The Air Quality Health Benefits of Climate Action in Connecticut

A Yale Center on Climate Change and Health Issue Brief

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Introduction

Burning fossil fuels—coal, oil, and natural gas—produces both climate-warming greenhouse gas emissions and local air pollutants. These air pollutants—in particular, ground-level ozone and fine particulate matter—cause illness and premature death every year in Connecticut, including asthma attacks, heart attacks, and other cardiovascular conditions.

Connecticut has the opportunity to take actions that simultaneously reduce our contribution to climate change and improve local air quality. By reducing the vehicle, electricity, heating, appliance, and industrial emissions that produce both types of pollution, we can improve health today and in the future. This is particularly important given that Connecticut has some of the worst smog (i.e., ground-level ozone) pollution in the eastern United States, and that rising temperatures—driven by climate change—will worsen this problem. Further, some communities—predominantly communities of color and low-income communities—are inequitably exposed to higher levels of air pollution, due to highways, power plants, and other sources that are sited close by.

The Governor's Council on Climate Change (GC3) *Phase 1 Report*,[1] the Connecticut General Assembly, and other public bodies have proposed a number of policies that will help to achieve the combined goals of climate action and improved local air quality. The Yale Center on Climate Change and Health highlights and expands these proposals with the following recommendations:

- **Increase adoption of zero-emission medium- and heavy-duty vehicles**
- **Reduce Vehicle Miles Traveled (VMT) 5% below 2019 baseline by 2030**
- **Accelerate replacement of oil, kerosene, and natural gas space and water heating with efficient electric or renewable energy alternatives**
- **Support healthy, affordable, energy efficient, and climate resilient housing by addressing the barriers to weatherization**
- **End reliance on petroleum to fuel power plants during winter peak demand**
- **Enact into statute a commitment to 100% zero carbon electric supply and generation by 2035**
- **Stop subsidizing municipal solid waste incineration plants through the Connecticut Renewable Portfolio Standard**

Pollution trends

OZONE ("SMOG")

Ground-level ozone is a pollutant that forms in the lower atmosphere when nitrogen oxides (NO_X) and volatile organic compounds (VOCs) react in the presence of heat and sunlight. Connecticut residents are exposed to some of the worst ozone-related air quality in the eastern United States. In fact, according to the American Lung Association's *State of the Air* 2020, Fairfield County experiences the highest ozone levels east of the Mississippi River, and the Hartford area is on the report's top 25 most polluted list.[2] While improvements have been made in past years, Connecticut still consistently fails to meet the National Ambient Air Quality Standards for ozone.

In *Climate Change and Health in Connecticut: 2020 Report*,[3] we evaluated Connecticut's progress on addressing ozone pollution. We found that since 1990, the annual number of days on which ground-level ozone exceeded safe levels decreased in all counties. However, air quality alert days still occurred frequently throughout the state: each year between 2015 and 2019, all counties had days recorded with ozone at levels unhealthy for sensitive groups (71–85 ppb), with Fairfield and New Haven counties having more than ten exceedances and at least one day reaching "unhealthy" levels (86–105 ppb) each year; during 2015–2019, all counties except Tolland County had at least one day reaching "unhealthy" levels.

$PM_{2.5}$ (PARTICLE POLLUTION)

Fine particulate matter, or $PM_{2.5}$, is an air pollutant made up of solid or liquid particles no more than 2.5 micrometers in diameter, or approximately 30 times smaller than the diameter of a strand of hair. $PM_{2.5}$ is especially dangerous to human health because its small size enables it to enter deep into the lungs and into the bloodstream.

It can either be emitted directly or formed in the atmosphere; burning fossil fuels releases precursor pollutants—including sulfur dioxide, NO_X, VOCs, and ammonia—which react in the atmosphere to form $PM_{2.5}$.

In *Climate Change and Health in Connecticut: 2020 Report*,[3] we tracked $PM_{2.5}$ levels in the five counties where data is collected: Fairfield, Hartford, Litchfield, New Haven, and New London counties. We found an overall declining trend in the annual number of days on which fine particulate matter exceeded safe levels. In addition, we found that, during at least the past eight years (2012–2019), no unhealthy, very unhealthy, or hazardous days (average $PM_{2.5}$ concentration over 55.5 ug/m^3) have been reported in any of the five monitored counties.

