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PUBLIC INTEREST COMMENT

Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, and New Residential Masonry Heaters

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INTRODUCTION

The Regulatory Studies Program of the Mercatus Center at George Mason University is dedicated to advancing knowledge about the effects of regulation on society. As part of its mission, the program conducts careful and independent analyses that employ contemporary economic scholarship to assess rulemaking proposals and their effects on the economic opportunities and the social well-being available to all members of American society.

This comment addresses the efficiency and efficacy of this proposed reconsideration from an economic point of view. Specifically, it examines how the relevant rule may be improved by more closely examining the societal goals the rule intends to achieve and whether this reconsideration will successfully achieve those goals. In many instances, regulations can be substantially improved by choosing more effective regulatory options or more carefully assessing the actual societal problem.

SUMMARY

The Environmental Protection Agency (EPA) is proposing new source performance standards (NSPS) for residential wood heaters, wood-fueled pellet heaters, Hydronic Heaters, Forced-Air Furnaces, and Residential Masonry Heaters. According to the EPA, these new lower-emission standards will generate improvements to the environment and to public health, primarily through the lowering of the emissions of pollutants like particulate matter, carbon monoxide, and volatile organic compounds. The EPA believes these pollutants contribute to increases in human mortality and other health problems.

Unfortunately, the EPA fails to acknowledge the high degree of uncertainty surrounding the proposed rule's estimated benefits. A growing literature is questioning the causal link between the total concentration of

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ambient particulate matter and mortality levels, especially at the low doses that exist today in many parts of the United States. Furthermore, the EPA overestimates the net benefits by failing to recognize emission reduction trends that will continue to take place without any federal regulatory requirement. The EPA also fails to empirically analyze whether customers may respond to the higher priced wood-fuel units by either delaying the replacement of older wood-fueled units or by switching to other fuel sources that produce more CO_2 emissions per unit of energy produced. Additionally, the EPA fails to consider the adverse effects of this rule on those with low incomes.

The EPA can enhance the analysis of this proposed rule by acknowledging the degree of uncertainty surrounding the health benefits of the regulation. The EPA should construct a more precise emission-reduction benefit measure that includes local variation specific to wood-stove use, such as background particulate levels and population. The EPA should also report the benefits using a hormetic, or J-shaped, dose response curve. In order to generate a more realistic baseline, the EPA should use recent, non-federally regulated emission reduction trends to project future emission improvements that will take place without any new federal regulation. This will provide a smaller, more realistic emissions baseline. The EPA should estimate the net effect of emissions, including the likely net increase in carbon dioxide emissions, that will be produced as households seek to avoid the more expensive new-units by extending the lifespan of wood-fuel units currently in operation and by switching from wood to other fuel sources. Finally, the EPA should include the costs faced by households who rely on wood stoves as an insurance mechanism against power outages and income or job loss.

UNCERTAINTY ABOUT BENEFITS ESTIMATES

While the EPA should be commended for pursuing the laudable goal of a cleaner environment and improvements in public health, there are several reasons to be skeptical of the level of benefits claimed from this regulation.

First, all of the quantified benefits from the regulation are due to reductions in the total particulate matter. However, a growing literature is contributing to doubts about the causal link between ambient particulate matter $(PM)_{2.5}$ levels and increases in mortality.[1] Additionally, the EPA regulates particulate matter under the National Ambient Air Quality Standards (NAAQS), which makes the proposed regulation an indirect, and perhaps impractical, way to achieve the EPA's objectives.

There is a high degree of uncertainty surrounding the EPA's benefits estimates. Although the EPA acknowledges these criticisms, it has not changed the way it evaluates uncertainty.[2] The EPA also acknowledges other sources of uncertainty with regards to its benefits analysis, including these two particularly important points from the list on page 7-13 of the Regulatory Impact Analysis for the rule:

1) The extrapolation of effect estimates is beyond the range of ozone or PM concentrations observed in the source epidemiological study.
2) Direct causal agents within the complex mixture of PM have not been identified.

