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ENVIRONMENTAL ASSESSMENT FOR PROPOSED ENERGY CONSERVATION STANDARDS FOR RESIDENTIAL CLOTHES WASHERS

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U.S. Department of Energy
Assistant Secretary,
Energy Efficiency & Renewable Energy
Office of Building Research and Standards
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ABBREVIATIONS AND ACRONYMS

Act or EPCA: Part B of Title III of the Energy Policy and Conservation Act, Public Law 94-163, as amended by the National Energy Conservation Policy Act, Public Law 95-619, the National Appliance Energy Conservation Act, Public Law 100-12, the National Appliance Energy Conservation Amendments of 1988, Public Law 100-357, and the Energy Policy Act of 1992, Public Law 102-486

AEO: *Annual Energy Outlook***,** DOE/EIA publication

BRS: DOE's Building Research and Standards office

BTU: British Thermal Unit

C: carbon

DOE: Department of Energy

EA: Environmental Assessment

EF: Energy Factor

EIA: Energy Information Administration

EJ: exajoule (10^{18} joules)

EPCA: Energy Policy and Conservation Act

GJ: gigajoule (10^{9} joules)

kt/a: thousand metric tons per year

kWh: kilowatt-hour

LCC: Life-Cycle Cost

LPG: liquified petroleum gas

MEF: Modified Energy Factor (cu. ft. / kWh per cycle)

Mt/a: millions of metric tons per year

NAECA: National Appliance Energy Conservation Act

NEMS: National Energy Modeling System

NEPA: National Environmental Policy Act of 1969

NES: National Energy Savings

NOPR: Notice of Proposed Rulemaking

NO_x: nitrogen oxides

PBP: Payback period

Quad: quadrillion Btu

RIA: Regulatory Impact Analysis

SO_2: sulfur dioxide

t: metric ton

TSL: Trial Standard Level

TSD: Technical Support Document

TWh: terawatt-hour

U.S.C.: United States Code

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) prepared this clothes washer environmental assessment (EA) pursuant to the National Environmental Policy Act of 1969 (NEPA)(42 U.S.C. 4321 et seq.), the regulations of the Council on Environmental Quality (40 CFR Parts 1500-1508), and the Department of Energy's regulations for compliance with NEPA (10 CFR Part 1021).

On November 14, 1994, DOE published an Advance Notice of Proposed Rulemaking (ANOPR). 59 FR 56423. On November 19, 1998, DOE published a Supplemental ANOPR (Hereafter referred to as the 1998 Supplemental ANOPR.). 63 FR 64344. On October 5, 2000, DOE published a Notice of Proposed Rulemaking (NOPR or proposed rule) for energy efficiency standards. 65 FR 59550. For the NOPR, we analyzed the energy savings, benefits and burdens of amended energy conservation standards for clothes washers and shared the results of these analyses with all stakeholders. Based on these analyses, several of the major stakeholders, including clothes washer manufacturers and energy efficiency advocates, submitted to the Department a joint proposal for the highest standard level which they believed to be technically feasible and economically justified. (Hereafter referred as the Joint Comment). Based on our review of the Joint Comment, we found the proposed standards technically feasible and economically justified. Therefore, the Department is adopting the energy conservation standards for clothes washers at Trial Standard Level (TSL) 3 (The clothes washer energy standards for Top Loading, Standard (1.6 $ft.^3$ or greater capacity) and Front Loading class clothes washers shall be 1.04 modified energy factor (MEF) in 1/1/2004 and 1.26 MEF in 1/1/2007.).

DOE proposed the clothes washer efficiency standards pursuant to Part B of Title III of the Energy Policy and Conservation Act, Public Law (P.L.) 94-163, as amended by the National Energy Conservation Policy Act, P.L. 95-619, by the National Appliance Energy Conservation Act, P.L. 100-12, by the National Appliance Energy Conservation Amendments of 1988, P.L. 100-357, and the Energy Policy Act of 1992, P.L. 102-486[a] (the Act or EPCA), which created the Energy Conservation Program for Consumer Products other than Automobiles.

The proposed clothes washer efficiency standard affects consumers and manufacturers of residential clothes washers.

2.0 PURPOSE AND NEED

The Energy Policy and Conservation Act, as amended, specifies that the Department must consider, for new or amended conservation standards, those standards that "achieve the maximum

[a]Part B of Title III of the Energy Policy and Conservation Act, as amended by the National Energy Conservation Policy Act, the National Appliance Energy Conservation Act, the National Appliance Energy Conservation Amendments of 1988, and the Energy Policy Act of 1992, is referred to in this notice as the "Act." Part B of Title III is codified at 42 U.S.C. 6291 et seq. Part B of Title III of the Energy Policy and Conservation Act, as amended by the National Energy Conservation Policy Act only, is referred to in this notice as the National Energy Conservation Policy Act.

improvement in energy efficiency which the Secretary determines is technologically feasible and economically justified" and which will "result in significant conservation of energy." Accordingly, DOE's proposed rule would be amending the energy conservation standard for residential clothes washers.

