WOOD BURNING, BIOMASS, AIR POLLUTION, AND CLIMATE CHANGE

BY

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Domestically and internationally, there is a trend toward greater reliance on the burning of wood as a partial response to the problems of global warming and climate change. But in labeling wood burning as a source of "renewable energy," consumers and corporations have overlooked a more compelling and immediate health problem. Worldwide, air pollution causes the deaths of approximately seven million people every year, far more than the number of deaths from climate change. Mortality is largely due to air emissions of fine particulate matter. Given the popularity of burning wood and regulatory loopholes, the public health effects of air pollution go underregulated, and often unregulated. As a source of energy that is generated by combustion and results in the direct emission of fine particulates, biomass is like coal, oil, and natural gas (non-renewable energy), and unlike solar and wind (renewable energy). Whether biomass may play a role in an effective climate change strategy is unclear and is the subject of ongoing debate. Recent attempts to address the problem of residential wood burning through the Environmental Protection Agency's New Source Performance Standards and New York City's Local Law 38 of 2015 demonstrate the political and legal challenges to regulating emissions from the burning of wood.

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I. INTRODUCTION

Air pollution from combustion is the ultimate example of humans' conquest of the environment. In essence, it involves the transformation of matter from the solid phase to the gaseous phase, and the suspension of solid particulates in the air.[1] While other species release chemicals into the air through the normal biological processes of respiration and excretion, humans are unique in their ability to transform their external environment through combustion, derived from years of social and cultural evolution. Because animals and plants rely on air for respiration, it is not surprising that air pollution has an effect on human health and the environment. The

[1] *See* John W. Rowe, *Foreword* to AMORY B. LOVINS & ROCKY MOUNTAIN INST., REINVENTING FIRE: BOLD BUSINESS SOLUTIONS FOR THE NEW ENERGY ERA xvi (2011) (discussing how burning coal creates air pollution).

transformation of environmental policy into energy policy is a reflection of the fact that combustion lies at the heart of the problem of air pollution.[2]

Considering air pollution from a purely anthropocentric point of view, public health alone provides a compelling rationale for doing something about the problem. The World Health Organization estimates that approximately seven million people throughout the world die from air pollution every year.[3] To put this figure into perspective, that organization forecasts an additional 250,000 deaths per year from the effects of climate change over the course of the years 2030–2050.[4] That number is less than four percent of the number of current annual deaths from air pollution.[5]

The burning of wood by individual consumers demonstrates the fundamental nature of the problem of air pollution. This Article discusses the air pollutants released by the process of burning wood and their impacts on human health and the environment; explores the ongoing debate over the characterization of biomass as a form of "renewable energy"; and discusses the hot spots for burning wood, both domestically and internationally. Finally, it discusses some of the political and legal obstacles to the latest effort of the Environmental Protection Agency (EPA) to deal with this problem in its revision of the New Source Performance Standard for residential wood heaters.[6]

II. AIR POLLUTANTS FROM BIOMASS AND IMPACTS ON PUBLIC HEALTH AND WELFARE

Air emissions from biomass present adverse effects on public health, due to criteria pollutants and hazardous air pollutants. They also present adverse effects on welfare, due to greenhouse gases. This Part considers the different impacts of biomass emissions.

A. Criteria Pollutants

The most common air pollutants in the United States, criteria pollutants, are the starting point for regulation of air pollution under the

2 This view is consistent with the views of energy policy analysts, and is reflected in the title of one publication exploring future energy options. *See* LOVINS & ROCKY MOUNTAIN INST., *supra* note 1, at ix.

3 World Health Org., *7 Million Premature Deaths Annually Linked to Air Pollution*, Mar. 25, 2014, http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/ (last visited Feb. 13, 2016).

4 World Health Org., *Climate Change and Health*, Sept. 2015, http://www.who.int/mediacentre/factsheets/fs266/en/ (last visited Feb. 13, 2016).

5 *See id.* (noting that climate change is expected to cause 250,000 additional deaths between 2030 and 2050); World Health Org., *7 Million Premature Deaths Annually Linked to Air Pollution*, *supra* note 3 (noting that approximately seven million people die as a result of air pollution annually).

6 The New Source Performance Standards program contemplates the setting of technology-based emissions standards for different categories of stationary sources of pollutants. Clean Air Act, 42 U.S.C. § 7411 (2012).

Clean Air Act (CAA).[7] Under section 108, EPA is required to identify criteria pollutants for regulation, if they are emitted from "numerous or diverse mobile or stationary sources," and if they "endager" public health or welfare.[8] EPA has identified six such pollutants—particulates, ozone, nitrogen oxides, sulfur dioxide, carbon monoxide, and lead.[9] Under section 109, EPA is required to set national ambient air quality standards for the criteria pollutants, including a primary standard for the protection of public health (human health) and a secondary standard for the protection of welfare (the environment).[10] Under section 110, states must prepare state implementation plans to attain the national ambient air quality standards.[11] Under section 107, EPA must designate areas as being in attainment or nonattainment with these standards.[12] The attainment status of an area has implications for permitting of industrial facilities. Permitting under the new source review program is more stringent in nonattainment areas than in attainment areas.[13]

The waste products of combustion include nitrogen oxides and fine particulates, two criteria pollutants.[14] In a revision to the national ambient air quality standard for nitrogen oxides in 2010, EPA concluded there is a causal relationship between nitrogen oxides and respiratory effects from short-term exposure.[15] But fine particulates present a far greater danger to public health. In a revision to the national ambient air quality standard for fine particulates in 2013, EPA found causation between exposure to fine particulates and mortality.[16] This was not a revolutionary development.

7 42 U.S.C. §§ 7401–7671q (2012); U.S. Envtl. Prot. Agency, *What Are the Six Common Air Pollutants?*, http://www3.epa.gov/airquality/urbanair/ (last visited Feb. 13, 2016).

8 42 U.S.C. § 7408(a)(1)(B) (2012). The statute directs EPA to identify them for regulation if they may endanger public health or welfare. *See id.* § 7408(a)(1)(A) (requiring the publication of a list of each air pollutant "*emissions of which*, in [the Administrator's] judgment, cause or contribute to air pollution which *may reasonably be anticipated to endanger public health or welfare*" (emphasis added)).

9 U.S. Envtl. Prot. Agency, *What Are the Six Common Air Pollutants?*, *supra* note 7; 40 C.F.R. §§ 50.4–50.18 (2016) (setting national ambient air quality standards for each of the criteria pollutants).

10 *See* 42 U.S.C. § 7409(a)(1)(A) (2012).

11 *See id.* § 7410(a)(1).

12 *See id.* § 7407(d)(1)(A).

13 *See id.* § 7475 (new source review for attainment areas); *id.* § 7503 (new source review for nonattainment areas).

14 Paul J. Crutzen & Meinrat O. Andreae, *Biomass Burning in the Tropics: Impact on Atmospheric Chemistry and Biogeochemical Cycles*, 250 SCIENCE 1669, 1673 (1990); *see also* 40 C.F.R. § 50.11 (2010) (standards for oxides of nitrogen); *id.* §§ 50.6, 50.18 (standards for particulate matter).

15 Primary National Ambient Air Quality Standards for Nitrogen Dioxide, 75 Fed. Reg. 6474, 6480 (Feb. 9, 2010) (codified at 40 C.F.R. pts. 50, 58) ("[T]he findings of epidemiologic, controlled human exposure, and animal toxicological studies provide evidence that is sufficient to infer a likely causal relationship for respiratory effects following short-term NO_2 exposure.").

16 *See* National Ambient Air Quality Standards for Particulate Matter, 78 Fed. Reg. 3,086, 3,103 (Jan. 15, 2013) (codified at 40 C.F.R. pts. 50–53, 58) ("Using a more formal framework for reaching causal determinations than used in prior reviews, the EPA concludes that a causal relationship exists between both long- and short-term exposures to $PM_{2.5}$ and premature

Modern science demonstrating a link between fine particulates and mortality dates back at least to the Harvard Six Cities Study in 1993.[17]

But nitrogen oxides also react with volatile organic compounds in the presence of sunlight, contributing to the formation of ozone.[18] In a proposed revision to the national ambient air quality standard for ozone in 2014, EPA found a causal relationship between ozone and respiratory effects from short-term exposure.[19] Effects include lung function decrements; pulmonary inflammation, injury, and oxidative stress; and airway hyper-responsiveness.[20]

Because of their impact on public health, fine particulates and ozone tend to drive EPA's regulatory efforts under the CAA.[21] At a population level, EPA has not identified a threshold below which there are no adverse effects on human health from fine particulates and ozone.[22] Because they are indirectly formed from the generation of nitrogen oxides and their transformation into nitrates, they are also closely tied together under EPA's guideline for air modeling.[23] Accordingly, the burning of wood contributes to the formation of the country's two most significant air pollution problems.

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mortality and cardiovascular effects and a likely causal relationship exists between long- and short-term $PM_{2.5}$ exposures and respiratory effects." (footnote omitted)).

17 *Id.*; 78 Fed. Reg. at 3,106–3,117; Douglas W. Dockery et al., *An Association Between Air Pollution and Mortality in Six U.S. Cities*, 329 NEW ENG. J. MED. 1753 (1993).

18 *See* National Ambient Air Quality Standards for Ozone, 79 Fed. Reg. 75,234, 75,241 (proposed Dec. 17, 2014) (to be codified at 40 C.F.R. pts. 50–53, 58).

19 *Id.* at 75,247 ("Based on this assessment, the [Integrated Science Assessment] determined that a 'causal' relationship exists between short-term exposure to O_3 in ambient air and effects on the respiratory system and that a 'likely to be causal' relationship exists between long-term exposure to O_3 in ambient air and respiratory effects." (footnotes omitted)).

20 *Id.* at 75,248–55.

21 *See, e.g.*, Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals, 76 Fed. Reg. 48,208, 48,218 (Aug. 8, 2011) (codified at 40 C.F.R. pts. 51–52, 72, 78, 97) (creating emissions trading programs for nitrogen oxides, sulfur dioxide, fine particulates, and ozone under the Cross-State Air Pollution Rule); U.S. Envtl. Prot. Agency, *Cleaning Up Commonly Found Air Pollutants*, http://www3.epa.gov/airquality/peg_caa/cleanup.html (last visited Feb. 13, 2016) (stating that fine particulates and ozone are the most widespread health threats).

22 78 Fed. Reg. at 3,119 ("While the EPA recognizes that there likely are individual biological thresholds for specific health responses, the Integrated Science Assessment concluded the overall evidence from existing epidemiological studies does not support the existence of thresholds at the population level, for effects associated with either long-term or short-term PM exposures within the ranges of air quality observed in these studies."); 79 Fed. Reg. at 75,244 ("Using the available scientific evidence to inform conclusions on the current and alternative standards is complicated by the recognition that a population level threshold has not been identified below which it can be concluded with confidence that O_3-attributable effects do not occur.").

23 40 C.F.R. pt. 51, App. W, § 5.1(b) ("Several of the pollutants mentioned in the preceding paragraph are closely related to each other in that they share common sources of emissions and/or are subject to chemical transformations of similar precursors. For example, strategies designed to reduce ozone could have an effect on the secondary component of PM-2.5 and vice versa. Thus, it makes sense to use models which take into account the chemical coupling between O3 and PM-2.5, when feasible." (citations omitted)).

B. Hazardous Air Pollutants

Criteria pollutants are not the only harmful air pollutants released by the burning of wood. This process also releases hazardous air pollutants, which are subject to direct regulation by EPA under CAA section 112.[24] Hazardous air pollutants were subject to a higher threshold for regulation in 1970, as they had to cause illness or mortality, and not just endanger public health or welfare.[25] Hazardous air pollutants in wood smoke include several aldehydes (formaldehyde, acrolein, propionaldehyde, acetaldehyde), benzene, toluene, methyl chloride, phenol, and catechol.[26]

The burning of wood releases mercury into the air, due to the fact that the wood previously absorbed mercury air emissions during its life as part of a plant or tree.[27] Mercury is the hazardous air pollutant that EPA intended to regulate through its Mercury and Air Toxics Standard for the utility industry in 2012.[28] This is considered to be one of EPA's more ambitious rules in the history of the CAA, with very high benefits and costs.[29]

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24 *See* TIMOTHY V. LARSON & JANE Q. KOENIG, U.S. ENVTL. PROT. AGENCY, A SUMMARY OF THE EMISSIONS CHARACTERIZATION AND NONCANCER RESPIRATORY EFFECTS OF WOOD SMOKE 35 tbl.2 (1993) (listing the pollutants in wood smoke); 42 U.S.C. § 7412(d) (2012) (requiring the maximum achievable degree of emissions reductions for hazardous air pollutants).

25 Pub. L. No. 91-604, 84 Stat. 1676 (codified at 42 U.S.C. §§ 7401–7671q (2012)). Under the 1970 amendments, Section 112 granted discretion to EPA to identify hazardous air pollutants and required it to publish a list of such air pollutants. *Id.* at 1685 (providing for the creation and implementation of national emission standards for hazardous air pollutants which "may cause, or contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness," and requiring that the Administrator publish a list of hazardous air pollutants within 90 days after the enactments' of the amendments). Frustrated with EPA's failure to identify more than eight hazardous air pollutants over the next 20 years, Congress eliminated EPA's discretion, deleted this language from the statute, and created a statutory list of 189 hazardous air pollutants. Clean Air Act Amendments of 1990, Pub. L. No. 101-549, 104 Stat. 2399, 2531–35 (codified at 42 U.S.C. §§ 7412(a)(6), 7412(b)(1) (2012)).

26 LARSON & KOENIG, *supra* note 24, at 35 tbl.2; 42 U.S.C. § 7412(b) (2012) (listing hazardous air pollutants).

27 Jiaoyan Huang et al., *Mercury (Hg) Emissions from Domestic Biomass Combustion for Space Heating*, 84 CHEMOSPHERE 1694, 1699 (2011) ("The Delta-C [the difference between ultraviolet black carbon and black carbon] and $PBM_{2.5}$ [fine particulate-bound mercury] results at two field sites indicate biomass combustion in winter can contribute a significant amount of mercury in the atmosphere. The global importance of this source is unknown; however, it may be important, especially in specific regions, and deserves further attention."). The two field sites were located in Rochester, New York, and the Huntington Wildlife Forest in Newcomb, New York. *Id.* at 1695–96. Different tree species have different emissions factors for particulate-bound mercury. *Id.* at 1696 tbl.1.

28 This rule is variously known as the Mercury and Air Toxics Standards (MATS), the mercury National Emissions Standards for Hazardous Air Pollutants (NESHAP), or the Utility MACT (for the maximum achievable control technology standard that is required by the rule). *See, e.g.*, National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, 77 Fed. Reg. 9304, 9304, 9306–07 (Feb. 16, 2012) (codified at C.F.R. pts. 60, 63).

29 White Stallion Energy Ctr., LLC v. U.S. Envtl. Prot. Agency, 748 F.3d 1222, 1263 (D.C. Cir. 2014), *rev'd* Michigan v. U.S. Envtl. Prot. Agency, 135 S. Ct. 2699 (2015) (J. Kavanaugh,

The irony is that the primary benefits of that standard arise not from the reduction of mercury emissions themselves, but from the reduction of fine particulates, the product of any form of combustion, and not just the product of the combustion of coal. Ostensibly, that rule under section 112 was intended to control hazardous air pollutants such as mercury, hydrochloric acid, hydrogen sulfide, selenium, arsenic, chromium, nickel, and cadmium.[30] But approximately ninety-nine percent of the monetized benefits of the rule were attributable to reductions in emissions of fine particulates, resulting in increases in human lives saved, and the avoidance of health problems.[31] Fine particulates are criteria pollutants, not hazardous air pollutants.[32] Accordingly, fine particulates emitted by the burning of wood by consumers reflect essentially the same problem addressed by the Mercury and Air Toxics Standard.[33] Of all pollutants, fine particulates present the most quantified harm.

dissenting) ("Put simply, the Rule is 'among the most expensive rules that EPA has ever promulgated.'" (quoting JAMES E. MCCARTHY, CONG. RESEARCH SERV., EPA'S UTILITY MACT: WILL THE LIGHTS GO OUT? 1 (2012))); 77 Fed. Reg. at 9,306 (summarizing benefits from the rule). While the utility industry was critical of the rule for being the costliest in the history of the CAA, the benefits outweigh the costs by a magnitude of three to nine, "depending on the benefit estimate and discount rate used." *See id.* The utility industry focused on the absolute value of the costs, rather than their comparison to the benefits from the reduction of fine particulates. *See* Amicus Curiae Brief of Murray Energy Corporation in Support of Petitioners at 20, Michigan v. U.S. Envtl. Prot. Agency, 135 S. Ct. 2699 (2015) (alleging that MATS "will impose far greater costs than any other category of sources that EPA has ever regulated under [the Clean Air Act]").

30 77 Fed. Reg. at 9310.

31 *Id.* at 9306 tbl.2. Assuming a three percent discount rate, total monetized benefits for 2016 are $37–$90 billion. Partial mercury related benefits are only $4–$6 million, and climate related co-benefits are only $360 million. The rest ($36–$89 billion) are attributable to $PM_{2.5}$-related co-benefits. Assuming a 7% discount rate, total monetized benefits for 2016 are $33–$81 billion. Partial mercury-related benefits are only $500,000–$1 million, and climate-related co-benefits are only $360 million. The rest ($33–$80 billion) are attributable to $PM_{2.5}$-related co-benefits.

32 U.S. Envtl. Prot. Agency, *National Ambient Air Quality Standards*, http://www3.epa.gov/ttn/naaqs/criteria.html (last visited Feb. 13, 2016); 40 C.F.R. 50.7(a) (annual and 24-hour primary national ambient air quality standards for fine particulates); 42 U.S.C. § 7412 (2012) (list of hazardous air pollutants).

33 The great discrepancy between the benefits from the reduction of fine particulates and the benefits from the reduction of hazardous air pollutants influenced the decision of the Supreme Court in *Michigan v. U.S. Environmental Protection Agency*. 135 S. Ct. 2699, 2712 (2015) ("We hold that EPA interpreted § 7412(n)(1)(A) unreasonably when it deemed cost irrelevant to the decision to regulate power plants. We reverse the judgment of the Court of Appeals for the D.C. Circuit and remand the cases for further proceedings consistent with this opinion."). The issue was whether EPA was required to consider the costs of regulating the utility industry at the point in time when it determined that it was "appropriate and necessary" to regulate them under Section 112. *Id.* at 2704. In the Clean Air Act Amendments of 1990, Congress imposed the condition that EPA could regulate the utility industry under Section 112 of the Clean Air Act, only if it was appropriate and necessary. *See* Pub. L. No. 101-549, § 301, 104 Stat. 2399, 2558 (Nov. 15, 1990) (codified at 42 U.S.C. § 7412(n)(1) (2012)). The D.C. Circuit had denied industry's challenge to the rule, holding that EPA did not need to consider costs at that point. *White Stallion Energy Ctr., LLC*, 748 F.3d at 1233, 1241. A majority of the Supreme Court reversed that judgment. The majority noted that the costs to industry ($9.6 billion) were 1,600 to

C. Greenhouse Gases

The nature and extent of the impact of biomass on welfare is complicated by the difficulty in accounting for greenhouse gases. With the participation of stakeholders, EPA has struggled with this accounting problem for years. The problem is discussed below.

1. The Accounting Problem

Any combustion process releases carbon dioxide, a chemical that cannot be controlled through conventional pollution control equipment.[34] In fact, it was not traditionally considered an air pollutant for much of the history of the CAA. But following the Supreme Court's landmark holding that the statutory definition of "air pollutant" is broad enough to include greenhouse gases, EPA has been regulating greenhouse gases from both mobile sources (cars and trucks) and stationary sources (industrial plants), in the new source review program.[35]

EPA maintains an annual national greenhouse gas emissions inventory, which allows for a comparison of different sectors' contributions to the generation of greenhouse gases.[36] Total greenhouse gas emissions for the entire nation in 2013 were 6,673.0 MMT CO_2 Eq.[37] Of this figure, over 80% of

2,400 times greater than the benefits from the reduction of hazardous air pollutants ($4 million–$6 million). *Michigan*, 135 S. Ct. at 2706. While the majority noted the "ancillary benefits" of approximately $90 billion from the reduction of fine particulates, it noted that EPA had not relied on these ancillary benefits, in its "appropriate-and-necessary" finding. *Id.* at 2706. In contrast, the dissenting opinion relied on the fact that these ancillary benefits were many times greater than the annual costs to industry. *Id.* at 2721 (Kagan, J., dissenting).

34 For this reason, the pollution control "technology" envisioned for carbon dioxide does not contemplate a baghouse, but rather, approaches such as energy-efficient control measures. *See* LARRY PARKER ET AL., CONGRESSIONAL RESEARCH SERVICE, BACT GUIDANCE FOR GREENHOUSE GASES FROM STATIONARY SOURCES 4 (2010) (setting forth considerations for best available control technology for greenhouse gases, under the new source review program); JOHN GALE ET AL., IPCC SPECIAL REPORT ON CARBON DIOXIDE CAPTURE AND STORAGE 19 (Bert Metz et al. eds., 2005) (explaining that carbon dioxide emissions can be controlled through capture and storage, which is distinct from the traditional end-of-stack control measures used for other pollutants).

35 Massachusetts v. U.S. Envtl. Prot. Agency, 549 U.S. 497, 528–29, 532 (2007) (holding that phrase "any air pollution agent" is sufficiently broad to extend to greenhouse gases). *See, e.g.*, Coal. for Responsible Regulation, Inc. v. U.S. Envtl. Prot. Agency, 684 F.3d 102, 113 (D.C. Cir. 2012) (discussing EPA's promulgation of a series of greenhouse gas-related rules, including the Tailpipe Rule and the Timing and Tailoring Rules, for the new source review program).

