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BY EMAIL AND CERTIFIED MAIL

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Re: Petition for Rulemaking to List Heating Appliances as a Source Category Under Section 111(b)(1)(A) of the Clean Air Act and to Issue New Source Performance Standards for that Category under Section 111(b)(1)(B)

Dear Administrator Regan:

Pursuant to the Administrative Procedure Act, 5 U.S.C. § 553(e), the Clean Air Act, 42 U.S.C. § 7401 et seq., and other relevant regulations and practices, the undersigned 26 environmental, public health, consumer protection, and healthy housing organizations submit this Petition to the Environmental Protection Agency (EPA) to initiate rulemaking proceedings to list heating appliances as a source category and promulgate standards of performance for new sources within the category under section 111(b) of the Clean Air Act.

I. BACKGROUND

The need to decrease emissions from all economic sectors has never been more urgent. Last year's Intergovernmental Panel on Climate Change (IPCC) report,[1] increasingly frequent climate disasters,[2] and the growing body of research on the devastating health impacts of air pollution confirm that the United States must dramatically reduce—and, before long, end—the combustion of fossil fuels across the entire economy. Unlike emissions from the energy and transportation sectors, however, emissions from buildings have been largely ignored by federal regulators, a reality that must change if we are to meet our international climate commitments and EPA is to fulfill its statutory obligation to protect public health and welfare.

Global emissions from the building sector hit a record high in 2019.[3] In the United States, the residential and commercial sectors now account for about 40% of total energy consumption[4] and 14% of net greenhouse gas (GHG) emissions.[5] Although lighting, electronic devices, and most cooling equipment are powered by electricity, the majority of U.S. buildings still utilize fossil fuels to power heating appliances like water heaters and furnaces, with over two-thirds of GHG emissions from U.S. residential and commercial sectors resulting from fossil fuel combustion.[6] More specifically, nearly half of U.S. homes rely on gas as their primary heating fuel.[7] Gas heating appliances such as water heaters, furnaces, boilers, stoves, and clothes dryers represent about 80% of fossil fuel-fired heating appliances and emit the majority of appliance pollution, including both climate-disrupting GHG emissions and pollutants that directly impact human health.[8] Oil- or propane-burning appliances, which make up most of the remaining 20%, emit carbon dioxide, nitrogen oxides, and sulfur dioxide at markedly higher rates than gas appliances.[9]

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[1] IPCC, *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [in press], https://www.ipcc.ch/report/ar6/wg1/.

[2] U.N. Office for Disaster Risk Reduction (UNDRR), *Climate and weather related disasters surge five-fold over 50 years, but early warnings save lives* (Sept. 1, 2021) https://news.un.org/en/story/2021/09/1098662.

[3] Press Release, U.N. Environment Programme (UNEP), *Building sector emissions hit record high, but low-carbon pandemic recovery can help transform sector* (Dec. 16, 2020), https://www.unep.org/news-and-stories/press-release/building-sector-emissions-hit-record-high-low-carbon-pandemic.

[4] U.S. Energy Information Administration (EIA), *Uses of Energy Explained*, https://www.eia.gov/energyexplained/use-of-energy/ (last visited Aug. 18, 2022).

[5] EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019, Table 2-10* (Apr. 2021), EPA 430-R-21-005, https://www.epa.gov/sites/default/files/2021-04/documents/us-ghg-inventory-2021-main-text.pdf.

[6] *Id.*

[7] EIA, *U.S. households' heating equipment choices are diverse and vary by climate region*, (Apr. 6, 2017), https://www.eia.gov/todayinenergy/detail.php?id=30672.

[8] *See* EIA, *Residential Energy Consumption Survey* (RECS) (2020), https://www.eia.gov/consumption/residential/data/2015/; EIA, *Commercial Buildings Energy Consumption Survey* (CBECS) (2012), https://www.eia.gov/consumption/commercial/data/2012/; EPA, *National Emissions Inventory* (NEI) (2017), https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data. Emissions data is discussed in greater detail below.

[9] EPA, *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment. Residential Clothes Dryers and Room Air Conditioners, Appendix 15A. Emissions Factors for Fuel Combustion from Natural Gas, LPG, and Oil-fired Residential Appliances, Table 15-A.1.1* (Apr. 2011), https://downloads.regulations.gov/EERE-2007-BT-STD-0010-0053/attachment_42.pdf. (CO_2 emissions from household fuel combustion of distillate oil, liquefied petroleum gas, and natural gas are 68.6, 58.7, and 50.6 kg/GJ,

Appliance pollution has significant health impacts, from increasing the rates of asthma to causing thousands of premature deaths each year. The COVID-19 pandemic has highlighted the danger of poor air quality and the compounding health impacts of air pollution on vulnerable populations like children, low-income communities, and individuals with preexisting health conditions.[10] Indeed, researchers in one recent study found that people who lived in areas with higher ambient concentrations of fine particulate matter, nitrogen dioxide, and ozone were more likely to experience severe outcomes when diagnosed with COVID-19.[11] Emissions regulations for heating appliances are long overdue and the need has never been greater.

We formally petition EPA to list heating appliances as a source category under section 111(b) of the Clean Air Act and to promulgate zero-emission standards for new appliances within the category—more specifically, performance standards that eliminate the emission of nitrogen oxides (NO_x)[12] from water heaters and furnaces, similar to the standards already set by multiple states and local air districts.[13] To protect public health while achieving the added benefit of advancing the Biden administration's carbon reduction goals,[14] EPA must set zero-emission standards for such appliances by 2030, with compliance required by product manufacturers. Establishing a nationally applicable date certain for the full phase-out of these fossil fuel-fired heating appliances will provide regulatory and market certainty for manufacturers, retailers, contractors, property developers, installers, and consumers. In addition, a date certain will allow for the funding and design of the programs necessary to implement the standards in an equitable manner.

Section 111(b) of the Clean Air Act (CAA) requires the EPA Administrator to identify and list categories of stationary sources that cause, or contribute significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare.[15] Within one year of listing a new source category, the Administrator must propose standards of performance for new sources within the established category.[16] The statute defines a "standard of performance" as "a standard

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respectively; NO_x emissions are 55, 66, and 40 g/GJ, respectively; and SO_2 emissions are 218, 7, and 0 g/GJ, respectively).

[10] EPA, *Indoor Air and Coronavirus (COVID-19)*, https://www.epa.gov/coronavirus/indoor-air-and-coronavirus-covid-19 (last visited Aug. 18, 2022).

[11] Chen et. al., *Association between long-term exposure to ambient air pollution and COVID-19 severity: a prospective cohort study*, 194(20) Canadian Med. Assoc. J. E693-E700 (May 24, 2022).

[12] Although this would be a NO_x-based standard, it would have the co-benefit of reducing emissions of all of the other pollutants discussed in this petition because the best system of emissions reduction is zero-emitting electric technology.

[13] *See, e.g.*, 30 Tex. Admin. Code § 117.3205(a)(2)(A), https://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=117&rl=3205; Utah State Construction and Fire Codes Act § 15A-6-102(2)(a)(i), https://le.utah.gov/xcode/Title15a/C15A_1800010118000101.pdf; Cal. Air Res. Bd., *2022 State Strategy for the State Implementation Plan: Draft Measures* 54 (Oct. 6, 2021) (summarizing California air districts' low- NO_x standards), https://ww2.arb.ca.gov/sites/default/files/2021-10/2022_SSS_Draft_Measures.pdf.

[14] *The Biden Plan for a Clean Energy Revolution and Environmental Justice*, https://joebiden.com/climate-plan/ (last visited Aug. 18, 2022).

[15] 42 U.S.C. § 7411(b)(1)(A).

[16] *Id.* § 7411(b)(1)(B).

for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated."[17] The D.C. Circuit has held that "one of the agreed upon legislative purposes" of section 111 standards is to "reduc[e] emissions as much as practicable."[18] Notably, section 111(b) applies only to *new* sources, defined by the statute as those constructed or modified after the publication of proposed standards that would apply to them.[19] This means that standards promulgated under this provision do not apply to existing sources (*i.e.*, those appliances already in use in homes, schools, and businesses across the country), but would instead apply only to appliances manufactured after the date established in the rulemaking.[20]

In the sections that follow, we first describe the process by which EPA lists new source categories and explain why the agency has an obligation to do so for heating appliances. Afterward, we describe the process by which EPA develops new source performance standards for sources in a listed category and describe options for EPA.

II. EPA MUST LIST HEATING APPLIANCES AS A SECTION 111 SOURCE CATEGORY.

A. The Process for Listing a Source Category under Section 111

Section 111(b) requires the EPA Administrator to identify and list categories of stationary sources that "cause[], or contribute[] significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare."[21] EPA commonly refers to this inquiry as an "endangerment finding," and has recognized that it entails two distinct components: first, the source category must "cause or contribute significantly to air pollution;" and second, that pollution must "be reasonably anticipated to endanger public health or welfare."[22] EPA must base an endangerment finding solely on the extent of a source category's emissions and the harm that a related air pollution problem poses to public health and welfare; it may not take into account

[17] *Id.* § 7411(a)(1).

[18] *Sierra Club v. Costle*, 657 F.2d 298, 325-26 (D.C. Cir. 1981).

[19] 42 U.S.C. § 7411(a)(2).

[20] Under section 111(d) of the statute, EPA issues existing source emission guidelines for source categories subject to 111(b) regulations, although these guidelines may apply only to emissions of pollutants other than those regulated under section 108-110 of the Clean Air Act (i.e., the NAAQS program) or section 112 (the hazardous air pollutant program). 42 U.S.C. § 7411(d)(1). Once EPA issues a guideline, states then develop, submit for EPA's approval, and administer plans that include standards of performance for existing sources that are consistent with EPA's guideline. *Id.*

[21] 42 U.S.C. § 7411(b)(1)(A).

[22] 81 Fed. Reg. 35,824, 35,828 (June 3, 2016).

other factors such as cost at the listing stage[23] (although it must consider such factors when establishing standards for a listed category).

Additionally, the Administrator lacks discretion to *not* list a source category if the endangerment finding is affirmative,[24] which Congress recently affirmed in a Congressional Review Act (CRA) resolution that reinstated certain New Source Performance Standards (NSPS) requirements for oil and gas sources.[25] EPA may, however, create sub-categories of sources within a broadly defined source category by "distinguish[ing] among classes, types and sizes ... for the purpose of establishing ... standards."[26]

Furthermore, EPA has long held that under section 111, listing decisions are made based on a source category's overall emissions.[27] That is, EPA need not find that specific individual pollutants emitted by the source category meet either the "significance" or "endangerment" criteria in order to list that source category.[28] In enacting the CRA resolution noted above, Congress effectively ratified this understanding of the statute, explaining in the House Report that EPA must "list a source category on the basis of *all* of its air pollutants, taken collectively, and regardless of whether any of them, taken individually, contribute significantly to dangerous air pollution."[29]

The sources that Petitioners urge EPA to include in a new source category encompass appliances that generate heat for some purpose in residential or commercial/institutional buildings (except for wood-burning appliances, which are already regulated under section 111). This category would cover several different end-uses, including space heating, water heating, cooking, and clothes drying. The useful output generated by all sources in this category—heat—remains the same. Furthermore, for all such sources, that heat is generated by the same basic method

[23] EPA itself affirmed this position in finding that greenhouse gas emissions from fossil fuel-fired power plants contributed significantly to dangerous air pollution. *See* 80 Fed. Reg. 64,510, 64,531 n.109 (Oct. 23, 2015) ("Nor does the EPA consider the cost of potential standards of performance in making this Finding. Like the Endangerment Finding under section 202(a) at issue in *State of Massachusetts v. EPA*, 549 U.S. 497 (2007) the pertinent issue is a scientific inquiry as to whether an endangerment to public health or welfare from the relevant air pollution may reasonably be anticipated. Where, as here, the scientific inquiry conducted by the EPA indicates that these statutory criteria are met, the Administrator does not have discretion to decline to make a positive endangerment finding to serve other policy grounds.").

[24] *Id. See also* 42 U.S.C. § 7411(b)(1)(A) (the Administrator "*shall* include a category of sources in such list if in his judgment it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare") (emphasis added).

[25] S.J.Res. 14, 117th Cong. (passed by Senate, Apr. 28, 2021; passed by House of Reps. as H.J.Res. 34, June 26, 2021; signed into law by President, June 30, 2021); *see also* H.R. Rep. No. 117-64, 9 (2021) ("[S]ection 111(b)(1)(A) requires the EPA to list 'a category of sources' for regulation if it 'causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare.'").

[26] 42 U.S.C. § 7411(b)(2); *Costle*, 657 F.2d at 318.

[27] *See, e.g.*, 81 Fed. Reg. 35,824, 35,842 (June 3, 2016) ("Though the endangerment finding is based on determinations as to the health or welfare impacts of the pollution to which the source category's pollutants contribute, and as to the significance of the amount of such contribution, the statute is clear that the endangerment finding is made with respect to the source category; CAA section 111(b)(1)(A) does not provide that an endangerment finding is made as to specific pollutants.").

[28] *Id.*

[29] H.R. Rep. No. 117-64, at 10 n.35 (emphasis added).

(primarily fuel combustion, but with electricity-based alternatives), using the same kinds of fuels (usually gas, propane, or oil), and emitting similar kinds of pollutants (described below).

In this regard, the proposed source category would be closely analogous to the residential wood heater source category, which covers "enclosed, combustion-controlled wood-fired appliances."[30] Under this category, EPA has thus far issued standards for new residential wood-burning stoves, hydronic heaters, forced-air heaters, and masonry heaters.[31] These sources differ in terms of specific technology and process methods, but all produce heat for some domestic use, including water-heating and space-heating.[32] And although EPA has exempted wood-burning cook stoves thus far due to a lack of information on emission reduction techniques,[33] its regulations define these devices as "wood-fired appliances" that fall within the scope of the source category.[34]

The source category Petitioners propose would be similar to the wood stove category, but would cover heating appliances *other* than those that burn wood. While EPA could define that source category without respect to any particular fuel or class of fuels, the vast majority of emissions directly emitted from such sources come from fossil fuel-fired heating appliances, and that is therefore the class of appliances we focus on throughout this petition. If EPA created a fuel-neutral category for residential and commercial/institutional heating appliances, it could then establish subcategories based on the fuel source (gas, oil, or propane), sector (residential, commercial, institutional, etc.), end-use (space heating, water heating, cooking, clothes drying, etc.), characteristics of the building in which the appliances are installed (single-family vs. multi-unit, newly constructed buildings vs. pre-existing structures), and other appropriate factors.

