WILLAMETTE UNIVERSITY
COLLEGE OF ARTS AND SCIENCES

Banishing the Burn:
Opposing waste incineration in the Willamette Valley

by

Surya Rainwater Lee

A Thesis Submitted in

Partial Fulfillment of the Requirements for the

Degree of Bachelor of Arts

in

Public Health

Thesis Advisor: Professor Joyce V. Millen

Submitted: May 4, 2022

BANISHING THE BURN:
OPPOSING WASTE INCINERATION IN THE WILLAMETTE VALLEY

Surya Lee

This study explores interrelated social, environmental, and public health effects associated with waste incineration. Waste incinerators, particularly old ones, are significant sources of pollution, emitting heavy metals such as lead, arsenic, and mercury into the air and soil. People living near waste incinerators are at elevated risk for developing respiratory ailments, cardiovascular illness, certain cancers, miscarriages, and more. For these reasons, communities throughout the U.S. are working to close down old incinerators. This study examines the complex array of reasons why, despite years of effort to close them down, some remain in operation, including Oregon's only waste incinerator, Covanta, located just north of Salem.

Keywords: *Waste incineration; human health; environmental justice; heavy metals; air pollution; childhood exposure; zero-waste*

TABLE OF CONTENTS

List of Figures

Land Acknowledgment

I would like to respectfully acknowledge that Willamette University was built on the stolen land of the Kalapuya. Today they are represented by the Confederated Tribes of the Grand Ronde and the Confederated Tribes of the Siletz Indians, whose relationship with this land continues to this day. I am grateful to the land itself, to those who have stewarded it for generations, and for the opportunity to study, learn, work, and be in community on this land. I recognize that my presence on this land is the outcome of years of genocide, ethnic cleansing, and internment of those Native to this land. I acknowledge that the University's history is fundamentally tied to colonization in the Willamette Valley. I respectfully acknowledge and honor past, present, and future Indigenous students of Willamette. I pledge to continue educating ourselves on the harm our presence has caused and work toward reducing that harm, *especially* in the fields of public health and environmental science which are used to further colonial, white supremacist, and eugenicist agendas in many ways. Finally, I thank those who have helped me come to this understanding.

Gratitude

First and foremost, I would like to express my sincere gratitude to my research participants, who were extremely helpful during my research. I would like to thank Lisa Arkin, Arjorie Arberry-Baribeault, and the rest of the Beyond Toxics team for their support and their willingness to take me on as an intern this semester. Thank you to my classmates in our senior seminar for getting me through a tough semester. I would also like to thank Professor Joyce Millen, Professor Melinda Butterworth, Professor Janet Lorenzen, and Joni Roberts for their guidance with this project. I would also like to acknowledge Professors Sammy Basu, Katja

Meyer, and Omari Weekes for their support throughout my time at Willamette. Finally, thank you to all of my friends, mentors, classmates, and family for your unconditional support and love throughout my time in college; I could not have done it without you!

Introduction

Throughout the world, seven million people die from air pollution each year (WHO, 2018). Air pollution causes a myriad of health effects, ranging from respiratory and cardiovascular diseases to cognitive impairment and behavioral problems. A large majority of air pollution is caused by human activity, especially industrial processes and vehicular emissions. In addition to these, waste incineration is considered a “major source” of air pollution (Manisalidis et al., 2020).

Waste incineration became a commonly used method of waste management in Western countries as an outcome of the industrial revolution, when changing societal norms around hygiene and consumption led to more packaging and products, and, ultimately, waste (EPA, 2016). The onslaught of waste caused apprehension about land scarcity from landfills, and people started seeking other options. The first documented incinerator in the United States (then called a destructor) was built in 1885 on Governors Island, New York. By 1950, there were hundreds in operation around the country.

Before the Clean Air Act, there were incinerators all over the country with very little air pollution control technology. When Congress passed the Clean Air Act in 1970, new federal regulations required incinerator managers to install advanced and expensive pollution control technologies. As a result, many incinerators closed (EPA, 2016). Others, however, were able to adapt to these regulations, and by the 1980s municipal solid waste incineration (MSWI)

accounted for 15% of municipal solid waste disposal (MSW) (EPA, 2016). A few government actions have eased regulations over the years. In 1970, the Resource Recovery Act (RRA) expanded the government role in solid waste management and gave more support to WTE practices (Hickman, 2001). This allowed for WTE facilities to establish themselves more in municipalities and the energy grid. In 1980, Subtitle C of RCRA was amended to exempt certain "special wastes" from hazardous waste regulation, including some in the WTE process (EPA, n.d.). This has allowed some of the most toxic products of waste incineration to go under-regulated, easing pressure off of the industry. In 2013, the Environmental Protection Agency (EPA) made a loophole that allows companies to reclassify waste as "materials" and avoid hazardous, industrial, and medical waste regulations (Global Alliance for Incinerator Alternatives [GAIA], 2021). This has further alleviated responsibility for the industry. Because of these changes in regulation, there are still 73 waste incinerators in operation as of 2019, all with well-established corporations behind them (Li, 2019).

Many of these existing incinerators are waste-to-energy (WTE) facilities (see figure 1), which create usable energy during the combustion process. Essentially, the combustion process generates steam, which then powers a turbine to produce electricity.

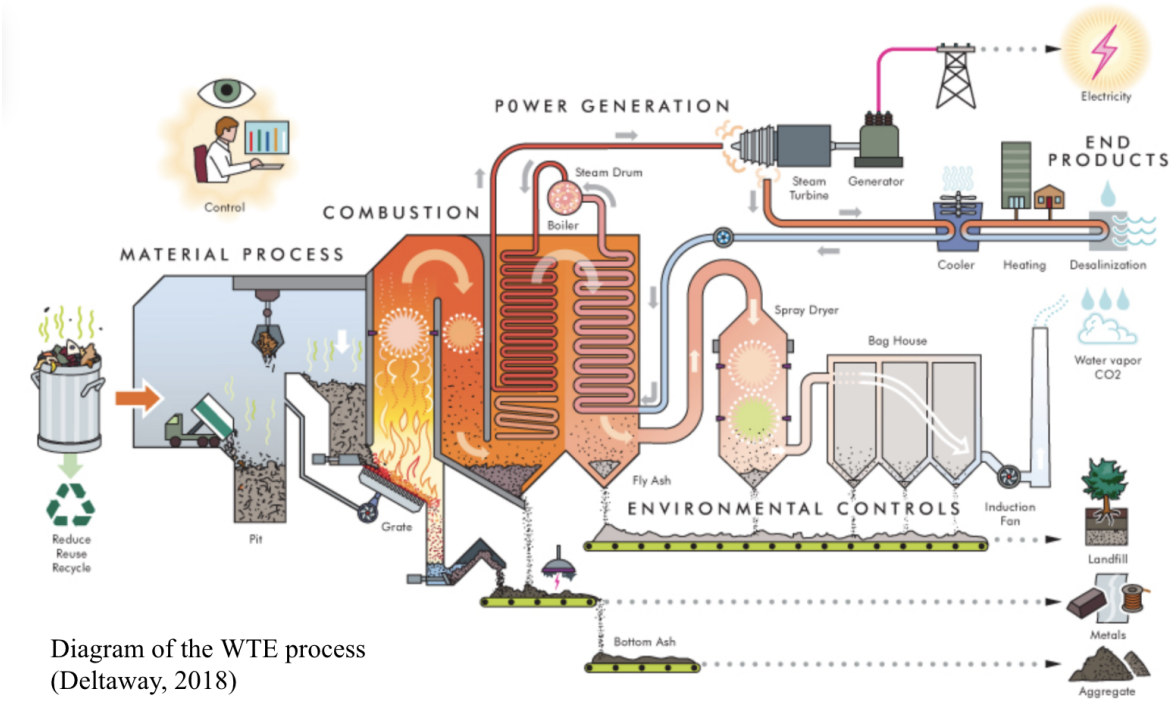

Diagram of the WTE process
(Deltaway, 2018)

Fig. 1: A Diagram of the Waste to Energy Process

While the WTE industry markets this as an essential, sustainable, and renewable energy source, the process does not live up to any of these claims. In reality, waste incineration is not economically efficient, costing twice as much as solar and three times as much as wind to produce energy (GAIA, 2021). Additionally, incinerators require a certain amount of trash to operate. Municipalities are fined by companies if there is not enough waste to operate, thus they divert waste from recycling and composting efforts (GAIA, 2021). The incineration industry pushes for renewable energy designation, which creates competition for actual renewable energy facilities (Donahue, 2018). Currently, the incineration industry, the federal government, and 23 US states classify WTE as a renewable energy source (Donahue, 2018). WTE is considered a "major source of greenhouse gasses," producing 68% more greenhouse gasses than landfills (Manisalidis et al., 2020; GAIA, 2021). But how renewable can something be if it depends on

unimpeded waste and consumption to operate? It cannot, especially if it has a plethora of externalities (costs that are pushed onto others), as is the case with waste incineration.

