Memorandum

TO: Docket for rulemaking: "Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces (EPA-HQ-OAR-2018-0195)"

DATE: November 20, 2018

SUBJECT: Supplemental Regulatory Impact Analysis (RIA) for "Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces" Introduction

1. Introduction

The U.S. Environmental Protection Agency (EPA) promulgated revisions in February 2015 to new source performance standards (NSPS) for residential wood stoves, and promulgated NSPS for other wood heating appliances such as pellet stoves, forced air furnaces, single burn rate stoves, and hydronic heaters. The EPA conducted this rulemaking under the authority of section 111 of the Clean Air Act (CAA), "Standards of Performance for New Stationary Sources," under which the EPA establishes federal standards of performance for new sources within source categories which cause or contribute significantly to air pollution, which may reasonably be anticipated to endanger public health or welfare. The 2015 NSPS broadened the applicability of the wood heaters regulation beyond adjustable burn rate heaters (i.e., "stoves", the focus of the original regulation) to specifically include single burn rate heaters, pellet stoves, hydronic heaters, and forced-air furnaces. Heaters/stoves and model lines manufactured after the compliance dates would be required to meet fine particulate matter ($PM_{2.5}$) standards. Since that action was economically significant according to Executive Order 12866 (i.e., either costs or benefits of $100 million or greater in any one year), the EPA prepared a regulatory impact analysis (RIA) of the potential costs and benefits associated with the 2015 NSPS, "Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces," (80 FR 13671). The March 2015 NSPS RIA is available at Docket ID No. EPA-HQ-OAR-2009-0734. EPA now proposes to allow an additional two years for sell-through of certain wood heaters – new residential hydronic heaters and forced-air furnaces, or central heaters, as defined in subpart QQQQ of this NSPS - beyond the compliance date of May 15, 2020 for Step 2 requirements contained within the 2015 NSPS. A sell-through is an allowance to manufacturers and retailers to sell for some period of time non-Step 2-compliant wood heaters past the compliance date of May 15, 2020. In addition, the proposal includes a request for comment on allowing an additional two years for sell-through of new wood stoves covered by the 2015 NSPS (sources covered under subpart AAA). Analysis and results for wood stoves is included in Appendix A of this supplemental RIA. The Agency also seeks comment on whether and what type of small business relief may be appropriate in place of the extended sell-through period.

Wood heater manufacturers and retailers informed the EPA in early 2018 that a substantial number of retailers are already reducing or even ending their purchases of Step 1 certified wood heating devices from manufacturers. The retailers are concerned they will not be able to sell these devices before the May 2020 Step 2 compliance date and will be left with unsaleable inventory. The Step 1 requirements became effective on May 15, 2015 and are emissions limits that reflect demonstrated wood heater technologies at that time. Step 2 requirements are more stringent emissions limits that manufacturers were expected to achieve by the May 15, 2020 compliance date. Meanwhile, as stated in the proposed

preamble and in the public docket for this rulemaking, manufacturers may need until May 2020 to develop, test, and certify wood heating devices to meet the 2020 Step 2 standards. Thus, some manufacturers may potentially face revenue losses in the near term to the extent that retailers are not willing to purchase the manufacturers' Step 1-certified models and the manufacturer does not yet have Step 2-certified models to sell. Further, as May 2020 approaches, it is reasonable to assume that retailers may become increasingly reluctant to purchase non-Step 2-compliant wood heating devices which they will not be able to sell after May 2020, resulting in stranded capital. EPA is aware that there are a small number of Step 2 certified models currently available to purchase. However, the price difference between the Step 2 models and Step 1 models may dampen demand for these heaters.

To address these issues, EPA is proposing to amend the 2015 NSPS, 40 CFR part 60, subpart QQQQ requirements to create a two-year sell-through period for Step 2 that is comparable to the Step 1 sell-through period. EPA is proposing an amendment that will allow Step 1-compliant hydronic heaters and forced-air furnaces manufactured or imported before May 15, 2020, to be sold at retail through May 15, 2022. Under this proposal, after May 15, 2022, only Step 2-compliant hydronic heaters and forced-air furnaces can be sold at retail.

EPA is seeking comment on this two-year sell-through period for Step 2, including both the need for a Step 2 sell-through period and, if a sell-through period is added, what length of sell-through period is reasonable, and why. EPA is also seeking comment on whether and what type of small business relief might accomplish the same goal. Further details on the proposal can be found in the proposal preamble.

This memorandum presents EPA's estimates of the cost savings and forgone health benefits that may result from the proposed additional two-year sell-through of residential hydronic heaters and forced-air furnaces.[1] This memorandum is a supplement to the RIA prepared for the 2015 NSPS; it does not replace the 2015 NSPS RIA but analyzes a proposed action that affects only a portion of the 2015 NSPS. The cost and emissions data from the 2015 NSPS RIA are used in this supplemental RIA. The baseline for this RIA is the 2015 NSPS, since the requirements of this standard remain in effect as of this proposal. In addition, this memorandum recognizes that consumers, in the absence of this rule, may behave largely in one of two ways. Because these heaters are durable goods, they may delay their purchase of new wood heaters if their existing wood heaters are still working, even if near the end of the replacement cycle. In the other extreme, despite the price difference, consumers may purchase Step-2 wood heaters because their existing heaters are not functioning. We do not contemplate in this analysis consumers switching to heaters that use other fuel types such as natural gas. We seek comment on the likely consumer response to the regulatory proposals and the market conditions driving them.

In addition, EPA is using a different method to calculate the estimates of forgone emission reduction for this analysis. We are presenting information on truncated emission reduction, instead of more typical annualized emission reduction estimates. For the final rule, the agency will provide annualized emission reduction estimates.

[1] To help commenters understand the estimated effects of an additional two-year sell through of new wood stoves, the cost savings, forgone emissions reductions and health benefits associated with including new wood stoves in this proposed sell through are included as an appendix.

Within the RIA, impacts will be estimated for appliances (or units, these terms are interchangeable in this RIA) covered under subpart QQQQ under three scenarios:

1. Hydronic heaters and forced-air furnace manufacturers covered under this proposal produce no additional appliances beyond the production estimates in the 2015 NSPS RIA and have no stranded Step 1-compliant models;
2. Manufacturers produce hydronic heaters and forced-air furnaces in the same quantities estimated for the 2015 NSPS RIA. However, non-Step 2-compliant hydronic heaters and forced-air furnaces, that would otherwise have been stranded, will now be available for sale for two years beyond the May 15, 2020 compliance date; and
3. Manufacturers take advantage of the additional two years of sales of non-Step 2-compliant hydronic heaters and forced-air furnaces by increasing production of these appliances. Newly produced non-Step 2 appliances will be available for sale in addition to those that would have otherwise been stranded.

These scenarios reflect the uncertainty within the data available to EPA in the proportion of appliances affected by this proposal that could comply with the Step 2 requirements in the 2015 NSPS by May 15, 2020. The scenarios also reflect the uncertainty in the reaction of manufacturers and retailers to this proposal. These same three scenarios will also be applied to residential wood stoves in this supplemental RIA; these impacts will be presented separately in Appendix A.

For scenario 1, it is assumed that manufacturers do not produce additional wood heaters beyond those projected in the 2015 NSPS RIA, and further, that they are able to sell all step 1-compliant appliances in advance of the 2020 compliance date. Therefore, there are no cost savings and no forgone emission reductions. As part of the rationale for this scenario, manufacturers are presumed to act with perfect foresight and consistent with the modeling of wood heater production estimates included in the 2015 NSPS RIA.