Consistent with this requirement, DOE's purpose in the proposed action is to reduce the consumption of energy used by clothes washers in the United States (U.S.). DOE's discretion is in deciding the level for a minimum efficiency standard, not if there should be one.

3.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

A DOE clothes washer standard analysis includes the energy saved by the clothes washer itself (always electrical), the energy used in an electric, gas, LPG or oil-fired water heater to heat water for the clothes washer, and the energy required by a clothes dryer (electric, gas or LPG) to remove the water remaining in laundry after a completed wash cycle. The metric used to measure the efficiency is called the Modified Efficiency Factor (MEF). Details are provided in the Clothes Washer Technical Support Document (TSD).[1]

After an initial analysis of ten different efficiency levels, the analysis was reduced to six possible TSLs. Of these, DOE proposes to set a clothes washer standard at TSL 3.

3.1 No Action Alternative

Under this alternative DOE would not publish a new minimum energy efficiency standard for clothes washers. By taking no action, DOE would be in violation of EPCA, which requires (1) DOE to determine whether to amend the statutory standard, and (2) that a minimum standard be set at a level that "shall be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified." EPCA, §325(l)(2)(A), 42 U.S.C. §6295(l)(2)(A). In addition to analyzing a baseline case in the TSD, a Draft Clothes Washer Regulatory Impact Analysis (RIA) was published that examines the no action alternative as well as other non-mandatory efficiency standards or voluntary incentive programs. It was determined in this report that the "no action" alternative would result in less energy reductions than the proposed standard. If "no action" were taken, the minimum efficiency requirement would remain at its current level, an Energy Factor (EF) of 1.18. Unlike the proposed MEF, the EF does not account for energy use in the clothes dryer. The current baseline value for EF corresponds to an MEF of 0.817 kWh/cycle, a lower minimum efficiency level than any other level being considered.

3.2 Proposed Standard

The major stakeholders, including manufacturers and energy efficiency advocates, have jointly submitted a proposed clothes washer efficiency standard to DOE that they feel is technically feasible and economically justified. This proposed clothes washer efficiency standard will provide significant energy savings and water savings to the nation. The proposed standard (TSL 3) would

go into effect in two stages, with a lower required improved efficiency (MEF of 1.04) by the year 2004 and a higher efficiency level (MEF of 1.26) by the year 2007. Additional details of the proposed TSL 3 and other TSL's are provided in the Clothes Washer TSD[1]. The TSD is available on a DOE internet site at http://www.eren.doe.gov/buildings/codes_standards/applbrf/clwasher.html.

The justification for selecting the proposed standard, TSL 3, over the other trial standard levels considered is explained in Section V.F, conclusions of the October 5, 2000 Federal Register Notice, page 59580. This Federal Register notice is also available on a DOE internet site at http://www.eren.doe.gov/buildings/codes_standards/applbrf/clwasher.html under "Notice of Proposed Rulemaking."

3.3 Alternative Standards

This EA presents the results of the environmental impacts from six clotheswasher efficiency trial standards. Each standard is an alternative action, and is compared against the no-action alternative. In the course of a typical appliance rulemaking, all alternatives are initially considered. To simplify the analysis for the final detailed selection process, some alternatives are eliminated from further analysis. Of the ten beginning standard levels, six have been analyzed in detail in this EA and four were eliminated from further analysis. Of the four eliminated, three trial standard levels with MEF's of 0.86 (5% energy reduction), 0.908 (10% energy reduction) and 0.961 (15% energy were eliminated from further consideration because it was determined that an MEF of 1.021 (20% energy reduction) was technically feasible and economically justified, making further consideration of the less efficient trial levels unnecessary. The fourth trial standard with a MEF of 1.485 (energy reduction of 45%) was eliminated due to its significantly higher increase in clothes washer retail price, life-cycle-cost and payback period. It is required that the maximum technically achievable level, in this case MEF of 1.634 (representing reduced energy use of 50%), be retained as part of the analysis.

3.4 Impacts of Proposed and Alternative Standards

The NOPR established that DOE determined that significant energy savings could be achieved through the adoption of an amended conservation standard for clothes washers. DOE considers the impacts of standards beginning with the most efficient level. Table 1 includes a summary of the analysis results to aid the reader in the discussion of the benefits and burdens for the different trial standard levels. DOE proposes to set a clothes washer standard at TSL 3 which is felt to be technically feasible and economically justified. Additional information on the six trial standard levels is provided in Section 5 of this EA, Environmental Impacts of the Proposed Action.