Context of Research

This research project was born out of my thesis internship with Beyond Toxics, an environmental justice nongovernmental organization based in Eugene, Oregon. Beyond Toxics works on a range of environmental health justice issues including health and social impacts of air, soil, and water pollution, and energy justice. Beyond Toxics, founded in 2000, specializes in legislative work, community education, and organizing. Their main work is categorized under climate justice, regenerative ecosystems, environmental justice, indoor pollution, and pesticide reform. Recently, they have worked on state-wide initiatives like The Energy Infrastructure Resilience Bill and the Emergency Heat Relief Package. They also run a bus tour to spread awareness about pollution in West Eugene. When I began my internship at Beyond Toxics, the director, Lisa Arkin, asked me to support the organization in their efforts to oppose the Covanta Marion waste incinerator facility by helping collect health and social data that could be used to build an environmental justice campaign. Beyond Toxics hired me to help collect data to support the claim that Covanta Marion is an environmental injustice.

The need for environmental justice data led me to start constructing this exploratory case study of Covanta Marion. The Covanta incinerator facility has been controversial since it was proposed in 1984. There is a long history of opposition and work surrounding the incinerator, mostly legislative initiatives. Many have written about the issues with it, ranging from water, air, and soil pollution concerns to greenhouse gas emission concerns (Loew, 2020). While there has been a variety of investigative journalism surrounding the facility, there has yet to be a single document compilation of these resources, which is where this case study comes in.

Intellectual Context of Case Study

Theoretical Context

This case study sits squarely in the field of environmental health. Environmental health is a main subset of public health which merges theories and practices of environmental science and public health to focus on the environmental context of health problems, outcomes, and solutions. As the American Public Health Association (APHA) explains, "environmental health focuses on the relationships between people and their environment, promotes human health and well-being, and fosters healthy and safe communities. Environmental health is a key part of any comprehensive public health system" (2021).

In order to situate the case study in the broader literature, I focused on the topics of environmental justice, the health impacts associated with waste incineration, and community engagement. This section will explain these three areas of study and practice, focusing on areas of the greatest relevance to the Covanta Marion case study.

Environmental Justice

The Environmental Justice movement (EJM) saw its formal start with unjust waste management. While there was work surrounding environmental injustices happening globally prior to this, the EJM gained "mainstream," formal, and legal traction in the United States in 1982 when members of a predominantly Black community in Warren County, North Carolina, organized a massive protest against a proposed toxic waste facility (NRDC, 2016). This protest, while ultimately unsuccessful, attracted national attention, and spurred members of Congress to commission a study of hazardous waste locations and the demographic situation of the areas surrounding them. Close on its tails were the studies: *Siting of Hazardous Waste Landfills and*

Their Correlation with Racial and Economic Status of Surrounding Communities and *Toxic Wastes and Race in the United States*, which both became foundational to the Environmental Justice Movement. *Siting of Hazardous Waste Landfills and Their Correlation with Racial and Economic Status of Surrounding Communities* was written by the Government Accountability Office, as an outcome of the protest in Warren County. *Toxic Wastes and Race in the United States* was commissioned by the United Church of Christ's Commission for Racial Justice. These studies introduced the terms "environmental racism" and "environmental justice" and demonstrated that communities of color were disproportionately exposed to environmental toxins from waste facilities (Chavis & Lee, 1987). From there, the EJM sprang into action, emboldened by concrete and irrefutable data and supplied with action items from the study recommendations (Agyeman, 2016). These recommendations laid the framework for the Principles of Environmental Justice established at the 1991 First People of Color National Leadership Summit, which brought together groups from different racialized and ethnic backgrounds to discuss their EJ agendas (Agyeman, 2016).

Both studies found a connection between exposure to environmental toxins and zoning laws. Beginning with the New Deal in the 1930s, communities of color were marked as "risky" places to lend, meaning there were fewer investments in these places (Tabuchi & Popovich, 2021). At the same time, banks consistently refused mortgages that would enable families of color to purchase homes in white suburbs, thus concentrating communities of color in urban centers (Gross, 2017). Laws also zoned suburbs for single family homes and zoned cities for industrial purposes, which pushed lower income, multi-generational (primarily BIPOC) families into cities (Baptista et al., 2021; Shonkoff et al., 2019). Subsequently, this zoning meant that affordable land was only available to low-income families in industrialized areas. These laws

also meant that there were cheaper land prices for industrial and polluting facilities, doubly intensifying pollution sources in communities of color (Zhong & Popovich, 2022; Stroud, 1999). These communities are known as sacrifice zones and EJ communities.

One of the main pollution sources facing EJ communities are WTE facilities. In fact, 80% of U.S. waste incinerators are located in EJ communities (Baptista et al., 2019). The WTE process produces an enormous number of pollutants, the most concerning of which are heavy metals, dioxins/furans, and particulate matter (often made up of the two former categories). These pollutants take several forms in the incineration process, the most harmful being fly ash (Sun et al., 2016). Fly ash is derived from the fumes of waste incinerators, and consists of concentrated pollutants like heavy metals, dioxins, and other particulates (Ibid., 2016). Older facilities like Covanta Marion have worse emissions due to outdated technology and more lenient regulations from governing bodies (Tait et al., 2020). Although newer facilities have better air pollution control technology, the technology intensifies the accumulation of pollutants in the fly ash (Di Caula, 2020). This means that even if older facilities were properly updated, the pollutants would just be intensified in ash to be disposed at a landfill, and, in places with heavy rains, can result in increased leachate (liquid from ash) that can permeate soil and groundwater resources (GAIA, 2021). Additionally, combusting certain waste types together can create new, more hazardous by-products that did not exist before incineration (Anonymous informant #2, personal communication, April 4, 2022). Just like with waste incinerators, landfills and waste transfer stations are almost always situated in EJ communities. The facilities use inefficient, polluting trucks to transfer waste, exposing community members to even more pollution from multiple sources (GAIA, 2021). Exposure to cumulative impacts from incinerators, trucks, transfer stations is often used as an excuse by the incinerator industry, who blame pollution on

other nearby sources. In reality, this is only a further argument for removing pollution sources, as EJ communities have to deal with the cumulative health impacts, and it is therefore extremely difficult to clearly identify the source of specific problems (Di Caula, 2020).

Health Impacts

The health impacts associated with waste incineration are intensely concerning. Inhalation, ingestion, and dermal (skin) contact are the main exposure pathways. Exposure to heavy metals, like lead, arsenic, cadmium, chromium, and mercury, present a myriad of health problems including DNA damage, cognitive impairment, and carcinogenesis (cancer) (Domingo et al., 2020; Engwa et al., 2019). Dioxins and furans are chemical byproducts of burning plastics and other industrial processes. They are considered persistent organic pollutants (also known as POPS) because they are uniquely resistant to environmental remediation. Inhalation or consumption of the heavy metals or the POPs is known to cause health problems like cancer, immune impairment, endocrine and nervous system disorders, and reproductive harm (Manisalidis et al., 2020; Tait et al., 2020). Particulate matter (PM), often comprised of both dioxins and heavy metals, are tiny particles that we cannot readily see, which can be inhaled very easily. Exposure to PM causes a host of health problems like cardiovascular, reproductive, and central nervous system malfunction (Manisalidis et al., 2020). Due to its minute size, PM is able to travel much further distances, have longer half-lives, and permeate our bodies in ways that larger particulates cannot. This means that even small exposures to PM can have deleterious lifelong health impacts.

