Testimony before the United States Senate Committee on Environment and Public Works

A Legislative Hearing to Examine S. 1345, the Comprehensive National Mercury Monitoring Act; S. 2476, the Environmental Justice Air Quality Monitoring Act of 2021; and S. ___, the Public Health Air Quality Act.

Testimony of Kathy Fallon, Director of Land and Climate
Clean Air Task Force

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1. Introduction

Thank you, Chairman Carper, Ranking Member Capito, and members of the committee for the opportunity to testify in support of Senate Bills S. 1345, the Comprehensive National Mercury Monitoring Act; S. 2476, the Environmental Justice Air Quality Monitoring Act of 2021; and S. ___, the Public Health Air Quality Act.

My name is Kathy Fallon, and I am the Director of Land & Climate at Clean Air Task Force (CATF), a nonprofit environmental organization founded in 1996 that works to curb air and climate pollution through policy and technology innovation. CATF was founded in the U.S. and is now a global organization. We have offices in Boston, Washington D.C., and Brussels, with staff working remotely around the world. Our scientific staff have expertise encompassing all three bills under consideration, with detailed understanding of the sources, fate and transport, measurement methods and the human and environmental health effects of air pollutants including mercury, air toxics, criteria pollutants, and greenhouse gases.

Prior to joining CATF earlier this year, I spent over twenty years working on air quality, the cycling of pollutants such as mercury, and the effects of air pollution on people and the environment. I have served as executive director of the Hubbard Brook Research Foundation—the research site where acid rain was first documented in North America, as the Science and Policy Integration Program Director at the Harvard Forest of Harvard University, and as a Senior Advisor at the Center for Climate Health and the Global Environment at the Harvard T.H. Chan School of Public Health. I have co-authored more than a dozen peer-reviewed journal papers and reports on mercury and its effects.

Collectively, these three bills would provide funding to establish and expand the nation's pollution monitoring capabilities and provide communities with data to quantify their risk from exposure to potentially harmful contaminants. While a robust monitoring network currently operates to assess criteria pollutant concentrations in ambient air, the network does not characterize the full spatial and temporal variations in pollution experienced by individuals at the neighborhood level. Accurately characterizing local conditions is especially important for communities that experience elevated air and mercury pollution. This includes overburdened and underserved communities near major point sources and highways as well as people who live remote from sources and consume fish from waters that are contaminated by the long-range transport of mercury.

2. S. 1345, the Comprehensive National Mercury Monitoring Act

a. Mercury Synopsis

The National Comprehensive Mercury Monitoring Bill would establish and, for the first time, fund an air, water, and fish and wildlife monitoring network for mercury. Mercury is a hazardous air pollutant that causes neurocognitive impairment and other harmful health impacts at elevated levels. Mercury monitoring has been pieced together with annual funding from state agencies, universities, and nonprofit organizations. Funding levels have fluctuated over time and the number of air quality and deposition sites monitoring mercury has been cut by one-third or more since 2010.[1] Moreover, while fish consumption is the primary pathway of human exposure, there is no coordinated, national long-term monitoring program for mercury in water or fish in the U.S.

While the U.S. has made remarkable progress in reducing mercury emissions over the past two decades, it is more important than ever to fund mercury monitoring due to (1) rising global mercury emissions, (2) changes in energy generation with energy security concerns, (3) climate change impacts on mercury cycling, (4) the persistence of sensitive watersheds where a small amount of mercury has large impacts, (5) disparities in mercury exposure among people with lower incomes and education levels as well as those from certain ethnic and racial groups in the U.S., and (6) growing knowledge about mercury's health impacts, including its effects at low concentrations.

b. How does mercury harm people and the environment?

<u>Health effects</u>

Mercury, in the form of methylmercury, is a potent neurotoxicant with harmful health effects for children and adults, including lost IQ, motor impairment, and cardiovascular disease. Importantly, no known threshold exists for methylmercury below which neurodevelopmental impacts do not occur.[2]

Children exposed to methylmercury during a mother's pregnancy can experience persistent and lifelong IQ and motor function deficits.[3] Based on blood mercury levels in women of childbearing age from the Centers for Disease Control between 2001-2018, approximately 100,000 to 300,000 children born in the United States each year are exposed to mercury levels that exceed EPA's Reference Dose (RfD) for methylmercury.[4] The societal costs of neurocognitive deficits associated with methylmercury exposure in the U.S. were estimated in 2017 to be approximately $4.8 billion per year.[5]

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[1] Sites in the Mercury Deposition Network (MDN) dropped from 120 sites in 2010 to about 80 today. Similarly, the number of sites in the atmospheric mercury monitoring network (AMNet) has declined from a high of 26 sites in 2016 to fewer than 15 in 2022. National Atmospheric Deposition Program (NADP), Program Office Report: 2022 Spring Meeting, Joint Subcommittee, D. Gay (2022), https://nadp.slh.wisc.edu/spring2022/.

[2] Glenn E. Rice et al., *A probabilistic characterization of the health benefits of reducing methyl mercury intake in the United States*, 44 Env't Sci Tech. 5216 (2010); Phillipe Grandjean & Martine Bellanger, *Calculation of the disease burden associated with environmental chemical exposures: application of toxicological in health economic estimation*, 16 Env't Health, no. 123, 2017.

[3] Phillipe Grandjean & Martine Bellanger, *Calculation of the disease burden associated with environmental chemical exposures: application of toxicological in health economic estimation*, 16 Env't Health, no. 123, 2017; Driscoll et al. Mercury Matters: A Science Brief for Journalists and Policymakers. 2018. https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2238/2018/12/Mercury-science-backgrounder_final1.pdf

[4] Center for Disease Control (CDC), National Health and Nutrition Examination Survey (2021), https://wwwn.cdc.gov/nchs/nhanes/; Elsie Sunderland et al., *Mercury Science and the Benefits of Mercury Regulation*, Harvard T.H. Chan School of Public Health, Center for Climate Health and the Global Environment (Dec. 16, 2021), https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2343/2021/12/Mercury_WhitePaper_121621.pdf.

[5] Grandjean, *supra* note 3.