The EPA states that its estimates go beyond those confirmed in the epidemiological study that is the foundation of the agency's findings. This means the benefits of the regulation are based entirely upon model selection, and not empirical evidence. The EPA assumes a linear dose response down to the origin, resulting in large benefits estimates. Selecting another model, such as a threshold or hormetic dose response at low doses, would produce vastly lower benefits estimates. Recent academic literature has suggested there may

1. For example, see Cox, LA, Jr., "Miscommunicating Risk, Uncertainty, and Causation: Fine Particulate Air Pollution and Mortality Risk as an Example," *Risk Analysis* 2012; 32(5): 765–767 and Fraas, A. and Lutter, R. (2013), *Risk Analysis* 33: 434–449. doi: 10.1111/j.1539-6924.2012.01883.x.
2. EPA, Final Report: Regulatory Impact Analysis (RIA) for Proposed Residential Wood Heaters NSPS Revision, (2014) pp. 7-4 – 7-14.

be reason to believe PM exhibits a hormetic dose response at low doses.[3] Therefore, the linear model used by the EPA results in an overestimation of benefits.

Next, the EPA fails to address whether the concentration of total particulate mass or the composition of those particulates are the cause of the health effects found in the cited studies. In order to provide a causal link, the EPA should determine which components of the particulate matter are the sources of the higher morbidity and mortality rates. For instance, Bell (2011) finds that higher concentrations of PM2.5 Nickel are associated with higher rates of cardiovascular or respiratory hospitalizations.[4]

As Bell, et. al. conclude:

> Because of these limitations, health risks could be associated with the true concentrations of a component or set of components that co-varies with $PM_{2.5}$ total mass, even if measured concentrations in this data set do not co-vary with $PM_{2.5}$ total mass because of measurement error. Further, we did not investigate the possibility that observed $PM_{2.5}$ health effects could result from a set of components with a collective concentration that co-varies with $PM_{2.5}$ total mass, although individual component concentrations do not.[5]

The EPA does acknowledge their assumption that "all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality."[6] But without a clear link between the chemical components of $PM_{2.5}$ that are associated with health effects, the EPA defaults to the assumption that the overall level of $PM_{2.5}$ is the source of health risks, rather than particular components of the total. If the health effects are due to a specific component of the particulate matter rather than the level of particulate matter, a more targeted, lower-cost and potentially higher-benefit air pollution regulation might be warranted. The EPA acknowledges that there is uncertainty in the causal connection between PM and human health outcomes.

Taken together, these points imply that a benefits estimate of zero is within the realm of possibility for benefits resulting from reductions in particulate matter. However, the EPA acknowledges that they "assume that the health impact function for fine particles is log-linear without a threshold in this analysis."[7] Thus, the EPA assumes PM-related health benefits continue all the way down to very low levels. However, econometrician Anthony Cox has shown that there may be a hormetic, or J-shaped, dose response curve for PM at low-dose levels.[8] If true, this implies there may be no negative health effects and potentially even health *benefits* to PM exposure at low-dose levels, rather than the harm the EPA assumes by model selection. Elsewhere, Cox has argued that the causal link between PM and human health benefits has not been adequately demonstrated at low doses.[9] The EPA appears to be pointing to correlations without assessing whether causation is present. Fortunately, there are tests that can be done to demonstrate whether causation is more likely.[10] The EPA would benefit from running these tests with the data it has available and presenting the results to the public.