The severity of these health effects depend on the timing of exposure during the life course, the most severe impacts affecting infants, children, pregnant people, and older adults (Jones et al., 2019). According to Helena Duch, an assistant professor of Population and Family

Health: “pregnancy through the first three years of life are the most critical time in terms of brain development” (Haelle, 2015). Exposure to toxins so early can cause oxidative stress, which can cause DNA damage (Di Caula et al., 2020). Additionally, because child lungs are proportionally larger to the rest of the body, compared to adults, there are more ways for toxins to enter the bloodstream through inhalation (Lebel, 2022). Exposure to many toxins can cause irreparable harm to reproductive organs, which can result in deadly miscarriages and other reproductive problems for pregnant people (Nesan & Kurrasech, 2020). For older adults, even small levels of air pollution exposure can cause pneumonia and heart attacks, among other respiratory and cardiovascular diseases (Yazdi et al., 2021).

Time of exposure during the life course is by no means the only thing that predicts serious health outcomes. Social determinants of health (SDOH) like education, access to healthcare, neighborhood and built environment, economic stability, and social and community context all play a role. In the case of waste incineration, lack of access to medical care makes diagnosis of health effects harder, thereby further limiting already insufficient epidemiological data (Domingo et al., 2020). Food insecurity is another compounding health factor, as antioxidant rich diets can help mitigate the impact of these pollutants (Domingo et al., 2020).

While the SDOH play a huge role in exposure and severity of impacts, all of these are mediated by race. These impacts are a part of a vicious cycle. As Harriet Washington demonstrates in her s groundbreaking work, *A Terrible Thing to Waste: Environmental Racism and Its Assault on the American Mind,* cognitive impairments caused by environmental toxins reinforce racist, eugenicist, sexist, and ableist stereotypes of Black, Indigenous, and Latinx children as “lazy and disruptive” (2020). As Washington illustrates, these stereotypes sabotage children’s education, thereby impacting their job, housing, food, and healthcare security down

the road. This further perpetuates the disproportionate exposure of communities of color to environmental hazards, like waste incinerators.

Community Engagement

While EJ communities are overburdened with environmental and health hazards like waste incinerators, they are often left out of conversations about these hazards. EJ has been excluded from mainstream environmentalism, which consistently values "pristine," quantitative data over lived experience and community knowledge (Agyeman et al., 2016). Most government funding and engagement is allocated to primarily white nonprofit organizations, who are tasked to address surface-level EJ problems as outsiders (Merilaäinen et al., 2021). These nonprofits are often mistrusted by EJ community members because of a long history of upholding hierarchical practices and abusing power (Morgan-Montoya, 2020). The new Infrastructure Bill spells out ways of improving environmental injustice, but it remains to be seen how the government will implement their ideas effectively (The White House, 2021). While there has been little meaningful work done by governments to address EJ thus far, EJ communities and organizations are working to change that reality through community-based research, movements, and solutions. This is the goal of Beyond Toxics in the case of Covanta Marion. Specifically, Beyond Toxics aims to assess the community sentiment toward the incinerator and identify pathways for action.

Research Methods

To clearly construct this case study, I used the exploratory case study framework outlined in Mark Kanazawa's book *Research Methods for Environmental Studies.* The exploratory framework is meant to answer the question of what is happening with a particular case study. This framework aims to answer the questions: what, where, when, and how of a given case. It is

usually applied to a case study that has not been thoroughly documented, in order to create a general, coherent picture. This kind of study is usually done with the intention to support more structured studies and actions in the future, as is this case study of the Covanta Marion waste incinerator.

I used several research methods to construct a clear exploratory case study of social, environmental and health effects of Covanta Marion. I began with a literature review into environmental justice, waste incineration and its associated health impacts, and community engagement. This literature review helped me understand the theoretical context of waste incineration from an EJ perspective, and identified what I needed to focus attention on r based on what past researchers have recommended. The literature review also included background research into Covanta Marion, including text analysis of the company's publicly accessible promotional materials, public testimony of community members and organizations, gray literature (including reports from Physicians for Social Responsibility, local news stories, and government documents such as permits and waste management plans. The majority of my research was devoted to this literature review and textual analysis.

My second set of methods consisted of communication with professionals who have been actively involved in opposing and trying to dismantle the Covanta Marion incinerator. This communication took the form of attending meetings and workshops. Specifically, I attended meetings with the Clean Air Now Coalition, several meetings with other groups of environmental health advocates, meetings with the DEQ, and Rise Up Environmental Justice leadership workshops for BIPOC in Oregon, led by Beyond Toxics. The meetings with the Clean Air Now Coalition (CAN) and other groups of environmental health advocates gave insight into the current state of opposition against Covanta Marion. The meetings with the DEQ allowed me

to understand the DEQ perspective on Covanta Marion and ask specific questions of them for my research. Finally, the Rise Up Environmental Justice leadership workshops through Beyond Toxics connected me with environmental justice organizers from all over Oregon, and provided training on proper EJ organizing.

I also conducted three key informant interviews with professionals who have worked on issues surrounding the Covanta Marion waste incinerator. I sourced these interview participants through the two previous data collection efforts. The interview participants were each approaching the incinerator from a different lens, and therefore had unique perspectives on the issues surrounding the facility. In order to protect them from retaliation from Covanta Marion, I have kept their identities private, and refer to them as "anonymous".

Over the course of my internship, I was tasked with two main deliverables (excluding this case study). I assisted with moss and soil sampling and conducted an analysis of the Cleaner Air Oregon Community Engagement Toolkit (see appendix E).

In order to collect environmental data on potential pollutants, Beyond Toxics worked with a lab to collect soil and moss samples to test for a variety of heavy metals. The goal of the moss study was to better understand the potential exposure to air pollutants coming from Covanta Marion. We mirrored sampling methods from recent studies in Oregon and Washington that used the same kind of moss and were generously guided by a Forest Service scientist, Dr. Sarah Jovan, who has been conducting this kind of research.

Fig. 2: A photo of the moss sampling; *Fig. 3: A photo of the incinerator from a nearby school*

We took samples of the moss (Orthotrichum Lyellii) off of trees, taking care that it was at least 1 meter above the ground (to account for confounding pollution sources). Moss is a cutting edge bioindicator for recent air pollution, acting like a sponge (Derrien et al., 2020; DEQ, 2018). Moss soaks up toxins from the surrounding air and can provide a snapshot of recent air pollutants, which can be used to determine human health risk in the same area. Soil sampling, on the other hand, is a commonly used scientific practice which can provide a more temporal understanding of possible pollutants. Because of the way soil contaminants collect in layers, the most recent closer to the surface, soil can provide data from a longer period of time. We use sterilized shovels to take surface soil near the trees with the moss growing on it.

As explained previously, young children are at a higher risk level for being harmed by pollution, thus we collected samples from schools near the incinerator. We used wind pattern data from McNary Airport for late winter to identify what areas were most likely to have the most deposition of toxins. While the data showed the wind blows from the south and southwest during late winter, we decided to sample from north to south, as the wind blows from the north the rest of the year. We ultimately took 2 soil samples from 3 different schools: the Siletz Tribal

Head Start, Gervais Elementary, and the Oregon Childhood Development Center (another Head Start for migrant children in the Brooks community).

Finally, I conducted an analysis of the Cleaner Air Oregon Community Engagement Toolkit (see appendix E). I do not elaborate on the results of this analysis, but it provided much needed insight into how the DEQ plans to include communities in conversations surrounding polluting facilities.

Case Study Findings

Background

The Covanta Marion waste incinerator was proposed in 1984, and despite opposition, began operation in 1987. Covanta Marion is a subsidiary of Covanta Energy Corporation, which owns and operates 40 incinerators globally. The company used to be called the Ogden Corporation, until 2001, when it changed its name to Covanta Energy Corporation, in an effort to deflect negative public attention from the company's past missteps and abuses. Covanta (then known as Ogden) had originally been involved in many industries, including entertainment and aviation, until 1999 when company leaders decided to focus corporate resources on Waste-to-Energy (WTE) because of its financial success.

Covanta Marion gets much of the Marion County municipal waste from the Salem-Keizer Recycling and Transfer Station (which is just down the road from a juvenile prison). The waste is then sent to the facility in trucks, where it is incinerated. The ash from the incineration is taken to the Woodburn ash landfill (which is located in another migrant farm working community). The leachate, which is the liquid that comes from the ash when it gets wet, is taken back to the

incinerator to be evaporated. This leachate can have high levels of heavy metals because it usually comes from the fly ash.