There is a robust and growing body of evidence indicating that heating appliances contribute significantly to air pollution that endangers public health, easily satisfying both the "significance" and "endangerment" components of a listing decision. EPA must therefore list them as a source category under section 111(b)(1)(A). Below, we first provide an overview of the different pollutants emitted by fossil fuel-fired heating appliances—namely, nitrogen oxides (NO_x),[35] carbon monoxide (CO), fine particulate matter ($PM_{2.5}$), and carbon dioxide (CO_2)—and describe how these pollutants endanger public health and welfare. Indeed, there can be no dispute that these pollutants satisfy the first factor required for section 111 listing decision. For years, EPA has regulated each of them under section 111 and (except for CO_2) under the National Ambient Air Quality Program as well, either as criteria pollutants or criteria pollutant precursors.[36] Although EPA therefore need not find anew that these pollutants endanger public health and welfare for the purposes of listing the source category we propose, we nonetheless

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[30] 52 Fed. Reg. 5,065, 5,066 (Feb. 18, 1987).

[31] *See* 40 C.F.R. 60, subparts AAA and QQQQ; 80 Fed. Reg. 13,672 (March 16, 2015).

[32] 40 C.F.R. § 60.531 (defining "wood heater" as "an enclosed, wood burning-appliance capable of and intended for residential space heating or space heating and domestic water heating").

[33] 79 Fed. Reg. 6,330, 6,353 (Feb. 3, 2014).

[34] 40 C.F.R. § 60.531.

[35] Data on these emissions and their health effects occasionally refer to nitrogen dioxide (NO_2) more specifically. NO_2 is one of a group of gases called nitrogen oxides, also referred to as "NO_x." While all of these gases are harmful to human health and the environment, NO_2 is sometimes used as the indicator for the various gaseous oxides of nitrogen.

[36] *See* 40 C.F.R. Part 50 (ambient air quality standards for ozone, carbon monoxide, and $PM_{2.5}$). EPA treats NO_x as both an ozone and $PM_{2.5}$ precursor.

discuss in the section that follows the harm posed by each of these pollutants in order to emphasize just how critical it is to control emissions from this source category.

Next, we describe how heating appliances such as gas water heaters and furnaces contribute "significantly" to these dangerous pollution problems, thus fulfilling both requirements for a source category listing. Both the emissions data presented below and the public health data for the pollutants in question come primarily from EPA, as well as from independent scientific studies and technical analyses. EPA's 2020 Integrated Science Assessment for Ozone,[37] 2019 Integrated Science Assessment for Particulate Matter,[38] 2016 Integrated Science Assessment for Oxides of Nitrogen,[39] and 2010 Integrated Science Assessment for Carbon Monoxide[40] focus directly on the health and welfare impacts of ambient exposure to the pollutants.

B. The Pollutants Emitted by Heating Appliances Endanger Public Health and Welfare.

1. Nitrogen Oxides

Nitrogen oxides (NO_x) are a family of pollutants that form in the air when fuel is combusted in the presence of air at high temperatures, including combustion in fossil fuel-fired heating appliances. It is well established that NO_x emissions endanger public health and welfare, both in and of themselves and as a chemical precursor to other ambient air pollutants—namely, ozone and fine particulate matter. EPA has repeatedly recognized the dangers of NO_x emissions and has regulated the pollutant under section 111 for other sources, including fossil fuel-fired steam generators,[41] municipal waste combustors,[42] nitric acid plants,[43] stationary gas turbines,[44] and Portland cement plants,[45] among others.

First, there is broad consensus in the scientific and public health community that direct exposure to NO_x itself negatively impacts human health. In its 2016 ISA, EPA found a causal relationship between short-term exposure to nitrogen dioxide (NO_2) and respiratory effects, as well as evidence suggesting a causal relationship between short-term NO_2 exposure and both cardiovascular effects and total mortality.[46] EPA also found a likely causal effect between long-term NO_2 exposure and respiratory effects, as well as evidence suggesting a causal

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[37] EPA, *Integrated Science Assessment (ISA) for Ozone and Related Photochemical Oxidants ("Ozone ISA")* (Apr. 2020), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=348522.

[38] EPA, *Integrated Science Assessment (ISA) for Particulate Matter ("PM ISA"*) (Dec. 2019), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534.

[39] EPA, *Integrated Science Assessment (ISA) for Oxides of Nitrogen ("NO_x ISA")* (Jan. 2016), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=310879.

[40] EPA, *Integrated Science Assessment (ISA) for Carbon Monoxide* ("*CO ISA*") (Jan. 2010), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=218686.

[41] 40 C.F.R. § 60.44.

[42] *Id.* § 60.55a.

[43] *Id.* § 60.72.

[44] *Id.* § 60.332.

[45] *Id.* § 60.62(a)(3).

[46] *NO_x ISA* at lxxxii, Table ES-1.

relationship between NO_2 exposure and cardiovascular effects, diabetes, adverse birth outcomes, cancer, and total mortality.[47] The report further acknowledged that people with asthma, children, and older adults are at increased risk for NO_x-related health effects.[48]

Secondly, after being emitted into the atmosphere, NO_x reacts with organic compounds in the presence of sunlight to form ground-level ozone, the primary ingredient of smog.[49] Researchers have long understood the serious detrimental health impacts from exposure to ground-level ozone.[50] Particularly clear is the "causal relationship between short-term ozone exposure and respiratory health effects," which is reflected in "a strong body of evidence integrated across controlled human exposure, animal toxicological, and epidemiologic studies, in addition to established findings from previous [air quality criteria determinations]."[51] These health effects include "lung function decrements, respiratory symptoms, and increased inflammation in young healthy adults," as well as "asthma exacerbation, COPD exacerbation, and hospital admissions and ED visits for combined respiratory disease."[52] It is estimated, for instance, that up to 11% of all asthma emergency room visits in the United States are attributed to ozone.[53] Asthma is a serious public health concern and research has shown that it disproportionately impacts communities of color. A report from the Asthma and Allergy Foundation of America showed that Black, Hispanic, and Indigenous populations have the highest rates of asthma in the United States, and that Black Americans are three times more likely than the general population to die from asthma.[54]

The scientific evidence also suggests a relationship between short-term ozone exposure and cardiovascular effects.[55] For instance, research has linked out-of-hospital cardiac arrests with short-term exposure to ozone.[56] Other studies indicate higher rates of stroke in populations following higher exposures to ozone. A study in Pennsylvania that used a time-stratified case-crossover analysis found that exposure to ozone on the current day increased the risk of total stroke hospitalization.[57] Another study in Nueces County, Texas evaluated associations with incident stroke and stroke severity in Corpus Christi between 2000 and 2012 and found elevated risk of having a first stroke with higher ozone concentrations in the preceding two days.[58] This is

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[47] *Id.*

[48] *Id*. at lxxxvii.

[49] *Ozone ISA* at lxiv.

[50] *Id.* at ES-16.

[51] *Id.* at 3-2.

[52] *Id.* at 3-79.

[53] Susan C. Anenberg et al., *Estimates of the Global Burden of Ambient $PM_{2.5}$, Ozone, and NO_2 on Asthma Incidence and Emergency Room Visits*, 126(10) Env't Health Persp. 107004 (Oct. 2018).

[54] Melanie Carver et al., *Asthma Disparities in America: A Roadmap to Reducing Burden on Racial and Ethnic Minorities*, Asthma and Allergy Foundation of America, (2020), https://www.aafa.org/asthmadisparities.

[55] *Ozone ISA* at 4-1 to 4-38.

[56] Katherine B. Ensor et al., *A Case-Crossover Analysis of Out-of-Hospital Cardiac Arrest and Air Pollution*, 127 Circulation 1192 (2013), https://doi.org/10.1161/circulationaha.113.000027.

[57] Xiaohui Xu et al., *Association between ozone exposure and onset of stroke in Allegheny County, Pennsylvania, USA, 1994-2000,* 41 Neuroepidemiology 2, 2-6 (2013), http://dx.doi.org/10.1159/000345138.

[58] Jeffrey J Wing et al., *Short-term exposures to ambient air pollution and risk of recurrent ischemic stroke*, 152 Env't Rsch 304 (Jan. 2017), https://doi.org/10.1016/j.envres.2016.11.001.

supported by two independent meta-analyses of multiple studies.[59] This evidence augments the long-standing body of literature demonstrating the serious impacts from short-term exposure to ozone pollution, including the increased risk of premature death.[60]

Long-term exposure to ozone is also linked to negative health outcomes. EPA's 2020 Ozone ISA finds a "likely" causal relationship between long-term ozone exposure and respiratory effects, as well as evidence suggesting a causal relationship between long-term exposure and cardiovascular health.[61]A number of recent studies, for example, "provide evidence of an association between long-term exposure to ozone and asthma development in children."[62] One recent study of 5,780 adults followed for a decade across six U.S. metropolitan regions found that long-term ozone was significantly associated with development of emphysema, having the same effect as 29 pack-years of smoking or three years of aging.[63] Additionally, in a study of 11 million Medicare enrollees in the Southeastern U.S., long-term ozone was associated with increased risk of first hospital admissions for stroke, chronic obstructive pulmonary disease, pneumonia, myocardial infarction, lung cancer, and heart failure.[64]

Health effects other than those impacting cardiovascular or respiratory systems are also likely. EPA found evidence linking either short-term ozone exposure, long-term exposure, or both, to adverse metabolic, central nervous system, and reproductive effects.[65] One 2017 study suggested that ozone exposure may be linked to approximately 8,000 stillbirths per year.[66] Studies carried out in California and Florida, with data from over 400,000 births each, found that elevated exposure to ozone during pregnancy was associated with higher risk of preterm birth.[67] A systemic review of birth studies in 2020 revealed a statistically significant association between heat, ozone, or fine particulate matter and adverse pregnancy outcomes.[68] The findings from this

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[59] Anoop SV Shah et al., *Short term exposure to air pollution and stroke: systematic review and meta-analysis*, 350 BMJ h1295 (2015), https://doi.org/10.1136/bmj.h1295; Wan-Shui Yang et al., *An evidence-based appraisal of global association between air pollution and risk of stroke*, 175.2 Int'l J. of Cardiology 307, 307-313 (2014), https://doi.org/10.1016/j.ijcard.2014.05.044.

[60] *Ozone ISA* at 14 ("Recent multicity epidemiologic studies conducted in the U.S. and Canada continue to provide evidence of consistent, positive associations between short-term ozone exposure and total mortality in both all-year and summer/warm season analyses across different averaging times concluding that there is 'likely' to be a causal relationship between short-term exposures to [ozone] and total mortality.").

[61] *Ozone ISA* at IS-7.

[62] *Id.* at 3-94, 3-116.

[63] Meng Wang et al., *Association between long-term exposure to ambient air pollution and change in quantitatively assessed emphysema and lung function*, 322(6) JAMA 546, 546-556 (2019), https://doi.org/10.1001/jama.2019.10255.

[64] Mahdieh Danesh Yazdi et al., *Long-term exposure to PM2. 5 and ozone and hospital admissions of Medicare participants in the Southeast USA*, 130 Env't Int'l 104879 (2019), https://doi.org/10.1016/j.envint.2019.05.073.

[65] *Ozone ISA* at IS-7.

[66] Mendola et al., *Chronic and Acute Ozone Exposure in the Week Prior to Delivery is Associated with the Risk of Stillbirth*, 14 Int'l J. Envt'l Rsch and Pub. Health 731 (2017), https://doi.org/10.3390/ijerph14070731.

[67] Oliver Laurent et al., *A statewide nested case-control study of preterm birth and air pollution by source and composition: California, 2001-2008,* 124(9) Env't Health Persp 1479, 1479-1486 (2016), https://doi.org/10.1289/ehp.1510133.

[68] Bruce Bekkar et al., *Association of Air Pollution and Heat Exposure With Preterm Birth, Low Birth Weight, and Stillbirth in the US: A Systematic Review*, 3(6) JAMA Network Open e208243 (2020), https://doi.org/10.1001/jamanetworkopen.2020.8243.

review suggest that exacerbation of air pollution and heat exposure related to climate change (discussed further below) may be significantly associated with risk to pregnancy outcomes in the US, and also showed that the subpopulations at highest risk were persons with asthma and minority groups, especially Black mothers.[69] Prolonged exposure to ozone may also accelerate cognitive decline in the early stages of dementia.[70]

Finally, ozone and/or NO_2 pollution disproportionately affects particular populations, such as people with preexisting respiratory or cardiovascular conditions, older adults, communities of color, and people who are active outdoors, especially outdoor workers.[71] Many studies have demonstrated that children with asthma experience decrements in lung function and increases in respiratory symptoms when exposed to ozone pollution.[72] Additionally, research from the University of Minnesota has found that communities of color experience levels of NO_2 exposure that are 38% higher than white communities.[73] Thus, ozone and NO_2 pollution does not harm all populations equally, but is most likely to burden specific communities, many of whom already suffer from income and public health disparities.

Beyond human health impacts, ozone and NO_x emissions have a substantial negative impact on human welfare. For decades, scientists have understood that ozone is harmful to vegetation, "interfering with carbon gain (photosynthesis) and allocation of carbon within the plant, making fewer carbohydrates available for plant growth, reproduction, and/or yield."[74] Ozone concentrations in the ambient atmosphere can thus have substantial effects on human welfare by reducing yields of key agricultural crops, inflicting foliar injury on existing plants, and inhibiting the growth of trees and forests that provide crucial ecosystem services such as natural carbon sequestration.[75] Furthermore, NO_x emissions are a major cause of eutrophication, a process in which the nitrogen in a body of water increases in relation to other nutrients like phosphorus and iron, often severely disrupting aquatic ecosystems that humans rely on for food, recreation, and other uses.[76] NO_x also contributes substantially to acid rain[77] and to atmospheric visibility problems.[78]

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[69] *Id.* at 8.