Table 1.--Summary of the Analysis Results*

Trial Standard Level	6	5	4	3	2	1
MEF	1.63	1.36	1.26	1.04 in 2004, 1.26 in 2007	1.09	1.02
Percent Reduction in Energy Use	50	40	35	~22 in 2004 ~35 in 2007	25	20
Total Energy Saved (Quads)	7.53	6.03	5.99	5.52	4.04	2.12
Water Savings (trillion gallons)	10.85	12.94	12.94	11.59	9.09	0.53
Emissions						
Carbon Equivalent (Mt)	134.6	107.3	106.2	95.1	70.9	38.1
NOx (kt)	364	283.1	280.6	253.5	193.6	115.6
SO_2 (kt)	31.41	30.31	30.31	28.11	30.31	31.41

* Values are all cummulative to 2030.

4.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 Geography

The clothes washer standard that DOE is proposing would apply to all 50 states and U.S. territories.

4.2 Air Resources

The primary focus of the EA is the effect of proposed efficiency standards on air resources. For this analysis, the EA uses a variant of DOE, Energy Information Administration's (DOE/EIA) National Energy Modeling System (NEMS), called NEMS-BRS (BRS is DOE's Building Research and Standards office), plus some additional analysis not using NEMS-BRS to determine the non-power sector air emissions.[b] The environmental analysis is similar to the utility sector analysis described in Chapter 12 of the Clothes Washer TSD.[1] Outputs of the environmental analysis are in a format similar to the results of the DOE/EIA's *Annual Energy Outlook 1999 (*AEO99).[3]

For each of the standard levels, DOE calculated total power sector emissions based on output from NEMS-BRS. DOE also conducted some additional analysis to calculate household emissions which are not covered by NEMS-BRS. The EA considers only two pollutants, nitrogen oxides (NO_x) and sulfur dioxide (SO_2), and one emission, carbon (C). Because emissions of SO_2 from power plants are capped by clean air legislation, physical emissions of this pollutant from electricity generation will be only minimally affected by possible clothes washer standards. The maximum SO_2 allowed by law will most likely still be produced, but because SO_2 emissions are traded, and if SO_2 emissions are lowered due to less power generation, then the cost of SO_2 emission credits may decrease slightly. Therefore, the EA does not consider changes in power sector SO_2 emissions, although it does household emissions savings. The only form of carbon tracked by NEMS-BRS is

[b]For more information on NEMS, refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is *National Energy Modeling System: An Overview 1998*, DOE/EIA-0581(98), February 1998. DOE/EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data.

carbon dioxide (CO_2), so the carbon discussed in this analysis is only in the form of CO_2, but is reported as mass of elemental carbon, in keeping with standard practice.

4.2.1 Assumptions

The EA uses the same basic assumptions as AEO99 and models the changes resulting from standards as variations from current policy. For example, the emissions characteristics of an electricity generating plant in the environmental analysis are the same as those used in AEO99, although the fuel mix used for generation and the construction program for new plants may deviate slightly as a result of reduced generation requirements under the standard, which in turn affects air emission results. As with the utility impact analysis in Chapter 12 of the TSD[1], the environmental emissions effects are assumed to be linear in the range of the standards decrements and results are extrapolated.

The EA also includes a sensitivity analysis for the proposed standard level, using the High and Low Economic Growth scenarios of NEMS-BRS. As described in Chapter 12 of the TSD[1], these scenarios cover a range of macro-economic growth assumptions. In addition, a separate sensitivity assuming high and low price elasticities are analyzed. The high and low price sensitivities have an effect on the magnitude of clothes washer shipments. Both sensitivity analyses are done for the case of the proposed standard level (TSL 3) only. Sensitivities were not done for all possible standard levels as they have been eliminated based on the results of the reference scenario.

4.2.2 Methods

4.2.2.1 Carbon

A detailed carbon module tracks carbon emissions in NEMS-BRS. The Carbon Module provides good results because it covers all sectors of the economy and their interactions. Because NEMS-BRS tracks carbon emissions based on the total energy consumption and produces comprehensive estimates of the benefits of proposed standards, actual household emissions are included and no external analysis is necessary. NEMS-BRS itself does not account for potential carbon savings that result from upstream processes, as described in the fuel-cycle section below.

Past experience with NEMS-BRS carbon results from power generation suggests that using marginal emissions estimates are more accurate than emissions based on simple forecast average factors for analysis of proposed appliance standards. First, the marginal fuel displaced by reduced generation as a result of proposed standards tends to be natural gas, which releases less carbon emissions than coal. Second, lowered electricity demand tends to slow down the construction of power generation capacity, thereby slowing improvement in energy conversion efficiency and emissions rates that typically result from deployment of newer technology.

4.2.2.2 Power Sector NO_x

NEMS-BRS reports two airborne pollutant emissions, NO_x and SO_2. Power sector NO_x results are based on forecasts of compliance with existing legislation at the time AEO99 was released and have proven stable and reasonable.