Although many studies of methylmercury toxicity focus on prenatal exposure, effects of adult exposures have also been documented, such as accelerated age-related declines.[6] Fine-motor function and verbal memory are compromised among adults who are exposed to elevated amounts of methylmercury.[7] Adults with high levels of methylmercury exposure can also experience cardiovascular effects, including increased risk of strokes and fatal heart attacks.[8] Other adverse health impacts of methylmercury exposure that have been identified in the scientific literature include endocrine disruption, diabetes risk, and compromised immune function.[9,10,11]

Populations that are sensitive to adverse health effects from methylmercury include the developing fetus, pregnant women and women of childbearing age, and adults who frequently consume fish and seafood. High fish consumers include people from households with lower incomes and education levels, people with higher incomes, and individuals from the following ethnic groups: Asian, Pacific and Caribbean Islander, Native American, Alaska Native, and those who identify as multi-racial.[12] Wildlife can also suffer the effects of mercury contamination—particularly those that depend on fish, such as the common loon and the bald eagle.

Exposure pathway

The dominant pathway of methylmercury exposure for people in the U.S. is the consumption of contaminated fish and seafood (fish and shellfish). The consumption of marine fish, often harvested from U.S. coastal waters, accounts for more than 80 percent of methylmercury intake by the general U.S. population.[13] Yet, millions of recreational and subsistence anglers who consume freshwater fish are among the most highly exposed populations.[14]

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[6] Deborah Rice & Stan Barone Jr., *Critical periods of vulnerability for the developing nervous system: Evidence from humans and animal models*, 108 Env't Health Persp. 511 (2000).

[7] Edna M. Yokoo et al., *Low level methylmercury exposure affects neuropsychological function in adults*, 2 Env't Health, no. 8, 2003.

[8] Giuseppe Genchi et al., *Mercury Exposure and Heart Diseases*, 14 Int'l J. Env't Rsch. Pub. Health 74 (2017); Elsie Sunderland et al., *Mercury Science and the Benefits of Mercury Regulation*, Harvard T.H. Chan School of Public Health, Center for Climate Health and the Global Environment (Dec. 16, 2021), https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2343/2021/12/Mercury_WhitePaper_121621.pdf.

[9] Shirlee W. Tan et al., *The endocrine effects of mercury in humans and wildlife, 39* Critical Rev. Toxicology 228 (2009).

[10] Ka He et al., *Mercury exposure in young adulthood and incidence of diabetes later in life: the CARDIA trace element study*, 36 Diabetes Care 1584 (2013).

[11] Jennifer F. Nyland et al., *Biomarkers of methylmercury exposure and immunotoxicity among fish consumers in the Amazonian Brazil*, 119 Env't Health Persp. 1733 (2011).

[12] Elsie Sunderland et al., *Mercury Science and the Benefits of Mercury Regulation*, Harvard T.H. Chan School of Public Health, Center for Climate Health and the Global Environment (Dec. 16, 2021), https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2343/2021/12/Mercury_WhitePaper_121621.pdf; Susan Silbernagel et al., *Recognizing and preventing overexposure to methylmercury from fish and seafood consumption: information for physicians*, J Toxicol. 2011 (Jul. 12, 2011).

[13] Elsie Sunderland et al., *Changes in the Edible Supply of Seafood and Methylmercury Exposure in the United States*, 126 Env't Health Persp., no. 1, 2018.

[14] Katherine von Stackelberg et al., *Results of a national survey of high-frequency fish consumers in the United States*, 158 Env't Rsch. 126 (2017).

The problem of elevated fish mercury levels is widespread across the U.S. The most recent national compilation of waterbodies that are listed by states as impaired is for the year 2011 and was published in 2013. At that time consumption advisories for mercury were in effect in all 50 states, one U.S. territory, and three tribal territories, and accounted for 81 percent of all U.S. advisories.[15] This constitutes more advisories for mercury than for all other contaminants combined.

<u>Fate and transport</u>
The primary pathway by which mercury enters the environment is air emission. The major sources of air emissions in the U.S. include coal-fired electric utilities and "other industrial process" as well as smaller sources such as electric arc furnaces used in steel production, and waste disposal.[16] Globally, the largest sources of mercury air emissions are small-scale gold mining operations, coal-fired power plants, and ferrous metal and cement production.[17] The countries of China, India, and Indonesia were reported to be the top three emitters in 2015 of total mercury.[18]

Once emitted to the atmosphere, mercury can travel anywhere from several hundred yards to hundreds of thousands of miles, depending on the species of mercury.[19] Eventually, it deposits onto the landscape in rain, snow, or aerosols or dust. Once deposited, mercury makes its way into soils and surface waters, where it can be converted into methylmercury—the only form that bioaccumulates in food chains. Through bioaccumulation, methylmercury can reach levels in fish tissue that are 100 million times higher than the concentrations in water—so even small amounts of mercury can have large impacts.[20]

c. How have mercury levels changed?

Important progress has been made in decreasing mercury emissions in the U.S. in recent years. The National Emissions Inventory shows that annual U.S. mercury emissions declined more than

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[15] U.S. EPA, 2011 National Listing of Fish Advisories, EPA-820-F-13-058 (Dec. 2013), https://19january2017snapshot.epa.gov/sites/production/files/2015-06/documents/technical-factsheet-2011.pdf.

[16] U.S. EPA, National Emissions Inventory (NEI) (2020), https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-documentation.

[17] United Nations Environment Programme (UNEP), Global Mercury Assessment 14 (2018), https://www.unep.org/globalmercurypartnership/resources/report/global-mercury-assessment-2018.

[18] UNEP, Global mercury assessment, https://www.unep.org/explore-topics/chemicals-waste/what-we-do/mercury/global-mercury-assessment (last accessed July 8, 2022).