[70] Galkina Cleary et al., *Association of Low-Level Ozone with Cognitive Decline in Older Adults*, 61 J. Alzheimer's Disease 1, 67-78 (2018), https://doi.org/10.3233/jad-170658.

[71] *Ozone ISA* at IS-50 to IS-62; American Lung Association (ALA), *State of the Air*, 24-26 (2021), https://www.lung.org/getmedia/17c6cb6c-8a38-42a7-a3b0-6744011da370/sota-2021.pdf.

[72] K. Mortimer et al., *The Effect of Air Pollution on Inner-City Children with Asthma*, 19 Eur. Respiratory J. 699 (2002), https://doi.org/10.1183/09031936.02.00247102; *ISA*, 6-120–21, 6-160.

[73] L.P. Clark et al., *National Patterns in Env't Injustice and Inequality: Outdoor NO_2 Air Pollution in the United States*, 9(4) PLOS ONE (2014), https://doi.org/10.1371/journal.pone.0094431.

[74] 80 Fed. Reg. 65,292, 65,369 (Oct. 26, 2015); *see also* EPA, *Integrated Science Assessment for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter—Ecological Criteria* (Sept. 2020), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=349473.

[75] 80 Fed. Reg. at 65,369-73.

[76] EPA, *Technical Bulletin: Nitrogen Oxides (NO_x), Why and How They Are Controlled*, 7 (Nov. 1999), https://www3.epa.gov/ttncatc1/dir1/fnoxdoc.pdf.

[77] Id. at 1-3.

[78] EPA, *Introduction to Visibility Issues*, 1-3–1-5 (Nov. 2001), https://www.epa.gov/sites/default/files/2015-05/documents/chap01.pdf

2. *Particulate Matter*

Particulate matter (PM) is the generic term for a broad class of substances that exist as discrete particles. These particles may be emitted directly from a variety of anthropogenic sources, including fossil fuel combustion, or may be formed in the atmosphere by transformations of other pollutants, including NO_x. PM is described in two primary classifications: PM_{10} (which are inhalable particles with diameters that are generally 10 micrometers and smaller) and $PM_{2.5}$, (which are inhalable particles with diameters that are generally 2.5 micrometers and smaller).[79] These particles—particularly $PM_{2.5}$—can lodge deep within the lungs when inhaled and enter the bloodstream, causing serious health ailments.

In 2019, EPA published an updated ISA for PM.[80] The 2019 ISA correlated short-term exposure to PM emissions with respiratory effects, cardiovascular effects, cancer, and mortality.[81] It found similar correlations between long-term exposure and respiratory effects, cardiovascular effects, nervous system effects, cancer, and mortality.[82] The report also identified many demographics that are at increased risk of a PM-related health effects, including: children, people of color, individuals with pre-existing cardiovascular and respiratory disease, those who are overweight or obese, current or former smokers, and populations that are of low socioeconomic status.[83] One of the key findings of the 2019 ISA was that the scientific evidence continues to support a "linear, no-threshold concentration—response relationship," meaning there is no safe level of PM exposure above 0.[84] Moreover, a recent study indicates that the adverse health impacts of $PM_{2.5}$ increase during extreme heat episodes,[85] which are now occurring with increasing frequency due to climate change.

Research published since the ISA's publication highlights the public health threat of particulate pollution. A 2020 report published in *Environmental Science and Technology Letters* estimated that approximately 100,000 premature deaths each year occur in the United States due to exposure to primary and secondary $PM_{2.5}$, attributing 8,600 of those deaths to $PM_{2.5}$ resulting from residential cooking and heating.[86] A study published last year in *Environmental Health Perspectives* paints an even grimmer picture, estimating between 120,000 to 130,000 annual premature deaths from $PM_{2.5}$ exposure *solely among those aged 65 and older*.[87] This latter report

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[79] EPA, *Particulate Matter (PM) Basic*s, https://www.epa.gov/pm-pollution/particulate-matter-pm-basics.

[80] *PM ISA*.

[81] *Id*. at ES-9.

[82] *Id*.

[83] *Id*. at ES-19.

[84] *Id*. at ES-*22.*

[85] M. Rahman, et al., *The Effects of Co-Exposure to Extremes of Heat and Particulate Air Pollution on Mortality in California: Implications for Climate Change*, Am. J. of Respiratory and Critical Care Med. (June 21, 2022), https://doi.org/10.1164/rccm.202204-0657oc.

[86] S. Thakrar, *Reducing Mortality from Air Pollution in the United States by Targeting Specific Emission Sources*, 7(9) Env't. Sci. Tech. Letter 639, 639–645 (July 15, 2020), https://doi.org/10.1021/acs.estlett.0c00424.

[87] E. Spiller et al., *Mortality Risk from $PM_{2.5}$: A Comparison of Modeling Approaches to Identify Disparities across Racial/Ethnic Groups in Policy Outcomes*, 129(12) Env't. Health Persp. (Dec. 8, 2021), http://dx.doi.org/10.1289/EHP9001.

also reflects profound inequalities across racial lines, finding that older Black Americans are three times more likely to die from $PM_{2.5}$ exposure compared to older white Americans.[88]

Like NO_x, particulate matter imposes substantial costs on human welfare. First, "[a]mbient concentrations of fine particles are the primary pollutant responsible for visibility impairment,"[89] affecting both urban and regional atmospheric viewsheds.[90] In developing its secondary ambient air quality standards for $PM_{2.5}$, EPA has devoted considerable attention to the persistent visibility problems resulting from particulate matter concentrations.[91] Aerosolized particles also contribute to climate disruption, "directly through radiative forcing and by indirect effects on cloud brightness, changes in precipitation, and possible changes in cloud lifetimes."[92] Additionally, EPA has also concluded that PM concentrations negatively affect plant photosynthesis and damage vegetative surfaces; inhibit ecosystem support services such as nutrient cycling and the regulation of flooding and water quality; and and harm wildlife through biomagnification of heavy metals up the food chain and bioconcentration of toxic compounds.[93]

3. Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless gas that is released when carbon-containing fuels are burned. CO can be extremely harmful to human health when inhaled in large amounts, as it displaces oxygen in the blood and deprives the heart, brain, and other vital organs of oxygen,[94] causing dizziness, nausea, confusion, tissue damage, and even death.[95] Even apart from its oxygen deprivation effects, CO exposure can cause heart damage that persists after the toxic gas has been eliminated from the blood.[96]

In 2010, EPA published a final Integrated Science Assessment (ISA) for carbon monoxide, which provides a comprehensive review of the research documenting the health impacts of this pollutant.[97] Although the ISA is now 12 years old, the findings are still relevant and have been reaffirmed in more recent studies.[98] The ISA found evidence of a causal relationship between short-term CO exposure and cardiovascular morbidity, central nervous system effects, respiratory morbidity, and mortality rates.[99] It also identified causal relationships between long-term CO exposure and central nervous system effects, birth outcomes and developmental effects, respiratory morbidity, and mortality rates.[100] The report found that people with pre-existing diseases (including coronary artery disease, chronic obstructive pulmonary disease, and

[88] *Id.*

[89] 67 Fed. Reg. 68,242, 68,254 (Nov. 8, 2002).

[90] 78 Fed. Reg. 3,086, 3,183 (Jan. 15, 2013).

[91] *Id.* at 3,186-3,202.

[92] *Id.* at 3,202-03.

[93] *Id.* at 3,202-04.

[94] Department of Labor, *OSHA Fact Sheet* (2002), https://www.hsdl.org/?view&did=14826.

[95] EPA, *What is Carbon Monoxide?*, https://www.epa.gov/indoor-air-quality-iaq/what-carbon-monoxide-0.

[96] Lifespan, *Carbon Monoxide May Cause Long-lasting Heart Damage*, ScienceDaily (Jan. 29, 2008), www.sciencedaily.com/releases/2008/01/080129125412.htm.

[97] *CO ISA*.

[98] More recent research and reports on the health effects of CO exposure are typically focused on indoor air quality.

[99] *CO ISA*, at 2-5.

[100] *Id*.

diabetes), developing children, and older adults as populations were particularly susceptible to CO-induced health effects.[101] Based on the serious public health risks posed by CO exposure, EPA has previously regulated CO emissions under Section 111 for multiple sources, including electric utility steam generating units,[102] petroleum refineries,[103] and ferroalloy production facilities.[104]

4. Carbon Dioxide

For many decades, scientists have understood that ambient concentrations of greenhouse gases like carbon dioxide (CO_2) trap radiation in the atmosphere and increase the surface temperature of the Earth. EPA formally determined in 2009 that six well-mixed GHGs—including CO_2—endanger public health and welfare because they are the "primary driver of current and projected human-induced climate change."[105] In the following 13 years, EPA has on multiple occasions reiterated its 2009 Endangerment Finding, concluding that more recent research, comprehensive reports, and data not only corroborate its findings from 2009 but strengthen them considerably.[106]

According to the 2020 Annual National Climate Report from the National Oceanic and Atmospheric Association (NOAA), 2020 was the fifth-warmest year on record, with an average annual temperature about 2.4 degrees Fahrenheit hotter than the 20th century average.[107] The 2020 data confirms a warming trend that has accelerated in recent years and decades. In fact, over the last 126 years, the five warmest years in the contiguous U.S. have all occurred since 2012.[108] Moreover, "[e]ach of the last four decades has been successively warmer than any decade that preceded it since 1850."[109] The IPCC also reported that "[g]lobal surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years."[110]

Simply put, the world is hurtling rapidly toward a scenario in which catastrophic climate change is no longer a mere possibility or even likelihood, but is an outright certainty without major policy interventions to eliminate emissions of GHGs such as CO_2. The IPCC's most recent Assessment Report warns that "[t]he cumulative scientific evidence is unequivocal: Climate change is a threat to human well-being and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a livable and sustainable future for all."[111] And the window is

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[101] *Id.* at 5-123.

[102] 40 C.F.R. § 60, Subpart DA.

[103] 40 C.F.R. § 60, Subpart J.

[104] 40 C.F.R. § 60, Subpart Z.

[105] 74 Fed. Reg. 66,496 (Dec. 15, 2009).

[106] *See e.g.*, 86 Fed. Reg. 63,110, 63,124-27 (Nov. 15, 2021).

[107] NOAA National Centers for Environmental Information, *Temperature and Precipitation Analysis*, *State of the Climate: Monthly National Climate Report for Annual 2020* (Jan 2021), https://www.ncdc.noaa.gov/sotc/national/202013.

[108] *Id.*

[109] IPCC AR6, *Summary for Policymakers* at 5, A.1.2.

[110] *Id.* at 8, A.2.2.

[111] IPCC, *Climate Change 2022: Impacts, Adaptation and Vulnerability-- Working Group II Contribution to the*

brief indeed: the Mercator Research Institute on Global Commons and Climate Change calculates that, at current global GHG emission rates, the world has merely six years and eleven months before it expends its remaining carbon budget of approximately 300 billion metric tons of CO_2 for staying within the critical threshold of 1.5°C of warming.[112] Above this threshold, many of the severest impacts of climate change will be irreversible.

The science behind GHG-driven climate change is so voluminous and well-established that a comprehensive discussion of its many impacts is beyond the scope of this petition. We do, however, provide a brief overview of the kinds of effects on public health and welfare that climate change is having and will continue to have in the future. First, GHG-driven climate change is already directly—and significantly—affecting public health.[113] EPA has previously recognized that "climate change is expected to increase ozone pollution over broad areas of the U.S., especially on the highest ozone days and in the largest metropolitan areas with the worst ozone problems, and thereby increase the risk of morbidity and mortality."[114] It further noted that "climate change, in addition to chronic stresses such as extreme poverty, is negatively affecting Indigenous peoples' health in the U.S. through impacts such as reduced access to traditional foods, decreased water quality, and increasing exposure to health and safety hazards,"[115] also describing the ways in which children are uniquely vulnerable to climate change.[116]

Heat is the most direct health threat from climate change,[117] particularly for older adults and young children, outdoor workers, low-income communities, communities of color, and people with chronic illnesses.[118] By 2090, 49 U.S. cities will see an estimated 9,300 additional premature deaths due to heat.[119] Recent heat events have brought this concern to the forefront,[120]

Sixth Assessment Report of the Intergovernmental Panel on Climate Change: Summary for Policymakers, 35 (2022), https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf.

[112] Mercator Rsch Institute on Global Commons and Climate Change, *Remaining Carbon Budget: That's How Fast the Clock is Ticking*, https://www.mcc-berlin.net/en/research/co2-budget.html (last visited August 18, 2022).

[113] A. Crimmins et al., US Global Change Research Program (USGCRP), *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (2016) at 26, https://health2016.globalchange.gov/; Br. of *Amici Curiae* American Thoracic Society, American Medical Association, American Academy of Pediatrics, American College of Physicians, and Leaders of Public Health Schools, et al., in Supp. of Resps., Nos. 20-1530, 20-1531, 20-1778, and 20-1780, *West Virginia v. EPA* (Jan. 25, 2020); Br. of *Amici Curiae* Climate Health Now and San Francisco Bay Physicians for Social Responsibility in Support of Def.-Appellee City of Berkeley at 14-19, *Cal. Restaurant Assoc. v. City of Berkeley*, No. 21-16278 (9th Cir. Feb. 8, 2022) (focusing specifically on health impacts from appliance GHG emissions).

[114] 80 Fed. Reg. 64,662, 64,682 (Oct. 23 2015).

[115] *Id.* at 64,683.

[116] *Id.*

[117] USGCRP at 30 (2016).

[118] Carina J. Gronlund, *Racial and socioeconomic disparities in heat-related health effects and their mechanisms: a review*, 1(3) Curr Epidemiol Rep. 165 (2014), https://doi.org/10.1007%2Fs40471-014-0014-4.

[119] EPA, *Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment*, 209-10 at 48 (2017), https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=335095.