Nevertheless, scientific evidence indicates that low-level air pollution still poses significant threats to public health, even when it is below National Ambient Air Quality Standard limits. For $PM_{2.5}$ in particular, this is important because pollution levels in Connecticut meet the federal annual limits, and yet the pollution still causes adverse health impacts and premature deaths. In fact, an independent panel, first convened by the Environmental Protection Agency, concluded that the current standard did not adequately protect human health and therefore unanimously recommended lowering the annual standard from 12 ug/m^3 to 8-10 ug/m^3 and the 24-hour standard from 35 ug/m^3 to 25-30ug/m^3.[4]

Causes of pollution

Burning of fossil fuels is a primary source of both fine particulate matter and ground-level ozone pollution and their precursors. We provide more detail on the varied sources, below. In addition, particulate matter is produced directly from sources including fires, construction sites, cooking, and vehicle tire and brake wear. Ground-level ozone precursors are also produced from human sources like chemical plants, solvents, gasoline stations, and paints, as well as trees and other plants, which release VOCs.[5]

TRANSPORTATION

The transportation sector is responsible for much of Connecticut's ozone and $PM_{2.5}$ pollution, as well as nearly 40% of the state's greenhouse gas emissions.[6] Specifically, in 2019 the transportation sector accounted for 62% of Connecticut's NO_X emissions and 37% of its VOC emissions (both ozone precursor pollutants) and 12% of $PM_{2.5}$.[7] Diesel-powered medium- and heavy-duty vehicles (e.g. school buses, tractor trailers, and garbage trucks) are a particular concern, because they also emit harmful organic compounds; diesel exhaust has been found to cause adverse health impacts including lung cancer and worsening of chronic heart and lung diseases, such as asthma.[8] The health harms are worst for people living along highways and in areas near industrial facilities and ports. One recent study found that, on average, communities of color in the Northeast and Mid-Atlantic regions breathed 66% more air pollution from vehicles than white residents.[9]

BUILDINGS

Space heating in residential and commercial buildings, as well as water heating, is responsible for not only one-quarter of Connecticut's greenhouse gas emissions, but also for the production of local air pollution, including ozone precursors and $PM_{2.5}$.[6] The latter is especially the case when the fuel used is home heating oil or kerosene. In Connecticut, approximately 40% of households use these fuel types.[10] Natural gas heating also produces both local air pollution and greenhouse gas emissions. Gas appliances, such as stoves, also have been found to produce concerning indoor air pollution concentrations, especially in smaller residences and when appliances are not well-maintained.[11]

ELECTRICITY

The electricity sector is responsible for approximately 20% of the state's greenhouse gas emissions.[6] Electricity is largely generated in Connecticut through natural gas and nuclear energy; wind and solar energy are a small but growing percentage. Oil remains a fuel source for some power plants, particularly older plants used during times of high demand. Electricity in Connecticut also is generated through municipal solid waste incineration, with five

facilities currently in operation. It is important to recognize that Connecticut consumes only approximately 73% of the power it generates; the rest is exported to other states.[12] More than 40 fossil fuel-powered generating units have been constructed in Connecticut since 1998; the state now has 54 such units in total.[12] Of these, 23 are located in environmental justice communities (as defined in state statute).[12] A new gas-fired power plant is being proposed in Killingly, which would both further lock in Connecticut to fossil fuel power generation and contribute to local air pollution.

OUT-OF-STATE SOURCES

Connecticut's decreasing trends in ground-level ozone and PM2.5 concentrations coincide with long-term national trends in air quality improvements, thanks to national and state environmental regulations. However, Connecticut-based actions alone can only improve our air quality to a certain point, since both forms of pollution can travel long distances from states to the west and south. In fact, a study found that 90% of Connecticut deaths caused by $PM_{2.5}$ pollution from electric power plants were due to sources outside the state border.[13] For ozone, the Environmental Protection Agency's cross-state air pollution modeling data indicates that approximately 50–60% of human-produced pollution originates outside of Connecticut.[14]

What does this mean for our health?