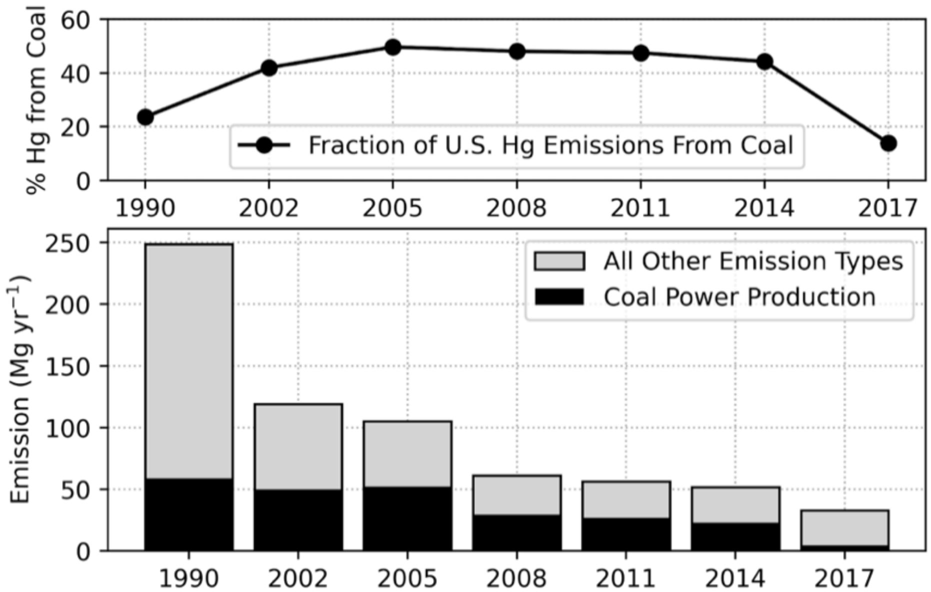
[19] Mercury can be emitted to the atmosphere as elemental mercury, reactive gaseous mercury, or particulate mercury. Gaseous and particulate mercury are oxidized forms that are more chemically reactive and soluble in water, so they have lower residence times on the order of hours to days and tend to deposit locally and regionally. Elemental mercury is more inert with a residence time on the order of approximately 6 months and is therefore capable of long-range global transport. Once mercury is emitted and deposited, it can also be re-emitted so it can persist in the environment for centuries to millennia.

[20] H. Chan et al., *Impacts of Mercury on Freshwater Fish-eating Wildlife and Humans.* Human and Ecological Risk Assessment, Jun 18, 2010, https://www.tandfonline.com/doi/abs/10.1080/713610013; Celia Chen et al., *Marine mercury fate: From sources to seafood consumers.* Env't Rsch. (Oct. 13, 2012), https://pubmed.ncbi.nlm.nih.gov/23121885/.

four-fold between 1990 and 2017.[21] Mercury emissions from electricity generating units (EGUs) decreased by 90 percent during that period.[22] The reduction in emissions from EGUs in the U.S. resulted in widespread reductions in utility-attributable mercury deposition with an average decrease in the contiguous U.S. of 90 percent.[23] As a result of the success of domestic mercury regulations and emissions control strategies, the fraction of mercury deposition in the U.S. from U.S. emission sources has decline from a surface area-weighted mean of 23-35 percent of total deposition in 1990 to 1-5 percent in 2020.[24]

<u>Figure 1. United States mercury emissions (1990 - 2017).</u>

Bottom: Annual mercury emissions from coal-fired power plants (*black*) and total U.S. emissions (*black + gray*). Top: the fraction of total domestic emissions from coal combustion. Data is from the U.S. EPA *National Emissions Inventory.*[25]



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[21] Connor I. Olson et al., *Mercury emissions, atmospheric concentrations, and wet deposition across conterminous United States: changes over 20 years of monitoring*, 7 Env't Sci. & Tech. Letters 376 (2020).

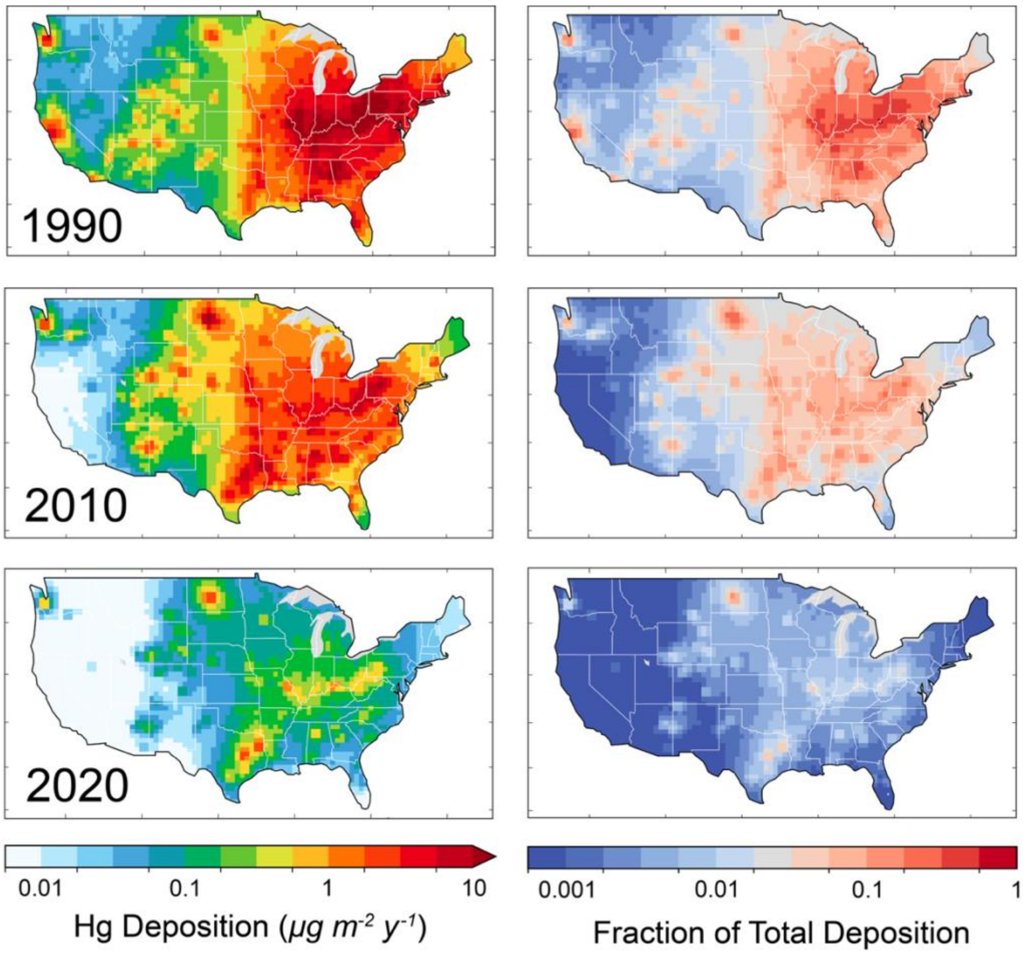
[22] U.S. EPA, NEI (2017), https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data.

[23] Elsie Sunderland et al., *A Template for a State-of-the-Science Assessment of the Public Health Benefits associated with Mercury Emissions Reductions for Coal-fired Electricity Generating Units*, Harvard Chan C-CHANGE White Paper (2022), https://www.hsph.harvard.edu/c-change/news/mercury-emissions-reductions/.