[120] Nadja Popovich and Winston Choi-Schagrin, *Hidden Toll of the Northwest Heat Wave: Hundreds of Extra Deaths*, The New York Times (Aug. 11, 2021), https://www.nytimes.com/interactive/2021/08/11/climate/deaths-pacific-northwest-heat-wave.html#:~:text=Washington%20State%20has%20officially%20reported,heat%2Drelated%20deaths%20so%20far.

particularly for the millions of Americans who lack access to air conditioning[121] and are therefore at greater risk of heat-related illness and death.[122] Although increased access to air conditioning and other climate resiliency measures can help limit heat-related deaths and illnesses, future increases in heat could "recurrently 'imprison people' indoors and may turn infrastructure failures (e.g., power outages) into catastrophic events."[123]

Climate change also is likely to worsen air quality by accelerating the formation of ground-level ozone pollution, increasing fine particle pollution and ozone pollution from wildfires, and making pollen and mold allergy seasons longer and more severe.[124] For example, there is consistent evidence that wildfire smoke exacerbates existing respiratory health problems, including increased risk of respiratory infections.[125] One study that modeled wildfire smoke exposures over the continental U.S. from 2008 to 2012 found that health costs from short-term smoke exposures totaled $63 billion in net present value over the study period, and $450 billion for long-term exposure effects.[126]

In addition to heat-related health risks, the IPCC reports that changes in temperatures and precipitation resulting from climate change will impact the "distribution and range of vector-borne diseases, such as malaria."[127] The USGCRP has similarly determined that climate change will likely alter the geographical extent and seasonal timing of tick- and mosquito-borne diseases like Lyme disease and West Nile virus.[128] The two species of ticks capable of spreading Lyme disease—the most common vector-borne illness in the U.S.[129]—have already expanded to new regions of the U.S. partly because of rising temperatures,[130] and their range expanded by

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[121] Lucas Davis, *How Many U.S. Households Don't Have Air Conditioning?*, Energy Institute at Haas (Aug.15, 2022), https://energyathaas.wordpress.com/2022/08/15/how-many-u-s-households-dont-have-air-conditioning/.

[122] Jacqueline E. Cardoza et al., *Heat-Related Illness Is Associated with Lack of Air Conditioning and Pre-Existing Health Problems in Detroit, Michigan, USA: A Community-Based Participatory Co-Analysis of Survey Data*, 17(16) Int J Environ Res Public Health 5704 (2020), https://doi.org/10.3390%2Fijerph17165704.

[123] Mora et al., *Twenty-Seven Ways a Heat Wave Can Kill You: Deadly Heat in the Era of Climate Change*, 10(11) Circulation: Cardiovasc. Qual. Outcomes (Nov. 7, 2017), https://doi.org/10.1161/CIRCOUTCOMES.117.004233.

[124] USGCRP at 70 (2016).

[125] C.E. Reid et al., *Critical Review of Health Impacts of Wildfire Smoke Exposure*, 124 Env't Health Persp. 1334 (2016), http://dx.doi.org/10.1289/ehp.1409277.

[126] Neal Fann et al., *The Health Impacts and Economic Value of Wildland Fire Episodes in the U.S.: 2008–2012*, 610-611 Sci. Total Env't. 802 (2018), https://doi.org/10.1016/j.scitotenv.2017.08.024.

[127] Department of Defense, Office of the Undersecretary for Policy, *Department of Defense Climate Risk Analysis* at 4, 9 (2021), (report submitted to National Security Council), https://media.defense.gov/2021/Oct/21/2002877353/-1/-1/0/Dod-Climate-Risk-Analysis-Final.Pdf.

[128] USGCRP at 130 (2016).

[129] Amy M. Schwartz et al., *Surveillance for Lyme Disease: United States, 2008-2015*, 66 MMWR 1 (2017), https://www.cdc.gov/mmwr/volumes/66/ss/ss6622a1.htm.

[130] R.J. Eisen et al., *Tick-Borne Zoonoses in the United States: Persistent and Emerging Threats to Human Health*, 58(3) ILAR J. 319 (2017), https://doi.org/10.1093/ilar/ilx005.

roughly 45% between 1998 and 2015.[131] In addition, rising temperatures, more extreme rainfall, and coastal storm surges are expected to increase the risk of water-[132] and food-borne illnesses. [133]

GHG-driven climate change also jeopardizes human health and welfare by affecting drastic changes in weather patterns. As the IPCC recently explained, in addition to increasing the frequency and intensity of heat waves (as noted above), climate change causes more extreme weather events such as hurricanes and tropical cyclones; heavier precipitation in some areas and, in others, agricultural and ecological droughts; an increase in the proportion of intense tropical cyclones; and reductions in Arctic sea ice, snow cover, and permafrost.[134] In a 2020 study, researchers from NOAA and the University of Wisconsin Madison estimated that hurricanes and tropical cyclones have become about 5% more likely to reach "major" hurricane status in each successive decade since 1979.[135] The 2020 hurricane season, for example, broke or tied several records, and climate change is projected to continue to increase hurricane intensity, making hurricanes more destructive by fueling higher wind speeds and more rainfall.[136]

Sea level rise resulting from climate change will also make coastal floods more frequent and severe during storms.[137] The IPCC recently determined that, in 2016, global sea level rise occurred at the fastest rate "since 1900 than over any preceding century in at least the last 3000 years."[138] Global average sea level rose by seven to eight inches between 1900 and 2017 and is likely to rise by 1.0 to 4.3 feet by the end of the century relative to the year 2000, with possible increases as high as 8.2 feet.[139] Rising sea levels are already making flooding more likely. For instance, since the 1960s, sea level rise has contributed to a 5- to 10-fold increase in minor tidal floods along the U.S. coast, which are expected to become more frequent, deeper, and wider in extent as sea levels continue to rise. The IPCC forecasts that flooding will become more likely in coastal cities due to "the combination of more frequent extreme sea level events (due to sea level rise and storm surge)."[140]

Heavy precipitation has likewise become more frequent and intense in most regions of the U.S. since 1901,[141] even as average annual precipitation has decreased in some regions.[142] Recent

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[131] R.J. Eisen et al., *County-Scale Distribution of Ixodes scapularis and Ixodes pacificus (Acari: Ixodidae) in the Continental United States*, 53 J. Med. Entomol. 349 (2016), https://doi.org/10.1093/jme/tjv237.

[132] USGCRP at 158 (2016).

[133] *Id.* at 190.

[134] IPCC AR6, *Summary for Policymakers,* at 15, B.2.

[135] James P. Kossina et al., *Global increase in major tropical cyclone exceedance probability over the past four decades*, 117(22) Proc. Nat'l Acad. Sci. 11975 (June 2020), https://doi.org/10.1073/pnas.1920849117.

[136] USGCRP at 257 (2017).

[137] USGCRP at 27 (2017).

[138] IPCC AR6, *Summary for Policymakers*, at 8, A.2.4.

[139] *Id.* at 25-26, 333, 343.

[140] IPCC AR6, *Summary for Policymaker*s, at 25, C2.6.

[141] *Id.* at 20.

[142] *Id.* at 207.

studies of Hurricane Harvey[143] and the 2016 flood in south Louisiana[144] concluded that climate warming made the record rainfall totals of both disasters more likely and intense. Just like other climate change impacts, precipitation variability—both very wet and very dry events—will also get more extreme with additional warming.[145] Under continued high GHG emissions, most U.S. regions are projected to experience two to three times more extreme precipitation events by the end of the century than they do now.[146] Rainfall during hurricanes making landfall in the eastern U.S. could also increase by 8 to 17% over the next century, compared to 1980-to-2006 levels.[147] Hurricanes and the resulting floods are especially dangerous for communities—often low-income communities and communities of color[148]—living near Superfund and hazardous waste sites, as was demonstrated in Newark after Hurricane Ida.[149] Hurricanes, storms, and flooding also contribute to increased prevalence of mold and mildew which further exacerbate public health issues like asthma and other respiratory illnesses.[150]

Climate warming also has exacerbated recent historic droughts and western U.S. wildfires by reducing soil moisture and contributing to earlier spring melt and reduced water storage in snowpack.[151] In the continental western U.S., human-caused climate change accounted for more than half of observed increases in forest fuel aridity from 1979 to 2015.[152] Drying of forest fuels has helped increase the number of large fires and has contributed to a doubling in fire area since the early 1980s.[153] One model suggests that anthropogenic climate change may have quintupled

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[143] David J. Frame et al., *The economic costs of Hurricane Harvey attributable to climate change*, 160 Climatic Change 271 (Apr. 8, 2020), https://doi.org/10.1007/s10584-020-02692-8; Kerry Emanuel, *Assessing the Present and Future Probability of Hurricane Harvey's Rainfall 2017*, 114 (48) PNAS 12681 (2017), https://doi.org/10.1073/pnas.1716222114; Mark D. Risser & Michael F. Wehner, *Attributable Human-induced Changes in the Likelihood and Magnitude of the Observed Extreme Precipitation During Hurricane Harvey*, 44 Geophysical Rsch Letters 12,457 (2017), https://doi.org/10.1002/2017GL075888; Geert Jan van Oldenborgh et al., *Attribution of Extreme Rainfall from Hurricane Harvey*, 12 Env't Rsch Letter 124009 (2017), https://doi.org/10.1088/1748-9326/aa9ef2.

[144] K. van der Wiel et al., *Rapid Attribution of the August 2016 Flood-inducing Extreme Precipitation in South Louisiana to Climate Change*, 21 Hydrol. Earth Sys. Sci. 897-921 (2017), https://doi.org/10.5194/hess-21-897-2017.

[145] IPCC AR6 at 19, B.3.2.

[146] USGCRP at 218 (2017).

[147] D.B. Wright et al., *Regional climate model projections of rainfall from U.S. landfalling tropical cyclones,* 45 Climate Dynamics 3365 (2015), https://doi.org/10.1007/s00382-015-2544-y.

[148] *See generally* Robert D. Bullard et al., *Toxic Wastes and Race at Twenty: 1987-2007*, United Church of Christ Justice & Witness Ministries, (2007), https://www.ucc.org/what-we-do/justice-local-church-ministries/justice/faithful-action-ministries/environmental-justice/environmental-ministries_toxic-waste-20/.

[149] Erik Ortiz, *'We've been forgotten': In Newark, N.J., a toxic Superfund site faces growing climate threats*, U.S. News (Oct. 1, 2020), https://www.nbcnews.com/news/us-news/we-ve-been-forgotten-newark-n-j-toxic-superfund-site-n1240706.

[150] Centers for Disease Control and Prevention, *Mold After a Disaster*, https://www.cdc.gov/disasters/mold/index.html.

[151] USGCRP at 231 (2017).

[152] *Id.* at 243.

[153] *Id.*

the risk of extreme vapor pressure deficit (a measure of atmospheric moisture) in the western U.S. and Canada in 2016, increasing the risk of wildfire.[154]

Higher warming also increases the probability and frequency of compound events, such as concurrent heatwaves and droughts in many regions. [155] For example, the Fourth National Climate Assessment concluded that large-scale shifts in the climate system, also known as tipping points, and the compound effects of simultaneous extreme climate events, have the potential to create unanticipated, and potentially abrupt and irreversible, "surprises" that become more likely as warming increases.[156] Moreover, the IPCC concludes that "[i]f global warming increases, some compound extreme events with low likelihood in past and current climate will become more frequent, and there will be a higher likelihood that events with increased intensities, durations and/or spatial extents unprecedented in the observational record will occur."[157] The crossing of tipping points could result in climate states wholly outside human experience and result in severe physical and socioeconomic impacts.[158]

All of the weather- and temperature-related effects of climate change—heat waves, droughts, flooding, sea-level rise, intensified hurricanes, and extreme weather events—will also affect human welfare in myriad ways that are separate from the health impacts described above. This includes reduced crop and livestock production in much of the world due to drought, extreme heat, pest and weed infestations, disease, and damage from storms, with consequent disruptions to the food supply; damage to forests due to larger and more intense wildfires, insect outbreaks, drought, and disease; severe disruptions to the water cycle as well as adverse effects on water quality; damage to, or destruction of, homes, buildings, beaches, recreational eras, roads, bridges, and other critical infrastructure due to sea-level rise and more powerful storms; devastating impacts on ecosystems, biodiversity, and wildlife, with mass extinctions expected of both plant and animal species; large-scale displacement of human populations; and an increased risk of war and conflict due to resource struggles.[159] Additionally, separate from climate change, high levels of CO_2 concentrations in the atmosphere are driving ocean acidification, which threatens the delicate underwater ecosystem by imperiling shell-based species such as oysters and coral, as well as various fish and seaweed species.[160] These are just a few of the devastating impacts that CO_2 emissions have on human welfare.

5. Pollution Impacts Specific to Heating Appliances

Thus far, we have focused on the general health and welfare impacts associated with NO_x, CO, PM, and CO_2. However, researchers have recently been working to pinpoint the *specific* effects

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[154] Simon F. B. Tett et al., *Anthropogenic Forcings and Associated Changes in Fires Risk in Western North America and Australia During 2015/16*, 99 BAMS S60-S64 (2018), https://doi.org/10.1175/BAMS-D-17-0096.1.

[155] IPCC AR6, *Summary for Policymakers*, at 25, C2.7

[156] USGCRP at 411-23 (2017).

[157] *Id.* at 26, C3.3.

[158] USGCRP 2017 at 411 (2017).

[159] 74 Fed. Reg. at 66,530-36.