HEALTH CONSEQUENCES OF OZONE

Ozone is a strong lung irritant. Exposure to ground-level ozone has been shown to cause respiratory symptoms such as coughing, wheezing, and shortness of breath; exacerbation of chronic obstructive pulmonary disease and asthma; increased susceptibility to lung infections; and increased risk of death.[15]

In the Northeast's urban areas, the hottest days often are associated with the highest concentrations of air pollutants, including ground-level ozone.[16] Heat catalyzes the chemical reactions between NO_X and VOCs that form ground-level ozone, and hot days are associated with increased use of vehicles and air conditioning (and therefore electricity) that generate NO_X and VOC pollution. This combination of extreme heat and poor urban air quality poses a major health risk to vulnerable groups.[16]

HEALTH CONSEQUENCES OF $PM_{2.5}$

In 2017 in Connecticut, there were 783 deaths attributed to $PM_{2.5}$; for the entire nation, this number was over 88,000 deaths in 2015.[17] Indeed, even in areas like Connecticut, where pollution levels meet the federal annual limits, long-term exposure to $PM_{2.5}$ can be deadly.[18]

The pollutant has been found to cause or aggravate heart and lung conditions including heart attacks, heart rhythm disorders, heart failure, respiratory symptoms, chronic obstructive pulmonary disease, asthma, and lung cancer.[19] Growing evidence also suggests that long-term $PM_{2.5}$ pollution exposure can harm the brain, including increasing the risk of dementia.[20,21]

Worsening the pollutant's health effects, toxic "hitchhiker" elements and compounds (including lead, cadmium, arsenic, and polycyclic aromatic hydrocarbons) can attach to $PM_{2.5}$ and thereby be brought deep into the lungs.[22] Chronic exposure during fetal growth or early childhood development has been linked to impaired brain development, pre-term birth, low-birth weight, and impaired lung growth; children also are at increased risk for later development of asthma, pneumonia, and chronic obstructive pulmonary disease.[23,24]

Who is most at risk?

The health harms of air pollution, particularly ozone, are experienced by everyone in Connecticut. However, some people are more exposed to air pollution and more sensitive to its health effects than others. Inequitable exposure is often due to longstanding, systemic factors, including institutionalized racism, the purposeful withdrawal of investment from low-income communities and communities of color by developers, government, and banks ("community disinvestment"), and barriers to access to housing,

medical services, and other important determinants of health.

POPULATIONS MOST AT RISK

- **Children and teens**: Since their lungs are still developing and they are likely to be active outdoors, children are at higher risk from both ozone and $PM_{2.5}$ pollution, especially for asthma exacerbations. In addition, ground-level ozone exposure may contribute to the initial development of asthma in children. Nationally, asthma is a leading cause of student school absenteeism.[25] In Connecticut, a 2015 analysis found that approximately one in 10 middle and high school students statewide reported an episode of asthma or an asthma attack in the past year, with the highest prevalence among non-Hispanic Black students.[26]

- **Older adults**: Older adults are more likely to have chronic medical conditions, particularly heart and lung conditions, that make them more sensitive to both $PM_{2.5}$ and ozone pollution.[2]

- **People with lung or heart disease, including asthma, chronic obstructive lung disease, and lung cancer**: For people with heart disease, short-term exposure to $PM_{2.5}$ can trigger heart attacks and other serious health problems. For those with lung disease, particularly asthma, both $PM_{2.5}$ and ozone pollution can cause difficulty breathing and can trigger asthma attacks.[2]

- **Communities of color and low-income communities**: People of color and people with low income are more likely to live in places with more exposure to air pollution, such as along highways and near industrial areas, ports, or power plants. They also may have higher sensitivity to air pollution's health impacts, due to higher rates of chronic medical conditions, inadequate access to medical care, or chronic psychosocial stress.[27]

- **Pregnant women and newborns**: $PM_{2.5}$ pollution has been linked to increased risk for preterm birth. In addition, exposure to even low levels of $PM_{2.5}$ pollution may increase the risk of low birth weight births, particularly for infants of Black mothers.[28] Particle pollution compounds the egregious statistic that Black mothers are three times more likely to die from pregnancy-related problems than White women and are at greater risk for preterm birth and for having a low-birth-weight baby.[29–31]

What can we expect in the future?

