices:

31 of 169 tput gas stream controlled by thermal oxidizer

3. Emissions Schedule for the Emission Point			
Continuous or Intermittent (C/I)?	I	**Seasonal Variation** Check box if none: ☒ Otherwise estimate seasonal variation:	
Minutes per hour:	60	Winter Percent	
Hours per day:	16	Spring Percent	
Days per week:	5	Summer Percent	
Weeks per year:	50	Fall Percent	

In an April 11, 2024, virtual public hearing (YouTube video), hosted by the Maryland Department of the Environment, Grace's lead scientists on the project stated, "we envision this running primarily between waking hours" for an unknown number of years (see YouTube video linked above, timestamps 32:34 and 1:03:50). The Grace scientists were unable to express an exact number of years, "we expect a fairly long run in terms of the number of years that we will operate this pilot plant."

This is untenable for folks who have just moved into our homes and especially for those of us with young children who need to be outdoors. As new members to the Cedar Creek community and Howard County as a whole, Grace is severely limiting our enjoyment of our new home and community.

It is unfair that Grace stands to gain with their pilot plant while their closest neighbors are negatively impacted. Grace gets to conduct research every day of the week nearly every week of the year for "4000 hours a year" for an unknown number of years. As a result, neighbors like me, lose access to my outdoor space due to pollution exposure and noise every day of the week, nearly every week of the year, for an unknown number of years.

Additionally, we get to worry about when the toxic air emissions, including, and especially, VOCs will increase our risks of respiratory ailments and cancer.

The potential health and safety impacts have already affected our family's plans. We've stopped investing in home improvements projects (which impacts local businesses); we are stressed about whether our neighborhood can weather this storm. Leaving would devastate our family. Staying would destroy our health. These are difficult decisions we shouldn't have to make 2 years into a new home but the risks of a pyrolysis incinerator so close is too serious to ignore.

5. WR Grace continues to contradict themselves in their documentation. We do not know what to believe and we do not trust them with our safety.

In the case of the pyrolysis incinerator that Grace wants to operate, details matter. I will give you one simple example that highlights this point. In WR Grace's permit application, they state the number of pounds of anticipated daily VOCs emitted is projected to be ***"0.218 lb/day"*** (see below screenshot from their Form 5EP submission).

FORM 5EP: Emission Point Data

6. Estimated Emissions from the Emission Point

Criteria Pollutants	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	(lb/day)	(ton/yr)
Particulate Matter (filterable as PM10)		0.000	0.000	0.000
Particulate Matter (filterable as PM2.5)		0.000	0.000	0.000
Particulate Matter (condensables)				
Volatile Organic Compounds (VOC)		0.014	0.218	0.027
Oxides of Sulfur (SOx)				
Oxides of Nitrogen (NOx)				
Carbon Monoxide (CO)				
Lead (Pb)				

As recently as Sunday, February 16, 2025, their website, intended to explain the pilot project, stated that "***218 lb/day***" of VOCs would be emitted -- **a 1,000x difference**. (see below screenshot from their website).

GRACE

12. What are the air emissions going to be from this project?

Because this project will produce modest air emissions, we have closely followed the MDE process to disclose them and obtain the proper permit. Potential daily emissions from this pilot, as disclosed in the permit application, include:

- 73 lbs of Carbon Dioxide (CO_2),
- .002 lbs of Carbon Monoxide (CO),
- .011 lbs of Nitrogen Oxides (NOx) and
- 218 lbs of Volatile Organic Compounds (VOC).
- Additionally, the application discloses essentially no Particulate Matter (PM) (we say "essentially" because the PM will be less than a pound a year, which amounts to two ten-thousandths of a pound of PM a day (.0002) or half a pound per year based on our operating hours)

See the permit application for details

A missed "comma or period" can be catastrophic. This is just one example of the carelessness and contradictions around what Grace has communicated regarding this plant and its impacts. Recklessness like this could be the difference between life and death. It can lead to more toxic emissions than projected, a fire, or an explosion. A mistake this big makes us wonder how many of their "facts" can be trusted. If they cannot get the details right now, how can we trust them to safeguard our health and safety in the future? **MY GREATEST DESIRE IS THAT MY HOME DOES NOT BECOME A TOXIC WASTE ENVIRONMENT DUE TO GRACE'S MISSED DECIMAL POINTS.**

6. WR Grace has a history of causing harm to communities

WR Grace has not been a good neighbor now or ever. Since they became a chemical company in the early 1950s, they have left a string of disasters across many cities including Columbia. Their consent order to clean up groundwater here continues and local communities such as Curtis Bay continue to experience issues related to having WR Grace as a neighbor. See the following links for more information on WR Grace's decades long negative impact on local communities: Wayne, NJ, Woburn, MA, Acton, MA, Libby, MO, Tampa, FL. In total, they have had 32 superfund sites to remediate and many toxic spills since including one as recently as 2023.