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3. Cox LA Jr. Hormesis for Fine Particulate Matter (PM2.5). Dose-Response. 2012.
4. Bell, M.L., HEI Health Review Committee. Assessment of the health impacts of particulate matter characteristics. Res Rep Health Eff Inst. 2012 Jan;(161): 5–38. PubMed PMID: 22393584.
5. Michelle L. Bell, Francesca Dominici, Keita Ebisu, Scott L. Zeger, Jonathan M. Samet. Spatial and Temporal Variation in PM2.5 Chemical Composition in the United States for Health Effects Studies. Environ Health Perspect. 2007 July; 115(7): 989–995. Published online 2007 April 20. doi: 10.1289/ehp.9621.
6. RIA, p. 7-13.
7. RIA, p. 7-14.
8. Cox, Hormesis for Fine Particulate Matter.
9. See for example Cox, Miscommunicating Risk, Uncertainty, and Causation.
10. Cox, LA, Jr. Improving Causal Inferences in Risk Analysis. George Washington University Regulatory Studies Center Working Paper, 2012.

Additionally, Lutter and Fraas show in a recent study that uncertainties surrounding benefits estimates from PM reductions may greatly exceed those the EPA acknowledged in previous analyses for PM-related rules.[11] Lutter and Fraas give the EPA the benefit of the doubt, and assume a causal relationship exists between PM and increases in mortality. They go on to demonstrate that benefits estimates vary greatly by modifying assumptions such as the value of reducing mortality risk or whether the toxicity is above or below the average for fine particles.

Other experts in the field of environmental risk assessment have shown similar skepticism about the benefits of PM-related regulations.[12] For example, the number of lives saved may be vastly overstated. The EPA's methodology appears to be at odds with the very standards it applied to its own analyses prior to 2009.[13] Former EPA economist Anne Smith finds that the EPA's assumptions could lead to the conclusion that 25 percent of all deaths in the United States as recently as 1980 were related to concentrations of $PM_{2.5}$, an assumption that is highly unlikely.

The EPA acknowledges that their "all benefit-per-ton estimates have inherent limitations. Specifically, all national-average benefit-per-ton estimates reflect the geographic distribution of the modeled emissions, which may not exactly match the emission reductions in this rulemaking, and they may not reflect local variability in population density, meteorology, exposure, baseline health incidence rates, or other local factors for any specific location."[14] That is, the model is based on current emissions and not predicted emission reductions. By using a national-average benefit-per-ton estimate, the EPA fails to account for the location-specific reductions that may take place as a result of the proposed rule. Moreover, the rule fails to account for background particulate levels when estimating the health effects. For instance, average wood use is twice as great in rural areas than in urban areas. Because rural areas have lower background-particulate levels, the national average benefit from emissions reduction, coupled with the linear-dose assumption, overestimates the per person health benefits proposed by this rule for rural residents. Furthermore, because the composition of rural particulates is different from urban particulates, the health effects are likely to be different than those estimated.[15] Moreover, if most of the emissions reductions will take place in rural areas with low population densities, the rule overestimates total health benefits realized by averaging these reductions across all US residents.

BASELINE ASSUMPTIONS

In the construction of the baseline, the EPA fails to account for consumers' demands for lower-emission and more efficient wood-fueled heating models.

Because much of the emissions (and the potential health and environmental effects) from wood stoves are locally concentrated, citizens using wood stoves are potentially exposed to a large fraction of the emissions from their own wood stove and the wood stoves of their neighbors.

Wood-stove operators are potentially exposed to odors and particulates from their own wood stove.

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11. Fraas, A. and Lutter, R. (2013), Uncertain Benefits Estimates for Reductions in Fine Particle Concentrations. *Risk Analysis*, 33: 434–449. doi: 10.1111/j.1539-6924.2012.01883.x

12. Anne E. Smith (2011). "Prepared Statement of Anne E. Smith, Ph.D. at a Hearing on "Quality Science for Quality Air" by the Subcommittee on Energy and the Environment , Committee on Science, Space, and Technology, United States House of Representatives, Washington, DC, October 4, 2011.

13. Smith, Anne, "An Evaluation of the PM2.5 Health Benefits in Regulatory Impact Analysis for Recent Air Regulations," *NERA Economic Consulting Report*, December 2011.

14. EPA, Final Report: Regulatory Impact Analysis (RIA) for Proposed Residential Wood Heaters NSPS Revision, (2014) pp. 7–8.