[160] NOAA, *Ocean Acidification*, https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-acidification (last visited Aug. 8, 2022).

of pollution emitted by heating appliances in buildings, with startling findings. The data reveal that NO_x emissions from buildings contribute significantly to health harms, nonattainment of National Ambient Air Quality Standards (NAAQS), and racial-ethnic disparities in pollution exposure. A recent report by RMI found that many of the areas with the highest NO_x emissions from buildings are in ozone nonattainment areas.[161] Four of the top five and 19 of the top 25 counties for appliance NO_x emissions are in ozone nonattainment areas.[162] Areas with high building emissions are also often in major population centers, which can result in higher rates of exposure to this pollution. In counties in ozone nonattainment areas, average NO_x emissions from buildings exceed average NO_x emissions from power plants.[163] And in counties in nonattainment areas classified as moderate or higher, buildings emit over twice as much NO_x as power plants on average.[164] Similarly, many of the areas where buildings make their greatest contributions to ambient $PM_{2.5}$ concentrations (primary and secondary) are in $PM_{2.5}$ nonattainment areas.[165]

These emissions produce major health harms. Analysis by Harvard public health researchers indicates that fossil fuel-fired heating appliance contributions to outdoor $PM_{2.5}$ alone caused roughly 6,000 premature deaths nationwide in 2017–more than eight times as many deaths as were caused by gas power plants.[166] Using EPA's Benefits Mapping and Analysis Program, RMI similarly found that the annual health impacts of fossil fuel appliance pollution include "up to 5,400 premature deaths, 2,300 heart attacks, 55,000 asthma attacks, 2,600 asthma-related emergency room visits, 1,140 hospital admissions, and 355,000 work loss days."[167] The monetized costs of this pollution include $45.8 billion health costs (in 2017 dollars) and $24.7 billion in climate costs, totaling over $70 billion in social costs in 2017 alone.[168]

These pollution impacts disproportionately harm communities of color. A recent peer-reviewed

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[161] Jim Dennison, Leah Louis-Prescott & Talor Gruenwald, *How Air Agencies Can Help End Fossil Fuel Pollution from Buildings*, at 6-7, Exh. 2, RMI (2021), https://rmi.org/insight/outdoor-air-quality-brief/; *see also* RMI & Sierra Club, *Fact Sheet: Why EPA Must Address Appliance Pollution*, at 2, Exh. 2 (June 4, 2021), https://rmi.org/wp-content/uploads/2021/04/rmi_factsheet_appliance_pollution.pdf.
[162] RMI and Sierra Club analysis based on EPA's 2017 National Emissions Inventory data.
[163] *Id.* ("RMI analysis of EPA's National Emissions Inventory shows that counties in ozone nonattainment areas experience over 850 tons of appliance NO_x pollution per year on average. That's more than the average emissions in those counties from all power plants, including coal-fired plants. And in counties in ozone nonattainment areas classified as moderate or higher, which must apply Reasonably Available Control Measures to all emissions sources, appliances emit 1,150 tons per year of NO_x on average—over twice as much as the average power plant emissions of 460 tons per year.")
[164] *Id.*
[165] *Id.* at 7, Exh. 3.
[166] *Id.* at 7 (citing RMI analysis using median estimates from the results of 3 reduced complexity models used in: Jonathan J. Buonocore et al., *A Decade of The U.S. Energy Mix Transitioning Away from Coal: Historical Reconstruction of the Reductions in the Public Health Burden of Energy*, 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c, as well as additional analysis from Jonathan Buonocore, Sc.D., the study's lead author).
[167] *Id.*
[168] *Id.*

study found that communities of color are exposed to twice as much outdoor $PM_{2.5}$ pollution from residential gas combustion as white communities.[169] This was the highest relative racial-ethnic disparity in pollution exposure for any of the 14 source categories studied, including power plants, vehicles, and industrial sources.[170] RMI's independent analysis similarly found that communities of color are substantially more likely to live in census tracts with higher rates of exposure to $PM_{2.5}$ from residential appliances, while the opposite is true for white communities.[171] Additionally, Black people are 55% more likely to die from causes related to appliance pollution than white people.[172] These disparities appear connected to a history of racist housing policies, with the highest levels of appliance pollution in many states and cities occurring in areas that were historically redlined under the Home Owners' Loan Corporation's (HOLC's) grading system.[173]

C. Heating Appliances Cause or Contribute "Significant" Quantities of Dangerous Pollution.

In the section above, we describe how the different pollutants emitted by fossil fuel-fired heating appliances such as gas water heaters and furnaces endanger public health and welfare. Here, we explain how the proposed heating appliances source category causes or contributes "significantly" to that pollution, thus requiring listing under section 111(b).

First, EPA correctly maintains that the agency must base a "significance" determination on the *totality* of pollution emitted by the source category, rather than the quantities of each individual pollutant emitted.[174] As noted above, Congress ratified this interpretation in legislation passed in 2021, with a House Report confirming that "section 111 contemplates that the EPA list a source category on the basis of all of its air pollutants, taken collectively, and regardless of whether any of them, taken individually, contribute significantly to dangerous air pollution."[175] Nevertheless, there is no doubt that even considering only NO_x, fossil fuel-fired heating appliances emit NO_x in "significant" quantities, requiring that EPA list them as a source category. EPA's own data show that fossil fuel-fired heating appliances emit more NO_x on the whole than several of the source categories that are already subject to section 111 performance standards for their NO_x emissions.

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[169] *Id.* at 8 (citing Christopher W. Tessum et al., *$PM_{2.5}$ Polluters Disproportionately and Systemically Affect People of Color in the United States*, 7 Sci. Adv. eabf4491, supplementary data file S2 (2021), https://doi.org/10.1126/sciadv.abf4491).

[170] *Id.*

[171] *Id.*

[172] *Id.*

[173] *Id.* at 9-11, Exhs. 6-7.

[174] *See, e.g.*, 81 Fed. Reg. 35,824, 35,842 (June 3, 2016) ("Though the endangerment finding is based on determinations as to the health or welfare impacts of the pollution to which the source category's pollutants contribute, and as to the significance of the amount of such contribution, the statute is clear that the endangerment finding is made with respect to the source category; CAA section 111(b)(1)(A) does not provide that an endangerment finding is made as to specific pollutants.").

[175] H.R. Rep. No. 117-64 at 10 n.35.

According to the National Emissions Inventory (NEI), U.S. sources emitted 9,938,000 tons of NO_x into the atmosphere in 2017.[176] Of this total, 2.71% (approximately 270,000 tons) resulted from residential fossil fuel combustion and 1.93% (192,000 tons) resulted from appliances associated with commercial/institutional fossil fuel combustion.[177] An analysis by RMI finds that all of those residential emissions (i.e., 270,000 tons) are associated with the kinds of appliances that would fall within the source category we propose, and that approximately 156,000 tons of NO_x resulting from commercial/institutional combustion (1.56% of nationwide emissions) were associated with such appliances.[178] Thus, a combined source category covering residential and commercial/institutional appliances would represent 4.27% (425,000 tons) of total NO_x emissions. By contrast, natural gas-fired power plants, which have been subject to section 111 NO_x standards under the stationary combustion turbine source category since 1977,[179] emitted 145,000 tons of this pollutant in 2017,[180] 66% less than appliances. Petroleum refineries, which have been subject to section 111 NO_x controls since 2007,[181] emitted 68,000 tons in 2017,[182] 84% less than appliances. And cement plants, which have also been subject to NO_x standards since 2008,[183] emitted 105,000 tons in 2017,[184] 75% less than appliances.

Even *before* EPA imposed NO_x standards on the latter two source categories, their NO_x emissions were lower than those associated with fossil fuel-fired heating appliances. The 2005 NEI reported approximately 113,000 tons of NO_x emissions from refineries[185] and approximately 222,000 tons from cement plants.[186] At 425,000 tons, 2017 NO_x emission from a source category covering residential and commercial/institutional heating appliances would be 273% and 93%

[176] EPA, *2017 National Emissions Inventory: Jan. 2021 Updated Release, Technical Support Document*, at 2-12 (Sub Total (no federal waters)), https://www.epa.gov/sites/production/files/2021-02/documents/nei2017_tsd_full_jan2021.pdf.

[177] *Id.* at 2-11.

[178] In order to filter out emissions from sources in these NEI categories that are already subject to EPA's section 111 standards for industrial, commercial and institutional steam generating units, see 40 C.F.R. § 60, Subparts Da and Db, or that otherwise are too large to be classified as a heating appliance, RMI limited the commercial/institutional emissions figure to non-point sources, point-sources with input heat capacities less than 10 MMBtu/hr, and point-sources classified in the NEI as space heaters.

[179] 44 Fed. Reg. 52,798 (Setp. 10, 1979); 40 C.F.R. § 60.332. Although this regulation was finalized in 1979, it applies to any source that was constructed or modified after October 3, 1977. 40 C.F.R. § 60.4330(b).

[180] EPA, *National Emissions Inventory–2017 National Emissions Inventory (NEI) Data* (data query for national NO_x emissions), https://enviro.epa.gov/enviro/nei.htm?pType=SECTOR&pReport=nation&pState=&pPollutant=&pPollutant=NOX&pSector=&pYear=2017&pCounty=&pTier=&pWho=NEI (last visited Aug. 4, 2022).

[181] 73 Fed. Reg. 35,838, 35,840-41 (June 24, 2008); 40 C.F.R. § 60.102a(b)(2). Although this regulation was finalized in 2008, the standards apply to at least some sources that were constructed or modified as early as May 14, 2007. 40 C.F.R. § 60.100a(b).

[182] *2017 NEI.*

[183] 75 Fed. Reg. 54,970, 54,990 (Sept. 9, 2010); 40 C.F.R. § 60.62(a)(3). Although this regulation was finalized in 2008, the NO_x standards apply to any source constructed or modified after June 16, 2008. 40 C.F.R. § 60.62(a)(3).

[184] *2017 NEI.*

[185] EPA, *National Emissions Inventory–Pollutant Emissions Summary Files for Earlier NEIs* (.mdb file from 2005 NEI titled 42 Category Summary), https://gaftp.epa.gov/air/nei/nei_criteria_summaries/2005summaryfiles/42_category_summaryr.zip (last accessed Aug. 4, 2022).

[186] *Id.*

higher than the respective 2005 emissions from refineries and cement plants. Appliance NO_x emissions thus considerably exceed levels that EPA previously found appropriate to control in other sources categories through issuance of section 111 standards.

Perhaps the most notable point of comparison is EPA's regulatory policy for waste combustion facilities. Between 1991 and 2010, the agency established standards for performance for NO_x emissions from seven categories or subcategories of waste combustors and incinerators: municipal waste combustors,[187] large municipal waste combustors,[188] small municipal waste combustors,[189] hospital/medical/infectious waste incinerators,[190] commercial and industrial solid waste incineration units,[191] other solid waste incineration units,[192] and sewage sludge incineration units.[193] Under the NEI, these sources fall within the broad "waste disposal and recycling" category (which includes other sources as well, such as recycling facilities). NEI data shows that in 1990—when none of the seven NSPS categories/subcategories listed above were yet controlled for NO_x—"waste disposal and recycling" accounted for 91,000 tons of NO_x[194]—a mere 21% of the amount of NO_x emitted today by appliances in residential and commercial/institutional buildings. Indeed, according to the NEI's data on national emission trends, waste disposal and recycling facilities have consistently emitted between approximately 80,000 and 160,000 tons of NO_x.[195] Appliance emissions in residential and commercial/institutional buildings thus far exceed the NO_x emissions of waste combustion facilities, which have been subject to section 111 controls for decades.

Heating appliances' CO_2 emissions are no less "significant" than their NO_x emissions. EPA's 2021 Inventory of Greenhouse Gas Emissions and Sinks shows that residential and commercial fossil fuel combustion accounted for 5.1% (336.8 MMT) and 3.8% (249.7 MMT) of total CO_2 emissions in 2019.[196] Together, these figures amount to 586 million metric tons of CO_2 emissions —almost 9% of the U.S. total—and the vast majority of those emissions result from the kinds of heating appliances that we urge EPA to include in a section 111 source category.[197] That amount

[187] 40 C.F.R. § 60.55a.

[188] *Id.* § 60.52b(d).

[189] *Id.*, Subpart AAAA, Table 1.

[190] *Id.*, Subpart Ec, Tables 1A and 1B.

[191] *Id.*, Subpart CCC, Table 1.

[192] *Id.*, Subpart EEEE, Table 1.

[193] *Id.*, Subpart LLLL, Tables 1 and 2.

[194] EPA, *National Emissions Inventory–Air Pollutant Emissions Trends Data* (.xlsx file titled National Tier 1 CAPS Trends), https://www.epa.gov/sites/default/files/2021-03/national_tier1_caps.xlsx (last accessed Aug. 4, 2022).

[195] *Id.*

[196] EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*: 1990-2019, 430-R-21-005 at 2-31 (Apr. 2021), https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2019.

[197] In contrast to the NEI, EPA's GHG Inventory does not provide emissions data at a sufficiently granular level to allow for a determination as to what percentage of emissions from residential and commercial fossil fuel combustion result specifically from appliances as opposed to larger sources. However, as discussed above, RMI's analysis of NEI emissions data suggests that 92% of the combined NO_x emissions from residential and commercial sectors result from appliances, while 8% result from larger sources with higher combustion points. Because NO_x is produced in greater quantities as combustion temperature increases whereas CO_2 is not, it is likely that the relative percentage of CO_2 emitted by larger combustion sources in the commercial and residential sectors is less than the relative percentage of NO_x emitted by those categories, and thus that well over 92% of the 586 million metric tons

exceeds the total GHG emissions of 179 countries on Earth, including the United Kingdom, France, Italy, South Africa, Vietnam, Egypt, Pakistan, Turkey, Argentina, and Poland. [198] Indeed, there are only fourteen nations whose total GHG emissions do *not* exceed those of U.S. residential and commercial buildings.[199] According to the federal Interagency Working Group's current central estimate of $53/metric ton for the social cost of carbon in 2020—a highly conservative value—commercial and residential buildings' 586 million tons of annual carbon emissions amounts to approximately $31 billion in climate damages per year.[200] This is "significant" under any conceivable understanding of that term.

Under EPA's current methodology, residential and commercial building GHGs also exceed the CO_2-equivalent emissions of the only source category other than electric generating units that EPA currently regulates under section 111 as to its GHG emissions: the oil and gas sector. In 2016, EPA amended the NSPS for oil and gas equipment to cover emissions of methane, the second-most abundant greenhouse gas after CO_2.[201] According to the most recent Inventory data that EPA had available to it when it finalized those amendments, the segments of the oil and gas sector that were subject to regulation[202] emitted approximately 9.3 million metric tons of methane in 2014, or 231 million metric tons in CO_2-equivalent values.[203] In that rulemaking, EPA

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associated with residential and commercial fossil fuel combustion result from the kinds of appliances that would be included in the proposed source category.

[198] This figure reflects country-by-country emissions data from 2018 derived from the WRI/CAIT data set. *See* World Resources Institute (WRI), Climate Watch: Data Explorer, https://www.climatewatchdata.org/ghg-emissions?end_year=2017&sectors=total-excluding-lucf&source=CAIT&start_year=1850 (last visited May 13, 2022).