Switching from fossil fuels to clean energy sources creates health benefits by reducing the emissions of local air pollution—including ground-level ozone and $PM_{2.5}$—and climate warming greenhouse gases. Researchers have estimated that an aggressive greenhouse gas emissions reduction scenario for the United States would avoid about 19,000 premature deaths nationwide in 2030 due to decreased $PM_{2.5}$ pollution, compared to the "business-as-usual" scenario.[32]

However, even with strong climate mitigation action, more ozone-related deaths are expected due to a "climate penalty:" everything else being equal, higher temperatures, as well as changes to atmospheric circulation patterns caused by climate change, are expected to bring about higher ground-level ozone concentrations, especially in already polluted areas.[33] One analysis estimated 200 to 300 excess deaths to occur in the Northeast in 2050 compared to 2000, due to this climate penalty.[34] The size of the climate penalty will depend on our collective action to reduce greenhouse gas emissions; the more we limit climate change, the smaller the increase in ground-level ozone levels and in the resultant excess premature deaths.[35]

Recommendations

The Yale Center on Climate Change and Health evaluated climate mitigation policy measures found in the GC3 *Phase 1 Report*, in proposed state legislation, and in national best practice policies. We identified the

following seven recommendations, which not only reduce greenhouse gas emissions but also produce strong air quality health benefits and prioritize equity and environmental justice.

In addition to the following in-state actions, Connecticut should continue to demand air pollution abatement in upwind states, through both the Clean Air Act's "Good Neighbor" provision and stronger federal clean air policies for power plants, industrial sites, vehicles, and other stationary and mobile sources.

1 Increase adoption of zero-emission medium- and heavy-duty vehicles (Aligns with GC3 recommendation 22)

Accelerating the deployment of zero-emission medium- and heavy-duty vehicles, including school and transit city buses, delivery trucks, and box trucks, is a core pathway to reducing health-harming diesel emissions and ratcheting down the transportation sector's greenhouse gas emissions. Connecticut can do so by adopting California's medium- and heavy-duty vehicle standards, which set stringent limits on NO_X emissions and establish a timeline to reach 100% of all medium- and heavy-duty vehicle sales being electric by 2045. This policy option is possible thanks to a provision in the Clean Air Act, which allows California to establish motor vehicle standards stronger than the federal standards and allows other states to adopt California's as their own. Connecticut has used this approach in the past to ratchet up its own standards, benefiting both the environment and human health.

Connecticut also should specifically incentivize the electrification of school buses. The City of Hartford has already set a goal of 100% electric school buses by 2035. Targeted funding, as well as technical assistance, is needed for school districts to make this transition. For instance, using funding from the Volkswagen Fuel Economy Settlement, New York's Voucher Program covers 100% of the extra cost for eligible electric school buses in areas designated as distressed communities.[36]

2 Reduce Vehicle Miles Traveled (VMT) 5% below 2019 baseline by 2030

Annual VMT in Connecticut has increased approximately 45% since 1985, reaching nearly 32,000 million in 2018.[37] To achieve its greenhouse gas emissions reduction targets, Connecticut must take actions to reverse this trend and achieve a 5% reduction in VMT by 2030. Doing so yields more benefits than climate mitigation alone: expanding public transportation, making streets safer for walking and biking, and supporting transit-oriented development together result in easier and more equitable mobility, improved local air quality from the reduction in tailpipe emissions, and the immediate health benefit of more physical activity. Connecticut Department of Transportation should align its highway and infrastructure projects, as well as long-range state and regional transportation plans, with this goal and with state climate mitigation targets. The state and transit authorities should aggressively pursue federal funding to support public transit and active transportation projects. Finally, transit-oriented development should be encouraged to reduce sprawl and make public transportation practical in suburban and urban areas. However, to avoid the unintended consequence of higher exposure to emissions from buses or trains,[38] such development should be paired with public transit electrification.