15. Rao, V., Frank, N., Rush, A., Dimmick, F. "Chemical Speciation of PM2.5 in Urban and Rural Areas," In *National Air Quality and Emissions Trends Report*, 2003 Special Studies Edition, U.S. Environmental Protection Agency. EPA Publication No. EPA 454/R-03-005.

Unlike many other types of environmental costs, those using wood stoves are potentially much more likely to bear most, if not all, of the costs of emissions. Therefore, potential wood-stove consumers are likely to search for ways to reduce emissions and increase efficiency.[16]

Wood-stove emissions often concentrate within a small geographic area. Given the local concentration, many local governments have strong incentives to regulate wood-stove emissions. They also have a better understanding of when particulate concentrations are too high and a greater motivation to design unique and creative ways to lower emissions.

The rule assumes that wood-stove–type products will not improve in the future without federal regulatory requirements, yet this is the reverse of what we have witnessed in the recent past. First, state and local regulations often require lower emissions than the 1988 EPA standard of 7.5 grams per hour (gr/hr) for noncatalytic wood stoves and 4.1 gr/hr for catalytic stoves. For instance, Washington State requires 4.5 gr/hr for noncatalytic wood stoves and 2.5 gr/hr for catalytic stoves. Moreover, according to the Hearth, Patio & Barbecue Association, approximately 85 percent of stoves sold in the United States meet these Washington State standards, even though the current EPA standard is much less stringent.[17] Some of this is due to state and local regulations for areas that have a large number of stoves and, given the flexibility under the National Clean Air regulations, have sought to improve air standards via reducing emissions through low-cost reduction policies. Another reason for lower emissions than required by law is simply that consumers are independently seeking both improved efficiency and reduced emissions.

An example of market-driven improvements is the invention and growth of pellet stoves. The precursor of pellet stoves was large heaters that used scrap wood and sawdust for fuel. The current miniature pellet stoves were first invented in the 1980s. Though not yet regulated by the EPA, pellet stoves produce much less particulate emission than wood stoves. The average pellet stove emits under 2 grams of particulates an hour while the standard under this proposed rule is 4.5g/hr for wood stoves.[18]

This improvement is due to producers striving to satisfy consumer demand. In 1990, less than 5,000 pellet stoves were sold, yet by 2012 manufacturers shipped just over 48,000 pellet stoves to sell in the United States, or about 30 percent of the US wood-stove market share.[19] Yet all of this innovation in the pellet stove market has taken place without any new federal regulations of wood stoves since 1988. Therefore, it is likely that these emission improvements will continue without any new regulations. By failing to account for these consumer- and producer-based innovations, the EPA's estimated baseline emission estimates are too high, thus exaggerating the rules' net benefits. In order to generate a more realistic baseline, the EPA should use recent trends in nonfederally regulated emissions reductions to project future emission improvements that will take place without any new regulation being implemented. This will provide a smaller, more realistic emissions baseline.

LIFE SPAN, SUBSTITUTABILITY, AND CARBON DIOXIDE

The EPA assumes that the life span of a typical wood stove is twenty years. Yet the EPA acknowledges