[24] Sunderland, *supra* note 13, at 16.

[25] Sunderland, *supra* note 13, at 14.

Figure 2. Simulated mercury deposition to U.S. ecosystems resulting from electric power generation (l*eft*) and the utility attributable deposition fraction (*right* for 1990, 2010, and 2020.[26]



These declines in U.S. mercury emissions and deposition associated with EGUs have produced substantial health benefits. New modeling analysis suggests reductions in power plant mercury emissions between a 2008-2010 baseline and 2020 produced the following health benefits[27]:

- Blood mercury levels in 60,000 to 100,000 women of childbearing age (16-49) dropped from above to below levels associated with the EPA RfD.
- As a result, 3,700 to 5,600 fewer babies are born per year with exposures above the RfD.
- Lower incidence of neonatal exposure led to 1900 fewer IQ points lost annually.
- 380,000 fewer adults experience increased risk of ischemic heart disease due to methylmercury exposure.
- 160,000 fewer individuals face increased risk of cardiovascular mortality.
- $1.2 to $1.5 billion in monetized health benefits due to reduced IQ deficits and cardiovascular mortality.

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[26] Sunderland, *supra* note 13, at 16 (simulations based on the new atmospheric chemistry described in Viral Shah et al., *Improved mechanistic model of the atmospheric redox chemistry of mercury,* 55 Env't Sci. & Tech. 14445 (2021)).
[27] Sunderland, *supra* note 23.

d. Why is mercury still a concern and why is monitoring needed?

Despite the substantial progress in reducing mercury emissions from sources in the U.S., mercury remains an important problem and health concern in need of federal funding for a national monitoring network for the following reasons:

i. Global mercury emissions, particularly from Asia, increased during the same period that electric utilities in the U.S. dramatically reduced their emissions. The most recent Global Mercury Assessment of 2018 reports that mercury emissions declined between 2010 and 2015 in North America and the European Union but increased in all other regions, with the largest increase by volume occurring in East and Southeast Asia and the highest emissions originating in China.[28] Given the long-range transport of mercury, these global emissions trends contribute to total mercury deposition in the U.S., offsetting some of the important reductions associated with declines in U.S. emissions. These trends raise renewed concerns about mercury deposition and its effects on fisheries and people who consume fish from U.S. waters. Mercury monitoring is needed to track these changing global emissions and their impact on atmospheric deposition, to understand the implications for exposure and health risks in the U.S., and to distinguish the impacts of global sources from U.S. sources.

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[28] UNEP, Global Mercury Assessment, (2018), https://www.unep.org/globalmercurypartnership/resources/report/global-mercury-assessment-2018.

Figure 3. Decadal *(left)* and annual *(right)* changes in global emissions of mercury from anthropogenic sources.[29]

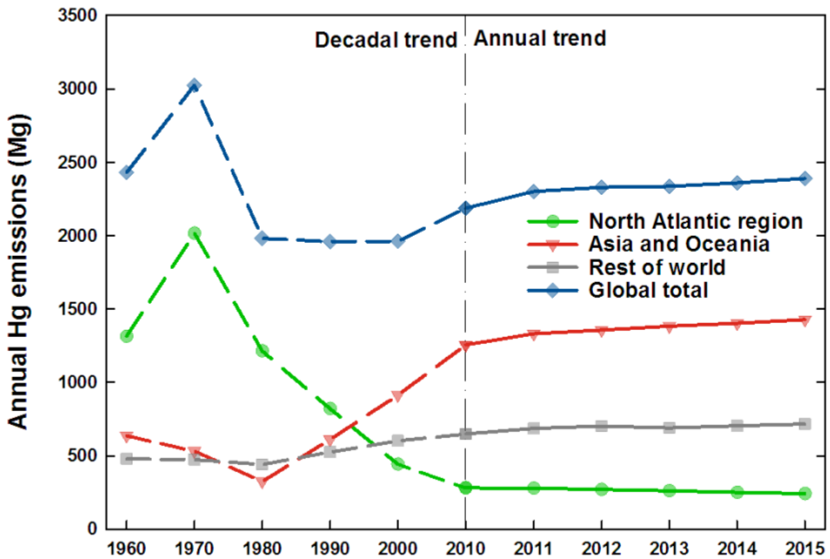
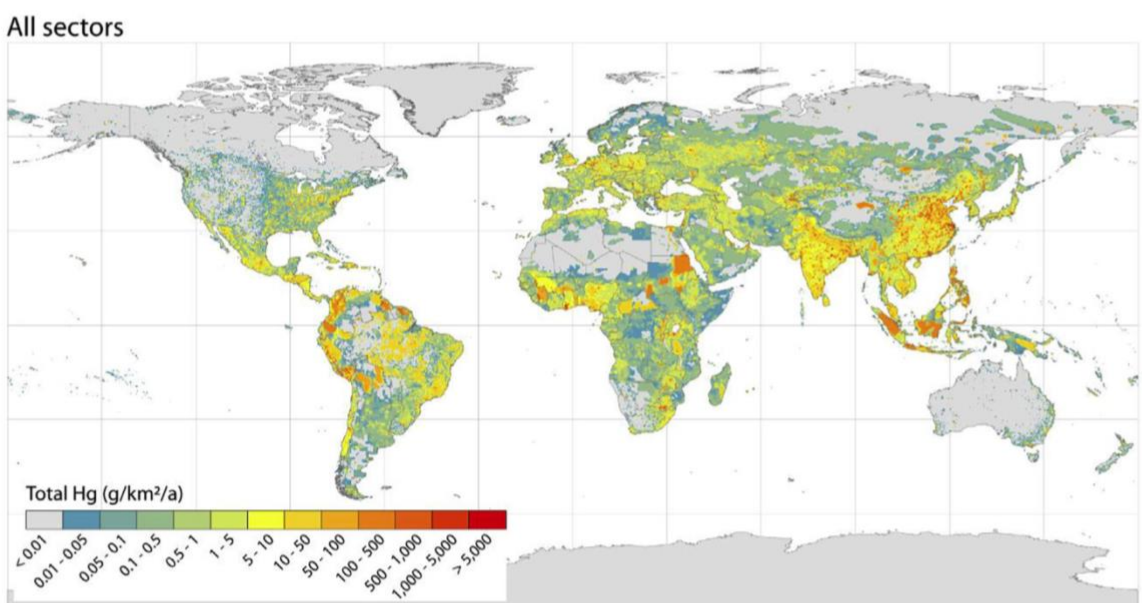