For scenario 2, units that are non-Step 2-compliant are assumed to be available for sale in 2021 and 2022. This scenario assumes that manufacturers produced more units than were needed for purchase by retailers prior to the sell-through. Hence, impacts of this proposal will occur beyond the 2015 NSPS compliance date. Retailers will receive additional revenues from the sale of non-Step 2-compliant units, and forgone emission reductions will occur not only during the sell through period, but over the life of the non-Step 2-compliant units.

For scenario 3, manufacturers affected by this proposal are assumed to produce additional non-Step 2-compliant units beyond those projected in the 2015 NSPS RIA in anticipation of the sell through period. Cost savings are experienced by manufacturers since the cost of producing non-Step 2-compliant models is estimated to be lower than that of Step 2-compliant models, and, as in scenario 2, manufacturers are able to sell units that would otherwise have been non-saleable after the compliance date for the 2015 NSPS. As in scenario 2, forgone emission reductions would be experienced during the sell through period and over the expected life of the non-Step 2-compliant units. As part of the rationale for this scenario, manufacturers are assumed to increase production in anticipation of the additional 2-year sell-through and retailers are assumed to be willing to carry and sell these units. Under this scenario, impacts begin in 2019 since manufacturers increase production prior to 2020.

To provide background to the estimation of cost savings and forgone emission reductions, we show in Table 1 the number of appliances projected to be sold (or shipments) from 2019-2022 according to the analyses done for the final 2015 NSPS. The number of wood stoves projected to be sold in those years can be found in Table A-1 in Appendix A. These projections of appliance shipments are the basis for the analyses of impacts under the three scenarios.

Table 1. Projected Appliance Sales from 2019-2022 for Hydronic Heaters and Forced Air Furnaces*

	2019	2020	2021	2022
Forced-Air Furnaces	30,058	30,659	31,272	31,898
Hydronic Heaters	15,048	15,349	15,656	15,969

*All estimates from the RIA for Residential Wood Heaters NSPS Revision. February 2015. Chapter 4, and U.S. Environmental Protection Agency (U.S. EPA), 2015. "Estimated Emissions from Residential Wood Heaters." January 30, 2015. Prepared by EC/R. p. 11.

Impacts presented in section 2 of this supplemental RIA include the estimated increase in revenues (hereafter called the "cost savings" for this proposal) to manufacturers that produce appliances affected by this sell-through and retailers of these appliances. The estimated forgone $PM_{2.5}$ emission reductions associated with this proposal, truncated at the close of the sell through period and covering years 2019-2022 are presented in section 3. Forgone emission reductions of volatile organic compounds (VOC) and carbon monoxide (CO) are also estimated for the years 2019-2022, but any forgone health and environmental impacts associated with these forgone emission reductions are not quantified or monetized due to lack of data, resources, and methodological limitations. Other impacts, such as for employment, energy, and small businesses, are in section 4. The estimated monetized forgone benefits associated with the truncated forgone $PM_{2.5}$ emission reductions are discussed in section 5. Finally, an assessment of net benefits (the cost savings minus the forgone monetized benefits) is presented in section 6. All estimates are presented in 2016 dollars and are relative to the baseline, which is the 2015 NSPS. Estimates are for 2019-2022 for scenario 2 and 3, though there are no impacts in 2019 under scenario 2. All cost savings and forgone monetized benefits covering years 2019-2022 only are presented in annual and present value (PV) terms. Scenario 2 is treated as the primary, or most representative, scenario analyzed in this RIA.

2. Cost Savings

For this analysis, EPA assumes the Step 2 levels of compliance through 2020 that are consistent with the 2015 NSPS RIA.[2] Because the compliance date for the 2015 NSPS is not changed by this proposal, all model development costs prior to 2020 are unaffected by this proposal. The cost savings estimated in this proposal are the increase in revenues to manufacturers and retailers from selling appliances covered under subpart QQQQ that are compliant with Step 1 (but not Step 2) two years beyond the May 15, 2020 compliance date.

[2] U.S. Environmental Protection Agency. Regulatory Impact Analysis for Residential Wood Heaters NSPS Revision. EPA-452/R-15-001. February 2015. p. 4-14. Available at https://www3.epa.gov/ttn/ecas/docs/ria/wood-heaters_ria_final-nsps-revision_2015-02.pdf.

The cost savings estimates for each scenario are based on the expected number of wood heaters produced that are Step 1-compliant in 2019. For each scenario, we estimate that 85 percent of the wood heaters produced to meet projected sales in 2019 are Step 1-compliant. This estimate of Step 1 compliance (and, therefore, non-Step 2 compliance) is consistent with wood heater model data taken as of summer 2018 from EPA's lists of certified wood stoves, certified hydronic heaters, and certified forced-air furnaces.[3] We also estimate that 20 percent of these Step 1-compliant units will not be sold until the sell-through period begins on May 15, 2020. For 2020, all wood heaters produced are expected to be Step 2-compliant, and therefore no Step 1-compliant wood heaters will be produced after 2019. We then project the sales of Step 1-compliant wood heaters for years 2020 through 2022.

For scenario 3, in addition to the leftover units sold under scenario 2, we estimate that manufacturers increase production of Step 1-compliant wood heaters by 10% in 2019 over projections reported in the 2015 NSPS RIA. The impacts associated with scenario 3 will be greater than those estimated for scenario 2 since a larger number of Step 1-compliant units are expected to be sold during the sell through extension.

The estimates of affected wood heaters under scenarios 2 and 3 are found in Tables 2 and 3, respectively. As shown in Table 2, we estimate that 5,110 forced air furnaces and 2,558 hydronic heaters that are Step 1-compliant would be sold during the two-year sell through period under scenario 2. Table 3 shows that 7,665 (5,110 + 2,555) forced air furnaces and 3,837 (2,558 + 1,279) hydronic heaters that are Step 1-compliant would be sold during the two-year sell through period under scenario 3. In recognition of the diminishing stock of Step 1-compliant units over the sell through period as well as the potential for variation in demand for Step 1-compliant units, especially lower demand as the end of the sell through period approaches, we estimate that 70 percent of the Step 1-compliant units will be sold in 2020, 25 percent in 2021, and 5 percent in 2022.

These calculations are also available for wood stoves, and can be found in Table A-2 in Appendix A.

Table 2. Estimated Appliance Sales from 2019-2022 for Hydronic Heaters and Forced Air Furnaces Under Scenario 2 *

	2019	2020	2021	2022
Forced Air Furnaces	30,058	30,659	31,272	31,898
Step 1	20,439	3,577	1,278	256
Step 1- Stranded units not sold in 2019**	5,110	--	--	--
Step 2	4,509	27,082	29,994	31,642
Hydronic Heaters	15,048	15,349	15,656	15,969
Step 1	10,233	1,791	640	128
Step 1 – Stranded units not sold in 2019**	2,558	--	--	--
Step 2	2,257	13,558	15,016	15841

*All estimates taken from or based on the RIA for Residential Wood Heaters NSPS Revision. February 2015. Chapter 4, and U.S. Environmental Protection Agency (U.S. EPA), 2015. "Estimated Emissions from Residential

[3] U.S Environmental Protection Agency. List of EPA Certified Wood Stoves, List of EPA Certified Hydronic Heaters, and List of Certified Forced-Air Furnaces. Retrieved in June 2018 from https://epa.gov/compliance/list-epa-certified-wood-stoves, https://epa.gov/compliance/list-epa-certified-hydronic-heaters and http://epa.gov/compliance/list-epa-certified-forced-air-furnaces.