36 U.S. ENVTL. PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2013 ES-1 to ES-2 (2015). In February 2016, EPA proposed an inventory for the years 1990–2014, requesting comment by March 23, 2016. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2014, 81 Fed. Reg. 8,713 (Notice of document availability and request for comments); U.S. ENVTL. PROT. AGENCY, DRAFT U.S. GREENHOUSE GAS INVENTORY REPORT: 1990–2014, available at http://www3.epa.gov/climatechange/ghgemissions/usinventoryreport.html (last visited March 6, 2016).

37 *Id.* at 2-1 to fig.2-1. The figure 6,673.0 MMT CO_2 Eq. refers to the equivalent of 6,673.0 million metric tons of CO_2. The reference to "equivalent" reflects the fact that there are different greenhouse gases with different Global Warming Potentials (GWPs). To compare them

emissions are attributable to carbon dioxide (5,505.2 MMT CO_2 Eq.), as opposed to other greenhouse gases.[38] Over 90% of these carbon dioxide emissions are attributable to fossil fuel combustion (5,157.7 MMT CO_2 Eq.).[39]

EPA accounts for wood biomass together with ethanol consumption in automobiles (a combined total of 283.3 MMT CO_2 Eq.).[40] Over 70% of these emissions are attributable to wood biomass (208.6 MMT CO_2 Eq.), and less than 30% are attributable to ethanol (74.7 MMT CO_2 Eq.).[41] But the 208.6 MMT CO_2 Eq. figure for wood biomass represents the contribution of all sectors—industrial, commercial, and residential.[42] Of this figure, the residential contribution is 59.8 MMT CO_2 Eq., slightly less than half the industrial contribution of 120.2 MMT CO_2 Eq., and greater than that of the commercial sector (7.2 MMT CO_2 Eq.) and electricity generation sector (21.3 MMT CO_2 Eq.)[43]

Methane is a greenhouse gas that has twenty-five times the Global Warming Potential of carbon dioxide.[44] The inventory allows for a comparison of different sectors' methane emissions. The residential sector contributes over half of all methane emissions from stationary sources.[45] Even though its greenhouse gas emissions from wood biomass are one-half those of the industrial sector, its methane emissions from the consumption of wood are four times greater than those of the industrial sector.[46] This paradox suggests that the industrial sector is more efficient at extracting or limiting the emissions of methane, a valuable commercial product. This highlights the wasteful nature of residential wood-burning.

Although the burning of fossil fuels and biomass has similar effects in terms of their benefit (generation of energy) and their harm (release of criteria pollutants and hazardous air pollutants), there is one important difference. Because the carbon content of fossil fuels was formerly sequestered beneath the earth's surface, the combustion of fossil fuels can only result in an increase, rather than a decrease, in the level of carbon dioxide in the atmosphere.[47] But this is not necessarily the case for the burning of biomass. In theory, the burning of biomass might not release any more emissions of carbon dioxide than would have occurred anyway,

according to a scale, scientists set the GWP for CO_2 equal to 1, and develop multipliers for the other greenhouse gases. *Id.* at 1-7 to 1-8.

38 *Id.* at 2-4 tbl.2-1.

39 *Id.*

40 *Id.*

41 *Id.* at 3-2 tbl.3-1.

42 *Id.* at 3-87 tbl.3-55.

43 *Id.*

44 *Id.* at 1-8 tbl.1-2.

45 *Id.* at 3-13 tbl.3-10 (4.1 MMT CO_2 Eq. from wood for the residential sector and 8.0 MMT CO_2 Eq. from all stationary sources in all sectors).

46 *Id.* (0.9 MMT CO_2 Eq. from wood for the industrial sector).

47 *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 511 (Susan Solomon et al. eds., 2007), *available at* http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4_wg1_full_report.pdf.

through the natural processes of plant decomposition.[48] On the other hand, while burning wood releases greenhouse gases immediately, natural decompensation of biomass releases greenhouse gases more gradually over a long period of time. Therefore, the impact on levels of carbon dioxide in the atmosphere resulting from the burning of biomass is a complex factual question involving the use of environmental accounting. Climate scientists have wrestled with this question, internationally and domestically.

2. The Intergovernmental Panel on Climate Change Approach

In 1996, the Intergovernmental Panel on Climate Change (IPCC) set forth instructions for completing national greenhouse gas inventories to facilitate reporting by individual nations.[49] In calculating the total emissions of greenhouse gases from stationary and mobile source activities, the IPCC stated that carbon dioxide emissions from combustion of biomass fuels were not to be included in totals for the energy sector.[50] Rather, nations would report such emissions in the land use account.[51] Therefore, the purpose was to avoid double counting. This did not mean the IPCC accepted the premise that biomass emissions are carbon-neutral. Rather, it stated that such emissions may or may not result in net carbon dioxide emissions, depending on whether the biomass was sustainably managed.[52]

In 2000, the IPCC set forth general guidelines for biogenic carbon emissions accounting.[53] It offered two different approaches. First, countries may adopt a land-based approach, which evaluates the change in carbon

48 AM. FOREST & PAPER ASS'N, BIOMASS CARBON NEUTRALITY 1 (2014), *available at* http://www.afandpa.org/docs/default-source/default-document-library/biomass-carbon-neutrality-one-pager.pdf.

49 *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, REVISED 1996 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES: REPORTING INSTRUCTIONS (1996), *available at* http://www.ipcc-nggip.iges.or.jp/public/gl/invs4.html.

50 *Id.* at 1.3 (select "Understanding the Common Reporting Framework (PDF)").

51 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, REVISED 1996 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES: WORKBOOK 1.3 (1996), *available at* http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf ("Biomass fuels are included in the national energy and CO_2 emissions accounts for information only. Within the energy module biomass consumption is assumed to equal its regrowth. Any departures from this hypothesis are counted within the Land Use Change and Forestry module.").

52 *See Id.* at 1.3 (explaining that total greenhouse gas emissions "may not be net emissions if the biomass is sustainably produced. If biomass is harvested at an unsustainable rate (that is, faster than annual regrowth), net CO_2 emissions will appear as a loss of biomass stocks in the *Land-Use Change and Forestry* module"); *id.* at 1.21 ("CO_2 emissions from the combustion of biomass fuels are accounted for in the Land-Use Change and Forestry Sector, if the wood has been produced unsustainably."). The reporting form contained a separate section for reporting such emissions. *Id.* at 1.14 ("Emissions and removals of CO_2 from decreases or increases in biomass stocks due to forest management, logging, fuelwood collection, etc. The category is either a net source if biomass harvest/destruction exceeds regrowth in the inventory year, or a net sink if regrowth exceeds harvest/destruction.").

53 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, LAND USE, LAND-USE CHANGE AND FORESTRY: SUMMARY FOR POLICYMAKERS 8 (2000), *available at* https://www.ipcc.ch/pdf/special-reports/spm/srl-en.pdf.

stocks on particular land units over a relevant period.[54] Second, they may adopt an activities-based approach, which evaluates the change in carbon stocks per unit area and time unit, and then multiplies them by the area on which each activity occurs and by the years it is applied.[55] The IPCC did not tell countries which approach to adopt. Therefore, this reinforces the notion that biogenic emissions may be included either in the accounts for the energy sector (based on the activity) or in the accounts for the land use sector (based on the land).

Having drawn this distinction, the IPCC reiterated the principles underlying the 1996 Guidelines. It stated that reduced emissions resulting from the substitution of biofuels for fossil fuel in the energy sector would be captured in the energy sector accounts, but any changes in biomass stocks resulting from the production of biofuels would be captured by the land use accounts.[56] In other words, increases in carbon dioxide from unsustainable management would be included in the land use accounts.

Despite the IPCC's statements that biomass could potentially result in an increase or decrease in net emissions of carbon dioxide, many people interpreted the accounting as assuming that biomass is carbon-neutral.[57] A group of scientists called into question this assumption, noting that it depends on the source of the biomass and the land use effects.[58] There appears to be a trend toward moderation on both sides of the debate. Environmentalists generally agree that the carbon-neutrality of biomass depends on the circumstances, but they are cautious about proposed projects because of the incentive for unsustainable practices.[59] The forestry

54 *Id.* at 9.

55 *Id.*

56 *Id.* at 6 n.2.

57 *See* Timothy D. Searchinger et al., *Fixing a Critical Climate Accounting Error*, 326 SCI. 527, 527 (2009), *available at* https://www.princeton.edu/step/people/faculty/michael-oppenheimer/recent-publications/Fixing-a-critical-climate-error-T.-Searchinger-et-al-2009-.pdf ("This accounting erroneously treats all bioenergy as carbon neutral, regardless of the source of the biomass, which may cause large differences in net emissions.").

58 *See generally id.* ("Bioenergy therefore reduces greenhouse emissions only if the growth and harvesting of the biomass for energy captures carbon above and beyond what would be sequestered anyway.").

59 *See generally* Sierra Club, *Biomass Guidance*, http://www.sierraclub.org/policy/energy/biomass-guidance (last visited Feb. 13, 2016) ("We believe that biomass projects can be sustainable, but that many biomass projects are not. We are not confident that massive new biomass energy resources are available without risking soil and forest health, given the lack of commitment by governments and industry to preservation, restoration, and conservation of natural resources. We are cautious in supporting projects based on 'clean' construction waste, forest byproduct waste or sustainable waste such as municipal tree trimmings because of the strong incentives for plant managers to use unsustainable or contaminated fuel if the intended supply runs short."); Nat. Res. Def. Council, *Biomass Energy and Cellulosic Ethanol*, http://www.nrdc.org/energy/renewables/biomass.asp (last visited Feb. 13, 2016) ("Biomass energy is a double-edged sword, depending on how and where it is produced."). Center for Biological Diversity takes a more forceful position, arguing that emission from biomass may actually be greater than those from fossil fuels, due to differences in energy efficiency. Ctr. for Biological Diversity, *Debunking the Biomass Myth*, http://www.biologicaldiversity.org/campaigns/debunking_the_biomass_myth/ (last visited Feb. 13, 2016) ("A plethora of recent

and wood products industry continues to advocate carbon-neutrality, but this position is tempered by language implying the need to consider the actual impacts of the life cycle of the biomass.[60]

In its 2014 Assessment, the IPCC identified the general assumption of carbon neutrality, cited studies discussing the shortcomings of this assumption, and attributed this assumption to a misunderstanding of the 1997 Guidelines.[61] According to the IPCC, "the total climate forcing of bioenergy depends on feedstock, site-specific climate and ecosystems, management conditions, production pathways, end use, and on the interdependencies with energy and land markets."[62] In short, the answer is that it depends.

scientific articles and studies have demolished this mythology, demonstrating that even when biomass is burned as a substitute for fossil fuels, the resulting CO_2 emissions may actually be worse for decades or even centuries to come. This period of increased emissions—known as the biomass 'carbon debt'—arises because plants don't contain as much energy as fossil fuels. So in order to get the same amount of energy, more trees than fossil fuels have to be burned, resulting in more CO_2 emissions per unit of energy produced.").

60 *See generally* WORLD BUS. COUNCIL FOR SUSTAINABLE DEV., RECOMMENDATIONS ON BIOMASS CARBON NEUTRALITY 3 (2015), http://www.wbcsd.org/Pages/EDocument/EDocumentDetails.aspx?ID=15347&NoSearchContextKey=true (last visited Feb. 13, 2016) (select "FSG Recommendations on Biomass Carbon Neutrality") The World Business Council for Sustainable Development report stated:

> If wood-producing forests have stable or increasing carbon stocks, they are producing carbon neutral wood. Assessments of forest carbon stocks should include all pools of forest carbon (e.g. above ground, below ground, litter) that are likely to be impacted by wood production. The area and time used to determine if forest carbon stocks are stable will vary and can significantly affect judgments regarding trends in forest carbon. The area used to judge the stability in forest carbon stocks should, however, include all areas providing wood for current and future use. The time used should be long enough to avoid being misled by temporary changes in forest conditions and to allow significant carbon impacts associated with past practices to be identified where they are associated with wood now being produced.

Id. See also AM. FOREST & PAPER ASS'N, *supra* note 48, at 3 ("Biomass used to create energy should be treated as carbon neutral where the growth rate of forests is greater than or equal to harvest levels."); Forest Am., *Adopting Policy for Forest Bioenergy That Recognizes Carbon Benefits of Forests*, http://forestamerica.org/issues/adopting-policy-forest-bioenergy-recognizes-carbon-benefits-forests (last visited Feb. 13, 2016) ("EPA's policy should reaffirm the scientifically sound and internationally accepted policy that forest bioenergy will not increase carbon in the atmosphere so long as overall forest carbon stocks . . . remain stable or are increasing.").

61 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 879 n.14 (2014), *available at* http://www.ipcc.ch/report/ar5/wg3/ (select "Full Report").

62 *Id.*

3. EPA's Accounting Framework for Biogenic Carbon Dioxide Emissions from Stationary Sources

To develop its own approach for accounting for the ambiguous case of biogenic carbon dioxide, EPA drafted a framework in 2011.[63] EPA revised this document in 2014.[64] Because it was originally drafted one year after the promulgation of EPA's Tailoring Rule, one purpose was to assist in the implementation of the Prevention of Significant Deterioration (new source review) and Title V programs of the CAA.[65] This program requires certain new or modified industrial facilities to obtain a preconstruction permit and install the best available control technology for air pollutants subject to regulation under the CAA.[66] The program applies if a new facility has potential emissions above a certain threshold, or if a modification of a facility increases emissions above a certain threshold.[67]

The approach that EPA ultimately develops will significantly affect federal policy on biomass emissions. If finalized as a policy statement, it will not have the force of law because it will not have been promulgated pursuant to the notice and comment procedures of the Administrative Procedure Act.[68] But any policy approach to this highly scientific and technical question will still be important. Courts afford EPA deference in

63 U.S. ENVTL. PROT. AGENCY, ACCOUNTING FRAMEWORK FOR BIOGENIC CO_2 EMISSIONS FROM STATIONARY SOURCES iv (2011), *available at* http://www.epa.gov/climatechange/Downloads/ghgemissions/Biogenic-CO2-Accounting-Framework-Report-Sept-2011.pdf.

64 U.S. ENVTL. PROT. AGENCY, FRAMEWORK FOR ASSESSING BIOGENIC CO_2 EMISSIONS FROM STATIONARY SOURCES ii (2014), *available at* http://www.epa.gov/climatechange/downloads/Framework-for-Assessing-Biogenic-CO2-Emissions.pdf.

65 *See* Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31,514, 31,514 (June 3, 2010) (codified at 40 C.F.R pts. 51–52, 70–71) ("EPA is tailoring the applicability criteria that determine which stationary sources and modification projects become subject to permitting requirements for greenhouse gas (GHG) emissions under the Prevention of Significant Deterioration (PSD) and title V programs of the Clean Air Act."). The Title V permit applies to "major sources" that are subject to substantive requirements of the CAA, including the Prevention of Significant Deterioration program permitting requirement. 42 U.S.C. § 7661a(a) (applicability); *id.* § 7661(2)(b) (defining a "major source" for purposes of Title V in terms of the definition of "major stationary source" in Section 302), *id.* 7602(g) (defining a "major stationary source" to include a stationary source with a potential to emit 250 tons per year or more of any air pollutant).

66 42 U.S.C. § 7475(a)(1), (4) (2012) (permit requirement and technology requirement for a "major emitting facility" under the Prevention of Significant Deterioration program, for attainment areas). While the CAA contains parallel provisions for new source review in nonattainment areas (the Nonattainment New Source Review program), greenhouse gases are subject only to Prevention of Significant Deterioration and not this other program, because there are no nonattainment areas for greenhouse gases, since they are not criteria pollutants.

67 *Id.* § 7479(1) (definition of "major emitting facility"). Incremental thresholds for determining applicability to modified facilities are located in EPA's regulations. *See* 40 C.F.R. § 51.166(b)(2)(i) (2014) (definition of "major modification" for Prevention of Significant Deterioration); *id.* § 51.166(b)(39) (definition of "significant emissions increase").

68 5 U.S.C. § 553(b)(3)(A) (2012) (notice and comment provisions for rulemakings do not apply to "interpretative rules, general statements of policy, or rules of agency organization, procedure, or practice").

judicial review of factual questions of a highly scientific and technical nature.[69]

As required by the CAA, EPA has created a Science Advisory Board to provide scientific advice to the agency.[70] In 2011, the Science Advisory Board provided comments on EPA's draft Accounting Framework.[71] As a preliminary matter, the Science Advisory Board agreed with EPA's decision to reject an all-or-nothing approach to biogenic carbon dioxide emissions from stationary sources, which would either treat them as equivalent to fossil fuel emissions (a categorical inclusion) or exempt them from greenhouse gas regulation (a categorical exclusion).[72] It rejected a categorical inclusion because biogenic sources emit fewer greenhouse gas emissions than fossil fuels, and a categorical inclusion would provide no incentive for encouraging the use of biomass.[73] But it also rejected a categorical exclusion because that would relieve a stationary source from the responsibility to control carbon dioxide emissions at all, and it would provide no incentive for best management practices.[74] Underlying its analysis was the premise that "carbon neutrality is not an appropriate a priori assumption; it is a conclusion that should be reached only after considering a particular feedstock's production and consumption cycle."[75] Important factors in this analysis include feedstock types, sources, and production methods.[76]

The need to evaluate a particular feedstock's production and consumption cycle stems from the regulatory mandate of the CAA. As the Science Advisory Board stated, "EPA is not charged with regulating regional or national forest carbon stocks: it must regulate stationary facilities."[77] It rejected the notion of assuming that all biomass is carbon-neutral, and that stationary sources should not be responsible for those carbon dioxide

69 Am. Farm Bureau Fed'n v. U.S. Envtl. Prot. Agency, 559 F.3d 512, 519 (D.C. Cir. 2009) ("We give an 'extreme degree of deference to the agency when it is evaluating scientific data within its technical expertise,' reviewing the agency's action to 'ensure that the EPA has examined the relevant data and has articulated an adequate explanation for its action.'" (quoting City of Waukesha v. U.S. Envtl. Prot. Agency, 320 F.3d 228, 247 (D.C. Cir. 2003))).

70 42 U.S.C. § 4365(a) (2012) ("The Administrator of the Environmental Protection Agency shall establish a Science Advisory Board which shall provide such scientific advice as may be requested by the Administrator."). Congress passed the law in 1977. Environmental Research, Development, and Demonstration Authorization Act of 1978, Pub. L. No. 95-155, § 8, 91 Stat. 1257, 1260 (Nov. 8, 1977). This act was codified in Chapter 55 of Title 42 of the United States Code, titled "National Environmental Policy." 42 U.S.C. § 4365(a) (2012). However, it is not part of the National Environmental Policy Act, located in the same chapter. *Id.* §§ 4321–4370h.

71 SCI. ADVISORY BD., U.S. ENVTL. PROT. AGENCY, SAB REVIEW OF EPA'S ACCOUNTING FRAMEWORK FOR BIOGENIC CO2 EMISSIONS FROM STATIONARY SOURCES (2011), *available at* http://yosemite.epa.gov/sab/sabproduct.nsf/0/57B7A4F1987D7F7385257A87007977F6/$File/EPA-SAB-12-011-unsigned.pdf.

72 *Id.* at 3–4.

73 *Id.*

74 *Id.* at 4.

75 *Id.* at 3.

76 *Id.* at 3–4.

77 *Id.* at 4.

emissions.[78] The ultimate question involves "knowing what the emissions would have been without the use of bioenergy and comparing it with emissions with the use of bioenergy."[79] This is popularly known as a counterfactual analysis.[80]

4. EPA's Deferral Rule

Because of the complexity of accounting for carbon dioxide, EPA attempted to postpone its regulation of greenhouse gases for a period of three years, one year after the promulgation of the Tailoring Rule.[81] In promulgating the Deferral Rule, EPA generally acknowledged comments regarding the accounting problem.[82] But the Deferral Rule did not make a specific provision for the accounting methodology to be applied.[83] During the public comment period, the forest and wood products industry submitted comments advocating a national approach.[84] Such an approach would be

78 *Id.* at 3 ("The SAB agrees with the agency that this approach would not be appropriate because it does not allow a link between the stationary source that is using biomass feedstocks and the emissions that are being measured. This link is critical in order to be able to regulate emissions at a stationary source level which is the way that greenhouse gas emissions are mandated to be regulated under the Clean Air Act. To adjust the stack emissions from stationary facility bioenergy based on the induced changes off-site in carbon stocks on land, a chain of custody has to be established with the source of the feedstock.").

79 *Id.*

80 *See, e.g.*, *id.* at 5.

81 Deferral for CO_2 Emissions from Bioenergy and Other Biogenic Sources Under the Prevention of Significant Deterioration (PSD) and Title V Programs, 76 Fed. Reg. 43,490, 43,496–97, 43,507 (July 20, 2011) (to be codified at 40 C.F.R. pts. 51–52, 70–71) ("[P]rior to July 21, 2014, the mass of the greenhouse gas carbon dioxide shall not include carbon dioxide emissions resulting from the combustion or decomposition of non-fossilized and biodegradable organic material originating from plants, animals, or micro-organisms.").

82 *Id.* at 43,505 (referring to carbon cycle dynamics, accounting methodologies used by other programs, components of accounting methodologies, and forest economics and sustainability, which EPA would consider pending the deferral).

83 *Id.* at 43,492, 43,496–97 (discussing further considerations required to address the complexity of determining an accounting method, and asserting that three years is a reasonable period to develop an accounting method).