4.2.2.3 Power Sector SO_2

The Clean Air Act Amendments of 1990 set an SO_2 emissions cap on all power generation, but permits flexibility among generators through the use of emissions allowances and tradable permits. SO_2 trading tends to imply that physical emissions effects of a standard will be zero because emissions will always be at, or near, the ceiling. There is virtually no real possible SO_2 environmental benefit from electricity conservation as long as there is enforcement of the emissions ceiling. A slight economic benefit may result only if coal generation falls and the reduced demand for SO_2 emission allowances lowers the allowance price. Because the effects considered here are too small to deliver reasonable estimates, the EA does not consider this possibility.

4.2.2.4 Household NO_x and SO_2

While NEMS-BRS has an algorithm for estimating emissions of NO_x and SO_2 from power generation, it does not estimate household emissions of these pollutants. Because households use natural gas, fuel oil, and LPG, the residential sector also contributes to NO_x and SO_2 emissions. This analysis therefore includes separate estimates of the effect of standards on household NO_x and SO_2 emissions, based on simple emissions factors derived from general literature. Although small, household SO_2 emissions savings are reported because the SO_2 emissions caps do not apply to the residential sector. Appendix EA-1 provides a detailed description of the methodology for deriving the emissions factors for residential combustion.

4.2.2.5 Fuel-Cycle Emissions

NEMS-BRS does not account for upstream emissions from energy losses during coal and natural gas production. The upstream processes include the mining of coal or extraction of natural gas, physical preparatory and cleaning processes, and transportation to the power plant. Appendix EA-2 shows upstream emission estimates for carbon, SO_2, and NO_x, along with the emissions factors and the relative percentage of upstream emissions to power plant emissions. Appendix EA-2 also provides a detailed description of the methodology used to derive these estimates. Although DOE does not report actual estimates of the effects of standards, the material in Appendix EA-2 provides the reader with a feel for the possible magnitude of upstream effects. According to the study by M.A. DeLuchi, approximately 8% of total coal fuel cycle carbon, NO_x, or SO_2 emissions are attributed to upstream coal production. The equivalent value for gas is 14%.

4.2.2.6 Interpolation

Because the size of the energy savings from standards are too small to produce stable power sector results in NEMS-BRS, it has been necessary to estimate results in the range of the standard levels' effects using interpolation. Appendix EA-3 describes the interpolation methodology in detail. A series of cases is executed in which the Residential Demand Module's clothes washer, clothes dryer and water heater loads are reduced for each of the fuel types (electricity, gas, oil and LPG) at incrementally higher savings than the standards levels. Actual standard level savings are then derived from these outputs.

4.2.2.7 Extrapolation

The current time horizon of NEMS-BRS is 2020 (modeling a 17-year period, 2004-2020), yet other parts of the appliance energy efficiency work reach 2030. As described in the utility analysis in Chapter 12 of the TSD, it is not feasible to extend the forecast period of NEMS-BRS for the purposes of this analysis, nor does EIA have an approved method for extrapolation of many outputs beyond 2020; therefore, to ensure consistency all extrapolations beyond 2020 presented here are simple replications of year 2020 results. As with the AEO99 Reference Case in general, the implicit assumption is that the regulatory environment does not deviate from the current known situation during the extrapolation period. Only changes that have been announced with date-certain introduction are included in NEMS-BRS. Consistent with this assumption, the household emissions factors used do not change in either the forecast or the extrapolation periods because little compelling evidence of tightening emissions standards for household appliances was forthcoming in the research described in Appendix EA-1. To emphasize the extrapolated results wherever they appear, they are shaded in grey to distinguish them from actual NEMS-BRS output.

4.3 Water Resources

The efficiency level and effective dates of the proposed rulemaking (TSL 3) are analyzed as well as the nine originally considered MEF standard levels. The original nine MEF values considered are: 0.860, 0.908, 0.961, 1.021, 1.089, 1.257, 1.362, 1.485, and 1.634. Water usage reduction per washer was obtained from the Association of Home Appliance Manufacturers (AHAM) data showing the amount of water use at each clothes washer efficiency level. The amount of national water usage reduction is determined by using a spreadsheet model that forecasts shipments and national energy savings (NES). The NES/Shipments model is described in detail in Chapters 9 and 10 of the Clothes Washer TSD accompanying the NOPR.

4.4 Socioeconomics

As part of the rulemaking process, the socioeconomic effect on consumers was analyzed. Analysis included determining the differences in life-cycle cost for the standard levels analyzed. See Chapter 7 and Appendix G of the TSD. In addition, a conjoint analysis and focus groups provided information on consumer preferences relating to clothes washers. See Chapter 8 and Appendix J of the TSD.

4.5 Environmental Justice

A consideration of Environmental Justice is made pursuant to Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. The Executive Order requires federal agencies to assess whether a proposed federal action causes any disproportionately high and adverse human health or environmental effects on low-income or minority populations. The proposed action causes no such adverse impacts.