[199] *Id.*

[200] Interagency Working Group on Social Cost of Greenhouse Gases, *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*, Table 1 (Feb. 2021), https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf. It is worth emphasizing that in making a listing decision, EPA may not lawfully consider compliance costs associated with controlling pollution from the source category in question. *See supra*. note 23 (citing EPA's discussion of this issue at 80 Fed. Reg. at 64,531 n.109). Petitioners cite these monetized damage figures not to suggest that EPA can or should engage in a cost-benefit analysis for the purposes of listing a source category, but rather to provide another useful data point illustrating just how significant CO_2 emissions from U.S. heating appliances are.

[201] Although EPA issued a rule in 2020 that removed section 111 methane standards for this source category, Congress reversed that decision through legislation passed (and signed by President Biden) in 2021, extinguishing all doubt as to EPA's authority *and its obligation* under the Clean Air Act to control those emissions. Consistent with Congress's will, EPA has continued to enforce the 2016 methane NSPS for oil and gas sources and has proposed both to strengthen those standards and extend similar requirements to existing sources.

[202] These include oil production and natural gas production, processing, transmission, and storage.

[203] 81 Fed. Reg.at 35,838; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2014, Tables 3-36 and 3-46 (Apr. 15, 2016), https://www.epa.gov/sites/default/files/2017-04/documents/us-ghg-inventory-2016-main-text.pdf. It is critical to note that this CO_2-equivalency value reflects EPA's use of a 100-year global warming potential (GWP) of 25. Environmental advocates—including many signatories to this petition—have strenuously urged EPA to instead use the 20-year GWP of 84 for methane, which more accurately reflects the time frame during which critical GHG emission reductions must occur in order to avoid the worst impacts of climate change. A calculation based on the 20-year GWP would yield 640 million metric tons of CO_2-e from oil and gas equipment, and research indicates that the true quantity of the sector's emissions are far greater still. Petitioners refer to EPA's calculations in the Inventory not to suggest that we believe they accurately reflect the sector's true emissions, or because we support the agency's use of a GWP of 25 rather than 84—we do not—but rather to emphasize that the GHG emissions from appliances in

determined that this quantity of GHG emissions qualified as "significant" for the purposes of section 111[204] (even while it reiterated that the statute did not require a methane-specific significant contribution finding for the oil and gas source category[205]). By themselves, residential combustion GHGs and commercial combustion GHGs would both exceed the oil and gas sector total that EPA deemed "significant"; and as a single combined source category, their emissions exceed it by a factor of three.

The agency subsequently attempted to revise this determination for the oil and gas sector by first removing transmission and storage infrastructure from the source category definition[206] and later establishing a baseline threshold of 3% of the national total for a source category's GHG emissions to be considered "significant."[207] Yet even under this divergent approach–which a number of environmental organizations, including a signatory to this petition, challenged in court[208]–residential and commercial heating appliance emissions would *still* easily qualify as "significant," exceeding 3% both individually and as a single category. In any event, Congress's CRA Resolution overturned EPA's revision of the oil and gas source category, fully reinstating the 2016 rule,[209] while the D.C. Circuit separately vacated EPA's 3% GHG threshold for "significance" rule on procedural grounds at the agency's own request.[210]

Beyond NO_x and CO_2, heating appliances in buildings emit significant quantities of both CO and particulate matter. According to the NEI, gas, oil, and propane combustion in the residential and commercial/institutional sectors resulted in approximately 250,000 tons of CO emissions into the atmosphere in 2017.[211] This is more than the CO emitted by such sectors as chemical manufacturing, cement manufacturing, pulp and paper mills, and gas-fired power plants. Indeed, residential and commercial building appliances emitted over four times more CO in 2018 than petroleum refineries, a source category already subject to CO regulations under section 111.[212]

As for particulate matter, of the two types of PM—$PM_{2.5}$ and PM_{10}—the smaller (and more harmful) of the two is the one most closely associated with emissions from heating appliances. According to the NEI, fossil fuel combustion in buildings in 2017 emitted 15,358 tons of primary $PM_{2.5}$ in 2017, with 7,567 from residential buildings and 7,791 tons emitted from

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residential and commercial buildings far exceed amounts that both EPA has already deemed significant enough to require regulation under section 111.

[204] 81 Fed. Reg.at 35,837-40.

[205] *Id.* at 35,841-42.

[206] 85 Fed. Reg. 57,018, 57,024-29 (Sept. 24, 2020).

[207] 86 Fed. Reg. 2,542, 2,552-4 (Jan. 13, 2021).

[208] *See* Pet. for Review, *Envtl. Def. Fund, et al. v. Andrew Wheeler, et al.* (original caption), No. 20-1359 (D.C. Cir. Sept. 14, 2020) and Emergency Mot. for Stay Pending Review; Mot. for Summary Vacatur at 8-17, *Envtl. Def. Fund*, No. 20-1359 (challenging EPA's removal of transmission and storage equipment from the oil and gas source category definition); Pet. for Review, *Am. Pub. Health Assoc., et al. v. EPA*, No. 21-1036 (D.C. Cir. Jan. 19, 2021) (challenging EPA's rule establishing a threshold of 3% of national emissions before a listed source category may be subject to GHG standards under section 111).

[209] *See supra*, note 25.

[210] Per Curiam Order, *Am. Pub. Health Assoc.*, No. 21-1036 (granting EPA's unopposed motion for voluntary vacatur and remand).

[211] EPA, *2017 NEI: Jan. 2021 Updated Release, Technical Support Document* at 2-12, https://www.epa.gov/sites/production/files/2021-02/documents/nei2017_tsd_full_jan2021.pdf.

[212] *Id.*

commercial/institutional buildings.[213] Even more significant are the large quantities of secondary $PM_{2.5}$ that result from heating appliances. As noted above, heating appliances emit significant quantities of NO_x that react with other atmospheric substances to form $PM_{2.5}$. For example, NO_x reacts with ammonia to form ammonium nitrate, which makes up a large proportion of atmospheric $PM_{2.5}$. According to data from a study by Harvard researchers on the health burden of energy, exposure to (mostly secondary) $PM_{2.5}$ pollution resulting from residential and commercial fossil-fuel appliance emissions caused roughly 6,000 premature deaths throughout the United States in 2017.[214] Similarly, research published in 2020 found that $PM_{2.5}$ emissions from residential cooking and heating resulted in 8,600 annual deaths throughout the United States.[215] While over half of those deaths were attributable to wood combustion, fossil fuel combustion in U.S. homes resulted in several thousand deaths annually.[216] Once again, this is a "significant" impact under any rubric.

All told, the data simply leave no doubt: heating appliances in residential and commercial buildings cause or contribute "significantly" to dangerous air pollution, with respect to both their overall emissions (which is the governing legal standard) and their emissions of the specific pollutants discussed above. EPA is thus obligated to list heating appliances as a source category under section 111(b)(1).

III. WITHIN ONE YEAR OF LISTING HEATING APPLIANCES AS A SECTION 111 SOURCE CATEGORY, EPA MUST ISSUE NEW SOURCE STANDARDS OF PERFORMANCE FOR WATER HEATERS AND FURNACES IN THE SOURCE CATEGORY.

In the preceding sections, we explained why EPA has the authority and obligation to list heating appliances as a source category under section 111. Once a new source category is listed, the statute requires the Administrator to publish proposed performance standards for new sources within the established category within one year of such listing.[217] The statute defines "standard of performance" as:

> a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any

[213] *Id*. For instance, one study found that between 40 and 69 percent of the $PM_{2.5}$ in the Salt Lake Valley was ammonium nitrate. Romak Puprov et al., *Composition and secondary formation of fine particulate matter in the Salt Lake Valley: Winter 2009*, Journal of the Air and Waste Mgmt Ass'n, (July 16, 2014), https://www.tandfonline.com/doi/pdf/10.1080/10962247.2014.903878.

[214] Dennison et al., *supra* note 161, at 7 (citing RMI analysis using median estimates from the results of 3 reduced complexity models used in: Jonathan J. Buonocore et al., *A Decade of The U.S. Energy Mix Transitioning Away from Coal: Historical Reconstruction of the Reductions in the Public Health Burden of Energy*, 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c, as well as additional analysis from Jonathan Buonocore, Sc.D., the study's lead author).

[215] Dedoussi et al., *Premature mortality related to United States cross-state air pollutio*n, 578(7794) Nature 261 (2020), https://doi.org/10.1038/s41586-020-1983-8.

[216] *Id*.

[217] 42 U.S.C. § 7411(b)(1)(B).

nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.[218]

EPA must first identify the means of achieving a performance standard—the "best system of emission reduction" (BSER)—by weighing a number of factors—before it sets the standard. Specifically, EPA must consider: (1) the amount of air pollution a system of emission reduction will eliminate, relative to other options;[219] (2) whether the system's cost is reasonable;[220] (3) the "nonair quality health and environmental impacts," both positive and negative;[221] (4) the system's "energy requirements";[222] the extent to which adoption of the system will drive technological innovation;[223] and (5) whether a system has been "adequately demonstrated"[224]

Once EPA identifies a BSER for a source category (or separate systems for different classes of sources within the broader category),[225] it can calculate the "degree of emission limitation achievable through the application" of that system and set a performance standard accordingly. Regulated sources need not use the specific BSER that EPA identified when setting a performance standard, so long as they achieve an equivalent level of emission reduction.[226] Furthermore, EPA need not, as part of a BSER determination, conclude that any particular technology should be applied to every new source in the category. Instead, the agency could assume increased (but less than universal) deployment of one or more reduction techniques and allow for emissions averaging and/or trading as part of the best system of emission reduction.[227]

The rulemaking Petitioners seek here would not be the first time EPA has issued section 111 standards for mass-produced consumer appliances. The agency promulgated new source

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[218] 42 U.S.C. § 7411(a)(1).

[219] *Costle*, 657 F.2d at 326 (explaining that there is "no sensible interpretation of the statutory words 'best . . . system' which ……………would not incorporate the amount of air pollution as a relevant factor to be weighed when determining the optimal standard for controlling . . . emissions.").

[220] *Id.* at 351; *Lignite Energy Council v. EPA*, 198 F.3d 930, 933 (D.C. Cir. 1999); *see also* 42 U.S.C. § 7411(a)(1).

[221]42 U.S.C. § 7411(a)(1); 80 Fed. Reg. 64,510, 64,539 (Oct. 23, 2015); *Costle*, 657 F.2d at 330-31.

[222] 42 U.S.C. § 7411(a)(1); *Costle*, 657 F.2d at 330-31.

[223] 80 Fed. Reg. at 64,540; *Costle*, 657 F.2d at 346-47.

[224] *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 391 (D.C. Cir. 1973) (quoting H. Rep. No. 91-1146, 91st Cong., 2d Sess. 10 (1970)) (EPA cannot identify a "purely theoretical or experimental means of preventing or controlling air pollution" as BSER, but "what may fairly be projected for the regulated future, rather than the state of the art at present.").

[225] *See* 42 U.S.C. § 7411(b) (authorizing "the Administrator to "distinguish among classes, types, and sizes within categories of new sources for the purpose of establishing [performance] standards.").

[226] *Id.* § 7411(b)(5) (noting that, with limited exception, "nothing in this section shall be construed to require, or to authorize the Administrator to require, any new or modified source to install and operate any particular technological system of continuous emission reduction to comply with any new source standard of performance.").

[227] *See, e.g.,* 71 Fed. Reg. 39,154, 39,159 (July 11, 2006) (allowing manufacturers to average emissions from mobile nonroad engines and certain stationary engines for purposes of demonstrating compliance with section 111(b) performance standards); 73 Fed. Reg. 3568, 3595 (Jan. 18, 2008) (allowing manufacturers of stationary spark ignition internal combustion engines to include a family of engines that contains both nonroad and stationary engines in the averaging, banking, and trading provisions applicable to nonroad engines).

performance standards for residential wood heaters in 1988[228] and updated those standards in 2015.[229] EPA's initial rulemaking proposal for wood heaters acknowledged that, "because wood heaters are mass-produced consumer items, a compliance scheme requiring that each facility be tested would be very costly," and set forth an alternative certification program through which representative heaters are tested:[230]

> If the representative wood heater meets the applicable emission limits, EPA would certify the entire model line. Individual wood heaters within the model line would be subject to labeling and operational requirements. Manufacturers[231] would then be required to conduct a quality assurance program to ensure that appliances produced within a model line conformed to the certified design, and met applicable emission limits.[232]

Similarly, the section 111(b) requirements for stationary compression ignition internal combustion engines and for stationary spark ignition internal combustion engines[233] adopt "a regulatory strategy . . . that is generally directed towards engine manufacturers" rather than engine owners/operators.[234] Although owners/operators are still subject to the emission standards themselves, owners/operators of smaller engines can meet their compliance obligations simply by purchasing engines that were certified by the manufacturer (which would be the only ones available for purchase in any event) and by operating and maintaining them according to the manufacturer's written specifications.[235] These NSPS further exempt owners/operators of area sources from Title V obligations, thus relieving small-scale owners/operators like hospitals, schools, and homeowners of permitting requirements and placing the onus of compliance squarely on manufacturers.[236]

Furthermore, state and local regulators have already implemented NO_x emissions standards for heating appliances due to the public health dangers associated with those emissions. For instance, California's South Coast Air Quality Management District (SCAQMD), which oversees the air quality for more than 17 million residents of Los Angeles, Orange, Riverside, and San Bernardino counties,[237] has controlled NO_x emissions from gas-fired central furnaces since 1978

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[228] 53 Fed. Reg. 5860-01 (Feb. 26, 1988) (Final Wood Heater NSPS); 52 Fed. Reg. 4994-01, 4995 (Feb. 18, 1987) (Proposed Wood Heater NSPS).

[229] 80 Fed. Reg. 13,672 (Mar. 16, 2015) (Revised Wood Heater NSPS).

[230] *Id*.

[231] Note that the residential wood heater standard is geared primarily at manufacturers, not homeowners. A similar compliance scheme would be used to regulate emissions from new appliances within the source category.

[232] 52 Fed. Reg. 4994-01, 4995 (Feb. 18, 1987).

[233] 40 C.F.R. Subparts IIII and JJJJ.

[234] 73 Fed. Reg. 39,154, 39,163 (July 11, 2006). While this language appears only in the preamble for the NSPS for stationary compression ignition internal combustion engines, it applies equally to the NSPS for stationary spark ignition internal combustion engines as well.