Wood Heaters." January 30, 2015. Prepared by EC/R. p. 11.
** Estimates are for appliances produced in 2019 but not sold until the sell-through period begins.

Table 3. Estimated Appliance Sales from 2019-2022 for Hydronic Heaters and Forced Air Furnaces Under Scenario 3*

	2019	2020	2021	2022
Forced Air Furnaces	30,058	30,659	31,272	31,898
Step 1	20,439	5,366	1,916	383
Step 1 – Produced but not sold in 2019**	5,110	--	--	--
Step 1 – Additional units produced for sell through	2,555	--	--	--
Step 2	4,509	25,293	29,356	31,515
Hydronic Heaters	15,048	15,349	15,656	15,969
Step 1	10,233	2,686	959	192
Step 1 -- Produced but not sold in 2019**	2,558	--	--	--
Step 1 – Additional units produced for sell through	1,279	--	--	--
Step 2	2,257	12,663	14,697	15,777

*All estimates taken from or based on the RIA for Residential Wood Heaters NSPS Revision. February 2015. Chapter 4, and U.S. Environmental Protection Agency (U.S. EPA), 2015. "Estimated Emissions from Residential Wood Heaters." January 30, 2015. Prepared by EC/R. p. 11. Estimates for 2019 reflect a 10% increase in production of Step 1-compliant heaters only based on sales projections from the 2015 NSPS RIA and an 85% compliance rate pre-2020.
** Estimates are for appliances produced in 2019 but not sold until the sell-through period begins.

The cost savings are estimated by assuming that the increase in revenue for each covered appliance during the two years of additional sell-through can be approximated by the avoided manufacturing cost associated with producing Step 2-compliant units. For scenario 2, in the absence of the proposal, manufacturers would be required to manufacture Step 2-compliant models to meet demand in 2020 and beyond. We assume under this scenario that total sales as projected in the 2015 NSPS RIA for these wood heater appliance categories will not change. Under the proposal, manufacturers are able to sell left over, Step 1-compliant wood heaters, displacing the sale of (and need to manufacture) a portion of the Step 2-compliant units. The per unit cost savings, under scenario 2, is therefore the total manufacturing cost of the displaced Step 2-compliant appliance (additional manufacturing cost + the base manufacturing cost), or $2,674 per forced-air furnace and $8,123 per hydronic heaters as shown in the unit cost memo prepared for the 2015 NSPS.[4] The other costs of manufacture such as research and development (R&D) are sunk and still required by the NSPS, and thus are not included in the cost savings estimate for this scenario.

Scenario 3 builds on scenario 2 in that, in addition to the stock of left-over step 1 units, manufacturers choose to make additional Step 1-compliant units, increasing production of these appliances by 10% in 2019, in anticipation of the 2-year sell-through extension. The per unit cost savings for the newly manufactured additional units are the incremental manufacturing costs associated with Step 2 appliance production, $1,700 per forced air furnace and $3,200 per hydronic heater, since manufacturers are choosing to produce additional Step 1-compliant units in 2019 in lieu of producing Step 2-compliant

[4] U.S. Environmental Protection Agency (U.S. EPA), 2015. "Unit Cost Estimates of Residential Wood Heating Appliances." January 30, 2015. Prepared by EC/R. p. 5.

appliances in 2020. The cost savings for the leftover Step 1-compliant models under this scenario are as reported under scenario 2 ($2,674 per forced air furnace and $8,123 per hydronic heater). As before, the R&D costs for developing the Step 2-compliant models are still required by the NSPS and are not affected by this proposal.

These appliance costs are then applied to the estimated number of Step 1 appliances that will be affected under each scenario using the estimates of appliances shipped annually for each category as found in Chapter 4 of the 2015 NSPS RIA and other calculations under scenarios 2 and 3 as shown earlier. Thus, the cost savings reflect the estimates derived in Tables 2 and 3, respectively, of the number of Step 1-compliant units that would be sold during the sell-through period. Finally, all the cost savings estimates are escalated to 2016 dollars from the original 2013 dollars to conform to Executive Order 13771 requirements by using the annual Gross Domestic Product (GDP) implicit price deflator.[5] Estimates of increased revenues to manufacturers and retailers are calculated for each year of the additional two-year sell-through. These total estimated cost savings for forced air furnaces and hydronic heaters under scenarios 2 and 3 are presented in Table 4 below. (Estimates for wood stoves are presented in the Appendix (Table A-2).)

Table 4. Estimated Cost Savings of the Proposal (2016$, millions)

		2019	2020	2021	2022
Scenario 1	Forced Air Furnaces	0	0	0	0
	Hydronic Heaters	0	0	0	0
	Annual Totals	0	0	0	0
Scenario 2 (primary)	Forced Air Furnaces	0	$7.2	$3.7	$0.7
	Hydronic Heaters	0	15.1	5.6	1.0
	Annual Totals	**0**	**22.3**	**9.3**	**1.7**
Scenario 3	Forced Air Furnaces	0	$10.5	$4.8	$0.9
	Hydronic Heaters	0	18.1	6.7	1.2
	Annual Totals	**0**	**$28.6**	**$11.5**	**$2.1**

To be consistent with the presentation of impacts in the 2015 NSPS RIA, we calculate the annual average of the cost savings over the period 2019-2022. For the primary scenario, this annual average is $8.3 million (2016 dollars). For scenario 3, the annual average is $10.6 million (2016 dollars). For wood stoves only, the annual average cost savings is $5.7 million for both scenarios 2 and 3. The cost savings for wood stoves is the same for each scenario because there is no difference in production costs between the Step 1 and Step 2-compliant models as stated in the unit cost memo. Thus, manufacturers only incur a cost savings for the sale of the leftover models as determined in scenario 2. Documentation for these calculations can be found in Appendix B for this supplemental RIA and in the spreadsheet that provides the estimates of forgone net benefits (including cost savings and forgone benefits) for this proposed rule.

Since this proposal is economically significant under Executive Order 12866, and this action is subject to Executive Order 13771, we provide estimates of the cost savings in present value (PV) terms for the

[5] For more information on the GDP implicit price deflator, see https://fred.stlouisfed.org/series/A191RD3A086NBEA. The 2016 annual GDP implicit price deflator is 1.04107 higher than the 2013 value (110.221/105.873). Accessed on November 5, 2018.

primary scenario. As can be seen in Table 5, the estimated total PV of the cost savings is $25 million (7% discount rate) and $29 million (3% discount rate). The equivalent annualized value (EAV) of the cost savings are $9 million (7% discount rate) and $10 million per year (3% discount rate). Present values are for 2016, and EAVs are consistent with the PVs. All estimates are in 2016 dollars. These estimates are presented in the spreadsheet that provides the estimates of forgone net benefits (including cost savings and forgone benefits) for this proposal.[6]

Table 5. Present Value of the Cost Savings for the Proposed Primary Scenario 2, discounted to 2016 (2016$, millions)

	7% Discount Rate	3% Discount Rate
2019	0	0
2020	21	22
2021	8	9
2022	1	2
Present Value in 2016	25	29
Equivalent Annualized Value	9	10

3. Forgone Emission Reductions

In this section, we present estimates of the forgone emissions reductions associated with each of the three scenarios. The estimated forgone emission reductions (as well as estimates of forgone benefits) are made under the assumptions discussed in section 1. The estimates do not account for any changes in baseline conditions since the analysis for the 2015 NSPS was conducted (e.g., technological change or other factors affecting compliance with the 2015 NSPS) nor do they account for any foregone trailing emissions reductions beyond 2022 that are associated with the installation of cleaner appliances in the years of the analysis. This includes the emissions factors estimated for Step 1 and Step 2 for each wood heater category included in this analysis, which are the same emissions factors included in the 2015 NSPS RIA.