3 Accelerate replacement of oil, kerosene, and natural gas space and water heating with efficient electric or renewable energy alternatives (Aligns with GC3 recommendation 9)

Replacing fossil fuel powered heating systems with efficient electric or renewable energy systems, such as air source or geothermal heat pumps, will reduce emissions of greenhouse gases and local air pollution, as well as ultimately drive down energy costs. Such replacements should be accelerated through financial incentives and policy directives. First, the Connecticut General Assembly should expand the energy types required to contribute to the Energy Efficiency Fund, so that customers using heating oil and other delivery fuels also contribute; currently, the state-mandated conservation charge is applied only to the bills of electricity and natural gas customers. The

increased funding should support more homes to switch their heating to efficient electric heat pumps or renewable technologies. Second, the state's 2022–24 Conservation and Load Management Plan should end rebates for new oil or gas heating appliances by prioritizing heat pump deployment, supported by discounted rates and targeted subsidies, so that the switch is cost-neutral for low-income households. These subsidies will be important to maintain until the cost of heat pumps and renewable heating technologies further decline, which is expected as the technologies reach economies of scale.[39] Multi-family buildings are a particularly promising focal area for heat pump installation; for instance, the New York City Housing Authority has set out an aggressive plan to electrify the space and water heating systems in its 2,410 residential units, in order to meet the City's climate mitigation targets.[40]

To achieve the full environmental and health benefits from electrification, however, the actions need to be coordinated with demand flexibility measures, such as smart thermostats and time-of-use electric rates, as well as energy efficiency and grid decarbonization.[39] This will help limit the amount of new electricity supply needed, particularly during peak periods, thereby reducing reliance on fossil fuel power plants to serve the higher electricity demand, while renewable sources are coming online. At the household level, this means that homes should be weatherized before installation of heat pumps, so that the heat pump system is properly scaled and run as efficiently as possible. At the system level, coordination through state planning processes, including the Integrated Resources Plan and the Conservation and Load Management Plan, are essential.

4 Support healthy, affordable, energy efficient, and climate resilient housing by addressing the barriers to weatherization

(Aligns with GC3 recommendation 7c)

Home weatherization, including adding insulation and replacing leaky windows and doors, helps to reduce energy use for both winter heating and summer cooling. Doing so lowers household energy costs, reduces greenhouse gas emissions, contributes toward a reduced need for energy during "peak" periods (see Recommendation 5), and reduces local air pollution, particularly when home heating oil is used. Weatherization also produces direct health benefits: in a national study of weatherized households, researchers found that residents experienced fewer bad physical or mental health days; suffered fewer persistent colds; experienced fewer doctor and emergency room visits and hospitalizations, including for heat stress and asthma; and were better able to pay their energy, medical, and food costs.[41]

However, health, safety, and legal barriers—such as asbestos, lead, gas leaks, and mold—prevent homeowners from being allowed to complete home energy audits and pursue full weatherization.[42] For example, a home with gas leaks or mold is required to have these issues resolved before air sealing or insulation can be installed.[42] We recommend that the Department of Energy and Environmental Protection (DEEP) and the Department of Social Services (DSS) continue to find ways to apply federal funds from the Weatherization Assistance Program and Low-Income Home Energy Assistance Program (LIHEAP) toward addressing these barriers. Encouraging progress has begun, with the Low-Income Energy Advisory Board recommending that the 2022 Connecticut LIHEAP Plan devote up to $2 million to address these health and safety barriers. If successful, this should be scaled up over time to meet demand. We also encourage DEEP and DSS to continue working together to create a more comprehensive approach to energy efficiency, weatherization, and utility assistance programs in order to maximize their reach and impact for low-income residents.