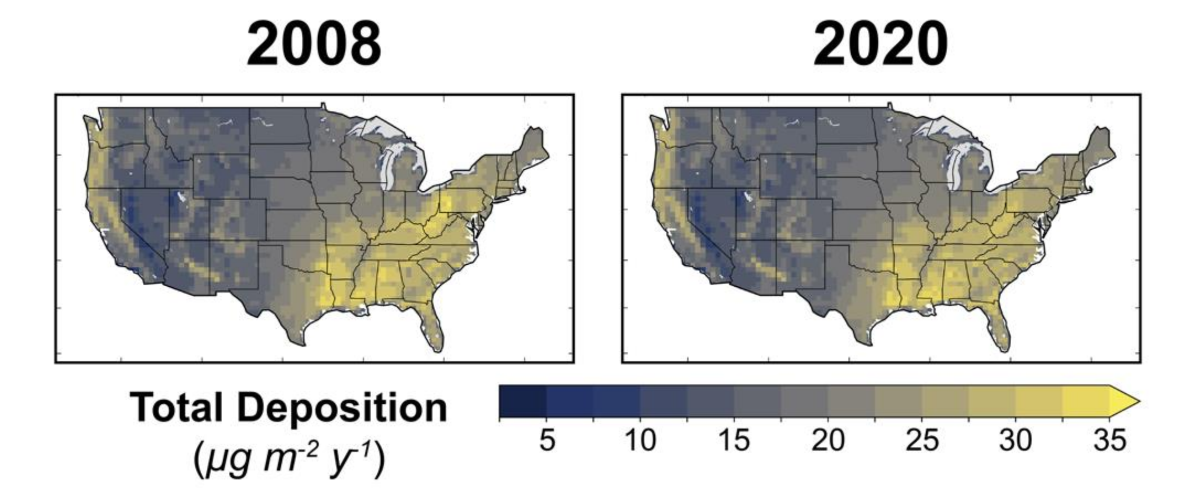
Figure 4. Spatial distribution (total) mercury emissions to air from anthropogenic sources in 2015 in kilograms per square kilometer per year.[30]



[29] David G. Streets et al., *Global and regional trends in mercury emissions and concentrations, 2010–2015*, 201 Atmospheric Env't 417 (2019).

[30] Frits Steenhuisen & Simon Wilson, *Development and application of an updated geospatial distribution model for gridding 2015 global mercury emissions*, 211 Atmospheric Environment 138 (1994).

Figure 5. Modeled Total U.S. Mercury Deposition from All Sources for 2008 and 2020. Darker blue colors represent lower deposition.[31]



ii. Global mercury emissions are likely to continue to increase globally given the resurgence in coal-fired generation in some countries in response to energy security concerns. For example, according to the National Bureau of Statistics, coal consumption in China increased 4.6 percent in 2021, the highest rate of growth in a decade.[32] Such trends raise further concerns about potential mercury deposition and exposure risks here in the U.S. Mercury monitoring is needed to better characterize changes in mercury deposition to the U.S. and its resulting exposure and health risks.

iii. Climate change is making the mercury problem worse by contributing to the re-release of legacy mercury from thawing permafrost,[33] the mobilization of more mercury from soils to surface waters under high rainfall events and wildfires,[34] the increased production of methylmercury due to amplification of productivity in some aquatic systems along with increased lake,[35] and increased bioaccumulation in some food chains as

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[31] Sunderland, *supra* note 23. Results are based on a nested simulation using the GEOS-Chem global chemical transport model described in Shah, *supra* note 26. Total deposition (top panels) shows mercury deposited from all sources.

[32] *China sees biggest growth in energy and coal use since 2011*, Reuters (Feb. 28, 2022), https://www.reuters.com/markets/commodities/china-sees-biggest-growth-energy-coal-use-since-2011-2022-02-28/.

[33] M. Florencia Fahnestock et al., *Mercury reallocation in thawing subarctic peatlands*, 11 Geochemical Persp. Letters (Oct. 14, 2019); Kevin Schaefer et al., *Potential impacts of mercury released from thawing permafrost*, 11 Nature Commc'ns 1 (Sept. 16, 2020)

[34] Aditya Kumar et al., *Mercury from wildfires: Global emission inventories and sensitivity to 2000–2050 global change*, 173 Atmospheric Env't 6 (1994).

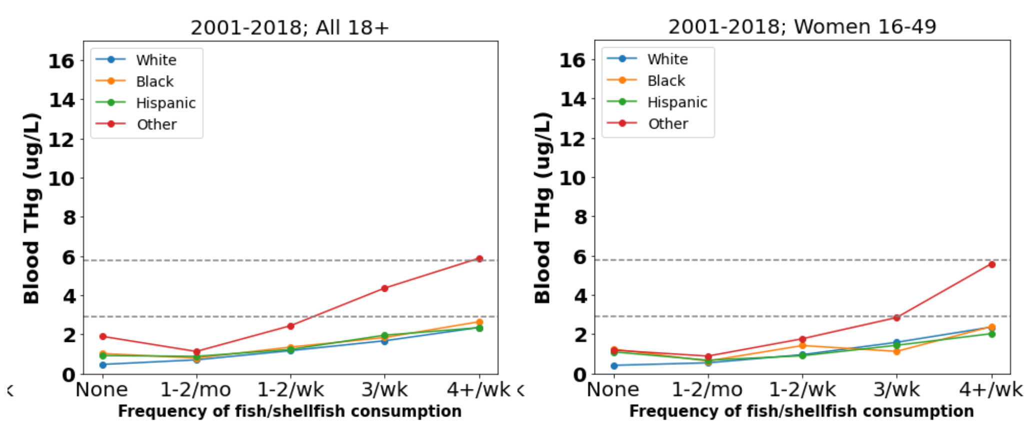
[35] David Krabbenhoft & Elsie Sunderland, *Environmental science. Global change and mercury*, 342 Sci. 1457 (Sept. 27, 2013).

surface waters get warmer.[36] Mercury monitoring is needed to identify and understand these changes as well as to recommend actions to safeguard the health of all people in the U.S. who consume fish and shellfish.

iv. Sensitive watersheds generate high fish mercury from low mercury inputs so even as emissions decline, some regions will continue to be hotspots of methylmercury in fish and wildlife. Mercury monitoring is needed to better understand what contributes to mercury sensitivity and where these sensitive watersheds exist.

v. Nationwide survey data show that methylmercury exposure among high-frequency fish consumers of more than 3 fish meals per week is higher among lower-income households and those with less than a high school education.[37] Data on mercury levels in blood show that disparities in methylmercury exposure exist in the U.S. population. For example, U.S. individuals who identified their ethnicity as "other" (i.e., Asian, Pacific and Caribbean Islander, Native American, Alaska Native, multi-racial and unknown race) consistently have blood mercury levels that are higher than other demographic groups between 2001-2018 based on NHANES/CDC data. Mercury monitoring is needed to better characterize differences in methylmercury exposure among people in the U.S. by income, education, and race and ethnicity.