Estimating the forgone emission reductions closely follows the procedure laid out above for estimating the increases in revenues to manufacturers and retailers. This is because the annual growth assumption and other necessary adjustments to the emissions from the 2015 NSPS RIA are similar. The one major difference in our procedure is to apply the estimated percent of emission reductions that will take place beginning in May 2022. This estimate will include the percent emission reductions applied for each appliance category in 2020 (when the Step 2 2015 NSPS requirements become effective) but adjusted to account for the increase in shipments and emissions between 2019 and 2022. The percent reduction in emissions is derived from emissions data for each pollutant presented in Chapter 4 of the 2015 NSPS RIA.

The forgone emission reductions occur as a result of the Step 1-compliant hydronic heaters and forced-air furnaces that are estimated to be stranded in 2020 under scenarios 2 and 3. These appliances are then available for sale during the two-year sell through period. The additional emissions generated by

[6] PV_EAVs-forgonebenefits+costsavings_RWHproposalfinal.xls. Available in the public docket for this proposal.

these appliances as compared to Step 2 appliances are calculated using the procedure described above. These emissions now occur later than projected under the emission analyses done for the 2015 NSPS RIA and continue through the life of the Step 1-compliant appliance. The forgone $PM_{2.5}$ emission reductions, truncated at the close of the sell through period, serve as an input to the calculation of forgone benefits, which are accounted for in Section 5.

Table 6 presents annual forgone $PM_{2.5}$ emission reductions, truncated at year 2022, for each scenario. (The forgone emission reductions for VOC and CO, also truncated, are presented in Table 5 and the truncated forgone emission reductions of each pollutant for each scenario for wood stoves are presented in Table A-5.)

Table 6. Estimated Annual Forgone $PM_{2.5}$ Emission Reductions(tons)[7]

		2019	2020	2021	2022
Scenario 1	Forced Air Furnaces	0	0	0	0
	Hydronic Heaters	0	0	0	0
	Annual Totals	0	0	0	0
Scenario 2 (primary)	Forced Air Furnaces	0	214	290	305
	Hydronic Heaters	0	57	78	82
	Annual Totals	**0**	**271**	**368**	**387**
Scenario 3	Forced Air Furnaces	0	320	434	458
	Hydronic Heaters	0	86	118	124
	Annual Totals	**0**	**406**	**552**	**582**

Note: Estimates do not reflect foregone emissions reductions beyond 2022.

For purposes of this supplemental RIA, and to be consistent with the presentation of impacts in the 2015 NSPS RIA, we calculate the annual average of the forgone emission reductions over the period of the additional sell-through.[8] These estimates are provided in Table 7. (Similar estimates are provided for wood stoves in Table A-6.) For Scenario 2 (the primary or proposal scenario), the annual average estimate of forgone emission reductions for the years 2019 to 2022 for $PM_{2.5}$ is 257 tons. This annual average forgone emission reduction estimate is about 2% of the average annual estimate of $PM_{2.5}$ emission reductions expected from the 2015 NSPS for the years 2019 to 2022 (12,638 tons).[9] We use this forgone emission reduction estimate as an input to the monetized benefits analysis presented in section 5. The procedure for estimating forgone emission reductions is found in Appendix B of this

[7] We note that the annual forgone emissions of $PM_{2.5}$ are 387 tons for Scenario 2 and would be 7,740 tons over the 20-year model life typical of hydronic heaters and forced-air furnaces. For Scenario 3, these estimates are 582 tons and 11,640 tons, respectively.

[8] The costs and benefits in the 2015 NSPS RIA were calculated as the annual average of impacts from 2015 to 2020 (inclusive). This presentation of impacts allowed for inclusion of impacts in the first year of implementation of Step 1 emissions limits (2015) and the first year of implementation of Step 2 emissions limits (2020). For more information on how impacts are presented in that RIA, refer to p. 1-3 of the 2015 NSPS RIA.

[9] Memo to David Cole, U.S. EPA, Gil Wood, U.S. EPA, and Amanda Aldridge, U.S. EPA from Ec/R, Inc. Residential Wood Heaters Cost Effectiveness Analysis. January 30, 2015. Calculated from data on p. A-24 of this memo.

supplemental RIA and in the cost and emissions spreadsheet for this proposal. The annual average of forgone $PM_{2.5}$ emission reductions for scenario 3 can also be found in Table 7, and so can the annual averages of forgone VOC and CO emission reductions for each scenario. More details on the annual forgone VOC and CO emission reductions can be found in Tables A-4 and A-5, respectively, in Appendix A.

Table 7. Annual Average of Forgone Emission Reductions from Hydronic Heaters and Forced-Air Furnaces at Each Scenario for Each Pollutant for the 2019-2022 Period (tons)

	$PM_{2.5}$	VOC	CO
Scenario 1	0	0	0
Scenario 2 (primary)	257	271	1,444
Scenario 3	385	551	2,162

Note: Values reported are not annualized and do not reflect foregone emissions reductions beyond 2022. .

4. Other Impacts

Energy and Employment Impacts

These proposed actions are anticipated to have negligible impacts on energy costs or usage. To the extent that Step 1-compliant hydronic heaters and forced-air furnaces continue to be sold for an additional two years, it is difficult to determine the precise energy impacts that might result from this proposed action. Wood-fueled appliances compete with other biomass forms for residential heating as well as more traditional energy sources such as oil, electricity and natural gas. There is also a lack of data to determine the potential for affected consumers to choose other types of fuels and their associated appliances, nor the potential impacts to employment by affected manufacturers. Employment may increase among affected manufacturers because of being allowed to continue sell-through of wood burning appliances for additional two years. For a complete discussion of employment impacts, see the 2015 NSPS RIA.

Small Entity Impacts

We prepared a small entity impacts analysis for the final 2015 NSPS that is included in the 2015 NSPS RIA. As part of that analysis, a profile of the industries subject to the 2015 NSPS indicated that a great majority (more than 90%) of affected firms were small businesses as defined by the Small Business Administration (SBA).[10] Industries that manufacture hydronic heaters and forced air furnaces will not be adversely impacted by this proposal. The small businesses in these industries will experience a net positive impact. We believe that the estimate of the percentage of firms affected by this proposal that are small is about the same as that for the 2015 NSPS. EPA guidance for implementing SBREFA (Small Business Regulatory Enforcement Fairness Act) indicates that no small business analysis is required as part of a rulemaking since affected small businesses will experience a positive net economic effect, though EPA has the discretion to prepare one in such an instance.[11]

[10] U.S. Environmental Protection Agency. Regulatory Impact Analysis for Residential Wood Heaters NSPS Revision. EPA-452/R-15-001. February 2015. p. 6-13. Available at https://www3.epa.gov/ttn/ecas/docs/ria/wood-heaters_ria_final-nsps-revision_2015-02.pdf.