4.6 Energy Consumption

Data from manufacturer questionnaires were used as input to a NES/Shipment spreadsheet model that forecasted shipment of clothes washers to the year 2030 and determined the savings of energy consumption to the nation both annually and cumulatively. Detail is provided in Chapters 4, 9 and 10 of the Clothes Washer TSD, published together with the NOPR. A sophisticated NES/Shipments spreadsheet model is described in the Clothes Washer TSD. This spreadsheet model forecasts the national shipments and energy use of clothes washers with and without standards.

5.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

5.1 Air Quality/ Emissions Impacts

5.1.1 Power Sector Emissions

Table 2 shows the annual power sector carbon and NO_x emissions for the proposed and alternative standard levels. The total carbon emission reductions range up to 5.2 Mt/a in 2020. NO_x emissions reductions reach up to 9.8 kt/a in 2020. Cumulative emissions savings for the power sector over the 17-year period modeled are listed in Table 3. All of the nine originally considered MEFs are shown, as well as the proposed two stage standard level and the reference case. The six TSL's selected for closer analysis are labeled as TSL 1 through 6. Of these, TSL 3 is being proposed. See details on the selection process in the Clothes Washer TSD. In Table 3 the lowest MEF of 0.860 represents a 5% reduction in energy use, whereas the largest MEF, 1.634, represents a 50% reduction in energy use over a baseline energy use level of 0.817, assumed to be equivalent to the current minimum clothes washer efficiency requirement. In this analysis, the reference case refers to cases with respect to the AEO99 Reference Case. All trial standard levels are compared to the reference case, which represents the no action alternative. This is also referred to as the baseline case, EF level of 1.18 and MEF level of 0.817.

Table 2. Power Sector Emissions for all Standards

NEMS-BRS Results Absolute Values of Emissions						AEO99 Ref. Case - Proposed Standards Emission Reductions as Compared to the No Action Alternative							
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
AEO99 Reference Case		**(No Action Alternative, MEF = 0.817)**										Extrapolation	
Carbon (Mt/a)[1,3]	588.9	612.9	653.2	704.6	744.6		0	0	0	0	0	0	0
NO_x (kt/a)[2,3]	4191.2	3547.1	3665	3819.2	3882.8		0	0	0	0	0	0	0
Proposed Standard Levels													
MEF = 0.860													
Carbon (Mt/a)	588.9	612.9	653.1	704.5	744.4	Carbon (Mt/a)	0	0	-0.1	-0.1	-0.2	-0.2	-0.2
NO_x (kt/a)	4191.2	3546.9	3664.8	3818.8	3882.4	NO_x (kt/a)	0	-0.2	-0.3	-0.5	-0.4	-0.4	-0.4
MEF = 0.908													
Carbon (Mt/a)	588.9	612.8	653	704.2	744	Carbon (Mt/a)	0	-0.1	-0.2	-0.4	-0.6	-0.6	-0.6
NO_x (kt/a)	4191.2	3546.5	3664.2	3817.7	3881.6	NO_x (kt/a)	0	-0.6	-0.8	-1.5	-1.2	-1.2	-1.2
MEF = 0.961													
Carbon (Mt/a)	588.9	612.7	652.8	703.8	743.5	Carbon (Mt/a)	0	-0.2	-0.4	-0.8	-1.1	-1.1	-1.1
NO_x (kt/a)	4191.2	3546	3663.6	3816.6	3880.7	NO_x (kt/a)	0	-1.1	-1.5	-2.6	-2.1	-2.1	-2.1
MEF = 1.021 Trial Standard Level 1													
Carbon (Mt/a)	588.9	612.7	652.7	703.7	743.3	Carbon (Mt/a)	0	-0.2	-0.5	-0.9	-1.3	-1.3	-1.3
NO_x (kt/a)	4191.2	3545.8	3663.3	3816.1	3880.3	NO_x (kt/a)	0	-1.3	-1.8	-3.1	-2.4	-2.4	-2.4
MEF = 1.089 Trial Standard Level 2													
Carbon (Mt/a)	588.9	612.5	652.3	702.9	742.3	Carbon (Mt/a)	0	-0.4	-0.9	-1.7	-2.3	-2.3	-2.3
NO_x (kt/a)	4191.2	3544.3	3662.1	3813.4	3879	NO_x (kt/a)	0	-2.8	-2.9	-5.8	-3.8	-3.8	-3.8

Table 2. Power Sector Emissions for all Standards (continued)