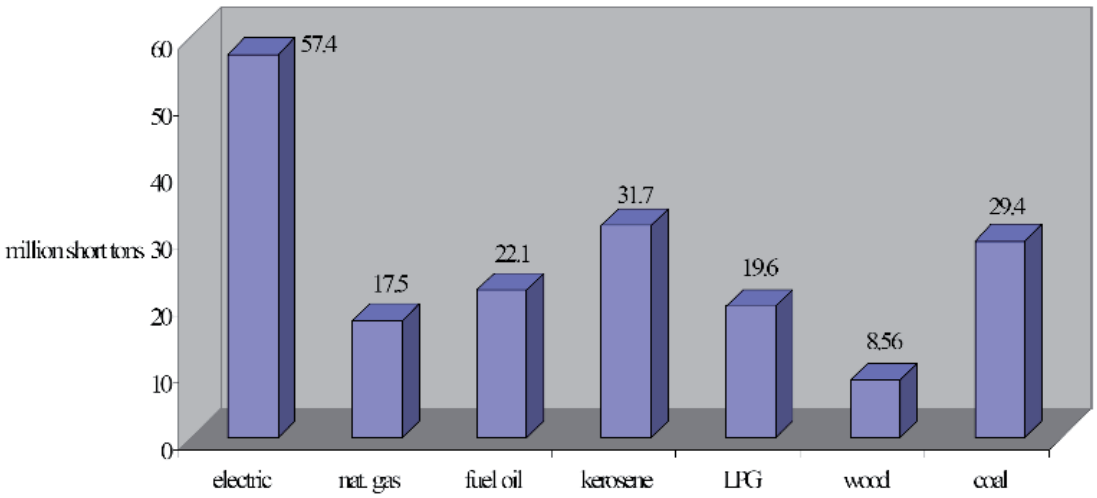
16. In addition, hauling firewood into the house requires a great deal of effort; thus wood operators also have a nonemissions-related incentive to use efficient wood stoves.
17. Responsible Wood Burning Factsheet, Hearth, Patio & Barbecue Association, viewed 3/25/14, http://static.hpba.org/fileadmin/factsheets/product/FS_ResponsibleWoodBurning.pdf
18. Pellet Stoves Make Huge Gains in Market Share, *Biomass Magazine*, viewed 3/25/14, http://biomassmagazine.com/articles/8765/pellet-stoves-make-huge-gains-in-market-share
19. James E. Houck and Paul E. Tiegs (1996). Residential Wood Combustion— PM2.5 Emissions, viewed 3/22/14, www.omni-test.com/publications/westar.pdf

that "most stoves in consumer homes emit for at least 20 years and often much longer."[20] By assuming a shorter operating lifespan than is actually the case, the EPA overestimates the rate of replacement and thus overestimates the benefits of this proposed rule. Furthermore, because newer units will be more expensive, households will likely seek ways to increase the life span of wood stoves that are currently in operation. By not accounting for this behavioral response, the EPA is likely further overestimating the predicted emissions reductions and corresponding health benefits.

Wood-fueled stoves serve as a substitute for oil-, gas-, and coal-based heating sources. The EPA acknowledges this and even notes that the increase in oil and gas prices in 2007 were a partial reason for the increased sales of wood stoves that year. Unfortunately, the EPA fails to use this relationship to estimate the cross-price elasticity to determine how sensitive consumers may be to an increase in the price of wood stoves. Without this estimate, the EPA is unable to determine the net effect of its regulation. That is, the EPA is unable to determine what fraction of households will switch from wood to other fuel sources and, given the switch, the net effect of emissions.[21]

One by-product of heat and energy production is carbon dioxide. Yet there is no discussion of how this rule alters carbon dioxide emissions. Carbon dioxide is emitted and sometimes sequestered throughout the process of procuring energy sources, as well as building, operating, and decommissioning equipment and facilities. Unlike traditional heating fuel, such as oil, gas, and coal, the trees grown for fuel sequester carbon dioxide. As shown in figure 1, using a full lifecycle measure, wood-based fuel produces much less net carbon dioxide emissions than other traditional fuel sources.[22] By not estimating the net additional emissions of carbon that will take place as citizens switch from wood to other fuel sources, the EPA overestimates the net benefit.

Figure 1. Carbon equivalents of greenhouse gases per quad of heat delivered.



Source: US EPA and Air Waste Management Association Conference. Emission Inventory: Living in a Global Environment, v. 1 *(1998): 373–384.*

In view of the EPA's concern over carbon dioxide emissions in other RIAs, the agency should include the social costs of greater carbon emissions as customers switch from wood to other fuel sources. More-

20. EPA, Final Report: Regulatory Impact Analysis (RIA) for Proposed Residential Wood Heaters NSPS Revision, (2014) pp. 4–12.
21. The compositional change of wood based emissions to fossil fuel-based emissions particulates may also affect health.
22. US EPA and Air Waste Management Association Conference. *Emission Inventory: Living in a Global Environment*, v. 1, pp 373–384, 1998.

over, given wood is a substitute for natural gas, electricity, and other heating sources, the EPA should also include a detailed analysis of how the availability of these substitutes might alter the response of consumers and result in more or less overall emissions.