[11] U.S. Environmental Protection Agency. Final Guidance EPA Rulewriters: Regulatory Flexibility Act as Amended by the Small Business and Regulatory Enforcement Fairness Act. November 2006. p. 13,

5. Forgone Benefits

We quantify the value of the forgone $PM_{2.5}$ emission reductions using an approach that is methodologically identical to one we employed in the 2015 analysis. For Scenario 2, using the truncated foregone emissions reported above, we estimate the yearly average total forgone monetized benefits for this proposal to be $100 million to $230 million at a 3% discount rate and $94 million to $210 million at a 7% discount rate for the period from 2019 to 2022. For scenario 3, we estimate $160 million to $350 million at a 3% discount rate and $140 million to $320 million at a 7% discount rate for the period from 2019 to 2022. All estimates reported in 2016$ (Table 8). Estimated values for wood stoves may be found in Table A-6. These estimated benefits reflect the monetized value of the reduction in incidence of morbidity and premature death projected under the 2015 NSPS that might no longer occur if this proposal is finalized as proposed. Data, resources, and methodological limitations prevented EPA from monetizing the forgone benefits from several important benefit categories. In the interest of brevity and consistency with the 2015 NSPS RIA, we refer readers interested in learning more about the methods employed to quantify the number and economic value of the PM-related impacts to the 2015 NSPS RIA (EPA, 2015).

Included among the non-monetized forgone benefits are those associated with reduced exposure to about 271 tons per year of VOCs. VOCs are also precursors to ozone formation, and therefore also associated with reducing health impacts due to ozone exposure. Further, this proposal is estimated to result in forgone reduction of 1,444 tons of CO each year, as well as benefits from pollutants whose emissions changes we did not quantify, such as black carbon emissions and several HAP emissions like benzene, formaldehyde, and dioxin. This proposal is also estimated to result in forgone reductions of ecosystem effects as well as visibility impairment attributable to the forgone PM emission reductions. Further, consistent with the analysis conducted for the 2015 NSPS RIA, the analysis presented here does not reflect the trailing emissions (those occurring beyond 2022) from appliances installed during the sell through period.

Table 8. Summary of Annual Average Monetized $PM_{2.5}$-Related Health Forgone Benefits Estimates for the New Residential Wood Heaters, New Residential Hydronic Heaters, and Forced-Air Furnaces NSPS Proposal, 2019-2022 (2016$)[a, b]

	Emissions Changes (tons)	Benefit per ton (Krewski, 3%)	Benefit per ton (Lepeule, 3%)	Benefit per ton (Krewski, 7%)	Benefit per ton (Lepeule, 7%)
Scenario 1	0	$400,000	$910,000	$360,000	$820,000
Scenario 2	257				
Scenario 3	385				

	Total Monetized Forgone Benefits (millions $2016 at 3%)			Total Monetized Forgone Benefits (millions $2016 at 7%)		
Scenario 1	0	to	0	0	to	0
Scenario 2	$100	to	$230	$94	to	$210
Scenario 3	$160	to	$350	$140	to	$320

Footnote 14. Available at https://www.epa.gov/sites/production/files/2015-06/documents/guidance-regflexact.pdf.

[a] All monetized forgone benefits are annual average estimates that reflect the average of annual forgone emission reductions expected to occur between 2019 and 2022 (inclusive) resulting from rulemaking implementation. All estimates are rounded to two significant figures so numbers may not sum across columns. The forgone monetized benefits do not account for effects from exposure to NO_2 or ozone, ecosystem effects, or impaired visibility, or trailing foregone emissions beyond 2022 for appliances installed during the sell through period. All fine particles are assumed to have equivalent health effects regardless of chemical composition, but the benefit per ton estimates vary depending on the location and magnitude of their impact on $PM_{2.5}$ levels, which in turn affect the number of individuals exposed. The forgone monetized benefits incorporate the conversion from precursor emissions to ambient fine particles. The benefit per ton method prevents us from reporting confidence intervals.

[b] Estimates of forgone VOC and CO health benefits are currently not monetized and are addressed only qualitatively.

The forgone benefits estimates presented in Table 8 are based on average annual estimates of forgone emission reductions realized between 2019 and 2022. Tables 9 and 10 present the PV of these forgone benefits and their equivalent annualized values for scenarios 2 and 3.

Table 9. Present Value of the Forgone Benefits of Scenario 2 discounted to 2016 (2016$, millions)*

	7% Discount Rate	3% Discount Rate
2019	$0 to $0	$0 to $0
2020	$90 to $210	$110 to $240
2021	$120 to $260	$140 to $320
2022	$120 to $260	$140 to $320
Present Value in 2016	$250 to $560	$350 to $780
Equivalent Annualized Value	$70 to $160	$90 to $210

*There are no forgone emission reductions in 2019 from Scenario 2, thus there are no forgone benefits for that year. Values presented do not reflect foregone benefits associated with trailing foregone emissions beyond 2022.

Table 10. Present Value of the Forgone Benefits of Scenario 3, discounted to 2016 (2016$, millions)*

	7% Discount Rate	3% Discount Rate
2019	$0 to $0	$0 to $0
2020	$100 to $230	$120 to $260
2021	$130 to $290	$150 to $350
2022	$130 to $290	$160 to $360
Present Value in 2016	$270 to $610	$380 to $860
Equivalent Annualized Value	$80 to $180	$100 to $230

*There are no forgone emission reductions in 2019 from Scenario 2, thus there are no forgone benefits for that year. Values presented do not reflect foregone benefits associated with trailing foregone emissions beyond 2022.

Characterization of Uncertainty in the Monetized Forgone $PM_{2.5}$ Benefits

A complex analysis such as this one includes many data sources as inputs, including emission inventories, air quality data from models (with their associated parameters and inputs), population data, population estimates, health effect estimates from epidemiology studies, economic data for monetizing benefits, and assumptions regarding the future state of the world (i.e., regulations, technology, and human behavior). Each input parameter is subject to uncertainty, which in turn affect the estimated forgone benefits estimate. When the uncertainties from each stage of the analysis are compounded, even small uncertainties can have large effects on the total forgone quantified benefits. Therefore, the estimates of annual forgone benefits should be viewed as representative of the magnitude of annual forgone benefits expected, rather than the actual forgone benefits that would occur every year.

This supplemental RIA does not include the type of detailed uncertainty assessment found in the PM NAAQS RIA (U.S. EPA, 2012). However, the results of the uncertainty analyses presented in the PM NAAQS RIA can provide some information regarding the uncertainty inherent in the forgone benefits results presented in this analysis. Sensitivity analyses conducted for the PM NAAQS RIA indicate that alternate cessation lag assumptions could change the $PM_{2.5}$-related mortality benefits discounted at 3% by between 10% and –27% and that alternate income growth adjustments could change the $PM_{2.5}$-related mortality benefits by between 33% and −14%.[12]

We did not simulate the change in the level and location of air quality changes associated with this rulemaking. As such, it is not feasible to estimate the proportion of benefits occurring in different locations, such as $PM_{2.5}$ nonattainment areas. Instead, we applied benefit-per-ton estimates, which reflect specific geographic patterns of emissions reductions and specific air quality and benefits modeling assumptions for each sector (US EPA, 2013). For more information and updated methodology, see the TSD describing the calculation of these benefit-per-ton estimates (U.S. EPA, 2018). We are unable to estimate the percentage of premature mortality associated with this specific action's forgone emission reductions at each $PM_{2.5}$ level. However, we believe that it is still important to characterize the distribution of exposure to baseline air quality levels. As a surrogate measure of mortality impacts, we provide the percentage of the population exposed at each $PM_{2.5}$ level in the baseline of the source apportionment modeling used to calculate the benefit-per-ton estimates for this sector. Baseline exposure is only one parameter in the health impact function, along with baseline incidence rates population, and change in air quality. Thus, the percentage of the population exposed to air pollution below the lowest measured level (LML) is not the same as the percentage of the population experiencing health impacts because of a specific emission reduction policy. Therefore, caution is warranted when interpreting the LML assessment for this action because these results are not consistent with results from rules that had air quality modeling.