Covanta has been the subject of public scrutiny in recent years, beginning with the approval of Cleaner Air Oregon (CAO) in 2018. CAO is a state health risk-based air toxics regulatory program that adds requirements to the DEQ's existing air permitting framework. CAO has a call-in process for existing facilities, which Covanta Marion is in the top priority category for. Currently, Covanta Marion is in the first stage of the call-in process because it has received many extensions. In the 2019 and 2020 legislative sessions, Covanta Marion lobbied for designation as a renewable energy source, which would allow the company to sell its energy for a larger profit. Both initiatives failed due to public opposition. Last year, Marion County ended their contract with Covanta Marion. This means that the county may no longer know what is being burned. It also means that the company will be responsible for ash disposal and property taxes, among other expenses. In December 2021, the DEQ issued a new solid waste permit to allow Covanta Marion to continue operating for 10 years, without making major changes that were requested during public comment (Loew, 2021). This allows Covanta Marion to continue its solid waste practices without making changes that the community has asked for. The DEQ has also given Covanta Marion more time for curbing their mercury emissions. The new wastewater permit gives the facility until May 2024 to provide a plan to reduce the mercury discharge into the Willamette River (Loew, 2022). It remains to be seen what will happen with the new air quality permit, which is up for public comment in the coming months. This past February 2022, Covanta Marion was fined a little over $15,000 for air quality violations including elevated carbon dioxide emissions (Loew, 2021). It is unclear if this violation will have an effect on this permit, or if the DEQ will continue to give Covanta Marion leniency. Regardless of the

forthcoming air quality permit, there is some potential for firmer regulation of Covanta Marion. Governor Brown issued an executive order in 2020 which included the Climate Protection Program (CPP), a plan to cut certain greenhouse gas emissions by 50% by 2035 and 90% by 2050. While this is a huge step for curtailing emissions in Oregon, there are still major gaps in the program, specifically around the energy and industrial sectors (Kiely, 2021). The relevance of CPP to Covanta Marion will depend on how the DEQ implements this program.

Surrounding Community

The Covanta Marion waste incinerator is located in Brooks, Oregon. Brooks is an unincorporated, primarily migrant farm working community, approximately 9 miles northeast of Salem. The community is home to at least five schools (depending on where you draw the boundary line), and is surrounded by farmland. As illustrated in figure 4 taken from EJSCREEN (the main government EJ visualization tool), Brooks and the surrounding area (indicated in the purple) have much higher percentages of people of color, those with low incomes, and young children, compared to the rest of the state (indicated in blue).

Brooks and the surrounding area are also at higher risk for exposure to a range of pollutants like PM, hazardous waste, waste water, and air toxics associated with cancer. Figure 5 illustrates this, with the Brooks area indicated in blue and the rest of the U.S. in purple. Given that ingestion and inhalation are the two main exposure pathways to the pollutants delineated previously, and that the area has a high proportion of young children and farmworkers, it can be extrapolated that their occupations may expose them to higher levels of pollutants. To clarify, there are other databases that show different data, but I chose EJSCREEN for its connection to

environmental justice.