84 U.S. ENVTL. PROT. AGENCY, DEFERRAL FOR CO_2 EMISSIONS FROM BIOENERGY AND OTHER BIOGENIC SOURCES UNDER THE PREVENTION OF SIGNIFICANT DETERIORATION (PSD) AND TITLE V PROGRAMS: SUMMARY OF PUBLIC COMMENTS AND RESPONSES 149 (2011), *available at* http://www.epa.gov/sites/production/files/2015-12/documents/rtc_6-30_final_comb.pdf (comment of Weyerhaeuser Corporation) ("[S]maller-scale assessments simply ignore the relevant information and the realities of forest management and biomass use, including the wide variety of geographic sources of and types of biomass used by any given facility."); *id.* at 151 (comment of Resource Management Service, LLC) ("The commenter further argued that carbon accounting should be at the national scale rather than at the stand or plot scale. Since forests are managed across the landscape, not on individual plots, the carbon stock changes need to emulate the way forests are managed."); *id.* (comment of National Alliance of Forestry Owners) ("The commenter argued that restricting forest carbon accounting to local areas and specific timeframes places arbitrary limits on the carbon cycle that distort the forest carbon picture."); *id.* at 152 (comment of Coalition for Biomass Generation) ("Since the generating facilities obtain biomass from a variety of different sources that constantly change (mostly wood that would not have been used for other purposes and wood waste), the commenter

beneficial to the industry, given data indicating a net increase in overall forest carbon stocks in the United States over the last several decades.[85] Most environmental groups did not address the accounting method issue in their comments.[86]

In the Deferral Rule, EPA did not entertain a discussion of health impacts. This is because the Deferral Rule was premised on the notion that greenhouse gases are subject to regulation under the Prevention of Significant Deterioration program based on their effect on climate, rather than their effect on public health.[87] In response to a comment that the Deferral Rule would result in a large increase in emissions of particulates and toxic air pollutants from biomass combustion, EPA disclaimed any authority to consider the health impacts of pollutants other than greenhouse gases, in this context.[88] As a result, by characterizing wood burning as a policy response to the problem of climate change, the forestry and biomass industry have largely avoided the issue of the adverse health impacts of the burning of wood, at least in the context of EPA's Deferral Rule.

An environmental group successfully challenged the Deferral Rule in the United States Court of Appeals for the District of Columbia, under the

recommends EPA to consider carbon neutrality on a real world basis and also recommends EPA consider carbon stocks nationally as the U.S. Forest Service does through its FIA program."); *id.* (comment of Georgia-Pacific) ("[T]he biological reality of tree growth makes plot- or stand-specific considerations unrealistic and impractical."); *id.* at 153 (comment of National Alliance of Forestry Owners) ("The commenter argues that any attempt to account for CO_2 fluxes at a smaller spatial scale would ignore the realities of the forest products industry and create arbitrary boundaries that distort the forest products market."); *id.* at 155 (comment of Weyerhaeuser Company) ("The commenter believes that any attempt to configure an accounting system within the perceived constraints of the facility-scale PSD program on a case-by-case basis would result in absurd results."); *id.* at 157 (comment of Hunton & Williams as counsel for Coalition for Biomass Generation) ("The commenter recommended a broader based, national level analysis that includes a review of the amount of carbon stocks nationally, as indicated by long-accepted tools such as the U.S. Forest Service FIA Program.").

85 *Id.* at 153–54 (comment of National Alliance of Forestry Owners) ("The commenter believed that this approach would be consistent with national inventory approach applied by the U.S. Forest Service that has demonstrated a net increase in overall forest carbon stocks in the U.S. of nearly 50% over the second half of the 20th Century, which has come during a time of unprecedented increase in demand for forest products for home construction, consumer goods, and energy.").

86 *See, e.g.*, *id.* at 149–51, 156–57 (comments of Tennessee Chapter of the Sierra Club, Massachusetts Department of Environmental Protection, Minnesota Pollution Control Agency, and Natural Resource Defense Counsel). The Wilderness Society submitted a comment suggesting factors to be considered in selecting an accounting method, but did not advocate for a particular geographic scope. *Id.* at 153.

87 *See* 76 Fed. Reg. 43,490, 43,492 (July 20, 2011) (to be codified at 40 C.F.R. pts. 51–52, 70–71) (discussing government efforts to promote bioenergy as a way to address climate change without any reference to the public health); *id.* at 43,506 (claiming the rule "does not establish an environmental standard intended to mitigate health or safety risks").

88 U.S. ENVTL. PROT. AGENCY, *supra* note 84, at 6, 36 (response to comment of Biofuelwatch/Energy Justice Network) ("We agree that EPA regulations should address harmful health impacts; however, the CAA does not always give EPA authority to consider health impacts as part of the regulatory development process for particular regulations. . . . This rule does not address emissions of other particulates and other toxic air pollutants.").

rationale that there was no statutory basis for a temporary exemption from the permitting requirement of the Prevention of Significant Deterioration program.[89] In vacating the rule, the Court rejected EPA's invocation of the three doctrines it had successfully used as the basis for its Tailoring Rule for greenhouse gases—the one-step-at-a-time doctrine, the administrative necessity doctrine, and the absurd results doctrine.[90] As a result, EPA was compelled to regulate greenhouse gases under the Prevention of Significant Deterioration program.

5. Biomass and EPA's Carbon Pollution Emission Guidelines for Existing Stationary Sources

In June 2014, EPA proposed a Carbon Pollution Emissions Guidelines Rule for fossil fuel power plants, as a major regulatory effort to address greenhouse gases.[91] It would directly regulate the states by setting state carbon pollution goals.[92] To meet these goals, the states would be responsible for submitting plans to EPA.[93] Although the rule would directly regulate the states rather than individual power plants, the success of the rule would depend on the power plants satisfying the requirements of any state plans.[94] State plans would be analogous to state implementation plans under section 110 of the CAA for addressing the national ambient air quality standards for criteria pollutants.[95] Because the affected sources subject to this proposed rule would be fossil fuel-fired power plants, the proposed rule would not apply to freestanding, dedicated biomass facilities.[96]

In the proposed rule, EPA identified biomass as one of a number of renewable power generation technologies available to states for attaining their objectives.[97] Specifically, with regard to electric generating units (EGUs), EPA identified "the use of biomass-derived fuels at affected EGUs" as a measure that could lead to carbon dioxide reductions.[98] Still, there was uncertainty regarding how large such reductions would be.[99] EPA noted

89 Ctr. for Biological Diversity v. U.S. Envtl. Prot. Agency, 722 F.3d 401, 408–09 (D.C. Cir. 2013).

90 *Id.* at 409–12.

91 *See* Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 34,830, 34,830 (proposed June 18, 2014) (to be codified at 40 C.F.R. pt. 60).

92 *Id.* at 34,953, 34,957–58.

93 *Id.* at 34,951.

94 *Id.* at 34,954–55 (compliance with state requirements, and therefore the success of the rule, is measured by the emissions and monitoring of the individual sources).

95 *See* 42 U.S.C. § 7410(a) (2012) (requiring each state to submit an implementation plan to EPA to attain the national ambient air quality standards, but allowing states flexibility in achieving those standards).

96 79 Fed. Reg. at 34,954 (all affected EGUs require fossil fuels to be used as heat input); *id.* at 34,955–56 (using § 60.5795(a)–(b)(2) as the basis for definition of "affected EGU").

97 *Id.* at 34,843–44 n.30.

98 *Id.* at 34,923.

99 *Id.* at 34,924 ("The plant growth associated with producing many of the biomass-derived fuels can, *to varying degrees for different biomass feedstocks*, sequester carbon from the

concerns with measuring the overall level of carbon dioxide emissions over the life of the combustion source.[100] Ultimately, EPA acknowledged that it would continue to revise its draft accounting framework for biomass-derived fuels, and that this framework would assist EPA and the states in assessing the impact of biogenic fuels.[101] Accordingly, the development of the informal accounting framework would affect the formal rulemaking effort.

In its Regulatory Impact Analysis, EPA set forth a chart of emissions factors for various fossil fuels and nonfossil fuels.[102] This provides a starting point for measuring the relative benefits of biomass against those of other fuel sources. The emissions factor is measured in units of lbs/MMBtu, or pounds of carbon dioxide released per million British thermal units generated. The emissions factor for biomass (195 lbs/MMBtu) is less than that for various coals (205.2–217.0 lbs/MMBtu), but greater than that for waste tires (189.5 lbs/MMBtu) and fuel oil (161.4–173.9 lbs/MMBtu).[103] It is also much greater than the emissions factor for natural gas (117.1 lbs/MMBtu), by far the fossil fuel with the lowest emissions factor.[104]

Reflecting the uncertainty regarding the net effect of biogenic carbon dioxide emissions, EPA acknowledged that this emissions factor does not reflect other emissions or sequestration that might occur during the life cycle of the fuel.[105] In practice, the actual emissions from a given fuel could be higher or lower than this figure.[106] For example, fossil fuel emissions that accompany the transport of biomass fuel to a combustion facility would be included. In contrast, the avoided emissions that would have resulted if the material had not been burned for energy would be offset against this figure.[107] To illustrate, if all the biomass would have been emitted into the atmosphere through natural decay, it would constitute double counting to include the burning of that material as an increase in atmospheric carbon dioxide.

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atmosphere. . . . As a result, *broadly speaking*, burning biomass-derived fuels for energy recovery *can yield climate benefits* as compared to burning conventional fossil fuels." (emphasis added)).

100 *Id.* ("The draft framework concluded that while biomass and other biogenic feedstocks have the potential to reduce the overall level of CO_2 emissions resulting from electricity generation, the contribution of biomass-derived fuels to atmospheric CO_2 is sensitive to the type of biomass feedstock used, and the way in which the feedstock is grown, processed, and ultimately combusted as a fuel for energy production.").

101 *Id.* at 34,925.

102 U.S. ENVTL. PROT. AGENCY, REGULATORY IMPACT ANALYSIS FOR THE PROPOSED CARBON POLLUTION GUIDELINES FOR EXISTING POWER PLANTS AND EMISSION STANDARDS FOR MODIFIED AND RECONSTRUCTED PLANTS 2-11 tbl.2-7 (2014), *available at* http://www2.epa.gov/sites/production/files/2014-06/documents/20140602ria-clean-power-plan.pdf.

103 *Id.*

104 *Id.*

105 *Id.* ("CO2 emissions presented here for biomass reflect combustion only. They do not include any other biogenic or fossil emissions/sequestration related to biomass growth, harvest, transportation or any other biomass or processing emissions as part of the carbon cycle.").

106 *See id.* (indicating by explicit reference to other emissions/sequestrations that factors outside of combustion emissions have an impact on actual emissions).

107 *See id.*

The final rule does not change the basic features of the proposed rule.[108] It sets forth state carbon pollution goals,[109] a procedure for submission of state implementation plans,[110] and it is based on direct regulation of the states, which in turn regulate industrial facilities.[111] The rule does not apply to freestanding, dedicated biomass facilities, or to non-fossil fuel units limiting their use of fossil fuels to less than 10% of the annual capacity factor.[112] In the preamble, EPA acknowledged that states can include qualified biomass in their plans and include provisions for how qualified biomass feedstocks will be determined.[113] EPA notes that it is in the process of developing its framework for biogenic carbon dioxide emissions, implying that this will affect future approaches.[114] State plan submissions must describe the types of biomass being proposed and why they should be considered "qualified biomass," and address the proposed valuation of biogenic carbon dioxide emissions.[115] In addition, state plans must specify how such emissions will be monitored and reported, and identify the specific evaluation, measurement, and verification (EM&V), tracking and auditing approaches for the feedstocks.[116] In the course of its review of a state plan, EPA will review the appropriateness and basis for the proposed determinations, and related accounting, monitoring, and reporting measures.[117] EPA states that "[n]ot all forms of biomass are expected to be approvable as qualified biomass."[118]

108 Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,665–72 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60) (summarizing major provisions). Key changes involved the setting of the mandatory reduction period, a revised determination of "best system of emissions reduction," uniform emission performance rates, state plan approaches, emission trading programs, extensions of plan submittal dates, provisions to encourage early action, provisions for electric system reliability, approaches for addressing employment concerns, and community and environmental justice considerations. *Id.* at 64,672–77.

109 *Id.* at 64,961–64 tbls.1–4.

110 *Id.* at 64,943–49 (to be codified at 40 C.F.R. §§ 60.5740–60.5790) ("State and Multi-Plan Requirements").

111 *Id.* at 64,942 (to be codified at 40 C.F.R. § 60.5710) ("Am I affected by this subpart?"); *id.* at 64,952–57 (to be codified at 40 C.F.R. §§ 60.5840–60.5860) ("Applicability of Plans to Affected EGUs").

112 *Id.* at 64,953 (to be codified at 40 C.F.R. § 60.5850) (exclusion for non-fossil units that have limited the use of fossil fuels to ten percent or less of the annual capacity factor or are subject to such a federally enforceable permit limitation).

113 *Id.* at 64,885. "Qualified biomass" is defined as "a biomass feedstock that is demonstrated as a method to control increases of CO_2 levels in the atmosphere." *Id.* at 64,961 (to be codified at 40 C.F.R. § 60.5880).

114 *Id.* at 64,885–86.

115 *Id.* at 64,886.

116 *Id.*

117 *Id.*

118 *Id.*

6. The Special Case of Human Breathing (Metabolic Emissions) and Contribution to Greenhouse Gas Emissions

The fact that EPA is now evaluating the relative contribution of biomass emissions to carbon dioxide levels in the atmosphere suggests a need for a better scientific explanation of the contribtuion of human respiration to carbon dioxide levels in the atmosphere. Climate scientists and EPA have assumed that human breathing is entirely carbon-neutral, based on the rationale that the amount of carbon dioxide exhaled by humans cannot be greater than the amount of elemental carbon ingested by eating plants or animals.[119] In other words, metabolic carbon dioxide emissions are part of a natural closed-loop system between the biosphere and the atmosphere, in which carbon dioxide is continuously taken out of the atmosphere by plants and then released into the atmosphere by respiration of the animals that eat them. These emissions are different from the emissions from fossil fuels, which are not part of this natural cycle. Rather, fossil fuels release carbon dioxide that was previously sequestered under the earth's surface.[120]

But the plants and trees that are the source of biomass are also part of this natural closed-loop system, and there is a legitimate debate whether the burning of biomass is carbon-neutral. At the very least, it depends on the circumstances. By analogy, it would also appear to be debatable whether the carbon dioxide emissions resulting from human consumption of biomass are carbon-neutral. In each case, the carbon in biomass is being transformed into carbon dioxide in the atmosphere. The only difference is that in the case of biomass, combustion plays a role in this transformation. In the case of metabolic emissions, the human body replaces combustion as the instrument in this transformation. There is no apparent reason why this difference should be material to whether such emissions are carbon neutral. If biomass emissions are not necessarily carbon neutral, then the same must be said about metabolic emissions.

There are several potential flaws in the traditional theory that human respiration does not contribute to carbon dioxide levels in the atmosphere. The first potential flaw is the assumption that human breathing returns carbon to the atmosphere that was only "briefly sequestered in plants."[121]

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119 U.S. Envtl. Prot. Agency, *When People Breathe, They Exhale Carbon Dioxide. Does This Contribute To Climate Change?*, https://climatechange.zendesk.com/hc/en-us/articles/212305707-When-people-breathe-they-exhale-carbon-dioxide-Does-this-contribute-to-climate-change (last visited Feb. 13, 2016).

120 *See* U.S. Envtl. Prot. Agency, *Overview of Greenhouse Gases*, http://www3.epa.gov/climatechange/ghgemissions/gases/co2.html (last visited Feb. 13, 2016) (explaining that carbon dioxide trapped in plants and forests is part of a natural, balanced carbon cycle, but the combustion of fossil fuels releases additional carbon dioxide into the atmosphere that is not part of this natural balance).

121 U.S. Envtl. Prot. Agency, *When People Breathe, They Exhale Carbon Dioxide*, *supra* note 119 ("Human respiration of carbon dioxide (CO_2) does not contribute to the build-up of CO_2 in the atmosphere. This is because the amount of CO_2 people exhale cannot be greater than the amount of carbon they put into their bodies by eating plants, or by eating animals that eat plants. Plants take up carbon dioxide from the atmosphere through photosynthesis. So the

This reasoning has an air of plausibility, but it is faulty. Humans also eat animals, which may sequester carbon for long periods of time. Even if carbon sequestration is temporary for a particular plant or animal, the total amount of sequestration in all plants and animals at one time is significant. By the terms of the theory itself, such sequestration would be matched by a decrease in carbon dioxide in the atmosphere. In other words, it is more appropriate to conceive of the atmosphere as a fluctuating system, rather than the atmosphere and biosphere as one static, closed-loop system. The real question is the magnitude and direction of the flow of carbon between the biosphere and the atmosphere.

A second potential flaw is EPA's assumption that "[r]oughly the same amount of CO_2 that humans exhale will then be taken up by plants to start the cycle again," according to a statement on its website.[122] Common sense would suggest this is not necessarily the case. There is no assurance that a particular molecule of carbon dioxide from human breathing will be absorbed by a plant or animal, either today, tomorrow, or a year in the future. Moreover, carbon dioxide has been characterized as a global pollutant that readily disperses in the atmosphere, without elevated local impacts. In addition, it is unclear how plants and animals would be able to distinguish between good carbon dioxide (from human breathing) and bad carbon dioxide (from industrial facilities), and selectively tailor their uptake to make the theory hold up in practice. Climate scientists have not provided a satisfactory explanation of this cycle.

Unfortunately, there are few studies exploring these questions, probably because the assumption of a closed-loop natural system is pandemic among climate scientists. In fact, it may be not so much a theory as an operating assumption in their accounting approach. But one peer-reviewed study provides data that suggest the need for further research. Two researchers have attempted to quantify "the direct CO_2 released by respiration of humans and domesticated animals, as well as CO_2 derived from the decomposition of their resulting wastes."[123] According to the study, total direct and indirect metabolic emissions from humans and domesticated animals (3.1 gigatons of carbon (GtC) per year) are about one-half the emissions from fossil fuel combustion, and nearly twice the emissions from changes in land use, based on data from a 2001 IPCC report.[124] The study concludes that the traditional discussions of fossil fuel emissions scenarios

carbon dioxide that humans and other animals exhale is simply returning the carbon dioxide that was briefly sequestered in plants to the atmosphere.").

122 *Id.* EPA does not indicate what it means by the word "roughly" in this statement.

123 Y. T. Prairie & C. M. Duarte, *Direct and Indirect Metabolic CO_2 Release by Humanity*, 4 BIOGEOSCI. 215, 215 (2007), *available at* http://www.biogeosciences.net/4/215/2007/bg-4-215-2007.pdf. The methodology involved calculations of per capita rates of respiration and excretion, tidal volume, and average carbon dioxide concentration of air expired. *Id.* In addition, it considered evidence of per capita organic waste decomposition, human population size, the population of domestic animals, estimated respiratory release, and decomposer respiration of their excreted products. *Id.* at 216.

124 *Id.* at 216.

"underestimate the likely increase in atmospheric CO_2 concentration by failing to account for demographics effects on the metabolic CO_2 release."[125]

In its national emissions inventory, EPA recognizes that land use changes are merely a proxy for greenhouse gas emissions.[126] EPA recognizes that this proxy may be imperfect because natural emissions—presumably emissions from volcanoes, forest fires, and other natural events—might be included with anthropogenic emissions.[127] It recognizes there is an element of subjectivity in drawing a distinction between natural and anthropogenic causes within the analysis of emissions from land use changes, and that the proxy is used because it is a practical approach.[128] Given the uncertainty regarding what is a natural emission of carbon dioxide and what is an anthropogenic emission of carbon dioxide, EPA should provide a more precise explanation of the role of metabolic carbon dioxide emissions. The contribution of carbon dioxide from human breathing is a question of scientific fact that is worthy of additional study, as much as the question of biomass. To the extent humans and animals may store or sequester carbon, that is a relevant offsetting factor, in the analysis of the cycle.[129] In explaining the role of metabolic carbon dioxide emissions in a circular manner, climate scientists and EPA have not provided a complete and accurate scientific explanation for the carbon cycle.

III. BIOMASS AND RENEWABILITY

The debate over biomass challenges people to reevaluate what constitutes a renewable energy in the first place. The characterization of sources of energy as "renewable" involves political choices by corporations and individuals. This Part considers the formation of those political choices.

125 *Id.*

126 INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2013, *supra* note 26, at 6-5 (2015) ("The IPCC (2006, Vol. IV, Chapter 1) considers all anthropogenic GHG emissions and removals associated with land use and management to occur on managed land, and all emissions and removals on managed land should be reported based on this guidance (see IPCC 2010 for further discussion). Consequently, managed land serves as a proxy for anthropogenic emissions and removals.").

127 *Id.* ("This proxy is intended to provide a practical framework for conducting an inventory, even though some of the GHG emissions and removals on managed land are influenced by natural processes that may or may not be interacting with the anthropogenic drivers.").

128 *Id.* ("Guidelines for factoring out natural emissions and removals may be developed in the future, but currently the managed land proxy is considered the most practical approach for conducting an inventory in this sector (IPCC 2010). The implementation of such a system helps to ensure that estimates of GHG fluxes are as accurate as possible, and does allow for potentially subjective decisions in regards to subdividing natural and anthropogenic driven emissions.").

129 Brian Palmer, *7 Billion Carbon Sinks: How Much Does Breathing Contribute to Climate Change?*, SLATE, Aug. 13, 2009, http://www.slate.com/articles/news_and_politics/explainer/2009/08/7_billion_carbon_sinks.html (last visited Feb. 13, 2016).

A. Renewability, Health, and the Environment

The irony of biomass is that it is recognized as a source of renewable energy that is an alternative to fossil fuels, even though the combustion of biomass releases air pollutants that have significant impacts on human health. In their search to find sources of energy other than fossil fuels, people have forgotten why air pollution from combustion is regulated in the first place.