6. Net Benefits

In Table 11, we present one perspective on the costs and benefits of this proposal by offering a comparison of the forgone benefits from the targeted pollutant – $PM_{2.5}$ (the costs of the proposal) -- truncated at the close of the sell through period, with the cost savings or increased revenues to manufacturers (the benefits of the proposal). Table 11 contains net benefits for the primary scenario (the proposal scenario). Note that in reporting the benefits, costs, and net benefits of this proposal in this table, we modify the relevant terminology to be more consistent with traditional net benefit/cost analysis. Net benefits, then, equals the benefits minus the costs (or, in the terminology applied elsewhere in this report, the cost savings minus the forgone benefits). These net benefits are presented using the annual average cost savings and forgone benefits as a basis.

Table 11. Cost Savings, Forgone Benefits, and Net Benefits of the Scenario 2 (Primary) Associated with the Targeted Pollutant, as an Annual Average for the 2019-2022 Time Frame (billions of 2016$)[a]

	3% Discount Rate	7% Discount Rate
Cost: Forgone Benefits[b]	($0.10) to ($0.23)	($0.09) to ($0.21)

[12] http://www.epa.gov/ttn/ecas/regdata/RIAs/finalria.pdf (pp 6-16).

Benefit: Cost Savings from Increased Manufacturers' and Retailers' Revenues		$0.01
Net Benefits:	($0.09) to ($0.22)	($0.08) to ($0.20)

[a]All estimates in this table are rounded to one decimal point, so figures may not sum due to independent rounding.
[b] Forgone benefits were calculated using a benefit-per-ton estimate corresponding to each of three regions of the U.S. The forgone health benefits reflect the forgone $PM_{2.5}$ benefits for the sell through period and reflect the range based on adult mortality functions (e.g., from Krewski et al. (2009) with Bell et al. (2004) to Lepeule et al. (2012) with Levy et al. (2005)). The forgone monetized health benefits do not account for forgone emissions of directly emitted VOC, CO, and hazardous air pollutants; trailing forgone $PM_{2.5}$ emissions beyond 2022, ecosystem effects; or visibility impairment.

In Table 12, we present the benefits, costs, and net benefits of this proposal's present values and show the present value of net benefits. The PV of the benefits (cost savings) are $0.01 billion (7% discount rate) and $0.01 billion (3% discount rate). The PV of the costs (forgone benefits) are $0.09 to $0.21 billion (7% discount rate) and $0.10 to $0.23 billion (3% discount rate). Hence, the PV of the net benefits are $0.07 to $0.19 billion (7% discount rate) and $0.07 to $0.20 billion (3% discount rate). The monetized present values of net benefits (or net present values) presented in Table 11 are negative as denoted by the values being in parentheses, meaning that the estimated costs (forgone benefits) of the proposal are greater than the estimated benefits (cost savings). All estimates are discounted to 2016 and are in 2016 dollars.

Table 12. Estimated Present Value of the Net Benefits of Scenario 2 (Primary) (billions of 2016$)

	7% Discount Rate	3% Discount Rate
PV of Benefits[1]	$0.025	$0.029
PV of Costs[2]	($0.09) to ($0.21)	($0.10) to ($0.23)
NPV of Net Benefits	($0.07) to ($0.19)	($0.07) to ($0.20)

[1] The PV of benefits are the cost savings (increased manufacturer and retailer revenue) as presented in Section 2.

[2] The PV of costs are calculated from the forgone monetized benefits as presented in Section 5. The PV of forgone benefits are the forgone benefits at 7 percent (3 percent) discounted to 2016 using a 7 percent (3 percent) discount rate. Results are rounded to two significant figures. Totals may not sum due to rounding.

Table 13 shows the equivalent annualized values of the net benefits for the proposal discounted at 7 and 3 percent. The equivalent annualized values (EAV) are the annualized present values, or the levelized flow of the present values, over the four years affected by the proposal. The EAV of the net benefits are $0.06 billion to $0.15 billion per year (7% discount rate) and $0.08 billion to $0.20 billion per year (3% discount rate). The negative values indicate that the EAV of the estimated benefits (cost savings) of the proposal are smaller than the EAV of estimated costs (forgone benefits). In addition, this calculation of net benefits does not capture forgone net benefits associated with the operation of units beyond 2022 that are non-Step 2-compliant, units that have a likely operational life of 20 years as mentioned earlier in Section 3.

Table 13. Estimated Equivalent Annualized Value of the Net Benefits of Scenario 2 (Primary) (billions of 2016$)

	7% Discount Rate	3% Discount Rate
EAV of Benefits[1]	$0.01	$0.01
EAV of Costs[2]	$0.07 to $0.16	$0.09 to 0.21
EAV of Net Benefits	($0.06) to ($0.15)	($0.08) to ($0.20)

[1] The EAV of benefits are the EAV of the cost savings presented in Section 2.

[2] The EAV of costs are calculated from the PV of the forgone monetized benefits as presented in Section 5. Results are rounded to two significant figures. Totals may not sum due to rounding.

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APPENDIX A

Table A-1. Projected Appliance Sales from 2019-2022 for Wood Stoves*

	2019	2020	2021	2022
Wood Stoves	102,000	104,040	106,121	108,243

*All estimates from RIA for Residential Wood Heaters NSPS Revision. February 2015. Chapter 4, and U.S. Environmental Protection Agency (U.S. EPA), 2015. "Estimated Emissions from Residential Wood Heaters." January 30, 2015. Prepared by EC/R. p. 11.

Table A-2. Estimated Appliance Sales from 2019-2022 for Wood Stoves Under Scenario 2 and 3 *

Scenario 2	**2019**	**2020**	**2021**	**2022**
Wood Stoves	102,000	104,040	106,121	108,243
Step 1	69,360	12,138	4,335	867
Step 1- Produced but not sold in 2019**	17,340			
Step 2	15,300	91,902	101,786	107,376
Scenario 3				
Wood Stoves	110,670	104,040	106,121	108,243
Step 1	69,360	18,207	6,502	1,301
Step 1 – Produced but not sold in 2019**	17,340			
Step 1 – Additional units produced for sell through	8,670			
Step 2	15,300	85,833	99,619	106,942

*All estimates taken from or based on the RIA for Residential Wood Heaters NSPS Revision. February 2015. Chapter 4, and U.S. Environmental Protection Agency (U.S. EPA), 2015. "Estimated Emissions from Residential Wood Heaters." January 30, 2015. Prepared by EC/R. p. 11.

** Estimates are for appliances produced in 2019 but not sold until the sell-through period begins.

Table A-3. Estimated Cost Savings at Each Scenario for Wood Stoves* (2016$, millions)

	2019	2020	2021	2022
Scenario 1	0	0	0	0
Scenario 2 (primary)	0	$15.9	$5.7	$1.1
Scenario 3	0	$15.9	$5.7	$1.1

Since there is no difference in production cost between Step 1-compliant and Step 2-compliant wood stoves, there is no cost savings to manufacturers beyond those occurring from selling leftover stoves during the sell through period. Thus, the cost savings are the same under each scenario.