7. Recent changes to federal funding will impact MDE's ability to monitor air pollution including WR Grace's pilot plant

Finally, I will leave you with this. Last week, it was announced that nearly $14 million in federal funds intended for Maryland Department of the Environment (MDE) were frozen, impacting their ability to monitor air pollution (see screenshot below from WYPR news article).

> About $13.7 million in direct grants to the Maryland Department of the Environment were "suspended" Tuesday, agency spokesman Jay Apperson said. They include funding for air pollution monitoring, mining-related projects, the expansion of electric vehicle chargers, coastal and forest restoration projects, and workforce training for energy-sector jobs.

We do not know if this funding will be reinstated. Without independent monitoring, there is no clear understanding of how Maryland or Howard County would be able to hold WR Grace to their projected emissions.

It is for all of these stated reasons, that I believe no company—present or future—should be allowed to operate a pyrolysis incinerator or similar technology involving "commercial plastic pellets or feedstock which produces flue gas and requires a permit from the state of Maryland" near residential homes. There should be no loopholes, no exceptions, and no grandfathering in for any company in Howard County.

I implore you, as the officials whom we elected to keep our communities safe, to do the right thing and approve CB11-2025. This measure will ensure that Howard County families stay safe from air pollution, fires, explosions hazards and pilot plants that lack community support and offer little to the adjacent communities.

Sincerely,

Shamieka Preston and family

From: sharon@everyactioncustom.com on behalf of Sharon Holley <sharon@everyactioncustom.com>
Sent: Monday, February 17, 2025 2:59 PM
To: CouncilMail
Subject: Support CB11-2025 for a safe buffer between WR Grace and surrounding neighborhoods

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Dear Howard County Council,

As a Marylander, I'm deeply concerned by W.R. Grace's proposed "advanced recycling" pilot plant. This plant would spew carcinogenic air pollution just 70 meters from local homes in the Cedar Creek neighborhood of Columbia, Maryland.

Let's be clear. "Advanced recycling" is neither advanced nor recycling. This is just a misleading term for burning plastic waste and turning our plastic pollution problem into an air pollution problem. Read more about this harmful practice here:
https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.momscleanairforce.org%2Fresources%2Fchemical-recycling-101%2F&data=05%7C02%7Cianderson%40howardcountymd.gov%7C415a37e0d5c8492ffc3008dd4f8d89ba%7C0538130803664bb7a95b95304bd11a58%7C1%7C0%7C638754191504423086%7CUnknown%7CTWFpbGZsb3d8eyJFbXB0eU1hcGkiOnRydWUsIlYiOiIwLjAuMDAwMCIsIlAiOiJXaW4zMiIsIkFOIjoiTWFpbCIsIldUIjoyfQ%3D%3D%7C0%7C%7C%7C&sdata=uQLxpqxyJ%2FCUpr2%2BWho0qCYMO1K8a6YT0NcEV7DcFok%3D&reserved=0

I urge you to support CB11-2025 to ensure a safe buffer between corporations like W.R. Grace conducting research and development (R&D) and residential neighborhoods.

This proposed facility not only will spew cancerous air pollution, but also is susceptible to fires, explosions, accidents, leaks, and more due to its experimental nature. Residents must be protected from these potential catastrophes by ensuring a safe buffer.

It is crucial that the Howard County Council listens to concerned community members and holds W.R. Grace accountable to public health standards. Please do not set the precedent that chemical companies and serial polluters like W.R. Grace can freely pollute and harm our communities. If this can happen in Cedar Creek, it can happen anywhere. Please protect Maryland families and keep our state safe.