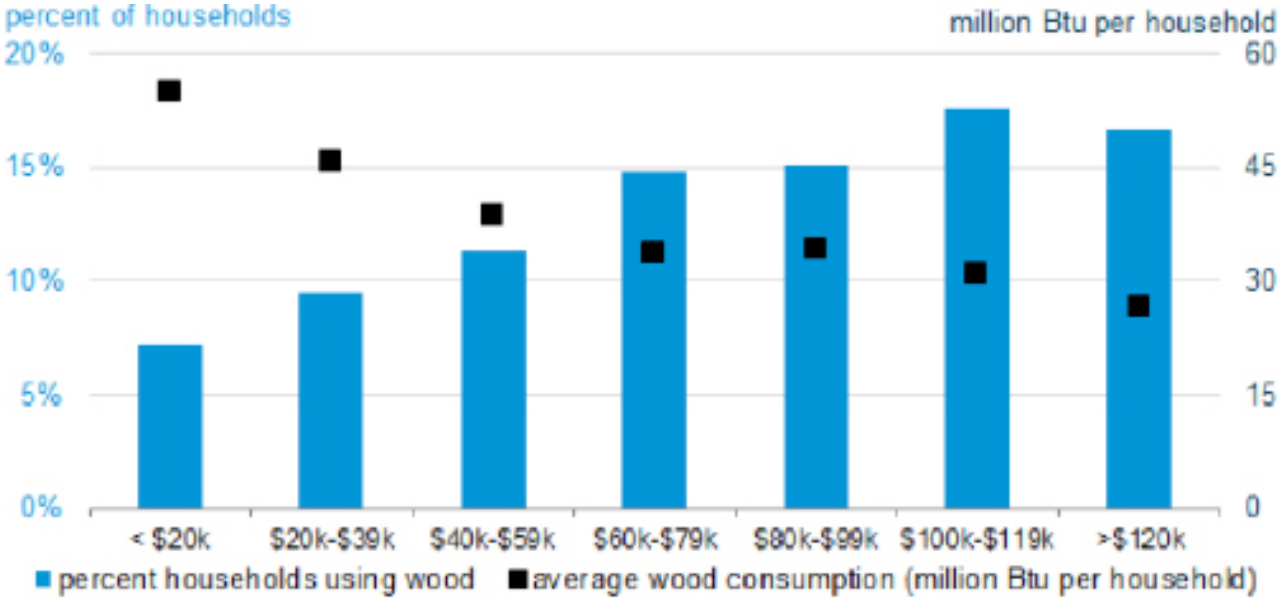
Furthermore, because the 2013 interagency working group that calculated the new social cost of carbon (SCC) did not take comments from the public, the EPA should continue to use the old SCC until such time as the public has had a chance to comment sufficiently on the methodology used in the interagency working group report and the report has been subjected to peer review.[23] If this proposed rule increases net carbon emissions, the net benefit of the proposed rule will be reduced by a smaller amount when using the older and lower SCC.

REGRESSIVE EFFECTS

The EPA estimates that that this regulation will have a minimal impact on the cost of production, yet it is difficult to say exactly how much wood-stove prices may rise as a consequence. Heating costs make up a higher proportion of low-income individuals' income, relative to high-income individuals', and it is worth acknowledging that this regulation may disproportionately burden low-income individuals.

For instance, figure 2 shows that although a greater fraction of high-income households use wood as a fuel for heat, low-income households consume more wood than high-income households.[24]

Figure 2. Wood use by income.



Source: US Energy Information Administration, 2009 Residential Energy Consumption Survey.