Table A-4. Estimated Annual Forgone VOC Emission Reductions (tons)

		2019	2020	2021	2022
Scenario 1	Forced Air Furnaces	0	0	0	0
	Hydronic Heaters	0	0	0	0
	Annual Totals	**0**	**0**	**0**	**0**
Scenario 2 (primary)	Forced Air Furnaces	0	225	306	322

	Hydronic Heaters	0	61	83	87
	Annual Totals	**0**	**286**	**389**	**409**
Scenario 3	Forced Air Furnaces	0	3458	623	647
	Hydronic Heaters	0	124	169	181
	Annual Totals	**0**	**582**	**792**	**828**

Note: Estimates do not reflect foregone emissions reductions beyond 2022.

Table A-5. Estimated Annual Forgone CO Emission Reductions (tons)

		2019	2020	2021	2022
Scenario 1	Forced Air Furnaces	0	0	0	0
	Hydronic Heaters	0	0	0	0
	Annual Totals	**0**	**0**	**0**	**0**
Scenario 2 (primary)	Forced Air Furnaces	0	1,203	1,633	1,719
	Hydronic Heaters	0	323	438	461
	Annual Totals	**0**	**1,526**	**2,071**	**2,180**
Scenario 3	Forced Air Furnaces	0	1,800	2,444	2,573
	Hydronic Heaters	0	483	656	690
	Annual Totals	**0**	**2,283**	**3,100**	**3,263**

Note: Estimates do not reflect foregone emissions reductions beyond 2022.

Table A-6. Estimated Annual Forgone Emission Reductions for Each Pollutant at Each Scenario for Wood Stoves (tons)

		2019	2020	2021	2022
$PM_{2.5}$					
	Scenario 2 (primary)	0	93	126	133
	Scenario 3	0	140	190	208
VOC					
	Scenario 2 (primary)	0	129	175	184
	Scenario 3	0	192	243	275
CO					
	Scenario 2 (primary)	0	1,506	2,044	2,152
	Scenario 3	0	2,253	3,065	4,168

Note: Estimates do not reflect trailing foregone emissions reductions beyond 2022.

Table A-7. Annual Average of Forgone Emission Reductions from Wood Stoves at Each Scenario for Each Pollutant for the 2019-2022 Period (tons)

	$PM_{2.5}$	VOC	CO
Scenario 1	0	0	0
Scenario 2 (primary)	88	122	1,426
Scenario 3	135	178	2,372

Note: Values are not annualized and do not reflect foregone emissions reductions beyond 2022.

Table A-8. Summary of Annual Monetized $PM_{2.5}$-Related Health Forgone Benefits Estimates for Wood Stoves – 2015 NSPS proposal in the 2019–2022 Time Frame (2016$)[a, b]

Scenario	Emissions Changes (tons)	Benefit per ton (Krewski, 3%)	Benefit per ton (LePeule, 3%)	Benefit per ton (Krewski, 7%)	Benefit per ton (LePeule, 7%)
Scenario 2	88	$404,274	$910,182	$364,715	$820,743
Scenario 3	135	$404,274	$910,182	$364,715	$820,743

	Total Monetized Forgone Benefits (millions $2016 at 3%)			Total Monetized Forgone Benefits (millions $2016 at 7%)		
Scenario 2	$36	to	$80	$32	to	$72
Scenario 3	$54	to	$122	$49	to	$110

[a]All monetized forgone benefits are annual estimates that reflect the average of annual forgone emission reductions expected to occur between 2020 and 2022 (inclusive) resulting from rulemaking implementation. All estimates are rounded to two significant figures so numbers may not sum across columns. The forgone monetized benefits do not account for effects from exposure to NO_2 or ozone, ecosystem effects, or impaired visibility. All fine particles are assumed to have equivalent health effects regardless of chemical composition, but the benefit per ton estimates vary depending on the location and magnitude of their impact on $PM_{2.5}$ levels, which in turn affect the number of individuals exposed. The forgone monetized benefits incorporate the conversion from precursor emissions to ambient fine particles. The benefit per ton method prevents us from reporting confidence intervals.

[b] Estimates of forgone VOC and CO health benefits are currently not monetized and will be addressed only qualitatively.

APPENDIX B

Calculation of Cost Savings and Forgone Emission Reductions

Calculation Procedure for Cost Savings (Increased Revenues to Manufacturers and Retailers)

The calculation of the cost savings for this proposal is the increased revenues hydronic heaters and forced air furnace manufacturers and retailers receive as a result of the 2-year sell through extension for these wood heaters. As mentioned earlier in this supplemental RIA, the impacts of this proposal are only estimated for the years 2019, 2020, 2021, and 2022. Impacts for 2022 are only for that portion of the year up to May 15, 2022, the date that marks the end of the sell through extension. An average of the cost savings estimated each year is also presented in the supplemental RIA.

The calculation of the cost savings uses the shipments data for hydronic heater and forced air furnace manufacturers for 2019, 2020, 2021, and 2022 that is in Chapter 4 of the 2015 NSPS RIA found at https://www3.epa.gov/ttn/ecas/docs/ria/wood-heaters_ria_final-nsps-revision_2015-02.pdf. In addition, the unit (or per wood heater) compliance cost estimates for each type of wood heater found in Chapter 5 of the 2015 NSPS RIA and shown in Section 2 of this supplemental RIA are also used in the calculation. We also present these estimates for wood stoves, a wood heater category not included in the proposal but for which comment is requested as to whether it should. A manufacturer that can sell a Step 1-compliant heater rather than a Step 2-compliant heater will experience an increase in revenue equal to the cost of compliance for that wood heater as shown in Chapter 5 of the 2015 NSPS RIA. For scenario 2, for hydronic heaters, this amount is $8,231(2013 dollars); for forced-air furnaces, this amount is $2,674 (2013 dollars). Under scenario 3, for hydronic heaters, this amount is $3,200 (2013 dollars); for forced-air furnaces, this amount is $1,700 (2013 dollars). For wood stoves, this amount is $1,295 (2013 dollars) under either scenario. Our analysis includes three scenarios. These scenarios are described earlier in the supplemental RIA. For scenario 1, the cost savings is zero, and the rationale for zero impacts is mentioned earlier in the supplemental RIA. For scenario 2, the primary scenario that is most representative of the impacts of the sell-through extension according to EPA, we calculate the increase in revenue for manufacturers and retailers using the following procedure:

1) Take the shipment data for the specific wood heater category for a specific year;
2) Apply an 85% estimate of non-Step 2 compliance for units in each affected wood heater category (reflecting the best Agency estimate based on available wood heater compliance data);
3) Estimate that twenty percent of the Step 1-compliant units will not be sold until after the sell-through period begins on May 15, 2020. For 2020, all wood heaters produced are expected to be Step 2-compliant, and therefore no Step 1-compliant wood heaters will be produced after 2019.