<u>Figure 6: Blood mercury concentrations in U.S. individuals identifying with different ethnic groups (2001-2018) for all people over age 18 (left) and for women between the ages of 16 and 49 (right). Dashed lines correspond to EPA's reference dose (RfD) for methylmercury (upper dashed line) and alternative RfD (lower dashed line).</u>[38]



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[36] Amina T. Schartup et al., *Climate change and overfishing increase neurotoxicant in marine predators*, 572 Nature 648 (2019).

[37] von Stackelberg, *supra* note 14.

[38] Based on the analysis by Phillipe Grandjean & Esben Budtz-Jorgensen, *Total imprecision of exposure biomarkers: implications for calculating exposure limits*, 50 Am. J. Indus. Med. 712 (2007).
Data from CDC, National Health and Nutrition Examination Survey (NHANES), https://wwwn.cdc.gov/nchs/nhanes/ (last accessed July 8, 2022).

vi. There is no known safe level of mercury consumption and effects are known to occur below the reference dose. In fact, serious health effects have been identified at methylmercury concentrations below the current EPA RfD of 0.1 ug/kg per day. Neonatal studies conducted in the United States, Europe, China, and Japan have consistently found low-level exposure to methylmercury below the EPA RfD for adverse neurobehavioral development.[39] For example, a study conducted in Boston showed adverse effects associated with prenatal methylmercury exposure on memory and learning, especially visual memory, in children.[40] Mercury monitoring is needed to better understand the prevalence and distribution of low-level mercury exposure and to inform people about how much fish and seafood to consume.

e. What will the Comprehensive National Mercury Monitoring Act achieve?

Critical investments in mercury monitoring have been made through the American Rescue Plan, but we need to do more. Even as mercury emissions decline in the U.S., high emissions are still common around the world. As we reduce emissions here at home, a Comprehensive National Mercury Monitoring Network will provide national-scale data to track changing mercury concentrations in air, atmospheric deposition, soils, surface waters, and fish and wildlife.

Data generated by the Network will allow policymakers and researchers to quantify the benefits of emissions reductions and help understand on-going risks from global emissions. As climate change alters mercury cycling, reliable, consistent monitoring will help scientists understand the implications for methylmercury exposure. Monitoring data will also provide information for knowing which waters can be removed from the list of impaired waters as mercury deposition declines. The data from this network will improve models that are relied upon for policy and human health risk assessments and strengthen our understanding of the disproportionate risks to lower income people and overburdened populations. Finally, as national policies and international actions take effect, measurements will help understand what residual risk exists, where, and for whom.

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[39] Sally Ann Lederman et al., *Relation between cord blood mercury levels and early child development in a world trade center cohort,* 116 Env't Health Persp. 1085 (2008); Emily Oken et al., *Maternal fish intake during pregnancy: Blood mercury levels and child cognition at age 3 years in a US cohort,* 167 Am. J. of Epidemiology 1171 (2008); Kristine Vejrup et al., *Prenatal mercury exposure, maternal seafood consumption, and associations with child language at five years,* 110 Env't Int'l 71 (2006); Wieslaw Jedrychowski et al., *Effects of prenatal exposure to mercury on cognitive and psychosocial function in one-year old infants: Epidemiological cohort study in Poland,* 16 Annals of Epidemiology 439 (2006); Jinhua Wu et al., *Effect of low-level prenatal mercury exposure on neonate neurobehavioral development in China,* 51 Pediatric Neurology 93 (2014); Yu Gao et al., *Prenatal exposure to mercury and neurobehavioral development in Zhoushan City, China,* 105 Env't Rsch. 390 (2007); Keita Suzuki et al., *Neurobehavioral effects of prenatal exposure to methylmercury and PCBs, and seafood intake: Neonatal behavioral assessment scale results of Tohoku study of child development,* 110 Env't Rsch. 699 (2010).

[40] Sara T.C. Orenstein et al., *Prenatal organochlorine and methylmercury exposure and memory and learning in school-age children in communities near the New Bedford Harbor Superfund Site, Massachusetts,* 122 Env't Health Persp. 1253 (2014).

Fish provides a healthy, low-cost source of protein and other nutrients that are essential for pregnant women, young children, and the general population. This summer, many people shopping for their 2022 July 4th barbecues experienced beef and chicken costs as much as 36 percent higher than this time in 2021. These price spikes make fish from local waters an important, low-cost alternative source of protein. As supply chain disruptions become more commonplace, a national mercury monitoring network is critical for helping people make good choices about where to fish and securing a safe, local, low-cost source of protein for all people in the U.S.

3. S. ___, the Public Health Air Quality Act of 2022, and S. 2476, the Environmental Justice Air Quality Monitoring Act of 2021

a. Policy Overview

S. ___, The Public Health Air Quality Act of 2022, to be introduced by Senator Duckworth, and and S.2476, the Environmental Justice Air Quality Monitoring Act of 2021, introduced by Senator Markey, are motivated in part by the November 2020 report "Opportunities to Better Sustain and Modernize the National Air Quality Monitoring System" prepared by the Government Accounting Office (GAO) and the August 2018 release of the National Air Toxics Assessment (NATA)[41] by US EPA.

The GAO found that the nation's monitoring infrastructure is aging while annual appropriations for state and local grants to fund pollution monitoring has decreased by an inflation-adjusted 20 percent since 2004. As a result, air quality managers have struggled to maintain the high-quality, comprehensive data collection required to properly assess ongoing health risks to the public from air pollution. The report found insufficient emphasis on measurements of air toxics near sources to assess risk and limited information on the use of low-cost sensors, which are a set of emerging technologies that could potentially transform how community members understand the air they breathe. A network of these instruments could report air pollution levels in real-time, available on every street corner, and readily accessible on a phone app or connected device.