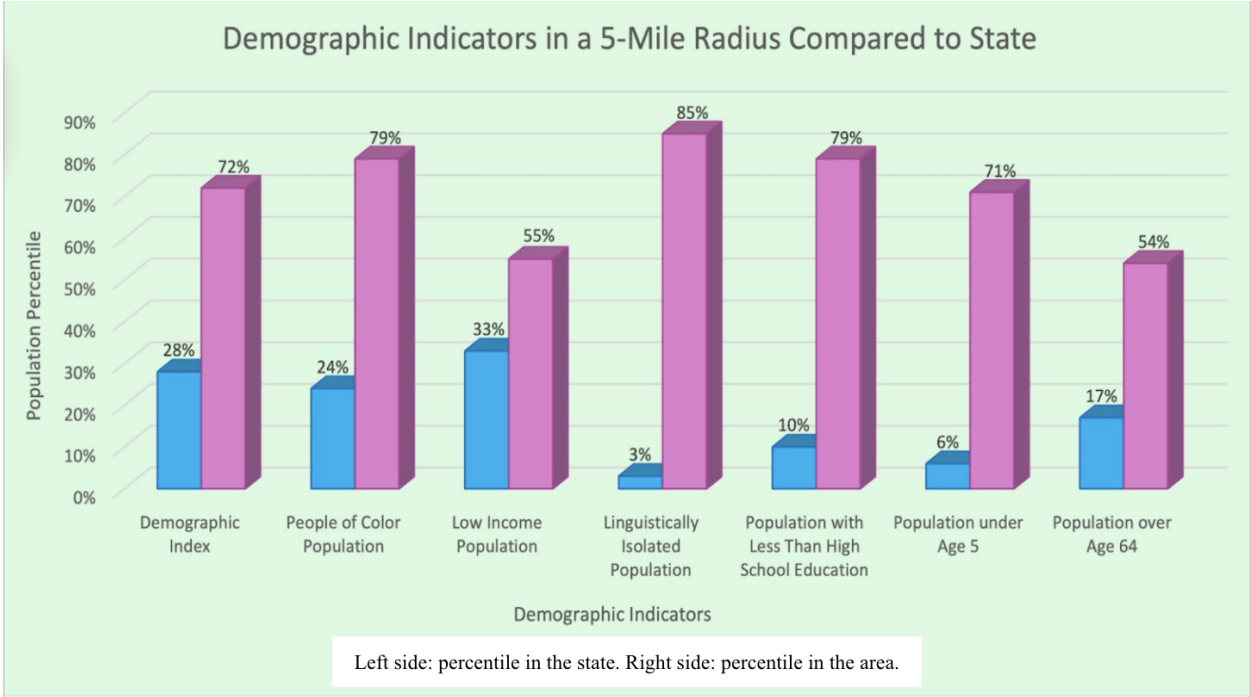

Fig. 4: A bar graph of demographic indicators for the Brooks community

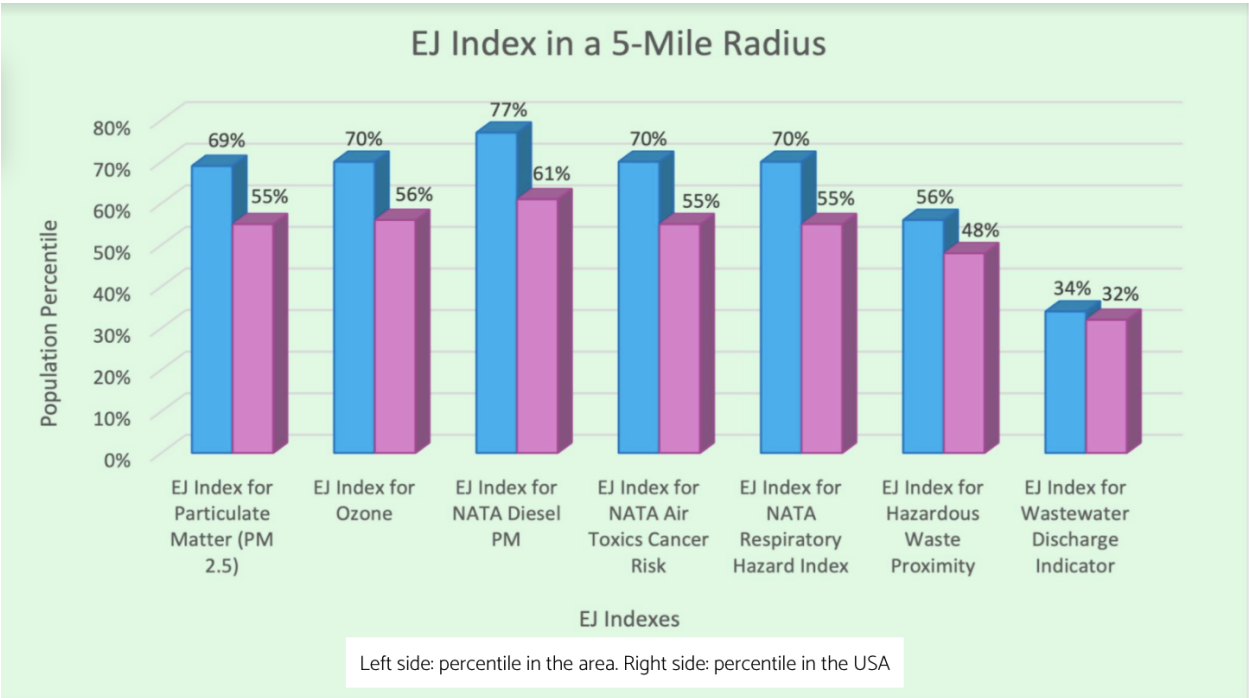

Fig. 5: A bar graph of Environmental Justice indicators for the Brooks community

The fact that Brooks is unincorporated has several serious implications for public health and environmental justice. Authors of a recently published article in the well-regarded academic journal, Social Science and Medicine argue that the unincorporated status is a structural determinant of health, because unincorporated communities are very often left out of public health research (Gomez-Vidal & Gomez, 2021). Moreover, "lack of municipal status limits unincorporated community residents' ability to effect change, as they must operate without the benefit of a local governmental structure that represents them" (Ibid., 2021). This is especially the case when the communities are low-income communities of color, like Brooks. The main reason behind this structural barrier is a lack of representation. Unincorporated communities do not have any official government, are subject to county laws only, and are therefore politically excluded, which inhibits access to resources like healthcare. There are also issues with data representation. As these communities have little legal status, they are lumped in with the rest of the county census data, which often misrepresents the circumstances in the community.

This lack of data is a huge barrier for efforts to resist environmental injustice, because without data there can be no "proof" and without proof there is usually no policy action (Wilson, 2020). The absence of accurate data has limited action against polluters in many EJ communities because the government relies on quantitative data to create legislation (Merilaäinen et al., 2021). However, researchers collecting this data are often outside the communities in question and therefore often miss the full picture (Ibid et al., 2021). These findings indicate that the community surrounding Covanta Marion has multiple characteristics of an environmental justice community, which signifies that action must be taken against the various injustices.

Waste Sources

Covanta Marion burns approximately 175,000 tons of waste every year, about two-thirds from local municipalities (households, small businesses, and supposedly non-hazardous sources). Although Covanta Marion is legally designated as a municipal waste incinerator, it burns 18,000 tons of medical waste and 6,000 tons of "supplemental" waste (Loew, 2020). The medical waste consists of blue bin (plastics from hospitals), and gray bin (human remains), though they are not separated before incineration. The "supplemental" waste is a mixture of industrial, hazardous, waste from law enforcement, and "confidential material" from all over the US and Southwest Canada (Loew, 2021). It is important to understand the sources of the waste burned in an incinerator because the types of emissions and their subsequent health risks depend on the material being combusted.

Key Players

There are several key players to note in the regulation of Covanta Marion: governmental public entities from the state and county and non-governmental organizations. The Department of Environmental Quality (DEQ) is in charge of managing waste and implementing Cleaner Air Oregon. The Marion County Commissioners are another key player, as they have oversight of all county administration, management, and policies concerning Covanta. The County Commissioners are advised by a Solid Waste Management Advisory Council (SWMAC) which is 50% citizens and 50% industry representatives. The Clean Air Now (CAN) coalition, which was started a few years ago, is a coalition in Oregon that supports transitioning from waste incineration to a zero-waste future. The coalition consists of 14 organizations and has historically been led by Beyond Toxics and Physicians for Social Responsibility (a Portland-based

organization). CAN leads opposition against Covanta Marion through legislative activism, public education, and regulatory oversight. These entities and organizations are important to know about because they make the decisions about how waste is disposed of, how Covanta Marion is regulated, who is impacted by pollution-related health risks, and who is responsible for those health risks.

How Is Covanta Marion Still Operating?

Through participation in CAN and other meetings and conducting of interviews with key players and key informants, I have begun to understand several key issues surrounding Covanta and the myriad strategies the corporation uses to remain in operation.

First and foremost, Covanta has been persistent with their greenwashing campaign. Greenwashing is the process of marketing something as environmentally friendly/sustainable when it is not. Much of Covanta's greenwashing is evident in their website marketing, framing their incinerators as sustainable alternatives to landfills and a renewable energy source. However, according to the energy justice network, incinerators are 80% worse for the climate, and emit 60% more harmful pollutants than landfills (Ewall, 2020).

Covanta Marion has also deflected pollution blame in a number of ways. By stating that they bring "waste to energy" and practice "chemical recycling," Covanta misleads the public about the deleterious environmental impact of their waste incineration practices (Rosenburg et al., 2021). Covanta Marion has gone so far as to connect their operations with immigration issues, claiming that the incinerator is necessary because of resource scarcity brought on by a larger population (Anonymous informant #3. Personal communication, April 11, 2022). This is an example of using public xenophobic fears to fuel a corporate agenda, but it is an effective one. Covanta has dealt with pollution-related health concerns by deflecting culpability onto I-5 which

runs alongside Brooks. While I-5 is undoubtedly polluting, that does not mean Covanta is not also causing harm. Because pollution from multiple sources is worse for human health, the presence of two environmental health hazards in one community may be even more evidence of environmental injustice.

Insufficient, delayed, and manipulated testing has been another way Covanta Marion has stayed in operation. While the facility is legally obligated to report accurate data to the state, the definition of "accurate" is loosely conceived. Covanta is only stack tested once a year for emissions and is allowed to hire its own contractor to do the testing. They are also permitted to stockpile "cleaner" waste to burn on their testing date. This means that the test does not give a clear picture of typical emissions, only the emissions of the least-toxic waste. As such, the emissions data are extremely biased, as is the way they are communicated to the public. Scientists suggest that only isokinetic sampling can accurately measure the pollution, and all other techniques only show a diluted picture (Anonymous informant #1. Personal communication, March 29, 2022). Moreover, the facility continuously fails to meet the testing deadlines set by the DEQ, and according to a news reporter that has investigated Covanta for several years, has even submitted data from alternative sources to avoid reporting its own emissions data (Loew, 2021). In fact, since the beginning of the call-in period for Cleaner Air Oregon in August 2020, Covanta has requested three extensions on a single source testing. Although other industrial facilities must now meet stricter regulations under Cleaner Air Oregon, Covanta Marion has been grandfathered in and are subject to less stringent standards and a longer timeline to meet them.

There are several regulatory issues concerning Covanta Marion, in addition to repeated extensions on emission testing. First, fly ash is considered a "special waste" under the Resource

Conservation and Recovery Act (RCRA), meaning it is exempt from standard hazardous waste regulations (EPA, n.d.). Oregon was until recently one of the worst regulated states for air pollution, ranking 5th in the nation for worst air quality, resulting from extremely limited toxic air regulation based on technology rather than health impacts (Rosenfeld, 2019; Whitman & Allen, 2017). Until Cleaner Air Oregon is properly implemented, this insufficient regulation will continue. One Covanta Marion-specific example of faulty regulation is how it regulates certain heavy metals like mercury. According to an anonymous source who has worked on Covanta Marion opposition for decades, the current regulation states that Covanta Marion has to emit less than 10 lbs of mercury *or* a certain percentage of mercury from the overall waste. This means that if the incinerator releases more than 10 lbs of mercury, but it is below a certain percentage of total emissions, the company is still in compliance with the regulation. This rule leaves a glaring hole in the regulation of pollutants, incentivizing more waste to be burned to eclipse heavy metal concentrations.

As with most polluting facilities, money plays a large role in Covanta Marion's continued survival. According to key informants and colleagues at Beyond Toxics, Covanta has an extremely active lobbying presence. One source said that "anytime the DEQ cracks down on Covanta, the industry lobbies against it and manages to evade regulations" (Anonymous informant #1. Personal communication, March 29, 2022). For example, in 1986, just before the incinerator began operation, the industry successfully lobbied for a bill that requires counties throughout the state to send their waste to the Covanta Marion incinerator, which is still in effect.

The incineration of medical waste plays an important role financially as well, because while regular waste is burned at $87 a ton, imported medical waste costs $550 a ton, which had (until recently) been split evenly between Covanta and Marion County (Loew, 21). Key

informants, who are active in Covanta opposition, assert that the money from medical waste incineration has padded county budgets, including paying for the new sheriff's office in Marion County (Anonymous informant #1. Personal Communication, March 29, 2022). When trying to gain designation as a renewable energy in Oregon, Covanta shelled out $29,000 to (mostly democratic) legislators to sponsor this initiative (Loew, 2020). This is emblematic of the corrupt forces of money in politics, and begs the question: Where else is Covanta Marion allocating money?