Whether a source of energy is renewable or sustainable is a subjective determination. According to a leading dictionary, renewable means "capable of being replaced by natural ecological cycles or sound management practices."[130] But in applying this or any other definition, there is some room for debate over what is renewable and what is not renewable. Coal, oil, natural gas, and nuclear power are generally not considered to be sources of renewable energy.[131] The prevailing reason appears to be that any fuel that can be mined from the earth is not a source of renewable energy. Any other source is a candidate, and there is a diversity of opinion on the subject. The noncontroversial examples are solar and wind power.[132] But the Department of Energy, EPA, and the European Union have embraced biomass as a renewable form of energy, which is more controversial.[133] Biomass represents 50% of all renewable energy consumed in the United States, and wood and wood-related products represent 46% of that share.[134]

The characterization of biomass as "renewable" is a policy choice that is not an inevitable conclusion. Because energy from biomass is derived from combustion, wood is unlike solar and wind, and instead like coal, oil, and natural gas. Solar and wind involve the ongoing generation of energy by the forces of nature. In contrast, wood is a biogenic material derived from

130 *Renewable*, MERRIAM-WEBSTER ONLINE DICTIONARY, http://www.merriam-webster.com/dictionary/renewable (last visited Feb. 13, 2016).

131 *See* 1 TUSHAR K. GHOSH & MARK A. PELAS, ENERGY RESOURCES AND SYSTEMS: FUNDAMENTALS AND NON-RENEWABLE RESOURCES 2 (2009) (ebook).

132 *See* U.S. Envtl. Prot. Agency, *State Climate and Energy Program: Renewable Energy*, http://www3.epa.gov/statelocalclimate/state/topics/renewable.html (last visited Feb. 13, 2016).

133 U.S. DEP'T OF ENERGY ET AL., GUIDE TO PURCHASING GREEN POWER: RENEWABLE ELECTRICITY, RENEWABLE ENERGY CERTIFICATES, AND ON-SITE RENEWABLE GENERATION 2 (2004), *available at* http://www.epa.gov/greenpower/documents/purchasing_guide_for_web.pdf ("While no form of electric power generation is completely benign, electricity generated from renewable resources such as solar, wind, geothermal, small and low-impact hydropower, and biomass has proved to be environmentally preferable to electricity generated from conventional sources such as coal, oil, natural gas, and nuclear."); Seita Romppanen, *The EU's Biofuels: Certified as Sustainable?*, 3 RENEWABLE ENERGY L. & POL'Y REV. 173, 175 (2012).

134 U.S. Energy Info. Admin., *Renewable Energy Explained*, http://www.eia.gov/energyexplained/index.cfm?page=renewable_home (last visited Feb. 13, 2016) ("In 2014, consumption of renewable energy sources in the United States totaled . . . about 10% of total U.S. energy consumption."); U.S. Energy Info. Admin., *Biomass Explained*, http://www.eia.gov/energyexplained/index.cfm?page=biomass_home (last visited Feb. 13, 2016) ("Biomass fuels provided about 5% of the energy used in the United States in 2014. Of that 5%, about 46% was from wood and wood-derived biomass, 44% was from biofuels (mainly ethanol), and about 10% was from municipal waste.")

plant life, which has been removed from the environment.[135] The harvesting of wood is analogous to the mining of fossil fuels, because both involve the extraction of solid material from the earth, for the purpose of combustion.

The key distinction between biomass and fossil fuels is the length of time for developing the fuel—tens of years versus millions of years.[136] In an attempt to differentiate biomass from fossil fuels, EPA has carefully defined renewable sources as those that may restore or replenish themselves "over short periods of time."[137] The Department of Energy has taken a similar approach, although the emphasis on short periods of time is more implicit than explicit.[138] The Biomass Energy and Alcohol Fuels Act of 1980, a federal statute intended to encourage the development of biomass, was also based on the premise that biomass is renewable.[139]

135 The close similarity between wood and fossil fuels is reinforced by the statement by the Office of Energy Efficiency and Renewable Energy that biomass "is unique among renewable energy resources in that it can be converted to carbon-based fuels, chemicals, or power." U.S. DEP'T OF ENERGY, OFFICE OF THE BIOMASS PROGRAM, ENERGY EFFICIENCY AND RENEWABLE ENERGY, BIOMASS MULTI-YEAR PROGRAM PLAN 1-1 (2014), *available at* http://www.energy.gov/sites/prod/files/2014/07/f17/mypp_july_2014.pdf. As a result, it concludes that "[b]iomass is the only renewable energy source that can offer a substitute for fossil-based, liquid transportation fuels in the near to mid-term." *Id.* The reason it is "unique" and convertible to carbon-based fuels is not surprising. Wood and fossil fules are both biogenic sources of energy, generated through combustion following the removal of the fuel from the environment.

136 Ecoreps, *Biofuel Info: Production & Facts*, http://www.ecoreps.com.au/biofuel.html (last visited Feb. 13, 2016).

137 U.S. Envtl. Prot. Agency, *Green Power Market: Green Power Defined*, http://www.epa.gov/greenpower/gpmarket/ (last visited Feb. 13, 2016) ("Renewable energy includes resources that rely on fuel sources that restore themselves over short periods of time and do not diminish. Such fuel sources include the sun, wind, moving water, organic plant and waste material (eligible biomass), and the earth's heat (geothermal)."); U.S. ENVTL. PROT. AGENCY ET AL., GUIDE TO PURCHASING GREEN POWER, RENEWABLE ELECTRICITY, RENEWABLE ENERGY CERTIFICATES, AND ON-SITE RENEWABLE GENERATION 4 (2010), *available at* http://www.epa.gov/greenpower/documents/purchasing_guide_for_web.pdf ("These electricity sources are derived from natural resources that replenish themselves over short periods of time, including the sun, wind, moving water, organic plant and waste material (biomass), and the Earth's heat (geothermal).").

138 U.S. Dep't of Energy, *Glossary of Energy-Related Terms*, http://energy.gov/eere/energybasics/articles/glossary-energy-related-terms#R (last visited Feb. 13, 2016) ("Renewable energy [is] [e]nergy derived from resources that are regenerative or for all practical purposes can not be depleted. Types of renewable energy resources include moving water (hydro, tidal and wave power), thermal gradients in ocean water, biomass, geothermal energy, solar energy, and wind energy. Municipal solid waste (MSW) is also considered to be a renewable energy resource."). This definition does not use the qualifier "over short periods of time," but this consideration is implicit in the language "regenerative or for all practical purposes can not be depleted." Fossil fuels could be regenerated, but it takes millions of years for this to happen, making it impractical.

139 *See* Pub. L. No. 96-294, 94 Stat. 611, 683 ("The term 'biomass' means any organic matter which is available on a renewable basis, including agricultural crops and agricultural wastes and residues, wood and wood wastes and residues, animal wastes, municipal wastes, and aquatic plants."). The purpose of the Act was to reduce American dependence on fossil fuels, resulting from the energy crisis of the late 1970s. *Id.* Then as now, the purpose was to find a source of fuel other than fossil fuels, although the motivation was based on international economic security, as opposed to climate change. To reduce American dependence on fossil fuels, the Act contained provisions favoring the development of biomass.

Health and environmental impacts would not appear to be relevant considerations in determining what is renewable, under a strict definition of this term.[140] But inevitably, such impacts do have an influence on people's subjective evaluation of what is a renewable energy. Indeed, health and environmental impacts of global warming and climate change are a motivation for the pursuit of renewable energy in the first place. Some advocates of nuclear power offer their energy as a better alternative to fossil fuels, even while conceding it is also nonrenewable.[141]

Renewability is a subjective policy judgment that a source of energy is desirable in the context of global warming and climate change, after considering the environmental impacts. For solar and wind, there is no meaningful dispute as to whether they are renewable. They do not involve the combustion of fuels, there are no direct mining impacts, and there are no direct emissions of fine particulates and carbon dioxide.[142] To be sure, they involve environmental impacts ancillary to their construction and operation, and those impacts may indeed be significant.[143] But the nature of their impacts has not been sufficient to exclude them from the category of renewable energy. Criticisms of these forms of energy tend to be based on their lack of viability, rather than their nonrenewability.[144] There is more controversy with respect to hydroelectric power, because of the ecological impacts from the construction and operation of dams.[145] But even in the relatively liberal state of California, small hydroelectric projects are still considered to be renewable for purposes of the Renewable Portfolio Standards program.[146]

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140 *Renewable*, MERRIAM-WEBSTER ONLINE DICTIONARY, http://www.merriam-webster.com/dictionary/renewable (last visited Feb. 13, 2016) (defining renewable resource as "capable of being replaced by natural ecological cycles or sound management practices").

141 World Nuclear Ass'n, *Energy for the World: Why Uranium?*, http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/introduction/energy-for-the-world-why-uranium.aspx (last visited Feb. 13, 2016) (classifying nuclear energy with fossil fuels as non-renewable, while noting that nuclear power saves the emission of about 2.6 billion tonnes of carbon dioxide per year, as compared with the 10 billion tonnes per year emitted by the fossil fuel industry).

142 *See* Union of Concerned Scientists, *Environmental Impacts of Renewable Energy Technologies*, http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/environmental-impacts-of.html (last visited Feb. 13, 2016).

143 *Id.*

144 *See* GEORGE TAYLOR & THOMAS TANTON, THE HIDDEN COSTS OF WIND ELECTRICITY, AMERICAN TRADITION INSTITUTE 13 (2012), *available at* http://eelegal.org/wp-content/uploads/2013/09/Hidden-Cost.pdf (explaining that the hidden costs of wind energy make it more expensive and non-competitive with conventional sources); *see also* J.P. Painuly, *Barriers to Renewable Energy Penetration; a Framework for Analysis*, 24 RENEWABLE ENERGY 73, 79–81 (2001) (discussing barriers to renewable energy proliferation).

145 Union of Concerned Scientists, *supra* note 142 (Hydroelectric Power).

146 CAL. PUB. UTIL. CODE § 399.12(e)(1)(A) (West 2015) ("A new hydroelectric facility that commences generation of electricity after December 31, 2005, is not an eligible renewable energy resource if it will cause an adverse impact on instream beneficial uses or cause a change in the volume or timing of streamflow."); *id.* (stating that under the Renewable Portfolio Standard program, an "[e]ligible renewable energy resource" includes a "renewable electrical generation facility"); CAL. PUB. RES. CODE § 25741 (West 2007) (including "small hydroelectric

Conversely, the lack of environmental impacts is evidence cited by some proponents of nuclear power in favor of its consideration as a renewable energy.[147] Applying a flexible definition of renewable, nuclear power could be considered renewable because it does not have direct emissions of air pollutants, uranium is not a fossil fuel, and the fuel could be replaced within a short period of time, assuming the implementation of breeder reactors.[148] But the fear of potential health and environmental impacts from radiation strongly influences the debate over whether this source of energy is renewable, either explicitly or implicitly.[149] Instead of concluding that nuclear power is not renewable because uranium fuel cannot be easily regenerated, the International Renewable Energy Agency rationalized its rejection of nuclear power based on the potential health and environmental impacts.[150] By analogy, people could make the same

generation of 30 megawatts or less" within the definition of "Renewable electrical generation facility," subject to the state's Renewable Portfolio Standard program).

147 Keith Johnson, *Is Nuclear Power Renewable Energy?*, WALL ST. J., May 21, 2009, http://blogs.wsj.com/environmentalcapital/2009/05/21/is-nuclear-power-renewable-energy/ ("[I]f the whole game in Washington is meant to be about producing electricity with fewer emissions of greenhouse-gases, it seems odd that nuclear power wouldn't be under consideration."). The article discusses failed attempts by Republican Congressman to enact legislation securing the same benefits for nuclear power as are afforded to renewable energies like solar and wind power. *Id.*

148 For scientific arguments in favor of treating nuclear power as a renewable resource, see generally W. BENNETT LEWIS, ATOMIC ENERGY OF CANADA LIMITED, THE SUPER-CONVERTER OR VALUBREEDER A NEAR-BREEDER URANIUM-THORIUM NUCLEAR FUEL CYCLE (1968), *available at* http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/40/103/40103721.pdf; Bernard L. Cohen, *Breeder Reactors: A Renewable Energy Source*, 51 AM. J. PHYS. 75, 75 (1983), *available at* http://88.167.97.19/temp/Breeder_reactors_A_renewable_energy_source_pad11983cohen.pdf ("We thus conclude that all the world's energy requirements for the remaining 5×10^9 yr of existence of life on Earth could be provided by breeder reactors without the cost of electricity rising by as much as 1% due to fuel costs. This is consistent with the definition of a "renewable" energy source in the sense in which that term is generally used."). The argument has been reiterated more recently by other scientists. *See, e.g.*, H. DOUGLAS LIGHTFOOT ET AL., NUCLEAR FISSION FUEL IS INEXHAUSTIBLE 1 (2006), *available at* http://www.computare.org/Support%20documents/Fora%20Input/CCC2006/Nuclear%20Paper%2006_05.htm ("Replacement of the current thermal variety of nuclear fission reactors with nuclear fission fast reactors, which are 100 times more fuel efficient, can dramatically extend nuclear fuel reserves. The contribution of uranium price to the cost of electricity generated by fast reactors, even if its price were the same as that of gold at US $14,000/kg, would be US $0.003/kWh of electricity generated. At that price, economically viable uranium reserves would be, for all practical purposes, inexhaustible.").

149 James Kanter, *Is Nuclear Power Renewable?*, N.Y. TIMES, Aug. 3, 2009, http://green.blogs.nytimes.com/2009/08/03/is-nuclear-power-renewable/ (last visited Feb. 13, 2016).

150 While it has extended the "renewable" label to biomass, the International Renewable Energy Agency has refused to do so for nuclear power, because it generates waste and because the mining of fuel creates land use impacts. "'IRENA will not support nuclear energy programs because it's a long, complicated process, it produces waste and is relatively risky,' Hélène Pelosse, its interim director general, told Reuters last week." *Id.* Instead, that agency has labeled nuclear power a "lower carbon technolog[y]," which is a more precise term for this source of energy. INTERNATIONAL RENEWABLE ENERGY AGENCY, RETHINKING ENERGY 23 (2014), *available at* http://www.irena.org/rethinking/Rethinking_FullReport_web_print.pdf ("The effect of the installation of renewables and other lower-carbon technologies (nuclear and natural gas), and

objections to the renewability of biomass, due to the health and environmental impacts in the form of fine particulates and harvesting of trees.

In contrast to all these sources for which there is a general consensus whether they are renewable, biomass presents the ambiguous case. While debate over biomass will likely focus on whether it is carbon-neutral, the debate should also consider the public health aspects of the combustion of biomass, which has been largely overlooked.

In theory, nuclear power is far more "renewable" than biomass, yet it is denied the "renewability" label because of the fear of health and environmental impacts. There is no reason why this reasoning should not also extend to biomass and wood burning, given the nature of the air pollutants (criteria pollutants and hazardous air pollutants) and their adverse impacts on public health.

B. Wood Burning and Individual Choices

With respect to health and environmental impacts, proponents of biomass assert that it is preferable to fossil fuels. But it depends on the particular fossil fuel. Biomass generates nearly as many carbon dioxide emissions as coal and significantly more carbon dioxide emissions than natural gas, a non-renewable source of energy.[151] In addition, biomass generates greater fine particulate emissions than natural gas.[152] A residential fireplace releases twenty times the amount of fine particulates as an EPA-certified woodstove, and an EPA-certified woodstove releases 169 times the amount of fine particulates as a gas furnace.[153]

Wood burning by individuals involves a problem of consumer choice among these options. That choice might involve factors other than public health concerns. For many people, the aroma of burning wood is something enjoyable. In addition, the burning of wood in a fireplace or campfire might appear to be an innocuous activity that does not have a significant impact on the environment. The result is that many individuals have a greater tolerance

improvements in efficiency of electricity production have been neutralised by the operation of existing and new installations of carbon-intensive technologies.").

151 *See* U.S. ENVTL. PROT. AGENCY, CLIMATE LEADERS, GREENHOUSE GAS INVENTORY PROTOCOL CORE MODULE GUIDANCE: DIRECT EMISSIONS FROM STATIONARY COMBUSTION SOURCES 23 (2008), *available at* http://www2.epa.gov/sites/production/files/2015-07/documents/stationarycombustionguidance.pdf (setting forth carbon content coefficients of 25.76-31.00 for coal and 14.47 for natural gas); *id.* at 25 (setting forth carbon content coefficient of 25.60 for wood and wood products).

152 AEA ENERGY AND ENVIRONMENT, MEASUREMENT AND MODELING OF FINE PARTICULATE EMISSIONS (PM_{10} & $PM_{2.5}$) FROM WOOD-BURNING BIOMASS BOILERS 12–13, tbls.2.2, 2.4 (2008), *available at* http://www.gov.scot/resource/doc/243574/0067768.pdf.

153 These multipliers were derived from U.S. Envtl. Prot. Agency, *Burn Wise Energy Efficiency*, http://www2.epa.gov/burnwise/burn-wise-energy-efficiency (last visited Feb. 13, 2016) (listing average emissions of fine particulates as 28 lbs/MMBtu of heat output for fireplaces, 1.4 lbs/MMBtu of heat output for an EPA-certified woodstove, and 0.0083 lbs/MMBtus of heat output for a gas furnace).

for fine particulates from residential wood burning, than for fine particulates from coal-fired power plants.[154]

Aside from consumer choice, there is also a question whether consumers have an available natural gas supply. Some areas of the country rely on wood burning to compensate for a lack of access to a natural gas pipeline.[155] Many environmentalists are opposed to the development of natural gas pipelines because of the impacts their construction has on wildlife, despite the fact that those pipelines would wean society from coal and wood burning and the resulting air pollution.[156] As a result, the preference for burning wood involves a tradeoff between human health and the environment.

For all these reasons, the residential sector tends to see wood burning as a viable source of energy, or at least it tends to be tolerant of its impacts on human health and the environment. As a result, the Energy Information Administration reports a significant increase in the use of wood as a residential fuel in the New England states from 2005 to 2012.[157] Throughout the entire United States, there has also been an increase in the reliance on wood as a source of energy for the residential sector.[158]

C. Wood Burning and Corporate Choices

At an industrial level, the emissions factors developed by EPA for certain industrial sectors enable the comparison of one form of energy with another. Wood-fired boilers generate far more emissions than natural gas-

154 *See, e.g.*, Severin Borenstein, *What Wood Smoke Has Taught Me About Fighting Climate Change*, ENERGY INST. AT HAAS, Feb. 3, 2014, https://energyathaas.wordpress.com/2014/02/03/what-wood-smoke-has-taught-me-about-fighting-climate-change/ (last visited Feb. 13, 2016) (discussing frustration with restrictions on wood burning in environmental groups who are otherwise concerned about climate change and greenhouse gases).

155 Many parts of New England do not have access to a natural gas pipeline, as reflected by a map of the Northeast Region Natural Gas Pipeline Network. *See* U.S. Energy Info. Admin., *Natural Gas Pipelines in the Northeast Region*, http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/northeast.html (last visited Feb. 13, 2016).

156 Jim Malewitz, *In Big Bend, Pipeline Opponents Claim Small Victory*, TEX. TRIB., July 24, 2015, http://www.texastribune.org/2015/07/24/big-bend-pipeline-opponents-claim-small-victory/ (last visited Feb. 13, 2016) ("Supporters say the pipeline will bring jobs to the region—even if almost all are temporary—spur more Texas drilling and yield a few million dollars in local tax revenue. Bringing natural gas into Mexico could help wean the nation's border cities off dirtier-burning coal, wood and heating oil. Opponents say the pipeline will at least temporarily mar the near-pristine landscape, bringing safety risks, with some fearing they will lose their land to eminent domain."); *see* Borenstein, *supra* note 154 ("Most [of my neighbors] are concerned about pollution in general and believe that greenhouse gases are causing potentially devastating climate change. Yet, they ignore warnings about the pollution from their wood fires, in some cases even blatantly violating the burning bans that have been called on nearly half of all days in the bay area since November 1.").

157 U.S. Energy Info. Admin., *Increase in Wood as Main Source of Household Heating Most Notable in the Northeast*, (Mar. 17, 2014), http://www.eia.gov/todayinenergy/detail.cfm?id=15431 (last visited Feb. 13, 2016).

158 *Id.* ("In total, about 2.5 million households (2.1%) across the country use wood as the main fuel for home heating, up from 1.9 million households (1.7%) in 2005.").

fired boilers.[159] In addition, wood-fired boilers generate far more emissions of carbon dioxide.[160]

Despite these greater emissions, companies are eager to exploit wood as a source of energy, motivated by the lower cost of burning wood and the political and cultural windfall from the label of a renewable energy.[161] Like consumers, corporations have choices. For a company operating a coal-fired power plant, the choice is between doing business as usual, converting to biomass, or converting to natural gas.[162] Coal-fired power plants have experimented with co-firing wood fuel, to varying degrees of success.[163]

The problem is complicated by conflicting governmental attitudes about the harvesting of wood for energy. Loggers have clear-cut sections of forests in North Carolina to export wood pellets to Europe, to finance European commitments to achieve greenhouse gas reductions under the Kyoto Protocol.[164] Ironically, such logging activities could not be conducted

159 For natural gas boilers, the emissions factor for particulate matter is 7.6 lbs/10^6 scf. U.S. ENVTL. PROT. AGENCY, COMPILATION OF AIR POLLUTANT EMISSIONS FACTORS, VOLUME I: STATIONARY POINT AND AREA SOURCES § 1.4 tbl.1.4-2 & n.c (5th ed. 1995), *available at* http://www3.epa.gov/ttn/chief/ap42/ch01/final/c01s04.pdf. All particulates are assumed to be less than 1 micrometer wide, making them fine particulates ($PM_{2.5}$). *Id.* To obtain lbs/MMBtu, one must divide by 1,020. *Id.* at n.a. Therefore, the emissions factor is equivalent to 0.00745 lbs/MMBtu, or less than 0.01 lbs/MMBtu. For wood boilers, the emissions factors for particulate matter are all greater than 0.01 lbs/MMBtu. *See id.* § 1.6, tbl.1.6-1, *available at* http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s06.pdf. With sophisticated controls such as an electrostatic precipitator, fabric filter, or wet scrubber, the emissions factors of 0.035-0.065 lbs/MMBtu for wood are approximately 5 to 9 times greater than the 0.00745 lbs/MMBtu emissions factor for natural gas. With the simple control of a mechanical collector, the emissions factors of 0.12–0.29 lbs/MMBtu for wood are approximately 16 to 39 times greater than the 0.00745 lbs/MMBtu emissions factor for natural gas. With no controls at all, the emissions factors of 0.25–0.43 lbs/MMBtu for wood are approximately 33 to 58 times greater than the 0.00745 lbs/MMBtu emissions factor for natural gas.