   Take the total manufacturing cost estimate for the specific wood heater. Under the proposal, manufacturers are able to sell left over wood heaters, displacing the sale of (and need to manufacture) a portion of the Step 2-compliant wood heaters. The cost savings is therefore calculated by applying the total manufacturing cost of the displaced Step 2-compliant wood

heaters (i.e., additional manufacturing cost + the base manufacturing cost). The R&D costs are sunk and still required by the NSPS;

4) Multiply the shipment data in 1) by the total manufacturing cost estimate in 2);
In recognition of the potential for variation in demand for Step 1-compliant units over the sell through period, especially lower demand for such units compared to Step 2-compliant units by the end of the sell through period, we estimate that 70 percent of the Step 1-compliant units will be sold in 2020, 25 percent in 2021, and 5 percent in 2022.

5) Since the additional manufacturing costs for each wood heater are in 2013 dollars, adjust costs to 2016 dollars by using the GDP implicit price deflator to generate results for each scenario. Applying the GDP implicit price deflator, costs in 2016 dollars are 1.04107 greater than costs in 2013 dollars.[13]

For Scenario 3, the calculation procedure is as follows:

1) Take the shipment data for the specific wood heater category for a specific year;
2) Begin calculations using 2019 shipment data. This scenario presumes manufacturers will begin increasing production in 2019 and not wait until 2020;
3) Adjust the 2019 shipment data to reflect a 10% economic growth rate rather than the 2.0% economic growth rate used in the 2015 NSPS RIA. This increase reflects the additional output of affected wood heaters in response to the sell-through extension in the context of this scenario.
4) Apply an 85% estimate of non-Step 2 compliance for units in each affected wood heater category (reflecting the best Agency estimate based on available wood heater compliance data);
5) Estimate that twenty percent of the Step 1-compliant units will not be sold until after the sell-through period begins on May 15, 2020. For 2020, all wood heaters produced are expected to be Step 2-compliant, and therefore no Step 1-compliant wood heaters will be produced after 2019.
6) Presume that 70 percent of the Step 1-compliant units will be sold in 2020, 25 percent in 2021, and 5 percent in 2022. In recognition of the potential for variation in demand for Step 1-compliant units over the sell through period, especially lower demand for such units compared to Step 2 compliant units by the end of the sell through period,
7) Take the additional manufacturing cost estimate for the specific wood heater. For this scenario, the cost is the additional manufacturing cost only because manufacturers have a choice to produce additional Step 1-compliant or Step 2-compliant wood heaters;
8) Multiply the shipment data in 1) by the additional manufacturing cost estimate for each wood heater category;
9) Since the additional manufacturing costs for each wood heater are in 2013 dollars, adjust costs to 2016 dollars by using the GDP implicit price deflator to generate results for each scenario.

[13] For more information on the GDP implicit price deflator, see https://fred.stlouisfed.org/series/A191RD3A086NBEA. The 2016 annual GDP implicit price deflator is 1.04107 higher than the 2013 value (110.221/105.873). Accessed on November 5, 2018.

Applying the GDP implicit price deflator, costs in 2016 dollars are 1.04107 greater than costs in 2013 dollars.

Since the procedure for scenario 3 is built off of scenario 2, the analytical procedures for these two scenarios are quite similar. Results for each scenario are found in the cost and emissions spreadsheet for this supplemental RIA, which is in the public docket for this rulemaking.

Calculation Procedure for Forgone Emission Reductions

The calculation of the forgone emission reductions for this proposal is the increased revenues hydronic heaters and forced air furnace manufacturers as a result of the 2-year sell through extension for these wood heaters. By "forgone emission reductions," we mean those emission reductions that would have taken place in the absence of the sell through extension. As mentioned earlier in this supplemental RIA, the impacts of this proposal are only estimated for the years 2019, 2020, 2021, and 2022. Impacts for 2022 are only for that portion of the year up to May 15, 2022, the date that marks the end of the sell through extension. An average of the forgone emission reductions estimated for each year is also presented in the supplemental RIA. We also present these estimates for wood stoves, a wood heater category not included in the proposal but for which comment is requested as to whether it should.

The calculation of the forgone emission reductions of $PM_{2.5}$, VOC, and CO uses the emissions data for emissions of these pollutants from hydronic heater and forced air furnace manufacturers for 2020, 2021, and 2022 that is in Chapter 4 of the 2015 NSPS RIA for scenario 2 and including 2019 emissions data for scenario 3. We estimate the forgone emission reductions using the emissions from the 2015 NSPS RIA and 2019 emissions, also from the 2015 NSPS RIA, as the baseline. Our analysis that generates these forgone emission reductions includes Scenarios 2 and 3 (since there are no impacts for scenario 1, as stated previously in the supplemental RIA).

We calculate the forgone emission reductions using the following procedure for scenario 2:

1) Take the emissions data for the specific wood heater category for a specific year;
2) Calculate the difference between the 2020 and 2019 emission reductions for each affected category;
3) Apply the factor of 0.85 to represent those emissions from non-Step 2-compliant units with the difference in emission reductions between 2020 and 2019;
4) Estimate that twenty percent of the Step 1-compliant units will not be sold until after the sell-through period begins on May 15, 2020. For 2020, all wood heaters produced are expected to be Step 2-compliant, and therefore no Step 1-compliant wood heaters will be produced after 2019;
5) Presume that 70 percent of the Step 1-compliant units with be sold in 2020, 25 percent in 2021, and 5 percent in 2020. These percentages of sales per year are included in the analysis in recognition of the potential for variation in demand for Step 1-compliant units over the sell through period, especially lower demand for such units compared to Step 2-compliant units by the end of the sell through period;

6) Present the cumulative forgone emission reductions for each year of the sell through period. That is, forgone emission reductions in 2021 are the sum of the forgone emission reductions from Step 1 units sold in 2020 and those sold in 2021. This calculation can then be applied in 2022 to present the forgone emission reductions for that year.

We calculate the forgone emission reductions using the following procedure for scenario 3:

1) Presume manufacturers will begin increasing production in 2019.

2) Apply the factor of 0.85 to represent those emissions from non-Step 2-compliant units with the difference in emission reductions between 2020 and 2019;

3) Presume a 10 percent increase in affected wood heater production over the amounts projected in the 2015 NSPS RIA, beginning in 2019. The higher rate of economic growth is a proxy for the increase of production of wood heater appliance shipments presumed to occur in this scenario.
4) Estimate that twenty percent of the Step 1-compliant units will not be sold until after the sell-through period begins on May 15, 2020. For 2020, all wood heaters produced are expected to be Step 2-compliant, and therefore no Step 1-compliant wood heaters will be produced after 2019.
5) Presume that 70 percent of the Step 1-compliant units with be sold in 2020, 25 percent in 2021, and 5 percent in 2020. These percentages of sales per year are included in the analysis in recognition of the potential for variation in demand for Step 1-compliant units over the sell through period, especially lower demand for such units compared to Step 2-compliant units by the end of the sell through period;
6) Present the cumulative forgone emission reductions for each year of the sell through period. That is, forgone emission reductions in 2021 are the sum of the forgone emission reductions from Step 1 units sold in 2020 and those sold in 2021. This calculation can then be applied in 2022 to present the forgone emission reductions for that year.

We note that there are no forgone emissions for wood stoves under Scenario 3 in 2019 since there are no emission reductions from the 2015 NSPS in 2019. Under the 2015 NSPS, emission reductions begin in 2020 since all wood stoves are expected to meet Step 1 requirements as of 2015 and the Step 2 requirements are not effective until May 15, 2020. Results for each scenario are found in the spreadsheet for forgone net benefits (including cost savings and forgone benefits) for this supplemental RIA, which is in the public docket for this rulemaking.