What Are Potential Avenues for Stopping Operations?

While the combination of insufficient regulation and testing coupled with disposable corporate funds paint a grim picture for Covanta opposition, there are a few potential pathways that could contribute to closing down Covanta Marion operations. In March 2020, Governor Brown issued an executive order directing state departments to lower greenhouse gas emissions, called the Climate Protection Program. While this order has seen little enforcement due to COVID-19 staffing shortages, Covanta Marion is not in compliance with its current emissions. Enforcement of this program could result in too much regulatory activity for Covanta Marion to keep up with.

Another potential avenue to end operations is to designate Covanta Marion as a medical waste incinerator. To date, despite burning 18,000 tons of medical waste a year, Covanta has avoided this designation. Medical waste incinerators have to operate at much higher standards, because of their increased release of dioxins and other harmful pollutants. According to an anonymous source, the incinerator would have failed to meet medical waste incineration regulations throughout the past decade (Anonymous informant #1. Personal communication, March 29, 2022).

Instituting zero waste programs is a promising solution to many environmental health issues, including waste incineration. There are several zero-waste initiatives in Marion County, but most of them have been slowed by COVID and county officials. A ‘pay as you throw’ campaign was pitched to the Salem city council, but was set aside due to COVID-19. This campaign is coming back through city staff, and will hopefully garner more support in the coming months. Zero-waste programs are essential to public health and sustainability, and have shown extraordinary outcomes in community building and sustainable job creation when applied to other localities (GAIA, 2021). In Suffolk County on Long Island, New York, a community has used diverted waste to create community gardens, has saved considerable money on waste fees, and has generated jobs to sustain the program (Ibid., 2021). If there was far less waste, the resources needed to run the incinerator could outweigh any financial benefits for both the company and county to continue operations.

Increased data collection, dissemination and community education are essential to Covanta Marion opposition. One key informant stated with conviction that most of the residents surrounding Covanta Marion do not know what the facility is and only know the bad smells and feelings associated with it (Anonymous informant #2. Personal Communication, April 11, 2021). This illustrates that the Brooks community needs more education about Covanta Marion. More knowledge about the associated risks could garner more public opposition, and put pressure on the DEQ to find alternate practices.

Limitations of Research Project

There were several limitations to this research. First and foremost, is my positionality as an outsider. I am not a part of the community that I am studying, and therefore am absolutely

missing important pieces of information. My own biases, as a privileged college student who has not experienced overt environmental injustice, likely show through in this report. I would welcome any feedback readers may have about this. In the same vein, I was unable to collect any direct community data. Due to some of my own medical constraints, I had to change my research methods drastically. I was still able to conduct three interviews, all of which were with people connected to larger organizations. I was unable to canvas the community as I had hoped to do and collect survey responses as I had originally intended. I am confident that the surveys and flyers I created (in Appendices B, C, and D) can be put to use in the future.

As far as scientific accuracy, there were several limitations as well. Most of the peer-reviewed literature was similarly from outsider researchers with their own biases that reflect in their knowledge making. Many of the articles that focused on health impacts surrounding certain incinerators discussed the difficulty of assigning culpability to the incinerator, because it is difficult to track where pollution is coming from if there are multiple sources. They also discuss the difference between health *risks* and health *impacts*. Much of the available literature focuses on health risks, and calls for more epidemiological data to ascertain actual impacts. There are also many discrepancies between the regulatory standards for incinerators around the world. Many of the studies I looked at were based in Europe, where there are more incinerators and more regulations that use the precautionary principle. The United States is fairly limited on incineration research and also has lower regulation standards, meaning that many of the findings discussed in the literature review findings may be more problematic in the U.S. Additionally, the literature described a long latency bias in measuring health impacts. Many of the most troubling pollutants take a long time to impact the body, and few long-term cohort studies have been conducted to try to capture this. Finally, the moss and soil samples were extremely limited,

providing minimal correlations or explanatory information (see appendix B).

Conclusion & Recommendations

With the limitations in mind, I have a few recommendations based on what I have learned over the course of this research study.

1. First, a larger scale moss and soil sampling would be helpful to better understand which areas are near the incinerator are most saturated with pollutants. While our moss testing showed the heavy metal concentrations were overall higher closer to the incinerator, this is only a tiny snapshot of the full picture. A much higher number of samples at multiple times during the year would provide more accurate data and would identify the best next steps.
2. Other methods of pollution measurements would also be useful. Some European researchers have started to use eggshells to measure dioxins as they can bioaccumulate in the shell. The researchers have been able to get the dioxin chemical signatures from the polluting facilities and match them to the dioxins found in the eggs, which is useful for establishing a stronger relationship (Arkenbout & Esbensen, 2017).
3. There is a need for epidemiological data collection. As described in the literature, only longitudinal epidemiological data analysis can properly help explain the health *impacts* of incinerators. Oregon's researchers have started using technological bracelets to measure pollution exposure for children. This would be useful to better understand human exposure and should be conducted alongside health screening. Along this line, a long-term cohort study of those living near the incinerator could provide better insight, though this can only be done with all ethical considerations adequately addressed. Of

course, researchers, no matter how well-intentioned, should not study the human impact of toxic exposures without concomitant efforts to prevent further exposure. t.

4. More support for community-based zero-waste initiatives could have amazing implications for the surrounding communities. Several municipalities around the world have created composting and repurposing programs in their communities, which have diverted waste from incineration, These efforts have also provided new jobs for residents including composting educators, community organizers, compost sorters, and gardeners.
5. A thorough timeline of Covanta Marion history would be helpful for future activists. I was unable to construct a thorough timeline of Covanta Marion history as I had originally intended, and I struggled a lot with following conversations about the incinerator because I did not have the historical knowledge of the facility. Creation of an ArcGIS storymap or something similar could be very beneficial for providing needed context to old and new activists and community-based organizations. I see this as a potential project for future students who are interested in public health and environmental justice.
6. Increased education in the community about the potential health impacts of the incinerator and the legal pathways to opposing it. Currently, the public involvement process for rulemaking is exceedingly inaccessible. To date, the DEQ has not engaged with the community in a meaningful way. There needs to be a pathway for open communication and removal of barriers like language differences, lack of internet access, no reliable transportation, and assumption of availability and childcare.
7. Understanding community priorities, knowledge, and capacity around the incinerator are crucial for a just opposition. Meaningful environmental justice work cannot succeed without relationship and trust building. One route to formal community engagement is

the new Cleaner Air Oregon community engagement toolkit, which is intended to guide DEQ officials in engaging with communities that may be impacted by nearby polluting facilities. As a part of my internship, I am working on analyzing this toolkit and providing feedback for how it can be improved. While the toolkit mostly relies on risk assessment data collected from the facilities, it also identifies public pressure as a reason to engage with the community, and could be useful for future action, if properly implemented.

Air pollution is of increasing concern, affecting millions of people worldwide. A "major source" of this air pollution is the waste incineration industry (Manisalidis et al., 2020). Emissions from waste incineration practices include heavy metals, dioxides and furans, and particulate matter, all of which have detrimental impacts on human health. Waste incineration is also a huge source of greenhouse gas emissions and contribute to the global climate crisis (GAIA, 2021). The harmful effects of waste incineration are unequally distributed. Communities of color and low income communities (which are often the same), are disproportionately exposed to pollution from waste incinerators. This inequitable distribution of risk only exacerbates the poor conditions that many are forced to live, breathe, work, and play in.

At the outset of this project, I sought to understand the historical and legislative contexts of Covanta Marion, and to collect data about community attitudes toward the incinerator. This case study of the Covanta Marion Waste-to-Energy incinerator can be used as a springboard for future work surrounding the facility, and can provide a background understanding of the facility for those new to the issue. Still, much more work and research are needed. Whether initiated by the DEQ, Clean Air Now Coalition, or independent organizations, relationship building, community education, and community data collection are imperative in any future work

surrounding Covanta Marion. Only reliable, thorough, community-based data and action can create equitable laws and policies.

References

Agyeman, J., Schlosberg, D., Craven, L., & Matthews, C. (2016). Trends and Directions in Environmental Justice: From Inequity to Everyday Life, Community, and Just Sustainabilities | Annual Review of Environment and Resources. *Annual Review of Environment and Resources*, *41*, 321–340.