160 For natural gas boilers, the emissions factor for carbon dioxide is 120,000 lb/10^6 scf. *Id.* at § 1.4 tbl.1.4-2. All fuel carbon is assumed to be converted to carbon dioxide. *Id.* at n.b. To obtain lb/MMBtu, one must divide by 1,020. *Id.* at n.a. Therefore, the emissions factor is equivalent to 117.65 lb/MMBtu. For wood boilers, the emissions factor for carbon dioxide is 195 lb/MMBtu. *Id.* § 1.6 tbl.1.6-3. 195 divided by 117.65 equals 1.66. Therefore, the emissions factor for carbon dioxide for wood boilers is approximately 1.66 times the emissions factor for natural gas boilers.

161 *See Wood: The Fuel of the Future*, ECONOMIST, Apr. 6, 2013, at 71.

162 *See* Katherine Tweed, *Cleaner Than Coal? Wood Power Makes a Comeback*, SCI. AM., Oct. 10, 2013, http://www.scientificamerican.com/article/wood-power-makes-comeback/ (last visited Feb. 13, 2016) (discussing efforts by coal-fired power plants to convert to combustion of biomass).

163 *See* Matthew L. Wald, *Power Plants Try Burning Wood with Coal to Cut Carbon Emissions*, N.Y. TIMES, Nov. 4, 2013, at B3.

164 Justin Scheck & Ianthe Jeanne Dugan, *Europe's Green-Fuel Search Turns to America's Forests*, WALL ST. J., May 27, 2013, at A1, http://www.wsj.com/articles/SB10001424127887324082604578485491298208114 (last visited Feb. 13, 2016); SARAH ASHTON ET AL., NAT'L ASS'N OF CONSERVATION DISTRICTS, WOODY BIOMASS DESK GUIDE AND TOOLKIT 126 (Eleanor K. Sommer ed. 2008) (explaining that countries "may be willing to pay a premium for wood" as they try to meet carbon taxes put in place by the Kyoto Protocol).

in Europe due to fewer forests and more stringent logging restrictions.[165] Oddly enough, the United States has allowed its forests to be harvested to enable European countries to meet greenhouse gas reduction obligations under an international agreement which the United States failed to ratify.[166]

Diverse conservative and liberal interests have criticized aspects of this practice. Some people have criticized it on the grounds of efficiency, because the cost of wood pellets is over twice the cost of natural gas, according to data from the Energy Information Administration.[167] Some people have criticized European governments for handing out wasteful subsidies to businesses when there are existing financial incentives for developing this form of energy.[168] Environmental groups have criticized the harvesting of wood for exportation of wood pellets on the grounds that domestic laws in the United States are not sufficiently protective of sustainable logging practices.[169]

But the ecological impact of harvesting wood is not the only result of cultural choices to burn wood. There are also impacts on air quality, discussed in the following Section of this Article.

IV. WOOD BURNING: THE DOMESTIC AND INTERNATIONAL SITUATION

Although wood burning is a problem domestically and internationally, an appreciation of the problem has been slow to develop.

A. States and Residential Wood Heaters

Population and climate are both factors affecting the level of emissions of fine particulates from woodstoves. The list of the states with the highest total emissions of fine particulates from residential wood burning includes

165 ASHTON ET AL., *supra* note 164, at 126. The wood pellets are primarily exported to Drax, a utility company in the UK. U.S. Energy Info. Admin., *UK's Renewable Energy Targets Drive Increases in U.S. Wood Pellet Exports* (Apr. 22, 2015), http://www.eia.gov/todayinenergy/detail.cfm?id=20912 (last visited Feb. 13, 2016).

166 *See* U.S. Energy Information Administration, *UK's Renewable Energy Targets Drive Increases in U.S. Wood Pellet Exports*, *supra* note 165.

167 Christopher Helman, *The Cost of Energy (and Why Shipping American Firewood to Europe Is a Crazy Idea)*, FORBES, May 28, 2013, http://www.forbes.com/sites/christopherhelman/2013/05/28/why-burning-american-forests-to-heat-european-homes-is-as-crazy-as-it-sounds/ (last visited Feb. 13, 2016).

168 *See Wood: The Fuel of the Future*, *supra* note 161 ("In its various forms, from sticks to pellets to sawdust, wood (or to use its fashionable name, biomass) accounts for about half of Europe's renewable-energy consumption."). The article notes that the use of wood as a fuel in Europe drastically increased once it was determined that it was a renewable energy resource. *Id.*

169 *See* NAT. RES. DEF. COUNCIL, FACT SHEET, THE TRUTH ABOUT THE BIOMASS INDUSTRY: HOW WOOD PELLET EXPORTS POLLUTE OUR CLIMATE AND DAMAGE OUR FORESTS 1–2 (2014), *available at* http://www.nrdc.org/energy/files/wood-pellet-biomass-pollution-FS.pdf.

states with very large populations—Michigan (population ranking: 8), Pennsylvania (6), New York (3), Ohio (7), and California (1).[170]

Table 1: Total Emissions Rankings[171]

Ranking (Total Emissions)	State	Total Emissions from Residential Wood Burning	Population Ranking (July 2009)
1	Michigan	39,691	8
2	Wisconsin	32,901	20
3	Minnesota	30,012	21
4	Pennsylvania	23,634	6
5	New York	22,939	3
6	Ohio	21,635	7
7	California	18,693	1
8	Washington	17,070	13
9	Oregon	15,034	27
10	Indiana	12,146	16

The list also includes midsized states with cold climates—Wisconsin (population ranking: 20), Minnesota (21), Washington (13), Oregon (27), and Indiana (16).[172] But the list does not include the smallest states. The state on the list with the lowest population is Oregon, a midsized state ranked 27th in population. We may infer that the smallest states do not generate as many aggregate emissions, due to their size.

But wood burning is a rural problem, as well as an urban problem. This problem cuts across states, regardless of population levels. To minimize the factor of population, it is helpful to compare states with respect to their per capita emissions. The list of the states with the highest per capita emissions of fine particulates from residential wood burning includes small rural states

170 Associated Press, *Top States for Residential Wood Burning, by Emissions*, SAN DIEGO UNION-TRIBUNE, Mar. 8, 2015, http://www.sandiegouniontribune.com/news/2015/mar/08/top-states-for-residential-wood-burning-by/ (last visited Feb. 13, 2016). The underlying data is from EPA. U.S. Envtl. Prot. Agency, *2011 National Emissions Inventory*, http://www.epa.gov/ttn/chief/net/2011inventory.html (last visited Feb. 13, 2016) (scroll to the "Sector Summaries" section. In the first box, select the button that says "national." In the second box, select the state. In the third box, select both "CAP – PM25 Filterable" and "CAP – PM25 Primary (Filt + Cond)." In the fourth box, select "Fuel Comb – Residential – Wood." Then click "Create CSV" button and an excel document will download.). State population rankings are from the Census Bureau. U.S. Census Bureau, *2010 Statistical Abstract: State Rankings*, https://www.census.gov/library/publications/2009/compendia/statab/129ed/rankings.html?cssp=SERP (last visited Feb. 13, 2016) (click on "Resident Population, 2009").

171 *Top States for Residential Wood Burning*, *supra* note 170; *2010 Statistical Abstract: State Rankings*, *supra* note 170.

172 *Top States for Residential Wood Burning*, *supra* note 170; *2010 Statistical Abstract: State Rankings*, *supra* note 170.

with colder climates—Vermont (population ranking: 49), New Hampshire (40), Maine (41), and Idaho (39).[173]

Table 2: Per Capita Emissions Rankings[174]

Ranking	State	Per Capita Emissions from Residential Wood Burning	Population Ranking (July 2009)
1	Vermont	22.80	49
2	Wisconsin	11.53	20
3	Minnesota	11.22	21
4	New Hampshire	9.85	40
5	Maine	9.51	41
6	Michigan	8.04	8
7	Oregon	7.77	27
8	Idaho	5.63	39
9	Washington	5.00	13
10	Iowa	3.77	30

Consistent with the trend toward increased wood burning in New England, three of these smaller states are New England states—Vermont, New Hampshire, and Maine. They rank first, fourth, and fifth in per capita emissions.[175]

Having identified the major states for residential wood burning, the question arises whether this activity has adversely affected overall air quality in those states.[176] A relevant benchmark is whether areas in these states are in attainment or nonattainment with the national ambient air quality standards for fine particulates.[177] If a state has designated an area as being in nonattainment with any primary national ambient air quality standard, that is

173 *Top States for Residential Wood Burning*, *supra* note 170; *2010 Statistical Abstract: State Rankings*, *supra* note 170.

174 *Top States for Residential Wood Burning*, *supra* note 170; *2010 Statistical Abstract: State Rankings*, *supra* note 170.

175 *Top States for Residential Wood Burning*, *supra* note 170.

176 For the sake of simplicity, this discussion focuses primarily on fine particulates. But wood smoke contributes to ambient concentrations of all six criteria pollutants (particulates, ozone, nitrogen oxides, sulfur dioxide, lead, and carbon monoxide), as well as hazardous air pollutants. LARSON & KOENIG, *supra* note 24, at 34, 35, tbl. 2.

177 The unit of analysis for the measuring air quality was originally the air quality control region (defined by the boundaries of the airshed), and not the entire state (defined by political boundaries). *See* Clean Air Act, 42 U.S.C. § 7407(b),(c)(2012). EPA's modern preference is to refer to "nonattainment areas." *See id.* § 7407(d)(1)(A) (requiring designations by state governors of attainment areas and nonattainment areas, under section 107). States are the actors that are required to attain the national ambient air quality standards, and they must prepare state implementation plans for this purpose. *See id.* § 7410(a)(1) (setting forth requirement to submit a state implementation plan to the Environmental Protection Agency); *id.* § 7401(a)(2) (setting forth requirements for state implementation plans).

strong evidence of an air quality problem.[178] But attainment with a national ambient air quality standard does not necessarily assure good air quality. Rather, this simply means that an area has passed the relevant test for attainment, as defined by the testing parameters—indicator, level, averaging time, and form.[179] In addition, the measurements must be undertaken according to certain technical protocols referenced in EPA regulations.[180] By way of example, for the daily standard for fine particulates, the indicator—the air pollutant that is monitored—is $PM_{2.5}$, the averaging time is 24 hours, the level is 35 $\mu g/m^3$, and the form is the 98th percentile, averaged over three years.[181] For the annual standard for fine particulates, the indicator is $PM_{2.5}$, the averaging time is one year, the level is 12.0 $\mu g/m^3$, and the form is the annual arithmetic mean, averaged over three years.[182] An area is a nonattainment area only if it fails these statistical tests.

Vermont, the leading state in per capita emissions of fine particulates from residential wood burning, is in attainment with the national ambient air quality standards for all criteria pollutants, including fine particulates.[183] But the state suffers from poor air quality as a result of residential wood burning, especially in the winter months, as evidenced by air quality alerts from the Vermont Agency of Natural Resources.[184] In addition, wood burning

178 Because the national ambient air quality standards are required to protect public health and the environment, the fact that an air quality control region is a nonattainment area demonstrates that air quality is not protective of public health or the environment. *See id.* § 7409(b)(1) (stating that primary standard must be "requisite to protect the public health"); *id.* § 7409(b)(2) (stating that secondary standard must be "requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air").

179 *See* 40 C.F.R. § 50.13 (2014) (setting forth indicator, level, averaging time, and form for primary national ambient air quality standard for fine particulates, for a 24-hour period); *id.* § 50.18 (setting forth similar metrics for the primary standard for fine particulates, for an annual period).

180 *See, e.g.*, *id.* § 50.18(b)–(c) (providing instructions on how to measure concentrations of particulate matter).

181 *Id.* § 50.18(c).

182 *Id.*; 40 C.F.R. pt. 50, app. N.

183 U.S. Envtl. Prot. Agency, *Green Book: Criteria Pollutant Nonattainment Summary Report*, http://www.epa.gov/airquality/greenbook/ancl3.html (last visited Feb. 13, 2016); 40 C.F.R. § 81.346 (2015).

184 *See, e.g.*, *Air Quality Alert in Rutland County*, WCAX NEWS, Feb. 21, 2014, http://www.wcax.com/story/24764934/air-quality-alert-in-rutland-county (last visited Feb. 13, 2016) ("An air quality alert was issued for Wednesday. It is in place until midnight for the western part of the county, including Rutland City. The state says stagnant air and cloud cover are trapping particulates in the air that could exceed public health standards."); *Air Quality Alert Issued in Rutland*, WCAX NEWS, Jan. 11, 2014, http://www.wcax.com/story/24412768/air-quality-alert-issued-in-rutland (last visited Feb. 13, 2016) ("An air quality alert has been issued in Rutland County through Friday at noon. The warning comes from the Vermont Agency of Natural Resources. Officials there say residents using wood stoves in the area are behind the potential for unhealthy air-quality standards."); *Air Quality Alert Issued for Rutland County*, WPTZ NEWS CHANNEL 5, Jan. 10, 2014, http://www.wptz.com/news/vermont-new-york/burlington/air-quality-alert-issued-for-rutland-county/23860838 (last visited Feb. 13, 2016) ("[A]ir quality alerts in winter are frequently due to wood stoves and coal plants.").

contributes to elevated levels of asthma throughout the state.[185] From a regional perspective, this may reflect a broader pattern of elevated asthma levels throughout the wood-burning New England states. Statistics from the Centers for Disease Control published in 2011 demonstrate levels of asthma in New England that are greater than national rates.[186]

Table 3: Asthma Prevalence in New England[187]

States in New England	Adult lifetime asthma prevalence (national rate: 13.3%)	Adult current asthma prevalence (national rate: 8.5%)
Maine	15.7%	10.3%
Rhode Island	15.4%	10.6%
Vermont	15.4%	9.9%
New Hampshire	15.3%	10.4%
Massachusetts	14.8%	9.6%
Connecticut	13.4%	8.8%

It is likely that coal-fired power plants play only a secondary role in this problem, as they are not common in New England, and they are nonexistent in Vermont and Rhode Island.[188]

In contrast to Vermont, the leading state in per capita wood burning, areas in the more populous wood-burning states have experienced problems with nonattainment for fine particulates.[189] But the relative contribution of

185 Meredith King, *Vermont Asthma Rates Surprisingly Among the Highest in the U.S.*, UVM OUT-REACH, Jan. 8, 2015, http://learn.uvm.edu/health-blog/asthma-rates-in-vermont (last visited Feb. 13, 2016) (attributing the problem of increasing asthma levels to wood stoves, at least in part).

186 Ctr. for Disease Control and Prevention, *State Data Profiles, 2011*, http://www.cdc.gov/asthma/stateprofiles.htm (last visited Feb. 13, 2016).

187 *Id.*

188 *See New England Coal Burn Falls Ahead of Summer*, ARGUS MEDIA, May 27, 2015, http://www.argusmedia.com/News/Article?id=1045180 (last visited Feb. 13, 2016) ("Only four major coal plants and a co-generation facility remain in New England from a fleet that in the 1990's provided almost one-fifth of regional generation."); Erin Ailworth, *The End of the Coal Era in Massachusetts*, BOSTON GLOBE, June 18, 2014, https://www.bostonglobe.com/business/2014/06/17/the-end-coal-era-massachusetts/QMqSUxb9wPe8WNL1Ys0goM/story.html (last visited Feb. 13, 2016) ("Mt. Tom, which stopped operating as of June 2, will officially close by October, the last of the state's three coal plants to schedule a permanent shutdown. Salem Harbor Power Station in Salem closed, as previously planned, on June 1, while Brayton Point in Somerset is scheduled to stop operating in 2017."); Lindsey Konkel, *Coal-Fired Power Plants Virtually Extinct in New England*, SCI. AM., July 1, 2013, http://www.scientificamerican.com/article/coal-fired-power-plants-virtually-extinct-new-england/ (last visited Feb. 13, 2016) (identifying six existing coal-fired power plants in New England, with two in the process of closing); U.S. Energy Info. Admin., *Vermont: State Profile and Energy Estimates*, http://www.eia.gov/state/analysis.cfm?sid=VT (last visited Feb. 13, 2016) (indicating that Vermont and Rhode Island are the only two states in the country without any coal-fired plants).

189 40 C.F.R. § 81.323 (2015); U.S. Envtl. Prot. Agency, *Green Book: Michigan Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_mi.html (last visited Feb. 13, 2016) (reflecting

wood burning to their nonattainment status is difficult to determine, because fine particulates are also released by industrial plants and mobile sources, prominent features of urbanization.[190] To a lesser extent, this may also be true for the midsized wood-burning states.[191]

In addition, the relative contribution of wood burning to nonattainment is masked by the complex regulatory framework for making the attainment determination. EPA's Ambient Air Quality Surveillance regulations set forth

past nonattainment for fine particulates in urban areas in Michigan); 40 C.F.R. §81.339 (2015); U.S. Envtl. Prot. Agency, *Green Book: Pennsylvania Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_pa.html (last visited Feb. 13, 2016) (reflecting past and present nonattainment for fine particulates in urban areas in Pennsylvania); 40 C.F.R. §81.333 (2015); U.S. Envtl. Prot. Agency, *Green Book: New York Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_ny.html (last visited Feb. 13, 2016) (reflecting past nonattainment for fine particulates in urban areas in New York); 40 C.F.R. §81.336 (2015); U.S. Envtl. Prot. Agency, *Green Book: Ohio Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_oh.html (last visited Feb. 13, 2016) (reflecting past and present nonattainment for fine particulates in urban areas in Ohio); 40 C.F.R. §81.315 (2015); U.S. Envtl. Prot. Agency, *Green Book: California Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www3.epa.gov/airquality/greenbook/anayo_ca.html (last visited Feb. 13, 2016) (reflecting past and present nonattainment for fine particulates in urban areas in California). The foregoing sections of EPA's Greenbook set forth nonattainment designations dating back to 1992. Only if EPA makes a determination that a state has come into attainment with a standard, and the improvement in air quality is the result of emissions reductions that are permanent and enforceable, may EPA redesignate a nonattainment area as an attainment area. *See* Clean Air Act, 42 U.S.C. § 7407(d)(3)(E) (2012). Therefore, a nonattainment designation demonstrates an air quality problem.

190 There is a general correlation between urbanization and nonattainment with the national ambient air quality standards for particulates, as well as for ozone. Large urban areas are characterized by concentrations of stationary sources and mobile sources, which contribute to the formation of fine particulates and ozone. Therefore, the largest metropolitan areas tend to have problems with both pollutants. *See* U.S. Envtl. Prot. Agency, *Green Book: Criteria Pollutant Nonattainment Summary Report*, http://www.epa.gov/airquality/greenbook/ancl3.html (last visited Feb. 13, 2016).

191 40 C.F.R. § 81.350 (2015); U.S. Envtl. Prot. Agency, *Green Book: Wisconsin Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_wi.html (last visited Feb. 13, 2016) (reflecting past nonattainment for fine particulates in urban areas in Wisconsin); 40 C.F.R. § 81.324 (2015); U.S. Envtl. Prot. Agency, *Green Book: Minnesota*, *Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants* http://www.epa.gov/airquality/greenbook/anayo_mn.html (last visited Feb. 13, 2016) (reflecting past and present attainment for fine particulates in all areas in Minnesota); 40 C.F.R. § 81.348 (2015); U.S. Envtl. Prot. Agency, *Green Book: Washington Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_wa.html (last visited Feb. 13, 2016) (reflecting past nonattainment for fine particulates in one urban area in Washington); 40 C.F.R. § 81.338 (2015); 40 C.F.R. § 81.338 (2015); U.S. Envtl. Prot. Agency, *Green Book: Oregon Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_or.html (last visited Feb. 13, 2016) (reflecting past and present nonattainment for fine particulates in urban and rural areas in Oregon); 40 C.F.R. § 81.315 (2015); U.S. Envtl. Prot. Agency, *Green Book: Indiana Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_in.html (last visited Feb. 13, 2016) (reflecting past and present nonattainment for fine particulates in urban areas in Indiana).

the basic requirements for monitoring for attainment.[192] These regulations require states to monitor air in urban areas in a manner that is representative of the entire urban area.[193] By requiring an analysis that is representative of an entire urban region, the process inherently tends to ignore localized hot spots of residential wood burning.

Similarly, the regulatory framework for performing the attainment evaluation masks the problem of residential wood burning in rural areas. EPA's regulations require the monitoring of air in rural areas away from large local emission sources.[194] By requiring an analysis of an entire rural region, the process inherently avoids a focus on hot spots of residential wood burning. This fact may contribute to the smallest wood-burning states having relatively few problems with nonattainment.[195]

In addition, the attainment formulas themselves make it difficult for residential wood burning to push an area into nonattainment. One exceedance of an annual or daily national ambient air quality standard is not sufficient to push an area into nonattainment.[196] The concept of an exceedance picks up only three of the relevant four metrics for performing the attainment evaluation—indicator, level, and averaging time. The fourth metric—form—allows a state to ignore or dilute exceedances in a manner that is quite surprising.

192 40 C.F.R. pt. 58 (2015).

193 *Id.* at app. D § 3(d)(1) ("Urban NCore stations are to be generally located at urban or neighborhood scale to provide representative concentrations of exposure expected throughout the metropolitan area.").

194 *Id.* § 3(d)(2) ("Rural NCore stations are to be located to the maximum extent practicable at a regional or larger scale away from any large local emission source, so that they represent ambient concentrations over an extensive area.").