NEMS-BRS Results Absolute Values of Emissions						AEO99 Ref. Case - Proposed Standards Emission Reductions as Compared to the No Action Alternative							
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
MEF = 1.257 Trial Standard Level 4												Extrapolation	
Carbon (Mt/a)	588.9	612.3	651.7	701.8	740.8	Carbon (Mt/a)	0	-0.6	-1.5	-2.8	-3.8	-3.8	-3.8
NO_x (kt/a)	4191.2	3544	3660	3810.2	3876.2	NO_x (kt/a)	0	-3.1	-5	-9.1	-6.5	-6.5	-6.5
MEF = 1.362 Trial Standard Level 5													
Carbon (Mt/a)	588.9	612.2	651.7	701.8	740.8	Carbon (Mt/a)	0	-0.7	-1.5	-2.8	-3.8	-3.8	-3.8
NO_x(kt/a)	4191.2	3542.8	3660.1	3809.8	3876.2	NO_x (kt/a)	0	-4.2	-5	-9.4	-6.5	-6.5	-6.5
MEF = 1.485													
Carbon (Mt/a)	588.9	612	651.5	701.2	739.7	Carbon (Mt/a)	0	-0.9	-1.7	-3.4	-4.9	-4.9	-4.9
NO_x (kt/ a)	4191.2	3541.3	3659.9	3807.6	3873.6	NO_x (kt/a)	0	-5.8	-5.1	-11.6	-9.1	-9.1	-9.1
MEF = 1.634 Trial Standard Level 6													
Carbon (Mt/a)	588.9	611.9	651.4	700.9	739.4	Carbon (Mt/a)	0	-1	-1.8	-3.7	-5.2	-5.2	-5.2
NO_x (kt/a)	4191.2	3540.8	3659.5	3806.8	3872.9	NO_x (kt/a)	0	-6.3	-5.5	-12.5	-9.8	-9.8	-9.8
PROPOSED LEVEL: MEF = 1.04 in 2004 & 1.26 in 2007 (TSL 3)													
Carbon (Mt/a)	588.9	612.7	652.1	702.2	741	Carbon (Mt/a)	0	-0.2	-1.1	-2.4	-3.6	-3.6	-3.6
NO_x (kt/a)	4191.2	3545.5	3661.2	3811.4	3876.1	NO_x (kt/a)	0	-1.3	-3.9	-7.8	-6.6	-6.6	-6.6

[1] Comparable to Table A19 of AEO99: Electric Generators

[2] Comparable to Table A8 of AEO99: Emissions

[3] All results to metric tons (t), equivalent to 1.1 short tons

Table 3. Cumulative Emissions Reductions through 2020: Power Sector

Emission	MEF (cu. ft. / kWh per cycle)									
	0.86	0.908	0.961	1.021 TSL 1	1.089 TSL 2	1.257 TSL 4	1.362 TSL 5	1.485	1.634 TSL 6	1.04 in 2004 1.26 in 2007 TSL 3 (PROPOSED MEF)
Carbon (Mt)	1.9	5.8	10.1	12	22.2	36.3	36.9	44.8	48.1	29.8
NO_x (kt)	6.2	19.1	33.3	39.6	72.2	114	116.3	144.8	155.5	93.5

5.1.2 Residential Sector (Household) Emissions

In the emissions reductions analysis, reductions in emissions resulting from a clothes washer standard, are separated into two parts: power sector and residential. The power sector consists of emissions emitted outside of the household and include primarily emissions generated at power plants used to generate electricity. Residential sector emissions (also referred to as household emissions) are those emitted physically at the residence. All emissions due to the generation of electricity are considered power sector. All emissions due to combustion at the physical location of the residence are considered residential sector emissions.

Included as part of the clothes washer measure of energy use, is the energy needed to heat the water that is used by the clothes washer and the energy used to dry the clothes in the clothes dryer. This is in addition to the electrical energy used to run the washer and dryer electric motors. Where a natural gas, oil or LPG fuel is used by the water heater, combustion emissions are emitted at the residence or household. Similarly, for those households having a gas-fired clothes dryer, emissions from the dryer's gas burner are also located at the residence. Emissions at the location of the residence are referred to as residential sector emissions. Details on the emission factors for combustion from natural gas, LPG, and oil-fired residential water heaters and clothes dryers are provided in Appendix EA-1.

Total household carbon, NO_x and SO_2 emissions savings are presented in Table 4 for all MEF standard levels. These figures represent the sum of emissions reductions that result from reduced combustion of natural gas, fuel oil and LPG at residences due to the different trial standard levels. The annual emissions savings in 2020 range from 0.06 to 1.73 Mt/a for carbon, 0.21 to 5.59 kt/a for NO_x and 0.06 to 1.59 kt/a for SO_2. These savings are in addition to the power sector savings reported above. Table 5 shows cumulative emissions savings for households over the 17-year period (2004-2020) modeled in NEMS-BRS.