[235] *See* 40 C.F.R. §§ 60.4211, 60.4243.

[236] *Id.* §§ 60.4200(c), 60.4230(c).

[237] South Coast Air Quality Management District (SCAQMD), *About*, http://www.aqmd.gov/nav/about (last visited June 23, 2022).

(with amendments in 1983, 2009, 2014, 2018, 2019, 2020, and 2021)[238] and from gas-fired water heaters since 1998 (with amendments in 2005, 2006, and 2018).[239] California's Bay Area Air Quality Management District (BAAQMD), which oversees air quality for approximately 7.5 million residents in nine Bay Area counties,[240] has also regulated NO_x emissions from gas-fired appliances—central furnaces since 1983[241] and water heaters since 1992 (with amendments in 2007).[242] Texas and Utah have regulated NO_x emissions from gas water heaters since 2000 and 2015, respectively.[243]

Recently, BAAQMD has signaled its intention to strengthen its NO_x standards for appliances, proposing a zero-NO_x standard for new gas-fired furnaces starting in 2029[244] and for new gas-fired water heaters starting in 2027 or 2031 (depending on the unit type, use, and size).[245] BAAQMD's proposal would also establish an "ultra low- NO_x" standard (i.e., a limit of 14 ng/J of NO_x compared to the current standard of 40 ng/J for furnaces) between 2023 and 2029.[246] These requirements would apply to "manufacturers, retailers/wholesalers, and installers and would affect Bay Area consumers when they replace their existing furnaces."[247] As BAAQMD notes in its proposal, "[s]pace and water heaters are the greatest source of NO_x emissions in the building sector" and "vent directly outdoors into the ambient air, affecting the local and regional air quality of the Bay Area."[248]

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[238] SCAQMD, Rule 1111- *Reduction of NO_x Emissions from Natural Gas-Fired, Fan-Type Central Furnaces* (Dec. 1, 1978, amended Oct. 1, 2021), http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1111.pdf.

[239] SCAQMD, Rule 1146.2- *Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters*, http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1146-2.pdf?sfvrsn=17.

[240] Bay Area Air Quality Management District (BAAQMD), *About the Air District*, https://www.baaqmd.gov/about-the-air-district (last visited June 23, 2022); BAAQMD, *An Introduction to the Air District*, Legislative Committee Meeting Jan. 15, 2020, Alan Abbs Legislative Officer, 2 (Jan. 15, 2020), https://www.baaqmd.gov/~/media/files/board-of-directors/2020/leg_presentation_011520-pdf.pdf?la=en (providing 7.5 million residents statistic).

[241] BAAQMD, Regul. 9, Rule 4- *Nitrogen Oxides from Fan Type Residential Central Furnaces*, https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/documents/rg0904.pdf?la=en&rev=e67bf6e164d94de39b44caa30ce17fd7.

[242] BAAQMD, Regul. 9, Rule 6- *Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters*, https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-6-nitrogen-oxides-emissions-from-natural-gasfired-water-heaters/documents/rg0906.pdf?la=en&rev=70876e62c74040df8c646077d00d3c86.

[243] 30 Tex. Admin. Code § 117.3200 to .3215; Utah Admin. Code R307-230-5.

[244] BAAQMD, Draft Amend. to Rule 9-4, Proposed Regul. 9-4-301.3 (May 19, 2022), https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20220519_04_reviseddraftamendments_rg0904-pdf.pdf?la=en.

[245] BAAQMD, Draft Amend. to Rule 9-6, Proposed Regul. 9-4-301.5 and 9-4-303.5 (May 19, 2022), https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20220519_05_draftamendments_rg0906-pdf.pdf?la=en.

[246] BAAQMD, *supra* note 244, Proposed Regul. 9-4-301.2; *see also* BAAQMD, *Notice of Preparation of an Env't Impact Report and Notice of Public Scoping Meeting for the Proposed Amend.*, 4 (May 19, 2022), https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20220519_02_nop_rules09040906-pdf.pdf?la=en.

[247] BAAQMD, *Notice of Preparation of an Env't Impact Report and Notice of Public Scoping Meeting for the Proposed Amend.*, at 4-5.

[248] *Id.* at 4.

Several other state and local regulators are considering zero-emission heating appliance standards: SCAQMD has included a zero-emission limit for residential and commercial water heating, space heating, and cooking devices in its 2022 Air Quality Management Plan;[249] the California Air Resources Board (CARB) Draft 2022 Scoping Plan[250] and Draft State Implementation Plan[251] include a zero-emission standard for new space and water heater sales; the New Jersey Department of Environmental Protection has proposed a rule to end permitting for certain fossil fuel boilers;[252] and the New York State Climate Action Council's Draft Climate Scoping Plan recommends zero emissions standards for fossil fuel combustion equipment in buildings, phasing in for various building sizes and types through 2035.[253]

A. Electric-Heat-Pump Technology Is the BSER for New Water Heaters and Furnaces within the Appliance Source Category.

Electric heat pumps, which are powered by an increasingly decarbonized electricity grid[254] rather than by the combustion of fossil fuels, do not directly emit *any* NO_x, CO, PM, or CO_2. And given the availability, efficiency, and reasonable cost of electric heat pumps, EPA should find that this technology is the best system of emission reduction for water heaters and furnaces.[255]

Air-source heat pumps work by moving heat from one place to another (from outdoors to indoors during the heating season, and from indoors to outdoors during the cooling season) instead of generating heat, so they use less energy to warm a building or a tank of water than conventional fossil fuel-fired heating appliances, which burn oil or gas to generate heat.[256] In fact, given recent improvements in heat pump technology, residential heat pumps are now between 2.2 and 4.5 times more efficient than an Energy Star gas furnace.[257] While efficiency is highest in places with

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[249] SCAQMD, *2022 Draft Air Quality Management Plan*, at 4-12-4-15, http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/draft2022aqmp.pdf?sfvrsn=12.

[250] CARB, *Draft 2022 Scoping Plan Update*, at 60 (May 10, 2022), https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf.

[251] CARB, *Draft 2022 State Strategy for the State Implementation Plan*, at 86 (Jan. 31, 2022), https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf.

[252] Proposed N.J.A.C. 7:27F-4, *Carbon Dioxide Emission Reductions from Boilers*; New Jersey Department of Environmental Protection, *Notice of Rule Proposal and State Implementation Plan Revision*, at 36, https://www.nj.gov/dep/rules/proposals/20211206a.pdf.

[253] New York Climate Action Council, *Draft Scoping Plan*, (Dec. 30, 2021), at 129, https://climate.ny.gov/Our-Climate-Act/Draft-Scoping-Plan#:~:text=The%20law%20created%20the%20Climate,usage%2C%20and%20ensure%20climate%20justice.

[254] Claire McKenna et al., *It's Time to Incentivize Residential Heat Pumps,* RMI (June 8, 2020), https://rmi.org/its-time-to-incentivize-residential-heat-pumps.

[255] Geothermal heat pumps are another available zero-emitting option for water and space heating. *See* DOE Office of Energy Efficiency & Renewable Energy, *Geothermal Heat Pumps*, https://www.energy.gov/eere/geothermal/geothermal-heat-pumps.

[256] Alexi Miller & Cathy Higgins, *The Building Electrification Technology Roadmap (BETR)*, New Buildings Institute (Jan. 2021), https://newbuildings.org/wp-content/uploads/2021/01/BuildingElectrificationTechnologyRoadmap.pdf; McKenna et al., *supra* note 254; *Selecting a New Water Heater, Energy Star*, https://www.energy.gov/energysaver/selecting-new-water-heater (last visited Oct. 19, 2021) ("[A]n electric heat pump water heater . . . might have lower energy costs than a gas-fired conventional storage water heater, even though local natural gas costs might be lower than the electricity rates.").

[257] McKenna et al., *supra* note 254.

mild winters, heat pumps are also more energy efficient than gas furnaces in cold climates.[258] Similarly, residential heat pump water heaters are between 2.5 and 5 times more efficient than Energy Star gas-fired water heaters.[259]

Electric heat pumps (for space and water heating) have been adequately demonstrated. In 2021, electric heat pumps accounted for 50% of space heating equipment sales in the United States.[260] And as of this year, more than 200 Energy Star-certified heat pump water heater models were available for sale.[261] Moreover, given President Biden's recent invocation of the Defense Production Act (DPA) authorizing the Department of Energy (DOE) to accelerate domestic production of five key energy technologies including heat pumps,[262] and the recent passage of the Inflation Reduction Act (IRA) that includes a significant investment in building decarbonization,[263] we can expect the availability of heat pumps to increase and their cost to continue to decrease. In 2020, heat pumps accounted for 18% of primary space heating equipment in homes (compared to 66 percent gas- or oil-fired appliances), up from 12% in 2015.[264] While heat pump water heaters represented only one percent of market share in 2012, more manufacturers have entered the U.S. market and sales increased by 25 times between 2006 and 2016.[265]

In addition to being widely available, electric heat pumps are cost-competitive in a growing range of applications.[266] Already, electric appliances have lower overall net present costs than fossil fuel-fired alternatives in many situations, such as in new construction, when replacing

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[258] *Id.*; *see, e.g.*, Michael Gartman & Amar Shah, *Heat Pumps: A Practical Solution for Cold Climates*, RMI (Dec. 10, 2020), https://rmi.org/heat-pumps-a-practical-solution-for-cold-climates/.

[259] Energy Star, *Water Heater Key Product Criteria,* https://www.energystar.gov/products/water_heaters/residential_water_heaters_key_product_criteria.

[260] Air-Conditioning, Heating, and Refrigeration Institute (AHRI), *Historical Data*, www.ahrinet.org/resources/statistics/historical-data.

[261] Energy Star, *Product Finder*, https://www.energystar.gov/productfinder/product/certified-water-heaters/.

[262] *FACT SHEET: President Biden Takes Bold Executive Action to Spur Domestic Clean Energy Manufacturing,* The White House (June 6, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/06/06/fact-sheet-president-biden-takes-bold-executive-action-to-spur-domestic-clean-energy-manufacturing/

[263] U.S. Green Buildings Council, *Inflation Reduction Act Buildings Provisions* (Aug. 2022), https://www.usgbc.org/sites/default/files/2022-08/Inflation-Reduction-Act-Buildings-Provisions-Aug2022.pdf.

[264] EIA, Table HC6.1 *Space Heating in U.S. Homes, by Housing Unit Type 2020* (May 2022), https://www.eia.gov/consumption/residential/data/2020/hc/pdf/HC%206.1.pdf; EIA, *2015 RECS Survey Data* (Aug. 2015-Apr. 2016), https://www.eia.gov/consumption/residential/data/2015/#sh.

[265] Paige Jadun et al., *Electrification Futures Study: End-Use Electric Technology Cost and Performance Projections through 2050*, NREL (2017) at 44, https://www.nrel.gov/docs/fy18osti/70485.pdf.

[266] *See* Jim Dennison, Leah Louis-Prescott & Talor Gruenwald, *How Air Agencies Can Help End Fossil Fuel Pollution from Buildings*, RMI (2021) at 12, (citing Gartman & Shah; Lacey Tan & Mohammad Fathollahzadeh, *Why Heat Pumps Are the Answer to Heat Waves*, RMI (Aug. 12, 2021), https://rmi.org/why-heat-pumps-are-the-answer-to-heat-waves/; Alexi Miller & Cathy Higgins, *The Building Electrification Technology Roadmap (BETR)*, New Buildings Institute (Jan. 2021), https://newbuildings.org/wp-content/uploads/2021/01/BuildingElectrificationTechnologyRoadmap.pdf; Livchak et al., *Residential Cooktop Performance and Energy Comparison Study*, Frontier Energy (July 2019), https://cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf).

propane or heating oil appliances, and when simultaneously replacing furnaces and air conditioners.[267]

B. EPA Should Set a Zero-NO_x Emission Performance Standard for New Water Heaters and Furnaces by 2030.

Because electric heat pump technology represents the best system of emission reduction for air pollution from fossil fuel-fired water heaters and furnaces and because utilization of that technology generates no emissions, EPA should set a performance standard of zero-NO_x emissions for these sources.[268]

Typically, appliances like water heaters and furnaces are only replaced at or near the end of their lifespan, which can be decades long. Thus, there will necessarily be a built-in lag time between a performance standard deadline that applies to the manufacture of appliances and when polluting fossil fuel-fired heating appliances will be out of circulation. To start the process of reducing the harmful air pollution from the heating appliance source category, EPA should set a 2030 deadline for a zero-emission performance standard. A national standard will give manufacturers the regulatory certainty needed to increase their production of zero-emission appliances and will bring down costs even further.

In order to streamline the implementation of a zero-emission standard, EPA could employ a phase-in approach, like it did in the wood heater NSPS rulemaking. Both the original wood heater standards and the 2015 amendments were implemented in two phases, with the second phase setting more stringent standards.[269] According to EPA, this "stepped compliance approach,"[270] was implemented to "allow manufacturers lead time to develop, test, field evaluate and certify current technologies across their consumer product lines to meet Step 2 emission limits."[271] A similar approach, with a mid-decade interim standard in 2025 before the eventual zero-emission standard in 2030, could be taken with the heating appliance category.

The phase-in approach could also be utilized to account for building age (i.e., limiting NO_x emissions from appliances in new construction before existing buildings) and for different

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[267] Dennison et al., *supra* note 266, at 12 (citing Claire McKenna et al., *All-Electric New Homes: A Win for the Climate and the Economy*, RMI (Oct. 15, 2022), https://rmi.org/all-electric-new-homes-a-win-for-the-climate-and-the-economy/; Steven Nadel, *Energy Savings, Consumer Economics, and Greenhouse Gas Emissions Reductions from Replacing Oil and Propane Furnaces, Boilers, and Water Heaters with Air-Source Heat Pumps* 40, ACEEE (July 2018), https://www.aceee.org/sites/default/files/publications/researchreports/a1803.pdf; Rewiring America, *Bringing Infrastructure Home: A 50-State Report on U.S. Home Electrification*, https://content.rewiringamerica.org/fact-sheets/bringing-infrastructure-home/bringing-infrastructure-home-50-state-report-on-us-home-electrification.pdf; Sherri Billimoria et al., *The Economics of Electrifying Buildings*, RMI (2018), https://rmi.org/insight/the-economics-of-electrifying-buildings/).