195 *See* 40 C.F.R. § 81.346 (2015) (reflecting present attainment for all criteria pollutants in Vermont); *id.* § 81.324 (reflecting present attainment in Minnesota); 40 C.F.R. § 81.330 (2015); U.S. Envtl. Prot. Agency, *Green Book: New Hampshire Nonattainment/Maintenance Status for Each County by Year for all Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_nh.html (last visited Feb. 13, 2016) (reflecting past and present attainment areas for fine particulates in New Hampshire); 40 C.F.R. § 81.320 (2015); U.S. Envtl. Prot. Agency, *Green Book: Maine Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_me.html (last visited Feb. 13, 2016) (reflecting past and present attainment for fine particulates in Maine); 40 C.F.R. § 81.313 (2015); U.S. Envtl. Prot. Agency, *Green Book: Idaho Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_id.html (last visited Feb. 13, 2016) (reflecting past and present nonattainment for fine particulates in one urban area in Idaho); 40 C.F.R. § 81.316 (2015);U.S. Envtl. Prot. Agency, *Green Book: Iowa Nonattainment Maintenance Status for Each County by Year for All Criteria Pollutants*, http://www.epa.gov/airquality/greenbook/anayo_ia.html (last visited Feb. 13, 2016) (reflecting past and present attainment for fine particulates in Iowa).

196 As a matter of terminology, the measurement of an air pollutant whose concentration exceeds the level of a standard is an "exceedance." 40 C.F.R. § 50.1(l) ("Exceedance with respect to a national ambient air quality standard means one occurrence of a measured or modeled concentration that exceeds the specified concentration level of such standard for the averaging period specified by the standard."). In contrast, nonattainment is defined by reference to all four metrics (indicator, level, averaging time, and form). *See id.* § 50.18 (annual and daily standards for fine particulates).

To illustrate, Appendix N to the part 50 regulations explains how states make the attainment determinations for fine particulates.[197] For the daily standard, the starting point is the taking of hourly measurements in accordance with the part 58 air monitoring requirements.[198] Generally speaking, there are two forms of air monitoring for fine particulates—continuous analyzers and manual $PM_{2.5}$ samplers.[199] In the case of continuous analyzers—a more robust form of monitoring—the hourly measurement is an average of fine particulate levels during the hour.[200] In the case of manual $PM_{2.5}$ samplers, the part 58 regulations require a state to conduct monitoring on at least a one-in-three day basis, unless data demonstrate levels within five percent of a national ambient air quality standard level, in which case the monitoring must be daily.[201] Therefore, this monitoring is no more robust than the monitoring with continuous analyzers. Because the hourly measurement is an average, it will not necessarily be the highest measurement of fine particulates during the course of the hour. The daily value is then determined by calculating a daily average of these hourly averages, or by calculating a 24-hour average concentration directly.[202]

For the entire year, a state must rank the daily values from highest to lowest.[203] A state may ignore all daily values in the top two percent, according to a table which facilitates the selection of the 98th percentile value. By way of example, if there are between 101 and 150 samples, the 98th percentile value would be the third highest value, which would mean that a state could ignore the highest two samples.[204] Presumably, the purpose of the 98th percentile value is to eliminate statistical outliers that may not be representative. But this is a convention that can understate an air quality problem.

The 98th percentile value is not the actual value that is used to compare with the national ambient air quality standard. Rather, a state may average this value with the 98th percentile values obtained for the following year and the year after that year, following the same procedures and rules.[205] This

197 40 C.F.R. pt. 50, app. N, § 1.0(a) (2014). ("This appendix explains the data handling conventions and computations necessary for determining when the national ambient air quality standards (NAAQS) for $PM_{2.5}$ are met, specifically the primary and secondary annual and 24-hour $PM_{2.5}$ NAAQS specified in § 50.7, 50.13, and 50.18.").

198 *Id.* § 2.0(c) ("Section 58.12 of this chapter specifies the required minimum frequency of sampling for $PM_{2.5}$.").

199 40 C.F.R. § 58.12(a), (d).

200 *Id.* § 58.12(a) (explaining that "[f]or continuous analyzers, consecutive hourly averages must be collected," except during periods of routine maintenance, instrument calibration, and during periods of exemption).

201 *Id.* § 58.12(d).

202 40 C.F.R. pt. 50, app. N, § 1.0(c) ("*Daily values* refer to the 24–hour average concentrations of $PM_{2.5}$ mass measured (or averaged from hourly measurements in AQS) from midnight to midnight (local standard time) from suitable monitors.").

203 *Id.* § 4.5(a) (Procedures and Equations for the 24–Hour $PM_{2.5}$ NAAQS).

204 *Id.* § 4.5, tbl.1 ("The 98th percentile for year y (P0.98,y), is the nth maximum 24-hour average value for the year where n is the listed number.").

205 *Id.* § 4.5(b) ("The 24–hour $PM_{2.5}$ NAAQS DV is then calculated by averaging the annual 98th percentiles using equation 4 of this appendix.").

three-year average is known as the "design value" that is used to make the attainment determination.[206] Thus, what is supposed to be a daily standard actually becomes a standard that is averaged over the course of a year, and then averaged over the course of three years, making it a diluted standard. Together with the 98th percentile limitation, this allows a state to launder its exceedances of the national ambient air quality standard.

Similarly, the process for evaluating attainment with the annual standard for fine particulates also tolerates fluctuations of air quality, over the course of time.[207] For each calendar quarter, a state calculates an average of the daily values—which themselves include averages, as discussed above.[208] Then the state calculates an average of those four quarterly averages, to arrive at an annual mean value.[209] As in the case of the daily standard, a state must average this annual mean value with the annual mean values for the following year and the year after that year.[210] Again, the process of repeatedly calculating averages of averages makes this a diluted standard that allows a state to launder its exceedences of a national ambient air quality standard.

As a result, there are a limited number of current nonattainment areas throughout the country for the 2006 national ambient air quality standard for fine particulates. They tend to be concentrated in a few states (California, Pennsylvania, Oregon, Utah, and Tennessee), although there are small pockets of nonattainment in other states (Alaska and Arizona).[211] Nonattainment with the original 1997 standard for fine particulates is still relevant, despite the fact that the standard was lowered in 2006.[212] With respect to the original 1997 standard, the pattern is similar, with current nonattainment areas in just a few states (California, Pennsylvania, Georgia, Tennessee, Missouri, Illinois, Kentucky, Montana, and Indiana).[213] Four of

206 *Id.* § 1.0(c) ("*Design values (DVs)* are the 3–year average NAAQS metrics that are compared to the NAAQS levels to determine when a monitoring site meets or does not meet the NAAQS, calculated as shown in section 4.").

207 *See id.* § 4.4 (Equations for the Annual $PM_{2.5}$ NAAQS).

208 *Id.* § 4.4(a) ("An annual mean value for $PM_{2.5}$ is determined by first averaging the daily values of a calendar quarter using equation 1 of this appendix.").

209 *Id.* § 4.4(b) ("Equation 2 of this appendix is then used to calculate the site annual mean.").

210 *Id.* § 4.4(c) ("The annual $PM_{2.5}$ NAAQS DV is calculated using equation 3 of this appendix.").

211 U.S. Envtl. Prot. Agency, *Green Book: Classifications of PM-2.5 (2006) Nonattainment Areas*; http://www.epa.gov/airquality/greenbook/rnc.html (last visited Feb. 13, 2016); U.S. Envtl. Prot. Agency, *Green Book: PM-2.5 Nonattainment Areas (2006 Standard)*.

212 There have been three rounds of fine particulate standards since 1997, when EPA carved out the categories of fine particulates and coarse particulates from the category of total suspended particulates, and directly regulated them as distinct criteria pollutants. In 1997, EPA promulgated an annual standard of 15.0 micrograms per cubic meter and a daily standard of 65 micrograms per cubic meter for fine particulates. 40 C.F.R. § 50.7 (2014). In 2006, EPA retained the annual standard, but lowered the daily standard to 35 micrograms per cubic meter. *Id.* § 50.13. In 2013, EPA retained the daily standard, but lowered the annual standard to 12.0 micrograms per cubic meter. *Id.* § 50.18.

213 U.S. Envtl. Prot. Agency, *Green Book: PM-2.5 (1997) Nonattainment Areas* (Oct. 1, 2015), http://www.epa.gov/airquality/greenbook/qntc.html (last visited Feb. 13, 2016); U.S. Envtl. Prot.

these states are on the list of leading burners of wood (California, Pennsylvania, Oregon, and Washington).[214]

In summary, the complex process for performing the attainment evaluation for the primary national ambient air quality standards for fine particulates tends to obscure the presence of hot spots for wood burning throughout the United States, thereby allowing states to launder their exceedances of national ambient air quality standards.

B. Developing Countries and Household Air Pollution

In the international arena, discourse on the combustion of biomass has largely been framed in terms of impacts on global warming and climate change. The air pollutant of concern is black carbon, a product of combustion.[215] Black carbon is a form of particulate matter, defined in terms of its broad ability to absorb solar radiation.[216] The absorption of heat by black carbon deposited on snow and ice tends to contribute to radiative forcing.[217] It can be particularly harmful for the climate when black carbon lands on glaciers and accelerates their melting.[218]

Black carbon is different from greenhouse gases in several important respects. First, it is not a gas at all, but a solid particle suspended in the air. Therefore, modeling of black carbon is based primarily on the physical properties of a solid, rather than on the chemical properties of a gas.[219] Second, while the six greenhouse gases continually accumulate in the atmosphere, black carbon falls to the ground soon after being emitted.[220] However, it is continuously added to the atmosphere through combustion, causing it to have a perpetual presence.[221]

Although black carbon is a general product of combustion, the source that presents a particular concern for global warming is the use of rudimentary cookstoves in developing countries in Africa and Asia. Because

Agency, *Green Book: PM-2.5 Nonattainment Areas (1997 Standard)* (Oct. 1, 2015), http://www.epa.gov/airquality/greenbook/mappm25.html (last visited Feb. 13, 2016).

214 *See supra* note 171 and accompanying text and table.

215 U.S. ENVTL. PROT. AGENCY, REPORT TO CONGRESS ON BLACK CARBON iii, 6 (2012), *available at* http://www.epa.gov/blackcarbon/2012report/fullreport.pdf.

216 *Id.* at 1–2. ("[Black carbon (BC)] can be defined specifically as a solid form of mostly pure carbon that absorbs solar radiation (light) at all wavelengths. BC is the most effective form of PM, by mass, at absorbing solar energy; other types of particles, including sulfates, nitrates and organic carbon (OC), generally reflect light.")

217 *Id.* at 40. Radiative forcing refers to changes in the energy balance in the Earth's atmosphere, with positive radiative forcing leading to surface warming. *Id.* at xxviii.

218 *Id.* at 4 ("Studies indicate that the effect of BC on seasonal snow cover duration in some regions can be substantial, and that BC deposited on ice and snow will continue to have radiative effects as long as the BC remains exposed (until the snow melts away or fresh snow falls). BC has also been shown to be a significant factor in the observed increase in melting rates of some glaciers and snowpack in parts of the Hindu Kush-Himalayan-Tibetan (HKHT) region (the 'third pole').").

219 *Id.* at 21, 25.

220 *Id.* at 25–26.

221 *Id.* at 17–18.

of the focus on global warming, energy, and economics, a review of the law review literature for most of the history of the CAA does not reveal much attention to the health effects from such cookstoves. In the early 1990s, there were some tangential references to the energy aspects of cookstoves in the law review literature.[222] Only in the late 1990s did a law review article focus on the public health impacts of air pollution from cookstoves.[223] Even while acknowledging the public health issue, subsequent articles continued the general trend of framing the discussion around climate change and energy policy.[224]

Several events contributed to the focus on climate change and energy policy. The first was the signing of the Kyoto Protocol, committing nations to quantitative reductions in greenhouse gases during the period 2008–2012.[225] As discussed above, the labeling of wood as a "renewable" source that will help to alleviate climate change has led to the harvesting of

222 *See* David Barrans, Note, *Promoting International Environmental Protections Through Foreign Debt Exchange Transactions*, 24 CORNELL INT'L L.J. 65, 86 (1991) ("Developing nations must either spend their revenues on foreign oil or cut trees from their forests for fuel. Increased energy efficiency in cookstoves and other apparatus could reduce both trade imbalances and deforestation in debtor nations, yet less than one percent of all foreign aid to developing nations is earmarked for improving energy efficiency."); Robert J. Saunders, *Is it Economically Viable for Developing Countries to Cut Down Carbon Dioxide Emissions?*, 9 ARIZ. J. INT'L & COMP. L. 205, 208 (1992) ("Many developing countries could increase energy consumption efficiency through the use, for example, of better motor speed controls and more efficient motors, refrigerators, air conditioners, water heaters, lighting in commercial buildings, window coverings, wood burning cookstoves, and charcoal kilns.").

223 *See* Gwynne Wiatrowski Guzzeau, *Indoor Air Pollution: Energy Problems in China's Residential Sector*, 11 GEO. INT'L ENVTL. L. REV. 439, 447–48 (1999) ("Because the supply of electricity remains strained, most households continue to burn raw fuels, such as wood and coal for their cooking and heating needs. Consequently, indoor air pollution created by coal burning stoves continues to be a problem, especially in China's rural areas." (citations omitted)).

224 *See* Richard L. Ottinger & Mindy Jayne, *Global Climate Change Kyoto Protocol Implementation: Legal Frameworks for Implementing Clean Energy Solutions*, 18 PACE ENVTL. L. REV. 19, 29 (2000) ("Approximately 1 billion people worldwide use cookstoves to boil their drinking water. This process is reliable, but it demands labor, imposes high economic, environmental and human health costs and is ultimately susceptible to limited fuel availability. It contributes to carbon dioxide emissions both through the combustion of the biomass and the destruction of forests needed to furnish the fuel wood." (citations omitted)); Symposium, *Sustainable Energy Development in Emerging Markets*, 24 U. PA. J. INT'L ECON. L. 759, 770 (2003) (discussing human health impacts); Ambuj D. Sagar et al., *Climate Change, Energy and Developing Countries*, 7 VT. J. ENVTL. L. 71, 81 (2006) ("Traditional biomass is mainly used for cooking and space heating. The inefficient burning of wood and coal in cookstoves has serious impacts on human health. The smoke from the wood burning contains many hazardous chemicals and particulates. Smoke from coal use in rural households is additionally problematic because of the emission of sulfur oxides and other toxics." (citations omitted)); Michael P. Vandenbergh et al., *Micro-Offsets and Macro-Transformation: An Inconvenient View of Climate Change Justice*, 33 HARV. ENVTL. L. REV. 303, 345 (2009) ("The most obvious increase in well-being from the switch to efficient cook stoves is savings in time, energy, or money associated with securing adequate fuel. Significant improvements also may occur in health and security.").

225 Kyoto Protocol to the United Nations Framework Convention on Climate Change art. 3(1), Annex B, Dec. 11, 1997, 37 I.L.M. 22, U.N. Doc FCCC/CP/1997/7/Add.1 (1998), *available at* http://unfccc.int/resource/docs/convkp/kpeng.pdf.

American forests for wood pellets.[226] The second was the publication of scientific articles exploring the relationship between black carbon emissions and global warming.[227] The problem was worthy of study because black carbon is not a gas like carbon dioxide, but a form of particulate matter, which has physically different impacts on the generation of heat, or radiative forcing.[228] The third was the publication of a famous article proposing a sector-by-sector approach to greenhouse gas reductions, which subsequently inspired eclectic approaches to greenhouse gas reduction.[229] Some scientists have suggested that a black carbon "wedge" may be achieved.[230] In response to these and other studies, in 2009 Congress passed an appropriations bill that required EPA to prepare a report to Congress on black carbon.[231]

In December 2009, EPA issued its Endangerment Finding for greenhouse gases, concluding that six greenhouse gases endanger human health and the environment, necessary for triggering their regulation under the mobile source program.[232] However, EPA expressly refrained from addressing black carbon, because it is not a greenhouse gas and its physical chemistry is different from that of the greenhouse gases.[233] Rather, it is an aerosol particle whose effect depends on the location and timing of

226 *See supra* notes 164–169 and accompanying text.

227 *See, e.g.*, Tami C. Bond & Haolin Sun, *Can Reducing Black Carbon Emissions Counteract Global Warming?*, 39 ENVTL. SCI. & TECH. 5921, 5921 (2005) (calculating a GWP for black carbon at 680 times that of carbon dioxide, on a 100 year basis).

228 Keith P. Shine et al., *Alternatives to the Global Warming Potential for Comparing Climate Impacts of Emissions of Greenhouse Gases*, 68 CLIMATE CHANGE 281, 286 (2005) (developing a new metric, Global Temperature Potential (GTP), the global mean temperature change at the end of a time horizon of 100 years, which results after a pulse emission of 1 kg of a chemical, as compared with the change resulting from a pulse emission of 1 kg of CO_2).

229 S. Pacala & R. Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, 305 SCI. 968 (2004). Professors Socolow and Pacala designed a graph representing the increase in CO_2 emissions over fifty years under a "business as usual" scenario, and identified readily-available technologies to achieve quantifiable reductions, represented as slices of a triangle. *Id.*

230 Andrew P. Grieshop et al., *A Black-Carbon Mitigation Wedge*, 2 NATURE GEOSCI. 533, 533 (2009) ("Steadily eliminating all present-day emissions of black carbon globally over the next 50 years would have an approximately equivalent climate mitigation effect to removing 25 Gt C from the atmosphere over the same period."). *Cf.* MILIND KANDLIKAR ET AL., COPENHAGEN CONSENSUS CTR., A PERSPECTIVE PAPER ON BLACK CARBON MITIGATION AS A RESPONSE TO CLIMATE CHANGE (2009), *available at* http://www4.ncsu.edu/~apgriesh/pubs/kandlikar_cc_2010.pdf (criticizing the notion that climate change could be addressed through black carbon).

231 Act of Oct. 30, 2009, Pub. L. No. 111-88, 123 Stat. 2904, 2938 (requiring EPA to submit the results of a study on domestic and international black carbon emissions within 18 months of the date of enactment).

232 Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496 (Dec. 15, 2009) (to be codified at 40 C.F.R. ch. 1). The six greenhouse gases addressed by EPA are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). *Id.* at 66,497.

233 *Id.* at 66,520.

emissions.[234] Shortly thereafter, prominent scientists provided testimony on black carbon pollution and cookstoves before Congress.[235]

EPA submitted its black carbon report to Congress in March 2012.[236] In the report, EPA concluded that the global health benefits of reducing black carbon emissions were significant (in the trillions of dollars), although it notes that literature was limited.[237] But the report noted even greater uncertainty in developing models for monetizing the climate change impacts.[238] Accordingly, even the black carbon report indicates that the case for addressing the public health impacts is stronger than the case for addressing the global warming impacts.

This conclusion is supported by EPA's experience reviewing and revising the national ambient air quality standards for particulates. For climate change impacts to be shown, scientists must establish a line of causation from emissions to atmospheric concentrations, to radiative forcing, to climate change, to impacts, and finally to damages.[239] In contrast, for health impacts the line of causation from emissions of fine particulates to damages is easier. In fact, EPA has been performing such an analysis since it promulgated the first primary national ambient air quality standard for fine particulates in 1997, and since it promulgated the first primary national ambient air quality standard for total suspended particulates in 1971.[240]

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234 U.S. Envtl. Prot. Agency, *Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act: EPA's Response to Public Comments*, Response 9-20, http://epa.gov/climatechange/endangerment/comments/volume9.html (last visited Feb. 13, 2016).

235 *Clearing the Smoke: Understanding the Impacts of Black Carbon Pollution: Hearing Before the Select Committee on Energy Independence and Global Warming House of Representatives*, 111th Cong. 1–2 (2010) (statement of Rep. Markey, Chairman, H. Select Comm. on Energy Indep. and Global Warming).

236 *See* REPORT TO CONGRESS ON BLACK CARBON, *supra* note 215.

237 *Id.* at 148 ("Although the body of literature is limited, available studies demonstrate that mitigating BC emissions would have substantial benefits for global public health, potentially avoiding millions of premature deaths each year valued in the trillions of $US. Although valuing health benefits around the world is complicated by data limitations, several studies undertaking such analyses have found that the mortality benefits alone are quite substantial and may alone justify mitigation efforts. Reducing BC emissions from transportation and residential sources, in addition to some BC-rich industrial sources, would likely achieve the greatest combined health and climate benefits. More information on the benefits and costs of individual measures in each country is needed to support policy decisions made at the national level.").

238 *Id.* at 156 ("Another way to evaluate the benefits of BC mitigation strategies and to compare them with the benefits of other climate mitigation strategies is to use valuation techniques to create monetary estimates of avoided damages. This would be equivalent to the approach adopted to compare the health benefits of different regulatory approaches discussed above in section 6.3. However, methods for establishing the economic value of the climate damages associated with BC are still being developed.").

239 *Id.* at 57 fig. 2-24.

240 *See* National Ambient Air Quality Standards for Particulate Matter, 62 Fed. Reg. 38,652, 38,711–12 (July 18, 1997) (to be codified at 42 C.F.R. §§ 410.6, 410.7); National Primary and Secondary Ambient Air Quality Standards, 36 Fed. Reg. 8,186, 8,187 (Apr. 30, 1971) (to be codified at 40 C.F.R. §§ 50.6, 50.7).

In September 2010, EPA and the Department of State launched the Global Alliance for Clean Cookstoves.[241] Departing from the traditional focus on climate change and energy policy, a press release justified the initiative primarily based on the protection of human health, and only secondarily based on the environment.[242] Moreover, it was highlighted by environmental justice considerations—it is women and children who are most harmed by air emissions from inefficient cookstoves in developing countries.[243] Therefore, health concerns and environmental justice concerns have reemerged as the basis for addressing air pollution from wood burning.