State and Local Air Monitoring Stations (SLAMS) provide core air pollution data to the general public, support compliance with the National Ambient Air Quality Standards (NAAQS) and emissions strategy development, and support air pollution research studies. As a subset of SLAMS, National Core Network (NCore) monitoring locations have a large complement of monitoring devices that go beyond a SLAMS site to further support air quality model evaluations, long-term health assessments, and ecosystem assessments. To assess air toxics constituents in the air, States operate National Air Toxics Trends Stations (NATTS) that identify trends in air toxics levels to assess progress toward emission reduction goals, evaluate public exposure, and characterize risk.

These established networks have their role and provide critical information to regulators, researchers, and the public. However, they are not designed to meet the other important goals that these two Senate bills would address. Expanded monitoring capabilities would permit

[41] U.S. EPA, National Air Toxics Assessment (Aug. 22, 2018), https://www.epa.gov/national-air-toxics-assessment.

assessment of (1) air pollution hotspots, or local areas of high pollution; (2) spatially dense, short-term air quality changes in real-time; and (3) air quality outside of major metropolitan areas, including rural communities as necessary.

While the GAO report assessed monitoring needs, US EPA relies on air quality modeling to conduct its periodic assessment of the exposure risk to air toxics. For two decades this effort was called the National Air Toxics Assessment, and in 2022 has been rebranded as the Air Toxics Screening Assessment.[42] The 2014 NATA incorporated updated unit risk values for Ethylene Oxide[43] that brought new attention to the potential cancer risk due to inhalation exposure for communities near industrial sources of this chemical.

CATF has relied on air quality modeling results like EPA's NATA as a critical tool to inform communities of their risk from exposure to air pollution. Our work includes assessing the health impacts from exposure to particulate derived from coal-fired power plants[44] and diesel engines.[45] Our efforts have also brought focus to differential impacts of air pollution between communities, as documented in assessments of the air toxics exposure risk from oil and gas production (in African American Communities: "Fumes Across the Fenceline"[46] and Tribal Communities: "Tribal Communities at Risk: the Disproportionate Impacts of oil and gas pollution on tribal air quality")[47] and to diesel and mobile source air toxics in environmental justice communities in Allegheny County, PA.[48]

Air pollution models are a cost-effective tool designed to provide estimates of pollution based on emissions and meteorological factors, and the results can highlight both spatial and temporal variability at fine resolutions. Model results are limited by a number of factors, including the accuracy of emission inputs, meteorological fields and parameterization of production and loss terms, like chemistry and deposition. They can provide evidence to help direct ambient measurements that more reliably determine risk in a community. This application of models was the impetus for the initial sections of the Public Health Air Quality Act of 2022.

The public health bill covers multiple monitoring initiatives. The first is described in section 3 and addresses health emergency monitoring at industrial facility fencelines, as indicated by EPA's NATA for 2014. Section 4 anticipates additional continuous monitoring at the release point and at the interface between the source and the community (i.e., fenceline) and the establishment of action levels for the most hazardous compounds. Section five directs EPA to double the number of NCore monitoring sites, with at least half of the new locations situated to

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[42] U.S. EPA, Air Toxics Screening Assessment, https://www.epa.gov/AirToxScreen (last accessed July 8, 2022).
[43] U.S. EPA, Evaluation of the Inhalation Carcinogenicity of Ethylene Oxide, EPA/635/R-16/350Fa (Dec. 2016), https://iris.epa.gov/static/pdfs/1025tr.pdf.
[44] CATF, Toll from Coal, https://www.tollfromcoal.org/ (last visited July 8, 2022).
[45] CATF, Deaths by Dirty Diesel, https://www.catf.us/deathsbydiesel/ (last visited July 8, 2022).
[46] CATF, Fumes Across the Fence-Line (Nov. 2017), https://cdn.catf.us/wp-content/uploads/2017/11/21092330/catf-rpt-naacp-4.21.pdf.
[47] CATF, Tribal Communities at Risk (May 2018), https://cdn.catf.us/wp-content/uploads/2018/05/21094517/Tribal_Communities_At_Risk.pdf.
[48] CATF & Cancer & Environmental Network of Southwestern Pennsylvania, National Air Toxics Assessment and Cancer Risk in Allegheny County Pennsylvania (updated May 2021), https://censwpa.org/wp-content/uploads/2021/07/NATA-Factsheet.pdf.

determine pollution levels in disadvantaged communities (e.g., excess disease incidence, impoverished, or otherwise vulnerable).

b. S. ___, the Public Health Air Quality Act

i. Health Emergency Air Toxics Monitoring Network

The monitoring proposal under this section responds to high cancer risk modeled by EPA for its 2014 National Air Toxics Assessment (NATA). Generally, the model allows the Agency to routinely, at reasonable cost and effort, estimate risk levels due to exposure to toxic contaminants without the need for excessive or expensive monitoring. The assessment for 2014 identified potentially harmful exposure levels to Ethylene Oxide (EtO), which mobilized a response to collect ambient samples to evaluate the accuracy of the modeled results.

As noted in the bill text, the routine toxics monitoring method may not be sufficient to determine ambient levels of EtO with sufficient precision. Experienced scientists recognize that multipollutant analytical methods often cannot be optimized for multiple components simultaneously due to different instrument sensitivity for each compound, wide ranges of toxicity, and variability in ambient concentrations. With the updated toxicity factor for EtO, the routine monitoring method detection limit is insufficient to determine the risk accurately at ambient levels near the 1 in 10,000 cancer risk threshold.

EPA has already made progress with researchers to develop new methods for use with an acceptable detection limit for the task at hand.[49] In addition, EPA has completed its air toxics assessment for 2017. The results of that year are somewhat different than 2014. Equally important, since that year, EPA reports updated emissions that indicate ten facilities stopped using EtO altogether, while another 20 installed emission controls for EtO. The one-point source that emits chloroprene has also implemented controls to reduce emissions.[50] These updates do not relieve the need to conduct fenceline monitoring at the locations with additional emission controls, although the expectation would be ambient levels may be substantially less than the model predictions based on recent emissions inventory reporting.