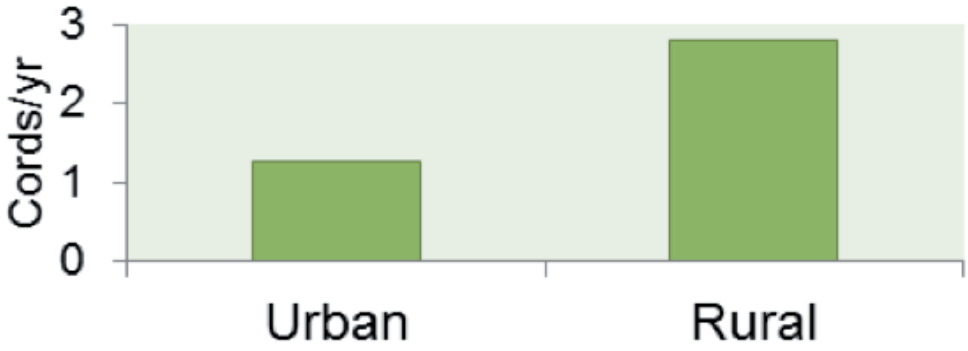
If the price of wood stoves increases greatly, low-income households may simply use fireplaces that result in less heat and greater emissions. Moreover, these low-income households are much more likely to be liv-

23. Interagency Working Group on Social Cost of Carbon, "Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866," (May 2013) and US Department of Energy, Office of Energy Efficiency and Renewable Energy, "Energy Conservation Program for Consumer Products: Landmark Legal Foundation; Petition for Reconsideration," 78 Fed. Reg. 159 (August 16, 2013).

24. US Energy Information Administration, "Increase in Wood as Main Source of Household Heating Most Notable in the Northeast," March 17, 2014, http://www.eia.gov/todayinenergy/detail.cfm?id=15431.

ing in rural areas that have more limited access to other sources of energy and thus, as shown in figure 3, use more wood than urban residents.

Figure 3. US Wood and Pellet Consumption.



Source: US Energy Information Administration, 2009 Residential Energy Consumption Survey. Graph created by Heated Up! *blog, accessed April 10, 2014, http://forgreenheat.blogspot.com/2012/10/us-government-winter-fuels-outlook.html.*

Recent academic research has shown that regulations such as the one proposed are often more in line with the risk preferences of wealthy households.[25] It is unlikely that poor households are worried about the risks posed from $PM_{2.5}$ and CO_2 when they face much larger risks elsewhere in their lives. Moreover, wood stoves often serve as a form of insurance for low-income households in two ways. First, wood stoves are a reliable source of heat and energy when storms result in power outages. Because rural customers are often the last group to have their electricity restored, wood stoves enable these families to heat their houses for the duration. Second, because wood can often be obtain directly, especially for families living in rural areas, low-income households who experience income or job loss are able to produce energy and heat their houses with an alternate source that does not require the same level of cash flow as acquiring heat through a public utility. The income and insurance they would lose in complying with this regulation may be better utilized towards other risk mitigation.

CONCLUSION

The EPA has proposed this regulation as a result of the authority granted it by the Clean Air Act. Given that this regulation is not required by statute, the EPA would be well advised to consider holding off on issuing such a regulation until such time as the benefits are more certain. By using a national-average benefit-per-ton estimate, the EPA fails to reflect the local reductions specific to the proposed rule. Furthermore, the EPA overestimates the net benefits by failing to recognize emission improvements that will continue to take place without any regulatory requirement. The EPA also fails to empirically analyze whether customers may respond to the higher priced wood-fuel units by delaying the replacement of older wood-fueled units and by switching to other fuel sources that produce more CO_2 emissions per unit of energy produced. Additionally, the EPA fails to consider the adverse effects of this rule on low-income American households.

25. Thomas, Diana, "Regressive Effects of Regulation," *Mercatus Working Paper*, Mercatus Center at George Mason University, (November 2012).