5 End reliance on petroleum to fuel power plants during winter peak demand

(Aligns with GC3 recommendation 12k)

Of Connecticut's 54 fossil fuel power plants, seven were constructed in the 1960's or earlier, and most of these operate using residual oil, a petroleum liquid.[12] Their outdated technology is inefficient, costly, and highly polluting. In fact, while these plants produce less than 1.8% of the electricity, they emit 3% of the total carbon dioxide emissions and 28% of the total NO_X emissions

from the state's fossil fuel plants.[12] These old plants, as well as about 20 others, function as "peaker plants," meaning that they are generally turned on sporadically when demand is high.[43] In Connecticut, this usually happens in the winter when natural gas supply is limited because it is being used for home heating. To protect health, these dirty peaker plants need to be retired. To address winter electricity demand, the state should prioritize actions including the use of battery storage and expanding its winter demand response programs, which encourage customers to reduce their energy use during peak demand times, such as through WiFi enabled thermostats and time-of-use pricing.

6 Enact into statute a commitment to 100% zero carbon electric supply and generation by 2035

Connecticut has set the laudable and attainable policy goal of 100% zero carbon electric supply by 2040. In fact, Connecticut anticipates already reaching 91% zero carbon electric supply by 2025, once planned offshore wind and grid-scale solar developments come online.[12] However, it is concerning, both from public health and climate mitigation perspectives, that this policy goal still allows for the *generation* of fossil fuel- powered electricity within Connecticut's borders, as long as that power is consumed in another state. In fact, Connecticut has increasingly become a net exporter of power to other states, and as a result, our residents bear the health and environmental burden of fossil fuel power generation.

Connecticut should expand its clean energy goal by enacting into statute a commitment to 100% zero carbon electric supply and generation by 2035, as well as a ban on the construction of fossil fuel power plants within its borders. Such a commitment aligns with the Biden Administration's aggressive goal to reach a nationwide carbon pollution-free electricity sector by 2035.

7 Stop subsidizing municipal solid waste incineration plants through the Connecticut Renewable Portfolio Standard

There are five municipal solid waste incineration, or waste-to-energy, plants in Connecticut; the two largest ones are located in environmental justice communities in Hartford and Bridgeport. These plants produce approximately 800,000 tons of carbon dioxide emissions, significant amounts of NO_X and sulfur dioxide (SO_2) emissions, as well as toxic air pollutants.[12] Nevertheless, these plants are considered eligible energy resources in Connecticut's Renewable Portfolio Standard (RPS), which is a state policy that requires electric providers to obtain a specific percentage of the energy they generate or sell from renewable sources; the electric providers can achieve this percentage through generating renewable energy themselves or from purchasing renewable energy credits from other electric generation projects that qualify as renewable. In fact, Connecticut law specifically carves out this space for waste-to-energy plants, since these facilities are the only eligible energy sources under Class II, one of the three classes of energy sources in the state RPS.[44] This means that the trash-to-energy plants receive a financial subsidy by producing renewable energy credits; electricity ratepayers have paid approximately $12 to $17 million per year to waste-to-energy facilities in recent years.[12]

Connecticut should not be incentivizing these plants, but rather using the RPS program to support renewable energy projects with positive community health and environmental benefits, such as small-scale and residential solar installations. Additionally, Connecticut DEEP, municipalities, and residents should continue to work toward "zero waste" strategies to significantly reduce the amount of trash Connecticut produces in the first place. Solutions under development in Connecticut include scaling up composting programs for food scraps and yard waste; and instituting unit-based pricing ("pay-as-you-throw"),[45] in which residents are charged by the amount they throw away rather than a flat fee, thereby encouraging waste reduction.

About this series:

YCCCH released *Climate Change and Health in Connecticut: 2020 Report* in September 2020. The comprehensive report tracks 19 indicators on climate change and health in Connecticut across four domains: temperature, extreme events, infectious diseases, and air quality. The issue brief series mirrors the four domains, summarizing key findings from the Report and extending it to include policy recommendations. To read the full report, visit:

https://publichealth.yale.edu/climate/policy_practice/connecticut/

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ENDNOTES: NEXT PAGE

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