C. Fossil Fuels and Biomass: A Comparison of Mortality

If health and environmental impacts are a factor in whether biomass should be characterized as a form of renewable energy, then it is appropriate to compare those impacts with the impacts of fossil fuels. Even if health and environmental impacts are not strictly a factor, it is still important to compare those impacts because there is a tradeoff in choosing between renewable energy and fossil fuels, and health impacts inform judgments about this tradeoff.

Under the CAA, EPA has gathered data on mortality from fossil fuel combustion from industrial facilities. Pursuant to executive orders dating back to the Reagan Administration, EPA must establish that the benefits of any major rule outweigh the costs.[244] With respect to fine particulates, benefits include the reduction of mortality (death) and morbidity (non-fatal disease and illness).[245]

Two recent major rulemakings illustrate the link between fine particulates from fossil fuel combustion and mortality. First, EPA promulgated the Cross-State Air Pollution Rule (CSAPR), a federal regulatory program for coal-fired power plants that involves emissions trading programs for nitrogen oxides and sulfur dioxide, to address the

241 U.S. Dep't of State, *Global Alliance for Clean Cookstoves*, http://www.state.gov/s/partnerships/cleancookstoves/ (last visited Feb. 13, 2016).

242 *See id.* ("The Alliance is an innovative public-private partnership, led by the United Nations Foundation and comprising over 1,000 partners to save lives, improve livelihoods, empower women, and combat climate change by creating a thriving global market for clean and efficient household cooking solutions.").

243 REPORT TO CONGRESS ON BLACK CARBON, *supra* note 215, at 67 ("The World Health Organization (WHO) estimates that indoor smoke from solid fuels is among the top ten major risk factors globally, contributing to approximately 2 million deaths annually. Women and children are particularly at risk."); *id.* at 81–82 (summarizing studies on health impacts on women and children).

244 President Reagan issued the first of these executive orders in 1981. *See* Exec. Order No. 12,291, 46 Fed. Reg. 13,193 (Feb. 19, 1981). President Obama issued the most recent executive order in 2011. *See* Exec. Order No. 13,563, 76 Fed. Reg. 3821 (Jan. 21, 2011).

245 78 Fed. Reg. 3,086, 3,106–09 (Jan. 15, 2013) (discussing mortality and morbidity studies, in the context of the revision of the annual national ambient air quality standard for fine particulates).

problems posed by fine particulates and ozone.[246] EPA estimated that the rule would reduce the number of $PM_{2.5}$-related premature deaths in 2014 by between 13,000 and 34,000.[247] As a baseline, EPA estimated a range of 130,000 to 320,000 $PM_{2.5}$-related premature deaths in the United States in 2005.[248] Second, EPA promulgated the Utility MACT, which imposed numerical emissions limitations for coal-fired power plants to reduce mortality resulting from exposure to fine particulates.[249] EPA estimated the rule would reduce deaths by 4,200, to 11,000 per year.[250]

EPA's range of 130,000 to 320,000 $PM_{2.5}$-related premature deaths encompasses all sources of fine particulates, not just coal-fired power plants.[251] The contribution of domestic power plants would necessarily be less than this range. Given larger populations in Asia and presumably less stringent regulations, estimates of mortality from emissions of coal-fired power plants may be even higher. For India, one study estimated a range of deaths from coal-fired power plants between 80,000–115,000 per year.[252] For

246 Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals, 76 Fed. Reg. 48,208 (Aug. 8, 2011) (codified at 40 C.F.R. pts. 51–52, 72, 78, 97); U.S. Envtl. Prot. Agency, *Cross–State Air Pollution Rule (CSAPR)*, http://www3.epa.gov/airtransport/CSAPR/index.html (last visited Feb. 13, 2016).

247 *Id.* at 48,309 ("We estimate that $PM_{2.5}$ improvements under the Transport Rule will, starting in 2014, annually reduce between 13,000 and 34,000 $PM_{2.5}$-related premature deaths, 15,000 non-fatal heart attacks, 8,700 incidences of chronic bronchitis, 8,500 hospital admissions, and 400,000 cases of aggravated asthma while also reducing 10 million days of restricted activity due to respiratory illness and approximately 1.7 million work-loss days.").

248 *Id.* ("A recent EPA analysis estimated that 2005 levels of $PM_{2.5}$ and ozone were responsible for between 130,000 and 320,000 $PM_{2.5}$-related and 4,700 ozone-related premature deaths, or about 6.1% of total deaths from all causes in the continental U.S. . . . . This same analysis attributed almost 200,000 non-fatal heart attacks, 90,000 hospital admissions due to respiratory or cardiovascular illness and 2.5 million cases of aggravated asthma among children and many other human health impacts." (citations omitted)).

249 National Emission Standards for Hazardous Air Pollutants From Coal and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, 77 Fed. Reg. 9,304 (Feb. 16, 2012).

250 U.S. ENVTL. PROT. AGENCY, REGULATORY IMPACT ANALYSIS FOR THE FINAL MERCURY AND AIR TOXICS STANDARDS at 5-103 (2011), *available at* http://www.epa.gov/ttn/ecas/regdata/RIAs/matsriafinal.pdf ("We estimate that in 2016 the rule will have reduced the number of $PM_{2.5}$-related premature deaths by between 4,200 and 11,000 and produce substantial non-mortality co-benefits.").

251 *See* FANN ET AL., ESTIMATING THE NATIONAL PUBLIC HEALTH BURDEN ASSOCIATED WITH EXPOSURE TO AMBIENT $PM_{2.5}$ AND OZONE 2–3, 12 (2011), *available at* http://ephtracking.cdc.gov/docs/Estimating_national_burden.pdf (describing CMAQ model based on all emissions for deriving mortality from $PM_{2.5}$).

252 CONSERVATION ACTION TRUST ET AL., COAL KILLS: AN ASSESSMENT OF DEATH AND DISEASE CAUSED BY INDIA'S DIRTIEST ENERGY SOURCE 1 (2013), *available at* http://www.greenpeace.org/india/Global/india/report/Coal_Kills.pdf ("The study finds that in 2011–2012, emissions from Indian coal plants resulted in 80,000 to 115,000 premature deaths and more than 20 million asthma cases from exposure to total PM10 pollution."); Lisa Friedman, *Coal-Fired Power in India May Cause More Than 100,000 Premature Deaths Annually*, SCI. AM., Mar. 11, 2013, http://www.scientificamerican.com/article/coal-fired-power-in-india-may-cause-more-than-100000-premature-deaths-annually/ (last visited Feb. 13, 2016) (summarizing report by Conservation Action Trust).

China, the estimate is approximately 257,000 deaths per year.[253] Both have populations over one billion,[254] but even their mortality rates from coal-fired power plants are dwarfed by the worldwide deaths from household burning of biomass and coal.

According to the World Health Organization, 4.3 million people die prematurely from illnesses attributable to household air pollution caused by burning solid fuels (biomass and coal), every year.[255] In contrast, worldwide deaths from ambient air pollution (outdoor air pollution) total 3.7 million.[256] Collectively, indoor air pollution and outdoor air pollution account for seven million deaths per year.[257] The problem of household air pollution is

253 Press Release, Greenpeace, Pollution From Coal Power Plants in the Beijing-Tianjin-Hebei Region Causes Nearly 10,000 Premature Deaths (June 18, 2013), http://www.greenpeace.org/eastasia/press/releases/climate-energy/2013/health-impacts-china-coal/ (last visited Feb. 13, 2016) ("A research project co-authored by Greenpeace on the health impacts of coal power plants shows that $PM_{2.5}$ pollution from the 196 coal-fired power plants in the capital region of Beijing-Tianjin-Hebei caused 9,900 premature deaths and nearly 70,000 outpatient visits or hospitalizations during 2011. 75% of the premature deaths are caused by the 152 coal-fired power plants in Hebei Province."); Christine Ottery, *Map: Health Impact of China's Coal Plants*, GREENPEACE, Dec. 12, 2013, http://energydesk.greenpeace.org/2013/12/12/map-health-impact-chinas-coal-plants/ (last visited Feb. 13, 2016) ("The level of emissions from coal plants in China in 2011 could have contributed to an estimated quarter of a million premature deaths that year, according to an analysis commissioned by Greenpeace . . . . The some 257,000 premature deaths—which theoretically could have been avoided if there was no air pollution—were calculated using modeling techniques based on the links between air pollution and risk of illness or death.").

254 According to recent figures from the United Nations, the population of China is 1,357,380,000 and the population of India is 1,213,370,000. UNITED NATIONS, DEP'T OF ECON. AND SOC. AFFAIRS, POPULATION AND VITAL STATISTICS REPORT 8 (2015), *available at* http://unstats.un.org/unsd/demographic/products/vitstats/sets/Series_A_2015.pdf.

255 World Health Org., *Household Air Pollution and Health* (2014), http://www.who.int/mediacentre/factsheets/fs292/en/ (last visited Feb. 13, 2016) (relying on 2012 data).

256 World Health Organization, *Ambient (Outdoor) Air Quality and Health* (2014), http://www.who.int/mediacentre/factsheets/fs313/en/ (last visited Feb. 13, 2016) ("Ambient (outdoor air pollution) in both cities and rural areas was estimated to cause 3.7 million premature deaths worldwide per year in 2012; this mortality is due to exposure to small particulate matter of 10 microns or less in diameter (PM_{10}), which cause cardiovascular and respiratory disease, and cancers.").

257 Combining the 4.3 million annual deaths from indoor air pollution with the 3.7 million annual deaths from outdoor air pollution would result in total annual deaths of 8 million. But the World Health Organization recognizes that people are exposed to both forms of pollution, and therefore lowers its estimate of total annual deaths to 7 million per year, the figure set forth at the beginning of this Article. *See* World Health Org., *7 Million Premature Deaths Annually Linked to Air Pollution*, *supra* note 3.

associated with cooking with biomass,[258] and it disproportionately affects people in less developed countries.[259]

V. EPA'S REVISED NEW SOURCE PERFORMANCE STANDARDS FOR RESIDENTIAL WOOD HEATERS (MARCH 2015)

Controversy over EPA's revised standards for residential wood heaters highlights the political and cultural challenges to reaching a domestic consensus for addressing the problem of wood burning. This is complicated by the constraints of federalism. The controversy is discussed below.

A. Overview of EPA's Final Rule

In 1970, Congress created the New Source Performance Standards Program, which involves technology-based emissions limitations for categories of stationary sources.[260] A "stationary source" is defined as "any building, structure, facility, or installation which emits or may emit any air pollutant."[261] The EPA Administrator must designate a category of stationary sources for regulation "if in his judgment it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare."[262] Then, EPA must promulgate regulations setting forth standards of performance for such a category.[263] Typically, standards of performance are numerical emissions limitations for achieving a "degree of emission limitation achievable," although there is

258 WORLD HEALTH ORG., WHO GUIDELINES FOR INDOOR AIR QUALITY: HOUSEHOLD FUEL COMBUSTION 1 (2014), *available at* http://reliefweb.int/sites/reliefweb.int/files/resources/HHFC_guidelines.pdf ("Global burden of disease estimates have found that exposure to HAP [Household Air Pollution] from cooking results in around 4 million premature deaths, with the most recent estimates from WHO reporting 4.3 million deaths for 2012. HAP is responsible for nearly 5% of the global disease burden (expressed as disability-adjusted life-years (DALYs)), making it globally the single most important environmental risk factor." (internal citations omitted)).

259 WORLD HEALTH ORG., BURDEN OF DISEASE FROM HOUSEHOLD AIR POLLUTION FOR 2012 (2014), *available at* http://www.who.int/phe/health_topics/outdoorair/databases/FINAL_HAP_AAP_BoD_24March2014.pdf ("Globally, 4.3 million deaths were attributable to household air pollution (HAP) in 2012, almost all in low and middle income (LMI) countries. The Southeast Asian and Western Pacific regions bear most of the burden with 1.69 and 1.62 million deaths, respectively. Almost 600,000 deaths occur in Africa, 200,000 in the Eastern Mediterranean region, 99,000 in Europe and 81,000 in the Americas. The remaining 19,000 deaths occur in high income countries."). INT'L RENEWABLE ENERGY AGENCY, BIOMASS FOR HEAT AND POWER: TECHNOLOGY BRIEF 1 (2015), *available at* http://www.irena.org/DocumentDownloads/Publications/IRENA-ETSAP_Tech_Brief_E05_Biomass%20for%20Heat%20and%20Power.pdf ("In 2012 bioenergy accounted for about 10% or 51 EJ of global energy demand—notably larger than any other single renewable energy option. Of these 51 EJ, the vast majority (27 EJ) came from the use of biomass in traditional wood-stoves in developing countries.").

260 Clean Air Amendments of 1970, Pub. L. No. 91-604, 84 Stat. 1676, 1683–84 (codified at 42 U.S.C. §§ 7401–7671q (2012)); CAA, 42 U.S.C. § 7411 (2012).

261 42 U.S.C. § 7411(a)(3) (2012).

262 *Id.* § 7411(b)(1)(A).

263 *Id.* § 7411(b)(1)(B).

authority for EPA to promulgate nonnumerical emissions standards, known as work practice standards.[264] Any standards of performance promulgated by EPA apply to new facilities, rather than to existing facilities.[265] EPA is required to review existing standards of performance every eight years, and revise them, if appropriate.[266]

Generally, EPA has used this program to promulgate standards of performance primarily for industrial facilities such as power plants.[267] Recognizing that residential wood heaters fall within the definition of stationary source, EPA promulgated a standard for them in 1988 to address emissions of particulates.[268] The standards are located in subpart AAA of EPA's regulations in Part 60.[269] EPA rejected the argument that they were not subject to regulation because they are commercial products.[270]

The 1988 standard was limited to wood heaters with an adjustable burn rate.[271] The standards for particulate matter were phased in over a period of time. Under Phase I, for new facilities manufactured after July 1, 1988 or sold at retail after July 1, 1990, the standard of performance for particulate matter was 5.5 grams per hour for a system with a catalytic combustor, and

264 A standard of performance must reflect the degree of emission limitation achievable through the application of the best system of emission reduction that has been adequately demonstrated, taking into account the cost of achieving the reduction and any non-air quality health and environmental impact and energy requirements. *Id.* § 7411(a)(1), (h) (authorizing EPA to promulgate a work practice standard if a numerical standard of performance is not feasible).

265 *See id.* § 7411(b)(1)(B) (granting EPA authority only to promulgate standards of performance for new facilities). Under section 111, there is authority to develop standards of performance for existing facilities, but that authority is earmarked for the states rather than for EPA. *Id.* § 7411(d)(1) (granting EPA authority to create a framework for the development of standards of performance for existing facilities by the states, through a process similar to that of section 110, relating to State Implementation Plans). EPA's Clean Power Plan is an example of the use of EPA's section 111(d) authority. *See* 79 Fed. Reg. 34,830, 34,832 (June 18, 2014) ("Under the authority of Clean Air Act (CAA) section 111(d), the EPA is proposing emission guidelines for states to follow in developing plans to address greenhouse gas (GHG) emissions from existing fossil fuel-fired electric generating units (EGUs)."); Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,710 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60) (setting forth a summary of EPA's section 111(d) authority, in the final fule).

266 42 U.S.C. § 7411(b)(1)(B) (2012).

267 *See* Standards of Performance for Electric Utility Steam Generating Units, 40 C.F.R. § 60.40Da (2014).

268 Standards of Performance for New Stationary Sources; New Residential Wood Heaters, 53 Fed. Reg. 5,860, 5,873 (Feb. 26, 1988) (to be codified at 40 C.F.R. pt. 60). This is known as Subpart AAA-Standards of Performance for New Residential Wood Heaters. *Id.* Litigation by the State of New York and the Natural Resources Defense Council led EPA to promulgate these standards. Standards of Performance for New Stationary Sources; Standards of Performance for New Sources; Residential Wood Heaters, 52 Fed. Reg. 4,994 (proposed Feb. 18, 1987) (to be codified at 40 C.F.R. pt. 60).

269 53 Fed. Reg. at 5,873; Standards of Performance for New Residential Wood Heaters, 40 C.F.R. pt. 60, subpt. AAA (2014).

270 *Id.* at 5,862–63 ("Nothing in the text or legislative history of section 111 suggests that a facility, such as a woodstove, cannot be a stationary source because it is mass-produced or a consumer product.").

271 *Id.* at 5,015 (to be codified at 40 C.F.R. § 60.532) (definition of "wood heater").

8.5 grams per hour for a system without a catalytic combustor.[272] Under Phase II, for new facilities manufactured after July 1, 1990 or sold at retail after July 1, 1992, the standard of performance for particulate matter was lowered to 4.1 grams per hour for a system with a catalytic combustor, and lowered to 7.5 grams per hour for a system without a catalytic combustor.[273] Affected facilities were subject to labeling requirements,[274] and manufacturers were subject to reporting and recordkeeping requirements.[275]

The 2015 rule expands the scope of coverage of the standard to include all single burn rate wood heaters/stoves/appliances, pellet heaters/stoves/appliances, and all other units falling within the scope of EPA's revised definition of "wood heater."[276] It also lowers the numerical emissions limitation over time. In place of the existing standard of 4.1 grams per hour for catalytic wood heaters and 7.5 grams per hour for noncatalytic wood heaters, the rule imposes a uniform standard of 4.5 grams per hour for units manufactured after May 15, 2015.[277] This will be lowered to a standard of 2.0 grams per hour for units manufactured after May 15, 2020.[278] While the standard is nominally set in terms of coarse particulates (PM_{10}), this is a matter of convenience for the industry because most of the particulate emissions will consist of fine particulates ($PM_{2.5}$).[279]

In addition, EPA promulgated subpart QQQQ for new wood-fired residential hydronic heaters, new wood-fired forced air furnaces, and any other new wood-fired appliance qualifying as a "central heater."[280] The rule makes them subject to their own emissions limitations, defined in terms of pounds of particulates per million British thermal units.[281] These facilities are also subject to their own labeling, certification, emissions testing, and reporting requirements.[282]

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272 *Id.*

273 *Id.*

274 *Id.* at 5,880–82.

275 *Id.* at 5,882–83.

276 Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, 80 Fed. Reg. 13,672, 13,676, 13,704 (Mar. 16, 2015) (to be codified at 40 C.F.R. § 60.530 et seq.).

277 *Id.* at 13,704. Ironically, this new standard is *less* stringent than the existing standard for catalytic wood heaters in the short term, allowing for the potential for backsliding. But EPA did not agree with commenters who requested that EPA continue the lower standard for catalytic wood heaters, and noted that by 2020 the limits would be more stringent at any rate. *Id.* at 13,687.

278 *Id.* at 13,704.

279 *Id.* at 13,678 ("Note that the emissions standards are 'as measured' by the test methods specified in the rule and are labeled as PM although the PM is essentially all $PM_{2.5}$. This avoids the potential extra testing costs of measuring $PM_{2.5}$ specifically."). Fine particulates ($PM_{2.5}$) are more harmful to health than coarse particulates (PM_{10}), resulting in a lower primary standard for a 24-hour period. *See* 40 C.F.R. § 50.6(a) (2014) (24-hour standard of 150 ug/m^3 for coarse particulates); *id.* § 50.13(a) (24-hour standard of 35 ug/m^3 for fine particulates).

280 80 Fed. Reg. at 13,680, 13,715 (to be codified at 40 C.F.R. § 60.5472 et seq.); *id.* at 13,715–16 (definitions of "central heater" and "wood heater") (to be codified at 40 C.F.R. § 60.5473).

281 *Id.* at 13,681 tbl.4, 13,716–17.

282 *Id.* at 13,680–83, 13,717–26.

Common to all heaters regulated by subpart AAA and subpart QQQQ is a prohibition on certain fuel types. A person is not allowed to burn garbage, yard waste, rubber, plastic, petroleum products, paints or paint thinners, asphalt, asbestos, construction or demolition debris, paper products (except for certain fire starters), railroad ties, pressure-treated wood, manure or animal remains, salt water saturated materials, unseasoned wood, any materials not included in the warranty and owner's manual, and any materials not included in certification tests.[283] In addition, a user must follow the owner's manual.[284]

B. Limitations of EPA's Rule

From the perspective of public health, the most significant shortcomings of this rule stem from the general nature of the section 111 program. In creating a five year phase-in period, EPA intends to ease the transition for the manufacturers of woodstoves, which are primarily small businesses.[285] This is allowed by the statute, which expressly permits EPA to take cost considerations into account.[286] In addition, the standard only applies to new units, and not existing units, consistent with the statutory program.[287] There are no change-out or replacement requirements, although EPA encourages the replacement of inefficient old units with newer units.[288] Such limitations create an obstacle to improving air quality areas that are in or near nonattainment.[289]

The rule does not purport to regulate hazardous air pollutants or carbon monoxide, although presumably such cogenerated pollutants would decline as a result of emission controls on particulate matter.[290] Residential wood combustion makes a significant contribution to the level of hazardous air

283 *Id.* at 13,705, 13,717.

284 *Id.*

285 *Id.* at 13,673 ("The potential impact on this industry that is comprised of over 90 percent small businesses was a concern to the EPA, and we have minimized these potential impacts to the degree possible while still achieving significant emission reductions. For example, we have incorporated stepped (phased) emission limits and streamlined certification procedures to ease the transition.").

286 CAA, 42 U.S.C. § 7411(a)(1) (2012).

287 80 Fed. Reg. at 13,675 ("The NSPS established under section 111(b)(1)(B) do not establish standards of performance for existing sources.").

288 *Id.* at 13,676 ("The EPA continues to encourage state, local, tribal, manufacturer, retailer and consumer efforts to change out (replace) older heaters with newer, cleaner, more efficient heaters.").

289 *See id.* at 13,675 ("Residential wood smoke causes many counties in the U.S. to either exceed the EPA's health-based NAAQS for fine particles or places them on the cusp of exceeding those standards. For example, in places such as Keene, New Hampshire; Sacramento, California; Tacoma, Washington; and Fairbanks, Alaska; wood combustion can contribute over 50 percent of daily wintertime fine particle emissions.").