This section also considers further monitoring at locations where exposure levels are predicted to be near the 10^{-4} threshold. This is an important recognition of uncertainties inherent in modeling best estimate emissions. Multiyear monitoring represents a sound approach given that cancer risks are based off lifetime exposure periods and substantial interannual variation can exist due to meteorological factors alone.

ii. Community Air Toxics Monitoring

This section outlines additional monitoring of major sources of air toxics that might reasonably be expected to emit enough pollution to result in ambient concentrations near levels of concern.

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[49] Aurelie Marcotte, The Current State of Ethylene Oxide in Ambient Air, The Magazine for Environmental Managers (May 2022), https://entanglementtech.com/wp-content/uploads/2022/05/marcotte.pdf.
[50] U.S. EPA, 2017 AirToxScreen Emissions Updates (Mar. 3, 2022), https://www.epa.gov/system/files/documents/2022-03/2017airtoxscreen-emissions-updates.pdf.

Generally, the effort would entail supplemental evaluation of the periodic modeling results and could provide stronger assurances to residents near major pollution sources that they are not exposed to dangerous levels of air pollution.

iii. NAAQS Monitoring Network

There are two primary elements under this section. The first is focused on expanding the number of NCore sites by a factor of 2, while providing some additional funding to assure existing locations are operating effectively. The second allocates resources to add at least 100 monitors to the SLAMS network to better characterize pollution in areas that may have insufficient or a complete lack of ambient pollution measurements. Based on the 2021 monitoring network for $PM_{2.5}$ and O_3, at least one monitor operated in 886 distinct counties where over 261 million people live. Nonetheless, over 70 million people live in a county without a regulatory monitor, representing just over 20% of the population and nearly 80% of US counties.

The intent of these additional monitors is to provide high quality pollution measurements in areas that generally lack direct knowledge of the local pollution burden. Siting criteria prioritizes communities with higher than average disease burden, poverty level and other socioeconomic factors, or susceptible individuals at increased risk of harm from air pollution exposure. In its Policy Assessment for the PM NAAQS review, EPA has reported wide discrepancies in exposure to $PM_{2.5}$ between Blacks and whites in major urban areas with existing monitors.[51] One might reasonably expect similar disparities exist in locations that currently lack measurements. The bill advocates an additional novel approach to use hybrid methods to assist in locating monitors in areas that are expected to have pollution concentrations near or above a NAAQS level. Hybrid methods combine multiple information sources like satellite estimates and air quality modeling surfaces.

iv. Sensor Monitoring

The final section of the Public Health bill allocates resources sufficient to deploy at least 1000 low-cost sensors with no fewer than 5 sensors per census tract. This move toward a low-cost sensor network overlaps in concept with the Environmental Justice Air Quality Monitoring Act. Monitors installed could be used to help identify local gradients in pollution and would complement the hybrid methods to help determine if and where more sophisticated regulatory monitors should be installed to assess compliance with ambient standards.

c. S. 2476, the Environmental Justice Air Quality Monitoring Act of 2021

This bill would establish a pilot program to expand air quality monitoring into EJ communities in recognition that the existing monitoring network does not provide data that fully represents the spatial and temporal variability of air pollution concentrations and associated human exposures.

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[51] U.S. EPA, Policy Assessment for the Reconsideration of the National Ambient Air Quality Standards for Particulate Matter, EPA-452/R-22-004 (May 2022), https://www.epa.gov/system/files/documents/2022-05/Final%20Policy%20Assessment%20for%20the%20Reconsideration%20of%20the%20PM%20NAAQS_May2022_0.pdf.

The program has several key components. First, each funded monitoring project would install a dense network of sensors to determine block level variability in pollutants of concern. Collected data would be readily accessible in real time to community members and regulatory agencies, providing critical information for people to plan their daily activities and alert air pollution managers of pollution events or persistence that may require a mitigating response. Priority will be given to projects situated in communities with high incidence of air pollution related illnesses, like asthma, and could be used by health researchers to better understand the connections between air pollution exposure and related illnesses. Each project should include a community engagement component to spread awareness regarding air pollution in the neighborhood and would provide employment and training opportunities for a range of positions, including monitoring device technicians, scientific staff, communication and technology specialists, community engagement liaisons and environmental health professionals. Resources provided under this program would be equally distributed between equipment acquisition/operation and human resources (staffing).

Under this program, the Administrator is required to track each funded project and evaluate its effectiveness. A final report would describe the suite of data collected and detail lessons learned. This information would include total project costs and determine the utility and cost of maintaining an existing program and would assist in decision-making regarding program expansion into new communities.

Funding from this effort would help jumpstart a movement across the nation to more accurately and completely monitor the spatial and temporal variability within neighborhoods. The recent development of low-cost technologies for air pollution monitoring has made such an effort affordable.

Already some communities have moved in this direction to their own benefit. In Pittsburgh, PA, local community members became frustrated because they were repeatedly impacted by emissions from local industry, but regulatory monitors were not situated to capture the plumes that wafted through their neighborhoods. They could often see or smell pollution, but lacking monitors, had little knowledge of what pollutants were carried in them or at what concentrations.

In response, the community members worked with scientists at Carnegie Mellon University, who helped develop a suite of monitors to generate data in support of community concerns. Their novel approach included installation of fixed location low-cost sensors for criteria pollutants (SO2, PM2.5, NO2), limited mobile monitoring from van-based equipment, high resolution cameras pointed toward known stationary sources of pollution and even a phone-based application called “Smell Pittsburgh”, which allows users to report time, geolocation, and severity of industrial smells.

This coordinated effort to monitor real-time pollution within their neighborhoods provided community members with quantified pollution estimates and an ability to track over time the variability of exposures to local air pollution. Armed with this information, the community was empowered to bring their knowledge to the Allegheny County Health Department to advocate for better enforcement of emissions limits for pollution sources embedded in their neighborhood.

4. Conclusion

Together, the three bills that are the subject of today's hearing represent a major leap forward for our nation's public health infrastructure. The United States currently lacks a comprehensive federally funded air and environmental monitoring system that informs individuals of air quality conditions in their local neighborhoods and tracks the transport of mercury and levels of methylmercury in fish and seafood from local waterways. These bills would establish critical monitoring networks for mercury, shore up our existing air quality monitoring infrastructure, and expand air quality monitoring into underserved locations that currently lack measurements needed to inform people in overburdened communities of their potential pollution exposures. Collectively, these air and environmental monitoring programs would help safeguard the health of people across the U.S. as we contend with shifts in global climate, energy security, and air emissions.