APHA. (2021). *Environmental Health*. https://www.apha.org/topics-and-issues/environmental-health

Arkenbout, A., & Esbensen, K. (2017). Sampling, monitoring and source tracking of dioxins in the environment of an incinerator in the Netherlands. *Eighth World Conference On Sampling And Blending*.

Baptista, A. I., & Perovich, A. (2019). *U.S. Municipal Solid Waste Incinerators: An Industry in Decline*. The New School. https://www.no-burn.org/wp-content/uploads/2021/03/CR_GaiaReportFinal_05.21-1.pdf

Bullard, R. D. (2001). Environmental Justice in the 21st Century: Race Still Matters. *Phylon (1960-)*, *49*(3/4), 151. https://doi.org/10.2307/3132626

Canfield, R. L., Henderson, C. R., Cory-Slechta, D. A., Cox, C., Jusko, T. A., & Lanphear, B. P. (2003). Intellectual Impairment in Children with Blood Lead Concentrations below 10 μg per Deciliter. *New England Journal of Medicine*, *348*(16), 1517–1526. https://doi.org/10.1056/NEJMoa022848

Castillo, F., Mora, A. M., Kayser, G. L., Vanos, J., Hyland, C., Yang, A. R., & Eskenazi, B. (2021). Environmental Health Threats to Latino Migrant Farmworkers. *Annual Review of Public Health*, *42*(1), 257–276. https://doi.org/10.1146/annurev-publhealth-012420-105014

Cole-Hunter, T., Cowie, C., Johnstone, F., Marks, G., Morawska, L., Morgan, G., Overs, M., & Porta-Cubas, A. (2019). *Waste-to-energy processes: What is the impact on air pollutants and health?* Centre for Air Pollution, Energy and Health Research (CAR). https://eprints.qut.edu.au/127966/

Covanta. (2019). *Waste-to-Energy—Covanta*. Retrieved April 12, 2022, from https://www.covanta.com/what-we-do/waste-to-energy

Daniel Rosenburg, Veena Singla, & Darby Hoover. (2021). *Burned: Why Waste Incineration Is Harmful*. NRDC. https://www.nrdc.org/experts/daniel-rosenberg/burned-why-waste-incineration-harmful

Darryl Fears. (2022, March 9). *Redlining means 45 million Americans are breathing dirtier air, 50 years after it ended*. Washington Post.

https://www.washingtonpost.com/climate-environment/2022/03/09/redlining-pollution-environmental-justice/

Deltaway. (2018). Waste-to-Energy: How It Works. *Deltaway*. https://deltawayenergy.com/2018/08/waste-to-energy-how-it-works/

Derrien, M. M., Zuidema, C., Jovan, S., Bidwell, A., Brinkley, W., López, P., Barnhill, R., & Blahna, D. J. (2020). Toward Environmental Justice in Civic Science: Youth Performance and Experience Measuring Air Pollution Using Moss as a Bio-Indicator in Industrial-Adjacent Neighborhoods. *International Journal of Environmental Research and Public Health*, *17*(19), 7278. https://doi.org/10.3390/ijerph17197278

Di Ciaula, A., Gentilini, P., Diella, G., Lopuzzo, M., & Ridolfi, R. (2020). Biomonitoring of Metals in Children Living in an Urban Area and Close to Waste Incinerators. *International Journal of Environmental Research and Public Health*, *17*(6), 1919. https://doi.org/10.3390/ijerph17061919

Dix, M. (2017). *Oxidative Stress: Definition, Effects on the Body, and Prevention*. Healthline. https://www.healthline.com/health/oxidative-stress

Domingo, J. L., Marquès, M., Mari, M., & Schuhmacher, M. (2020). Adverse health effects for populations living near waste incinerators with special attention to hazardous waste incinerators. A review of the scientific literature. *Environmental Research*, *187*, 109631. https://doi.org/10.1016/j.envres.2020.109631

Donahue |, M. (2018). *Report: Waste Incineration: A Dirty Secret in How States Define Renewable Energy*. Institute for Local Self-Reliance. https://ilsr.org/waste-incineration-renewable-energy/

Engwa, G. A., Ferdinand, P. U., Nwalo, F. N., & Unachukwu, M. N. (2019). Mechanism and Health Effects of Heavy Metal Toxicity in Humans. In *Poisoning in the Modern World—New Tricks for an Old Dog?* IntechOpen. https://doi.org/10.5772/intechopen.82511

EPA. (2016). *Basic Information about Energy Recovery from Waste | Municipal Solid Waste | US EPA*. https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/basic.html

Ewall, M. (2020). *Landfills are bad, but incinerators (with ash landfilling) are worse*. Energy Justice Network. http://www.energyjustice.net/files/incineration/incineration_vs_landfills.pdf

Ghassabian, A., Vandenberg, L., Kannan, K., & Trasande, L. (2021). Endocrine-Disrupting Chemicals and Child Health. *Annual Review of Public Health*, *62*, 26.

Gomez-Vidal, C., & Gomez, A. M. (2021). Invisible and unequal: Unincorporated community status as a structural determinant of health. *Social Science & Medicine*, *285*, 114292.

https://doi.org/10.1016/j.socscimed.2021.114292

Gross, T. (2017). A "Forgotten History" Of How The U.S. Government Segregated America. *NPR*. https://www.npr.org/2017/05/03/526655831/a-forgotten-history-of-how-the-u-s-government-segregated-america

Haelle, T. (2015). *Toxic Exposure | Columbia Public Health*. Columbia Mailman School of Public Health. https://www.publichealth.columbia.edu/public-health-now/news/toxic-exposure

Hiatt, R. A., & Brody, J. G. (2018). Environmental Determinants of Breast Cancer. *Annual Review of Public Health*, *39*(1), 113–133. https://doi.org/10.1146/annurev-publhealth-040617-014101

Karim, M. A. (2019). The current status of MSW disposal and energy production: A brief review of waste incineration. *MOJ Ecology & Environmental Sciences*, *4*. https://doi.org/10.15406/mojes.2019.04.00129

Lebel, E. D., Finnegan, C. J., Ouyang, Z., & Jackson, R. B. (2022). Methane and NO_x Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes. *Environmental Science & Technology*, *56*(4), 2529–2539. https://doi.org/10.1021/acs.est.1c04707

Loew, T. (2021-a). *Covanta Marion garbage incinerator ends partnership with county*. Statesman Journal. Retrieved January 26, 2022, from https://www.statesmanjournal.com/story/news/2021/06/28/covanta-marion-incinerator-ends-partnership-marion-county-incinerator-burn-trash/7783846002/

Loew, T. (2021-b). *Covanta Marion gets state approval to operate for 10 more years*. Statesman Journal. Retrieved January 26, 2022, from https://www.statesmanjournal.com/story/news/2021/11/26/covanta-marion-gets-state-approval-operate-10-more-years/8766873002/

Loew, T. (2021-c). *Public raises concerns about Covanta incinerator's impact on the environment*. Statesman Journal. Retrieved January 26, 2022, from https://www.statesmanjournal.com/story/news/2021/10/10/brooks-salem-oregon-environment-greenhouse-gas-concerns-may-slow-covanta-incinerator-permit-deq/6005613001/

Loew, T. (2021-d). *State: Covanta needs a plan to discharge less mercury into Willamette River*. Statesman Journal. Retrieved January 26, 2022, from https://www.statesmanjournal.com/story/news/2021/12/22/brooks-oregon-marion-county-permit-proposal-covanta-mercury-discharge-willamette-river/8985933002/

Loew, T. (2020-e). *Bill to give Covanta incinerator renewable energy credits put on hold*. Statesman Journal. https://www.statesmanjournal.com/story/news/2020/02/13/bill-give-covanta-incinerator-

enewable-energy-credits-put-hold/4741635002/

Loew, T. (2021-f). *Oregon adopts controversial plan to reduce greenhouse gas emissions*.https://www.statesmanjournal.com/story/news/politics/2021/12/16/oregon-adopts-controversial-climate-change-plan-reduce-greenhouse-gas-emissions/8919291002/