290 *Id.* ("[E]mission reductions associated with the requirements of this final rule will generate health benefits by reducing emissions of $PM_{2.5}$, other criteria pollutants, such as CO, and non-criteria HAP.").

pollutants, nationwide.[291] Although carbon monoxide is the product of inefficient combustion, EPA decided not to create a standard based on efficiency linked to carbon monoxide emissions.[292] The cost–benefit analysis was based exclusively on the benefits resulting from the reduction of fine particulates, as opposed to the reduction of other air pollutants.[293]

Finally, EPA continues to ignore the harmful emissions from the household fireplace, one of the most significant and longstanding areas of underregulation in air pollution law. EPA does not regulate fireplaces, even though they are an obvious source of residential wood combustion.[294] The reason is not that air emissions from fireplaces are insignificant or harmless. Rather, EPA does not consider fireplaces to be a net source of heat.[295] In the proposed rule, EPA set forth its longstanding view that most of the heat goes up the chimney, rather than into the living area.[296] Comments on the proposed rule further validated EPA's position.[297] Perversely, the wasteful nature of fireplace combustion is the very rationale for why EPA does not regulate fireplaces. But EPA's obligation under the Clean Air Act is to

291 *Id.* at 13,673 ("Nationally, residential wood combustion accounts for 44 percent of total stationary and mobile polycyclic organic matter (POM) emissions, which account for nearly 25 percent of all area source air toxics cancer risks and 15 percent of noncancer respiratory effects.").

292 *Id.* at 13,682 ("[W]e considered requiring efficiency standards (heat output divided by fuel input) to ensure that heaters are efficient and burn no more wood than necessary for the heat demand so that the consumers can save money on fuel and so that the emissions are lower. We did not propose an efficiency standard because we concluded we do not yet have sufficient data, but the final rule uses our section 114 authority to require efficiency testing and reporting to the EPA.").

293 *Id.* at 13,694 ("For this rule, we were only able to quantify the monetized health co-benefits associated with reduced exposure from directly emitted $PM_{2.5}$.").

294 *Id.* at 13,677 ("The revised subpart AAA does not apply to fireplaces as defined in Subpart AAA."); *id.* at 13,702 (to be codified at 40 C.F.R. § 60.530(c)(3)) (exclusion for fireplaces). Fireplaces were excluded from the original rule in 1988, as well. Standards of Performance for New Stationary Sources; New Residential Wood Heaters, 53 Fed. Reg. at 5,873 (excluding "[o]pen masonry fireplaces constructed on site").

295 *See* Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, 80 Fed. Reg. at 13,703 ("*Fireplace* means a wood-burning appliance intended to be used primarily for aesthetic enjoyment and not as a space heater.").

296 Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, and New Residential Masonry Heaters, 79 Fed. Reg. 6,330, 6336 (proposed Feb. 3, 2014) (to be codified at 40 C.F.R. pt. 60) ("Fireplaces were not included in the 1988 NSPS for residential wood heaters because typical fireplaces are not considered to be effective 'heaters.' Most of the heat content from the wood burned in a typical fireplace is lost out the chimney rather than heating a room.").

297 U.S. ENVTL. PROT. AGENCY, RESPONSE TO COMMENT ON PROPOSED RULE, "STANDARDS OF PERFORMANCE FOR NEW RESIDENTIAL WOOD HEATERS, NEW RESIDENTIAL HYDRONIC HEATERS AND FORCED-AIR FURNACES, AND NEW RESIDENTIAL MASONRY HEATERS" 76 (2015), *available at* http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2009-0734-1775 ("Only a few comments suggested that fireplaces are heaters and should be covered in this NSPS. The more persuasive comments included data that reaffirmed our rationale in the proposal that fireplaces are far more likely to be used for ambience and that almost all fireplaces waste more heat out the chimney than useful heat to the house. Thus, this rulemaking does not include open fireplaces.").

regulate for the protection of public health and welfare, and not to regulate heaters per se.[298] Inefficiency of fireplaces is not a reason for not regulating them. Rather, it is an additional policy reason in favor of regulating them.

The lack of federal regulation of fireplaces means that any regulation is left to state and local governments. But the barriers to regulating fireplaces are significant. The level of emissions from an individual fireplace would likely fall within exemption limits in state air pollution control laws.[299] While state and local building codes may regulate the construction of new fireplaces, they do not necessarily impose the emissions control requirements typical of an EPA air pollution program. The problem is complicated by the legal and political difficulty of retrofitting units that may be decades or hundreds of years old. There may be architectural challenges. But this is not a justification for ignoring the problem.

C. State and Federal Conflict over EPA's Rule

Cultural reaction against EPA's new federal air pollution standards for wood stoves has led to recent state laws and bills refusing to enforce them.[300] Recent laws in Michigan, Virginia, and Missouri abstain from enforcing the federal standard for woodstoves.[301] But the laws do not purport to exempt wood heaters from compliance with federal law, as that would violate the Supremacy Clause of the Constitution.[302]

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298 42 U.S.C. § 7411(b)(1)(A) (2012) (requiring EPA to identify a category of stationary sources for regulation "if . . . it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare").

299 *See, e.g.*, N.Y. COMP. CODES R. & REGS. tit. 6, § 201-3.2(c)(1) (West 2015) ("Exempt activities" include "Stationary or portable combustion installations with: . . . a maximum rated heat input capacity of less than one million Btu/hr burning coal or wood."). U.S. Dep't of Energy, *Wood and Pellet Heating*, http://energy.gov/energysaver/wood-and-pellet-heating (last visited Feb. 13, 2016) ("Pellet stoves have heating capacities that range between 8,000 and 90,000 Btu per hour. They are suitable for homes as well as apartments or condominiums."). The pellet stoves described by the Department of Energy would be covered by the New York exemption.

300 *See, e.g.*, Associated Press, *Lawmakers in Minnesota, Other States Fight to Keep Wood Fires Burning*, MINN. PUB. RADIO NEWS, Mar. 9, 2015, http://www.mprnews.org/story/2015/03/09/states-fight-to-keep-wood-fires-burning (last visited Feb. 13, 2016) (referring to recent laws barring enforcement of the federal standards in Missouri, Michigan, and Virginia, and pending bills in Wisconsin, Minnesota, and West Virginia).

301 MICH. COMP. LAWS § 324.5514(1) (2015) ("The department of environmental quality shall not do any of the following: (a) Promulgate a rule limiting emissions from wood heaters. (b) Enforce against a manufacturer, distributor, or consumer a federal regulation limiting emissions from wood heaters and adopted after May 1, 2014."); MO. REV. STAT. § 643.055.1 (2015) ("The department shall not regulate the manufacture, performance, or use of residential wood burning heaters or appliances through a state implementation plan or otherwise, unless first specifically authorized to do so by the general assembly."); VA. CODE ANN. § 10.1-1307(G) (2015) ("The Board shall not: 1. Adopt any regulation limiting emissions from wood heaters; or 2. Enforce against a manufacturer, distributor, or consumer any federal regulation limiting emissions from wood heaters adopted after May 1, 2014.").

302 *See* U.S. CONST. art. VI, § 2 ("This Constitution, and the Laws of the United States which shall be made in Pursuance thereof; and all Treaties made, or which shall be made, under the Authority of the United States, shall be the supreme Law of the Land . . . .").

Rather than being a preemption issue, the controversy involves the delegation of authority to implement the standard under CAA section 111(c). Under the statute, states may request delegation of authority over this program from EPA.[303] Even if EPA delegates such authority, Congress reserves to EPA the authority to enforce the program directly against stationary sources.[304] The State of Michigan,[305] the Commonwealth of Virginia,[306] and the State of Missouri[307] all have received a delegation of

303 CAA, 42 U.S.C. § 7411(c)(1) (2012) ("Each State may develop and submit to the Administrator a procedure for implementing and enforcing standards of performance for new sources located in such State. If the Administrator finds the State procedure is adequate, he shall delegate to such State any authority he has under this chapter to implement and enforce such standards.").

304 *Id.* § 7411(c)(2) ("Nothing in this subsection shall prohibit the Administrator from enforcing any applicable standard of performance under this section."). This provision codifies the concept of "overfiling," which involves the federal agency either bringing an enforcement action in the absence of state action, or bringing an enforcement action in the presence of state action. Generally speaking, this practice is permissible under major federal environmental laws. The practice was rejected in one case under the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901–6992 (2012). Harmon Indus. v. Browner, 191 F.3d 894, 902 (8th Cir. 1999) ("[W]e find that the EPA's practice of overfiling, in those states where it has authorized the state to act, oversteps the federal agency's authority under the RCRA."). However, this appears to be a minority rule among courts that have dealt with the issue of overfiling. Thomas A. Benson, Note, *Perfect* Harmony*: The Federal Courts Have Quarantined* Harmon *and Preserved EPA's Power to Overfile*, 28 WM. & MARY ENVTL. L. & POL'Y REV. 885, 901 (2004) ("The pattern for CWA and CAA cases is clear. In each of the five cases since *Harmon*, courts have rejected efforts to extend the case to other statutes, essentially walling off *Harmon* in the RCRA portion of the United States Code."). United States v. Murphy Oil USA, Inc., 143 F. Supp. 2d 1054, 1091 (W.D. Wis. 2001) ("I conclude that *Harmon Industries* is inapplicable to Clean Air Act enforcement actions. Not only is the act devoid of the language the Eighth Circuit deemed important, § 7413(e) suggests that Congress anticipated overfiling and approved it when it provided that prior penalties paid could be taken into consideration in determining new penalties.").

305 The State of Michigan received a delegation of authority in 1984. 49 Fed. Reg. 28,708, 28,711 (July 16, 1984) ("This delegated authority includes all future standards promulgated for additional pollutants and source categories and all revisions and amendments to existing and future standards.").

306 The Commonwealth of Virginia received a delegation of authority in 1981. 46 Fed. Reg. 43,300, 43,300 (Aug. 27, 1981) ("[D]elegation of enforcement authority for future NSPS and NESHAP standards is hereby granted subject to the following conditions . . . ."). Pursuant to this delegation, the State of Virginia periodically submits a request to EPA for a revision of its delegation authority, to administer additional regulations. *See, e.g.*, Letter from Michael G. Dowd, Dir., Air Div., Va. Dep't of Envtl. Quality, to Diana Esher, Dir., Air Prot. Div., U.S. Envtl. Prot. Agency, July 16, 2014, *available at* http://archive.epa.gov/reg3artd/airregulations/delegate/web/pdf/va_7-16-2014_deleg_update_request_ltr.pdf ("The revision is being provided in order for the department to retain its authority to enforce the NSPSs and NESHAPs under the delegation of authority granted by EPA on August 27, 1981 (46 FR 43300).").

307 The State of Missouri received a delegation of authority in 1985. 50 Fed. Reg. 933, 933 (Jan. 8, 1985) ("Under the terms of the new procedures . . . Missouri will automatically receive authority to implement and enforce the federal Standards of Performance for New Stationary Sources (NSPS) . . . upon the state's adoption of additional standards."). In 1989, Missouri was authorized to implement the NSPS for Residential Wood Heaters. 55 Fed. Reg. 28, 29 (Jan. 2, 1990). Unlike the case of Michigan and Virginia, EPA periodically publishes delegation notices in the federal register for Missouri and other states within EPA Region VII. The most recent delegation notice from EPA was valid for state regulations effective as of 2015. 80 Fed. Reg. 10,596 (Feb. 27, 2015).

authority with respect to the standard for woodstoves. As a matter of EPA policy, the legal ability to enforce and implement this program is a precondition for the delegation of authority.[308] If state law prevents a state agency from enforcing the program, delegation is not appropriate.[309] Therefore, state laws refusing to enforce the federal standard could lead to the withdrawal of a delegation of authority under the standard, in whole or in part.

With respect to the standard for residential wood heaters, it is noteworthy that EPA has contemplated giving states only a limited role. Even if a state has received a delegation under this program, it does not include authority over substantive decisions.[310] Rather, delegation is limited to most enforcement activities.[311] In the proposed rule, EPA justified such a division of authority by noting that the proposed delegation section was based primarily on the provisions of the existing standard from 1988.[312] In addition, EPA underscored that the delegation covers matters where "local enforcement is essential."[313]

In the original standard, EPA expressly set forth the authorities that could not be delegated, but it did not set forth the authorities that could be delegated.[314] Still, the preamble to that final rule indicated that EPA would play a centralized role in the administration of the standard.[315] EPA intended that any delegation include the authority to conduct inspections, but it did

308 U.S. ENVTL. PROT. AGENCY, GOOD PRACTICES MANUAL FOR DELEGATION OF NSPS AND NESHAP 2 (1983), *available at* http://www3.epa.gov/airtoxics/112(l)/goodpracticesmanual 081009.pdf ("The Clean Air Act precisely states that the States should have the primary authority for implementing the NSPS and the NESHAPs programs. The Clean Air Act sets very few conditions on the transfer of this authority . . . . The criteria to be used by the EPA RO's [Regional Offices] in determining when they should transfer these programs are flexible. The major requirement is that the State must affirm their intent to implement and enforce the programs and show that they are able to do so both legally and programmatically.").

309 *See id.*

310 These include decisions relating to certifications, standards and test methods, laboratory and third-party certifier approvals, the content of owner's manuals, and hearings and appeals procedures. *See* Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, 80 Fed. Reg. 13,672, 13,715 (Mar. 16, 2015) (to be codified at 40 C.F.R. §60.539a(b)); *id.* at 13,727.

311 *Id.* at 13,715, 13,727 (to be codified at 40 C.F.R. § 60.5482(a)).

312 Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, and New Residential Masonry Heaters, 79 Fed. Reg. 6,330, 6,367 (proposed Feb. 3, 2014).

313 *Id.*

314 Standards of Performance for New Stationary Sources; New Residential Wood Heaters, 53 Fed. Reg. 5,860, 5,884 (Feb. 26, 1988) (codified at 40 C.F.R. § 60.539a (1989)).

315 *See id.* at 5,871–72 ("Because wood heaters are mass-produced consumer products marketed nationally and affecting many States, wood heater NSPS implementation and enforcement requires Federal oversight to ensure national consistency. Therefore, EPA has decided that a centralized program operated by EPA's staff in Washington, DC, and Research Triangle Park, NC, is the most efficient and effective way to meet the Agency's responsibilities for certifying wood heater model lines, accrediting wood heater testing laboratories, conducting emission audit testing, and making applicability determinations.").

not rule out the possibility of it including other enforcement activities as well.[316]

In summary, recent laws in Michigan, Virginia, and Missouri do not attempt to create exemptions from the applicability of EPA's revised standard. Rather, they merely prevent the state from participating in the implementation of the program under CAA section 111(c). The result is not a constitutional crisis, but an enforcement inconvenience for EPA, which cannot rely on uncooperative states to enforce the standard. In those states, enforcement will depend upon EPA alone.[317]

D. New York City and Local Law 38 of 2015

State and local governments are not entirely hostile to EPA's increased regulation of wood burning. The experience in New York City tells a different story than that seen in Michigan, Virginia, and Missouri. On May 6, 2015, Bill de Blasio, mayor of New York City, signed into law an amendment to New York City air pollution control code.[318] The amendment addresses outdoor wood boilers, fireplaces, and wood burning heaters, among other things.[319] For outdoor wood boilers, the law imposes certain qualitative requirements (they may not activate smoke detectors, impair visibility, or cause visible plumes on neighboring property), as well as quantitative requirements (they must meet certain thermal output rating, certification, and distance requirements).[320]

With respect to fireplaces (both new and existing) there are two general requirements. First, no person shall operate a fireplace as a primary source of heat unless the source that normally supplies heat to the building is inoperable because of certain emergencies or natural disasters.[321] Because there is ambiguity in what is a "primary source of heat," the New York City Department of Environmental Protection's interpretation of this law will be important.[322] Second, no person shall operate a fireplace unless it is in compliance with applicable federal emissions limitations under 40 C.F.R.

316 *Id.* at 5,872.

317 *See* Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, 80 Fed. Reg.13,672, 13,715 (Mar. 16, 2015) (to be codified at 40 C.F.R. §60.539a(b)); *id.* at 13,727 ("Nothing in these delegations will prohibit the Administrator from enforcing any applicable requirements.").

318 N.Y.C. Council, *Air Pollution Control Code*, http://smokiusa.com/nyc (last visited Feb. 13, 2016) (demonstrating mayor signing into law amendments to New York City air pollution control code).

319 N.Y.C. LOCAL LAW NO. 38 §§ 24–26 (2015) (codified at N.Y.C. ADMIN CODE §§ 24-149.1 to 24-149.3), *available at* http://www1.nyc.gov/assets/buildings/local_laws/ll38of2015.pdf.

320 *Id.* § 24 (codified at N.Y.C. ADMIN CODE § 24-149.1).

321 *Id.* § 25 (codified at N.Y.C. ADMIN CODE § 24-149.2(b)).

322 Given EPA's view that a fireplace is not used primarily as a heater, it is not clear whether this language is a significant limitation on the ability to operate a fireplace. Applying EPA's view, one could argue that a fireplace would never be a "primary source of heat" at all, unless there is no other source of heat. *See* discussion *supra* notes 294–300 and accompanying text. The result would be a diluted requirement and a loophole in air pollution regulation.

§ 60.532, EPA's revised New Source Performance Standard.[323] Here, the City of New York intends to reinforce the federal standard, in contrast to certain states refusing to enforce it.[324]

There are also two specific requirements. First, no person shall operate a new fireplace unless it is operated solely on natural gas or on renewable fuel.[325] Given the ambiguity of what is a renewable fuel, the Department of Environmental Protection's interpretation of this law will be important. While the city attempts to provide specific definitions of "renewable fuel" and "renewable biomass," the uncertainty of how EPA interprets these concepts at the federal level could influence the interpretation of this law.[326] Second, no person shall operate an existing fireplace unless it is operated with the use of treated firewood having a moisture content of 20% or less, or by renewable fuel or other material designated by the Department.[327] Again, there is ambiguity regarding what is a "renewable fuel."

With respect to wood burning heaters, there are two requirements. First, no person shall operate a wood burning heater as a primary source of heat unless the source that normally supplies heat to the building is inoperable because of certain emergencies or natural disasters.[328] This requirement mirrors the requirement for fireplaces. Again, there is ambiguity regarding what is a "primary source of heat." Second, no person shall operate any wood burning heater unless it is operated solely on renewable fuel and it complies with the Part 60 regulations.[329] Again, there is ambiguity regarding what is a "renewable fuel."

In addition, there may be an ambiguity regarding the scope of the units that are subject to these requirements. The definition of "wood burning heaters" is limited to indoor devices burning pellets for aesthetic purposes.[330] Therefore, the apparent intent may be to regulate units that are subject to the federal exclusion for fireplaces.[331] But these units are subject to a

323 N.Y.C. LOCAL LAW NO. 38 § 25 (codified at N.Y.C. ADMIN CODE § 24-149.2(e)).

324 Technically, the reference to the federal standard does not impose any new substantive requirement for residential wood heaters. It just means that if the federal standard applies, then the local law also requires compliance with it. Therefore, the real purpose for the reference appears to be to facilitate enforcement by the city.

325 *Id.* (codified at N.Y.C. ADMIN CODE § 24-149.2(c))

326 *Id.* § 3 (codified at N.Y.C. ADMIN CODE § 24-104(49)) ("'Renewable' fuel means fuel produced from renewable biomass or captured from landfills or wastewater treatment."). "Renewable biomass" is defined to include items such as crops and crop residue, tree residues, slash and pre-commercial thinnings from non-federal forest land, biomass cleared from the vicinity of buildings and other areas to reduce the risk of wildfire, algae, and separated yard waste or food waste. *Id.*

327 *Id.* § 25 (codified at N.Y.C. ADMIN CODE § 24-149.2(d)).

328 *Id.* § 26 (codified at N.Y.C. ADMIN CODE § 24-149.3(a)).

329 *Id.* (codified at N.Y.C. ADMIN CODE § 24-149.2(b))

330 *Id.* § 3 (codified at N.Y.C. ADMIN CODE § 24-104(53)) ("Wood burning heater" means "any enclosed, permanently installed, indoor device burning pellets designed to be used primarily for aesthetic purposes.").

331 *See* Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, 80 Fed. Reg. 13,672, 13,703 (Mar. 16, 2015) (to be codified at 40 C.F.R. §60.531) (definition of "fireplace") ("A model line that is clearly positioned in the marketplace as intended to be used primarily for aesthetic enjoyment and not as a room

requirement to comply with the Part 60 regulations, which does not apply to fireplaces.

With an extremely high population density, New York City has identified the problem of wood burning and has taken legal steps to deal with the problem. But much depends on how the Department of Environmental Protection will interpret the ambiguities in the new law, by way of formal regulation or informal policy. Conceivably, EPA's development of a national policy with respect to biomass may have an influence on the interpretation and enforcement of this law.

VI. CONCLUSIONS

In the pursuit of a source of renewable energy as an alternative to fossil fuels, many people have erroneously become fixated on biomass, even though it presents harm to public health. Burning wood and other biomass is responsible for air quality problems domestically and internationally, most tragically in the form of millions of annual deaths from household air pollution in developing countries.

As a source of fine particulates and hazardous air pollutants resulting from combustion, biomass is more similar to coal, oil, and natural gas (non-renewable energy), than it is to wind and solar power (renewable energy). Because of its health and environmental impacts, nuclear power has been denied the "renewable energy" label. The higher death toll from the combustion of biomass suggests similar treatment for biomass.

The pursuit of biomass is the result of political and cultural choices being made by both consumers and corporations. EPA's effort to revise the New Source Performance Standard for residential wood heaters illustrates a cultural affinity for wood burning, with some states actually refusing to enforce more stringent standards for the protection of public health. The effort of New York City to address the problem of wood heaters reflects an attempt to go in the direction of promoting public health, although much depends on how the city agency will implement the new law.

heater, as demonstrated by product literature (including owner's manuals), advertising targeted at the trade or public (including web-based promotional materials) or training materials is presumptively a fireplace model line.").