Sincerely,
Sharon Holley
3737 Patterson Ave Gwynn Oak, MD 21207-6319 sharon@browndowntown.org

From: Spencer Clarke <spencer.clarke.e3uo@statefarm.com>
Sent: Monday, February 17, 2025 7:00 PM
To: CouncilMail
Subject: cb11 - suppport

Follow Up Flag: Follow up
Flag Status: Flagged

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Testimony in Support of CB11

Good evening, members of the Howard County Council.

My name is Spencer Clarke and my family and I live in River Hill.

W.R. Grace claims to be a responsible corporate citizen, but their track record tells a different story. From a nitric acid spill in Curtis Bay to being sued by Baltimore County for plastics misuse, their history is riddled with environmental violations. And beyond Maryland, communities in Libby, Montana, and Massachusetts are still dealing with the toxic legacies they left behind. Now, they want to build a pyrolysis incinerator—something both the EPA and MDE have classified as such—just 200 feet from homes and backyards. Yet, they continue to mislead the public by insisting it's not an incinerator. If we allow this project to proceed, we are not just putting our community at risk—we are setting a dangerous precedent that could allow other hazardous facilities to be built in inappropriate locations. This is why CB11 is necessary. Howard County must put the health and safety of its residents first.

Please pass CB11.

Thank you,

Spencer Clarke

From: Zain Qazi <zainqazi@gmail.com>
Sent: Monday, February 17, 2025 5:11 PM
To: CouncilMail
Subject: Zain Qazi testimony for CB11-2025
Attachments: ZQ CB11-2025.docx

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Hello,

My name is Dr. Zain Qazi and I am a resident at Cedar Creek. My testimony in support of CB11-2025 is attached.

Thank You!,
Zain Qazi, MD

Good evening councilmembers and thank you for giving me the opportunity to speak today. My name is Dr. Zain Qazi and I am a physician and parent of a 2 and 4 year old living in Cedar Creek here to speak in support of CB11-2025 with my concerns regarding Grace chemicals.

We moved our family here about two years ago after a series of tumultuous rentals, looking all over Maryland and Virginia, settling on one of the "best Cities to Raise a Family in America", according to Niche in 2024 - Columbia, MD. At that time, we took a deep breath of relief assuming we had landed ourselves in the ideal place to raise our young family.

When deciding to live in Columbia, we were assured that this new community being built next door to Grace Chemicals would not be adversely affected, as Grace exclusively used their facility for administrative purposes. Beyond that, we were told the land was previously owned by Grace, but that the Maryland Department of Energy was overseeing the care of their contaminated land. Imagine our shock to incidentally hear about a public hearing regarding research being proposed next door to us in order to recycle plastic by utilizing an "Innovative catalyst", as described in their permit request. The more we looked into it, they were also given responsibility to monitor the previously contaminated land which we are now living on.

Greater shock ensued when we found out that R&D is alive and well at the Grace facility next door and has been for years. Their proposed process includes attempting to recycle plastic with this catalyst and burning the emitted known carcinogens via pyrolysis (which will go into our air), and storing other byproducts in bins to be transferred elsewhere. This is beyond disconcerting, given that there are a number of individuals in our community who can't even open their rear windows given their proximity to Grace and the resultant air and noise pollution.

Everything about this process has been opaque as we only perchance found out about the public hearing thanks to one of our neighbors. Nobody reached out to our HOA to notify them about this application. Nobody engaged our community - quite the opposite had taken place. These do not come off to me as actions of an organization trying to be a good neighbor.

In brief summary:

1. They contaminated what is now the land we live on, and the water can never be used. We'll have to trust Grace is monitoring the soil and air.
2. They then had this land rezoned for residential purposes under the agreement that they would carry out community improvement efforts (bike trails, community center, etc). These will never happen, but they got paid.
3. They waited until the last house in the neighborhood sold, then put up big black fences facing peoples backyard and subsequently applied for a permit to do this new research.
4. Grace has a history of lawsuits stemming from environmental violations and contaminating communities in their efforts to maximize profits.
5. An environmental justice index was developed in 2020 which excluded the neighborhood (our neighborhood) which is literally adjacent to grace. We didn't exist back then.
6. MDE has tasked Grace with monitoring themselves, and at this point MDE has had their own funding cut off. Again, Grace is not a model citizen, it is a company beholden to shareholders. We are a community just trying to raise our families