Loew, T. (2021-g). *Paint, oil, plastic. What is Covanta burning in Brooks, Oregon?* Statesman Journal. https://www.statesmanjournal.com/story/news/2021/06/27/marion-county-covanta-industrial-municipal-medical-waste-incenerator/5296771001/

Loew, T. (2021-h). *Covanta Marion garbage incinerator ends partnership with county*. Statesman Journal. https://www.statesmanjournal.com/story/news/2021/06/28/covanta-marion-incinerator-eds-partnership-marion-county-incinerator-burn-trash/7783846002/

Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E. (2020). Environmental and Health Impacts of Air Pollution: A Review. *Frontiers in Public Health*, *8*. https://www.frontiersin.org/article/10.3389/fpubh.2020.00014

Merilaäinen, E., Kelman, I., Peters L.E.R, & Shannon, G. (2021). Puppeteering as a metaphor for unpacking power in participatory action research on climate change and health. *Climate and Development,* (ahead-of-print), 1-12. https://doi.org/10.1080/17565529.2021.1930509

Morgan-Montoya, S. (2020). Nonprofit Industrial Complex 101: A primer on how it upholds inequity and flattens resistance. *CCF*. https://communitycentricfundraising.org/2020/08/10/nonprofit-industrial-complex-101-a primer-on-how-it-upholds-inequity-and-flattens-resistance/

Muller, C., Sampson, R. J., & Winter, A. S. (2018). Environmental Inequality: The Social Causes and Consequences of Lead Exposure. *Annual Review of Sociology*, *44*(1), 263–282. https://doi.org/10.1146/annurev-soc-073117-041222

Nesan, D., & Kurrasch, D. M. (2020). Gestational Exposure to Common Endocrine Disrupting Chemicals and Their Impact on Neurodevelopment and Behavior. *Annual Review of Physiology*, *82*(1), 177–202. https://doi.org/10.1146/annurev-physiol-021119-034555

ODEQ. (2018). *Evaluation of Moss Sampling as a Methodology for Evaluating Air Toxics, Using Portland as a Study Area*. Oregon Department of Environmental Quality.
Oregon Department of Environmental Quality. (n.d.). *Evaluation of Moss Sampling as a*

Kiely, P. (2021). *Oregon's New Climate Protection Program Helps Move Governor Brown's Climate Pledge to Policy, But Gaps Remain*. Environmental Defense Fund. https://www.edf.org/media/oregons-new-climate-protection-program-helps-move-governor-browns-climate-pledge-policy-gaps

Paul, K. C., Haan, M., Mayeda, E. R., & Ritz, B. R. (2019). Ambient Air Pollution, Noise, and Late-Life Cognitive Decline and Dementia Risk. *Annual Review of Public Health*, *40*(1), 203–220. https://doi.org/10.1146/annurev-publhealth-040218-044058

Rosenfeld, J. (2019). *The Top Seven U.S. States with the Worst Air Quality | Molekule Blog*. https://molekule.science/the-top-seven-u-s-states-with-the-worst-air-quality/

Sacoby Wilson. (2019). *Community Science for Environmental Justice with Sacoby Wilson*. http://www.publichealthunited.org/podcasts-2/

Shonkoff, J. P., Slopen, N., & Williams, D. R. (2021). Early Childhood Adversity, Toxic Stress, and the Impacts of Racism on the Foundations of Health. *Annual Review of Public Health*, *42*(1), 115–134. https://doi.org/10.1146/annurev-publhealth-090419-101940

Sun, X., Li, J., Zhao, X., Zhu, B., & Zhang, G. (2016). A Review on the Management of Municipal Solid Waste Fly Ash in American. *Procedia Environmental Sciences*, *31*, 535–540. https://doi.org/10.1016/j.proenv.2016.02.079

Tabuchi, H., & Popovich, N. (2021). People of Color Breathe More Hazardous Air. The Sources Are Everywhere. *The New York Times*. https://www.nytimes.com/2021/04/28/climate/air-pollution-minorities.html

Tait, P. W., Brew, J., Che, A., Costanzo, A., Danyluk, A., Davis, M., Khalaf, A., McMahon, K., Watson, A., Rowcliff, K., & Bowles, D. (2020). The health impacts of waste incineration: A systematic review. *Australian and New Zealand Journal of Public Health*, *44*(1), 40–48. https://doi.org/10.1111/1753-6405.12939

Tangri, N. (2021). *Waste Incinerators Undermine Clean Energy Goals* [Preprint]. Climate. https://doi.org/10.31223/X5VK5X

TCU. (2019). *The History of Burning Trash for Energy*. Trash Cans Unlimited. https://trashcansunlimited.com/blog/the-history-of-burning-trash-for-energy/

Tessum, C. W., Paolella, D. A., Chambliss, S. E., Apte, J. S., Hill, J. D., & Marshall, J. D. (2021). PM2.5 polluters disproportionately and systemically affect people of color in the United States. *Science Advances*. https://doi.org/10.1126/sciadv.abf4491

US EPA, O. (2016). *Special Wastes* [Overviews and Factsheets]. https://www.epa.gov/hw/special-wastes

van den Bosch, M., & Meyer-Lindenberg, A. (2019). Environmental Exposures and Depression: Biological Mechanisms and Epidemiological Evidence. *Annual Review of Public Health*, *40*(1), 239–259. https://doi.org/10.1146/annurev-publhealth-040218-044106

Washington, H. (2019). *A Terrible Thing to Waste: Environmental Racism and It's Assault On The American Mind*. Little, Brown Spark. https://www.hachettebookgroup.com/titles/harriet-a-washington/a-terrible-thing-to-wast 9780316509428/

Whitman, R. & Allen, P. *Methodology for Evaluating Air Toxics, Using Portland as a StudyArea*. Oregonian, G. C. | T. (2017). *New rules will help Oregon curb air toxics and protect health: Guest opinion*. Oregonlive. https://www.oregonlive.com/opinion/2017/11/new_rules_will_help_oregon_cur.html

Yazdi, M. D., Wang, Y., Di, Q., Wei, Y., Requía, W., Shi, L., Sabath, M., Dominici, F., Coull, B., Evans, J., Koutrakis, P., & Schawrtz, J. (2021). *Air pollution can harm hearts, lungs in elderly | News | Harvard T.H. Chan School of Public Health*. Retrieved May 3, 2022, https://www.hsph.harvard.edu/news/hsph-in-the-news/even-low-levels-of-air-pollution-ca n-harm-hearts-lungs-in-elderly/

Zhong, R., & Popovich, N. (2022). How Air Pollution Across America Reflects Racist Policy From the 1930s. *The New York Times*. https://www.nytimes.com/2022/03/09/climate/redlining-racism-air-pollution.html

Appendix:

A: Key Informant Interview Guide

B: Covanta Marion Community Sentiment Recruitment Flyer

C: Covanta Marion Community Sentiment Survey in English

D: Covanta Marion Community Sentiment Survey in Spanish

E: Cleaner Air Oregon Community Engagement Toolkit Analysis

F: Lab Report from The Moss and Soil Sampling

Metal	RSL Air	M1	M2	M3	All units = mg/kg = ppm
Arsenic	0.000016	ND	ND	ND	
Barium	0.00052	24.3	57	27.2	
Cadmium	0.00001	0.102	0.216	ND	
Chromium	0.0001	1.34	2.96	1.38	
Lead	0.00015	1.69	4.67	2.04	
Selenium	0.021	ND	ND	ND	
Silver	NA	ND	ND	ND	
Mercury	0.00031	0.0867	0.184	0.0595	
Metal	RSL or HHSL Soil	S1	S2	S3	mg/kg
Arsenic	0.07	2.11	2.92	2.31	
Barium	15,000	59.9	93.1	89.3	
Cadmium	1.7	ND	ND	0.198	
Chromium	120,000	8.86	13.1	11.2	
Lead	80	19.6	6.81	86.3	
Selenium	390	ND	ND	ND	
Silver	390	ND	ND	ND	
Mercury	23	0.035	0.0316	0.156	
	RSL= Regional Screening Level				
	HHSL= Human Health Screening Level				
*If the U.S. EPA Regional Screening Level for a metal results in a risk for cancer that is 4x greater than the Human Health Screening Level (HHSL), the HHSL value is used instead. This level is then calle the "Cal modified". Cal Modified is used for Arsenic and Lead, as well as recommended for Cadmium.					
Unique Findings					
Above RSL					