Table 4. Change in Annual Household Emissions for MEF Standards

Year ⇨	2000	2005	2010	2015	2020	2025	2030
MEF = 0.860						**Extrapolation**	
Carbon (Mt/a)	0	0	-0.03	-0.05	-0.06	-0.06	-0.06
NO_x (kt/a)	0	0	-0.1	-0.18	-0.21	-0.21	-0.21
SO_2 (kt/a)	0	0	-0.03	-0.05	-0.06	-0.06	-0.06
MEF = 0.908							
Carbon (Mt/a)	0	0	-0.11	-0.19	-0.23	-0.23	-0.23
NO_x (kt/a)	0	-0.11	-0.4	-0.69	-0.82	-0.82	-0.82
SO_2 (kt/a)	0	0	-0.12	-0.2	-0.24	-0.24	-0.24
MEF = 0.961							
Carbon (Mt/a)	0	-0.1	-0.23	-0.38	-0.46	-0.46	-0.46
NO_x (kt/a)	0	-0.23	-0.8	-1.39	-1.66	-1.66	-1.66
SO_2 (kt/a)	0	-0.1	-0.25	-0.42	-0.51	-0.51	-0.51
MEF = 1.021 Trial Standard Level 1							
Carbon (Mt/a)	0	-0.1	-0.33	-0.56	-0.67	-0.67	-0.67
NO_x (kt/a)	0	-0.35	-1.21	-2.12	-2.57	-2.57	-2.57
SO_2 (kt/a)	0	-0.2	-0.7	-1.27	-1.59	-1.59	-1.59
MEF = 1.089 Trial Standard Level 2							
Carbon (Mt/a)	0	-0.18	-0.61	-1.05	-1.28	-1.28	-1.28
NO_x (kt/a)	0	-0.56	-1.97	-3.44	-4.17	-4.17	-4.17
SO_2 (kt/a)	0	-0.2	-0.69	-1.24	-1.52	-1.52	-1.52
MEF = 1.257 Trial Standard Level 4							
Carbon (Mt/a)	0	-0.22	-0.74	-1.3	-1.6	-1.6	-1.6
NO_x (kt/a)	0	-0.67	-2.31	-4.13	-5.08	-5.08	-5.08
SO_2 (kt/a)	0	-0.2	-0.69	-1.24	-1.52	-1.52	-1.52
MEF = 1.326 Trial Standard Level 5							
Carbon (Mt/a)	0	-0.22	-0.74	-1.29	-1.6	-1.6	-1.6
NO_x (kt/a)	0	-0.67	-2.31	-4.14	-5.09	-5.09	-5.09
SO_2 (kt/a)	0	-0.2	-0.69	-1.24	-1.52	-1.52	-1.52

Table 4. Change in Annual Household Emissions for MEF Standards (Continued)

Year ⇨	2000	2005	2010	2015	2020	2025	2030
MEF = 1.485						**Extrapolation**	
Carbon (Mt/a)	0	-0.23	-0.75	-1.34	-1.68	-1.68	-1.68
NO_x (kt/a)	0	-0.69	-2.39	-4.34	-5.43	-5.43	-5.43
SO_2 (kt/a)	0	-0.2	-0.69	-1.25	-1.56	-1.56	-1.56
MEF = 1.634 Trial Standard Level 6							
Carbon (Mt/a)	0	-0.24	-0.77	-1.38	-1.73	-1.73	-1.73
NO_x (kt/a)	0	-0.71	-2.45	-4.46	-5.59	-5.59	-5.59
SO_2 (kt/a)	0	-0.2	-0.7	-1.27	-1.59	-1.59	-1.59
PROPOSED MEF = 1.04 in 2004 & 1.26 in 2007 Trial Standard Level 3							
Carbon (Mt/a)	0	-0.12	-0.6	-1.15	-1.58	-1.58	-1.58
NO_x (kt/a)	0	-0.35	-1.87	-3.66	-4.97	-4.97	-4.97
SO_2 (kt/a)	0	-0.11	-0.56	-1.1	-1.49	-1.49	-1.49

Table 5. Cumulative Emissions Reductions through 2020: Households

Emission	MEF									
	0.86	**0.908**	**0.961**	**1.021 TSL 1**	**1.089 TSL 2**	**1.257 TSL 4**	**1.362 TSL 5**	**1.485**	**1.634 TSL 6**	**1.04 in 2004 1.26 in 2007 TSL3 (PROPOSED MEF)**
Carbon (Mt)	0.6	2.3	4.7	6.8	12.9	15.9	15.9	16.5	16.9	13.9
NO_x (kt)	2.2	8.4	16.9	25.8	42	50.4	50.5	53	54.4	43.9
SO_2 (kt)	0.6	2.5	5.2	15.5	15.1	15.1	15.1	15.3	15.5	13.2

5.1.3 Power and Residential Sector Emissions

Cumulative emissions reduction for the power sector and households (excluding upstream emissions) over the 17-year period modeled are presented in Table 6 below.