[268] Although the standard Petitioners recommend is a NO_x-based standard, similar to those already implemented or proposed by various states and local air districts, this zero-emissions standard would have the co-benefit of reducing all direct emissions from the covered appliances, including CO, $PM_{2.5}$ and CO_2 emissions.

[269] 53 FR 5860-01, *Standards of Performance for New Stationary Sources; New Residential Wood Heaters*.

[270] 80 FR 13672-01 (at 13676), *Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces*.

[271] *Id*.

climate regions. Cold-climate heat pump technology is rapidly advancing—on average, the efficiency of new heat pumps increases by about two percent annually.[272] Rising cold temperature coefficient of performance values, a measure of energy efficiency, have made heat pumps effective in some Nordic climates.[273] EPA could consider a phase-in approach for northern climates (for instance, Climate Zones 6, 7, and 8 in ASHRAE Standard 169)[274] that would modestly delay implementation dates based on subsequent technology advancements for a limited phase-in period.

C. The Supreme Court's Holding in *West Virginia v. EPA* Does Not Prohibit EPA From Designating Electric-Heat-Pump Technology as the BSER for New Water Heaters and Furnaces.

Recently, the Supreme Court had occasion in *West Virginia v. EPA*[275] to clarify the kinds of emission reduction measures that may and may not be included in the BSER. Three particular aspects of that opinion are worth highlighting. ***First***, in that case, the Court held that EPA lacked authority to designate a BSER premised on shifting electricity generation away from existing coal and gas plants and toward new renewable energy resources like wind and solar.[276] In so holding, the Court distinguished this latter approach, which sought to "improve *the overall power system*" and force existing regulated sources to either reduce their own production or subsidize their cleaner competitors, with technology-based measures that would improve the "emissions performance of individual sources" *themselves*.[277] The Court further ratified an interpretation of the statute that would permit the agency to adopt not only "add-on controls" as elements of the BSER, but also "inherently lower-emitting processes/practices/designs."[278]

The BSER that Petitioners propose for water heaters and furnaces—electric heat pumps—is precisely the kind of "inherently lower-emitting process" that the Court looked favorably on in *West Virginia*. Heat pumps emit zero direct pollution, and unlike the kinds of generation-shifting measures the Court rejected in *West Virginia*, would allow individual sources *themselves* to meet a zero-emissions standard, rather than "reducing their own production, subsidizing an increase in production by cleaner sources, or both."[279]

Second, *West Virginia* addressed EPA's emission guidelines for *existing* sources issued under section 111*(d)*, rather than *new* source standards issued under section 111*(b)*. The fundamental basis for the Court's holding was that by selecting a BSER that "direct[ed] existing sources [in

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[272] Gustav Bolin et al., *Building decarbonization: How electric heat pumps could help reduce emissions today and going forward*, McKinsey & Company (July 25, 2022), https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/building-decarbonization-how-electric-heat-pumps-could-help-reduce-emissions-today-and-going-forward.
[273] *Id*.
[274] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), *Size and Design Right: How Standard 169 Helps Engineers With Updated Climate Data*, ASHRAE Journal Newsletter (Dec. 28, 2021), https://www.ashrae.org/news/ashraejournal/size-and-design-right-how-standard-169-helps-engineers-with-updated-climate-data.
[275] 142 S.Ct. 2587 (2022).
[276] *Id.* at 2615-6.
[277] *Id.* at 2595 (cleaned up) (emphasis in original).
[278] *Id.* at 2604 (cleaned up).
[279] *Id.* at 2603.

the electric power sector] to effectively cease to exist"[280] and thereby "drive an . . . aggressive transformation in the domestic energy industry,"[281] EPA was assigning to itself a "decision[] of vast economic and political significance,"[282] which it could not do without clear statutory authorization from Congress.[283]

By contrast, the BSER that Petitioners propose for a heating appliances category—electric heat-pump technology—would apply only to new sources, and would in no way affect existing appliances, let alone require them to cease operation. This is wholly distinct from a generation-shifting scheme for existing power plants that the Court rejected in *West Virginia*. By their very nature, section 111(b) standards are intended to facilitate technological improvement on a prospective basis by requiring that new sources use the latest and lowest-emitting technology, even while at least some existing sources may continue to use older technology that would not comply with the new source standards. For this reason, the D.C. Circuit has held that "[b]ecause it applies only to new sources, we have recognized that section [111[(b)] looks toward what may fairly be projected for the regulated future, rather than the state of the art at present,"[284] and has rejected arguments that "any [source] now in existence [must] be able to meet the proposed standards" for new sources.[285]

Third, nothing in *West Virginia* suggests that a non-emitting BSER is inherently suspect under section issue section 111(b). As noted above, the Court's fundamental holding was that by effectively requiring existing fossil fuel-fired power plants to subsidize renewable competitors or shut down, EPA was arrogating to itself a degree of authority under section 111(d) that would have required clear congressional authorization, which the statute did not provide. Nowhere did the Court suggest that zero-emitting technology *itself* necessarily exceeds the scope of EPA's section 111 authority, particular with regard to new sources. Indeed, the express language of the statute directly refers to "inherently low-polluting or nonpolluting" processes as a legitimate "technological system of continuous emission reduction"[286]—a section 111 designation that is closely related to (and, if anything, narrower in scope than) a "system of emission reduction."

In fact, EPA has previously regulated air pollution sources under section 111 by setting zero-emissions standards based on the use of non-emitting technology as the BSER. Since 2016, EPA's section 111(b) requirements for oil and gas sources mandate a methane emission rate of zero for pneumatic controllers at gas processing plants, designating instrument air (as opposed to gas-driven) technology as the BSER.[287] The agency also noted that electricity was another non-emitting option available for these sources.[288] These requirements have posed no major disruption to the oil and gas sector since their issuance six years ago, and EPA has proposed to extend them to pneumatic controllers across the entire oil and gas sector.[289] A BSER for water

[280] *Id.* at 2612 n.3.
[281] *Id.* at 2604 (cleaned up).
[282] *Id.* at 2605 (cleaned up).
[283] *Id.* at 2610-14.
[284] *Lignite Energy Council,* 198 F.3d at 934 (quoting *Portland Cement Ass'n*, 486 F.2d at 391).
[285] *Portland Cement Ass'n*, 486 F.2d at 391.
[286] 42 U.S.C. § 7411(a)(7)(A).
[287] 81 Fed. Reg. 35,824, 35,844 (June 3, 2016); 40 C.F.R. § 60.5390a(b)(1).
[288] 81 Fed. Reg. at 35,880.
[289] 86 Fed. Reg. 63,110, 63,178-9 (Nov. 15, 2021).

heaters and furnaces based on electric heat-pump technology could thus function similarly under section 111(b).

IV. IMPLEMENTING PERFORMANCE STANDARDS EQUITABLY

For all of the reasons discussed above, Petitioners seek a rulemaking to list heating appliances as a section 111 source category and soon after establish standards of performance for newly manufactured water heaters and furnaces. Furthermore, while Petitioners believe that zero-emission alternative technology is affordable and becoming increasingly accessible for all households and businesses, there are additional steps the agency can take to ensure that new standards are implemented in an equitable manner. EPA should work closely with impacted communities and the state and federal agencies that administer existing programs and funding sources to facilitate a transition of the building sector away from fossil fuels.

Fossil fuel-fired heating appliances are already subject to federal efficiency standards through the Department of Energy (DOE). EPA issuing emissions standards for the same appliances would not prevent DOE from continuing to update efficiency standards, nor would it affect DOE's legal obligation to do so.[290] In similar situations of regulatory overlap, most notably the issuing of vehicle GHG emissions standards and CAFE standards, EPA has engaged in joint rulemakings with other agencies to harmonize their respective regulations.[291] DOE has rulemakings well-underway to review the current efficiency standards for the equipment discussed in this petition and those rulemakings should proceed to conclusion. However, EPA should consult with DOE on the best way to coordinate future appliance efficiency and emissions standards rulemakings to ensure that each set of standards is developed and implemented as effectively as possible. EPA should also coordinate with the various state and local air regulators that already regulate heating appliance NO_x emissions,[292] especially those that are currently developing zero-NO_x standards similar to the one requested in this petition.[293]

While zero-emitting electric heat-pump appliances are already the most cost-effective choice for new construction,[294] when replacing propane or heating oil appliances, and when simultaneously replacing furnaces and air conditioners,[295] Petitioners recognize that financial assistance may be

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[290] Jack Lienke et al., *Regulating New Fossil-Fuel Appliances Under Section 111(b) of the Clean Air Act*, Institute for Policy Integrity, at 16 (2021), https://policyintegrity.org/publications/detail/regulating-new-fossil-fuel-appliances (citing *Massachusetts v. EPA*, 549 U.S. 497, 513 (2007)).

[291] *Id.*

[292] *See supra*, notes 13 and 240-53.

[293] *See supra*, notes 244-53.

[294] Sherri Billimoria et al., *The Economics of Electrifying Buildings*, RMI (2019), https://rmi.org/insight/the-economics-of-electrifying-buildings/.

[295] Dennison et al., *supra* note 267, (citing Claire McKenna et al., *All-Electric New Homes: A Win for the Climate and the Economy*, RMI at 12 (Oct. 15, 2022), https://rmi.org/all-electric-new-homes-a-win-for-the-climate-and-the-economy/; Steven Nadel, *Energy Savings, Consumer Economics, and Greenhouse Gas Emissions Reductions from Replacing Oil and Propane Furnaces, Boilers, and Water Heaters with Air-Source Heat Pumps,* ACEEE at 40 (July 2018), https://www.aceee.org/sites/default/files/publications/researchreports/a1803.pdf; Rewiring America, *Bringing Infrastructure Home: A 50-State Report on U.S. Home Electrification*, https://content.rewiringamerica.org/fact-sheets/bringing-infrastructure-home/bringing-infrastructure-home-50-state-r

necessary for many consumers to make the transition from gas, oil, and propane appliances to non-emitting alternatives. Many households may also need to undergo weatherization to allow heat pumps to operate at maximum efficiency; others will need electric panel upgrades or replacements and more basic safety and health upgrades before even weatherization can begin. To avoid exacerbating historic injustices,[296] policymakers must act at the local, state, and federal levels to ensure that marginalized communities are among the first to benefit from the transition away from fossil fuel systems in favor of electric technology. Existing programs, such as the Weatherization Assistance Program administered by DOE,[297] the Low Income Home Energy Assistance Program administered by the Department of Health and Human Services,[298] and the Lead Hazard Reduction Grant Program administered by the Department of Housing and Urban Development,[299] among others, can and should be expanded to fill this need.

V. CONCLUSION

The data is incontrovertible: heating appliances in residential and commercial buildings contribute significantly to pollution that endangers public health and welfare. The emissions from these sources are major drivers of the dual crises of climate change and unclean air and, with respect to NO_x and CO_2, are substantially greater than emissions of other source categories that have been regulated under section 111(b) for years or decades. The agency must, therefore, list heating appliances as a source category under section 111(b)(1)(A). Within one year of making such a listing, EPA must issue standards of performance for NO_x emissions from new water heaters and furnaces within this category, designating electric heat pumps as the best system of emission reduction and permitting zero direct emissions, with unit manufacturers responsible for compliance. Finally, although we focus on EPA's regulatory authority in this petition, we recognize that policymakers—not just at EPA, but at other federal agencies as well as at the state and local government levels—must approach building electrification in a just, comprehensive, and cross-collaborative manner. This strategy will entail not only EPA's issuance of standards of performance for appliances, but also the provision of financial assistance, economic incentives, weatherization services, workforce development programs, and other

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eport-on-us-home-electrification.pdf; Sherri Billimoria et al., *The Economics of Electrifying Buildings*, RMI (2018), https://rmi.org/insight/the-economics-of-electrifying-buildings/.

[296] *See generally*, Green & Healthy Homes Initiative, *Leading with Equity and Justice in the Clean Energy Transition: Getting to the Starting Line for Residential Building Electrification* (2021), https://www.greenandhealthyhomes.org/wp-content/uploads/2021-GHHI-Leading-with-equity_wp_Final.pdf.

[297] The Weatherization Assistance Program (WAP) reduces energy costs for low-income households by increasing the energy efficiency of their homes. *See* U.S. DOE Office of Energy Efficiency & Renewable Energy, *Weatherization Assistance Program Factsheet* (Jan. 2021), https://www.energy.gov/eere/wap/downloads/weatherization-assistance-program-fact-sheet.

[298] The Low Income Home Energy Assistance Program (LIHEAP) provides federally funded assistance to low-income households for managing costs associated with home energy bills, energy crises, weatherization, and energy-related minor home repairs. *See* U.S HHS Office of Community Services, *Low Income Home Energy Assistance Program Factsheet* (2021), https://www.acf.hhs.gov/ocs/fact-sheet/liheap-fact-sheet.

[299] The Lead Hazard Reduction grant program (LHR) serves to identify and control lead-based paint hazards in eligible privately owned housing for rental or owner-occupants. The need to address lead paint in housing remains high across the country and presents a health and safety barrier to weatherization efforts. See U.S. HUD Programs Division, *Lead-Based Paint & Lead Hazard Reduction Demonstration Grant Programs*, https://www.hud.gov/program_offices/healthy_homes/lbp/lhc.

policy tools by agencies such as the Departments of Energy, Health and Human Services, and Housing and Urban Development. This will help ensure a fair and equitable transition away from fossil fuel-fired appliances and toward cleaner, safer alternatives.

Respectfully submitted,

350 Eugene
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Earthjustice
Electrify Corvallis
Electrify Now
Environment America
Evergreen Action
Green & Healthy Homes Initiative
Interfaith Earthkeepers
Mothers Out Front
National Center for Healthy Housing
New Buildings Institute (NBI)
New York Communities for Change
NY Public Interest Research Group
NY-GEO, New York Geothermal Energy Organization
Physicians for Social Responsibility
Public Health Law Center
Redwood Energy
Respiratory Health Association
RMI
Rewiring America
Sealed
Sierra Club
U.S. PIRG
WE ACT for Environmental Justice
ZeroCarbonMA