Table 6. Cumulative Emissions Reductions through 2020: Household and Power Sectors

Emission	MEF									
	0.86	**0.908**	**0.961**	**1.021 TSL 1**	**1.089 TSL 2**	**1.257 TSL 4**	**1.362 TSL 5**	**1.485**	**1.634 TSL 6**	**1.04 in 2004 1.26 in 2007 TSL 3 (PROPOSED MEF)**
Carbon (Mt)	2.5	8.1	14.8	18.9	35.2	52.3	52.8	61.3	65	43.7
NO_x (kt)	8.4	27.5	50.3	65.4	114.2	164.4	166.7	197.8	209.9	137.4
SO_2 (kt)	0.6*	2.5*	5.2*	15.5*	15.1*	15.1*	15.1*	15.3*	15.5*	13.2*

*Results include only household emissions reductions because the power sector emissions cap implies that savings from electricity generation will be negligible.

Cumulative emissions reductions for the power sector and households (excluding upstream emissions) with the forecast extended through 2030 are in Table 7.

Table 7. Cumulative Emissions Reductions through 2030: Household and Power Sectors

Emission	MEF									
	0.86	**0.908**	**0.961**	**1.021 TSL 1**	**1.089 TSL 2**	**1.257 TSL 4**	**1.362 TSL 5**	**1.485**	**1.634 TSL 6**	**1.04 in 2004 1.26 in 2007 TSL 3 (PROPOSED MEF)**
Carbon (Mt)	5.1	16.4	30	38.1	70.9	106	107	127	135	95.1
NO_x (kt)	14.4	47.4	87.4	116	194	281	283	344	364	253.5
SO_2 (kt)	1.2*	4.9*	4.9*	31.4*	30.3*	30.3*	30.3*	30.9*	31.4*	28.1*

*Results include only household emissions reductions because the power sector emissions cap implies that savings from electricity generation will be negligible.

5.1.4 Fuel-Cycle Emissions

The effects of standards on upstream emissions are not reported here. Please refer to Appendix EA-2 for a general description of the possible magnitude of these effects.

5.1.5 High and Low Sensitivity Analysis for Air Emissions

The Annual Energy Outlook (AEO), a document produced yearly by DOE/EIA, forecasts emission outputs. As part of its analysis, the AEO analyzes sensitivities for assumptions of high and low economic growth for the nation. These assumptions of economic activity in turn produce differences in fuel use and fuel prices. The Reference Case, refers to the emissions predicted in AEO99, i.e., without a new clothes washer standard.

In Tables 8 and 10, DOE reports the equivalent results for the High and Low Economic Growth Cases for the proposed TSL 3. Table 8 shows the annual emissions savings from the power sector with the corresponding annual change in household emissions shown in Table 10.

In addition to the high and low economic activity AEO scenarios, additional sensitivities were analyzed based on predictions of how much clothes washer shipments would decrease for an increase in clothes washer price (i.e., high and low assumptions for price elasticity) that may accompany an increase in clothes washer efficiency. Detailed analysis is reported in Chapter 9 of the TSD. DOE reported the equivalent results for assumptions of high and low price elasticity scenarios for the proposed standard level. Table 9 shows the annual emissions savings from the power sector with the corresponding annual change in household emissions shown in Table 11.

Shown in Tables 12 and 13 are the low and high sensitivities for the proposed proposed rulemaking scenario. Table 12 shows results for the low and high economic growth cases. Generally, the carbon savings for the Low Economic Growth Cases are slightly lower than those reported for the comparable Reference Case standards scenario while the savings for the High Economic Growth Cases are slightly higher than those reported for the Reference Case. Table 13 covers high and low price elasticities with MEFs of 1.04 and 1.26 in the years 2004 and 2007, respectively. The price elasticity sensitivities are chosen to represent a relatively large drop and a relatively small drop in forecasted shipments when a new minimum efficiency standard takes affect. See the Shipments and National Energy Savings in Chapters 9 and 10 of the TSD for more detailed discussion.

Table 8. High and Low Economic Growth: Annual Power Sector Emissions for Proposed Standard (Trial Standard Level 3)

NEMS-BRS Results						Difference from AEO99 Reference						
	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020	2025	2030
AEO99 High Economic Growth Reference Case						**Difference from AEO99 Reference Case**					**Extrapolation**	
Carbon (Mt/a)[1,3]	590.6	628.9	679	741.8	799	4.5	32.6	46.6	71.7	104		
NO_x (kt/a)[2,3]	4200	3628.7	3764.8	3937.2	4000.7	18	163	163	236	263		
MEF = 1.04 in 2004 & 1.26 in 2007 High Economic Growth												
Carbon (Mt/a)	590.6	628.7	677.8	739.4	795.1	Carbon (Mt/a)	0	-0.2	-1.2	-2.4	-3.9	-3.9	-3.9
NO_x (kt/a)	4200.3	3626.2	3760.3	3929.1	3994.6	NOx (kt/a)	0	-2.5	-4.5	-8.06	-6.1	-6.1	-6.1
AEO99 Low Economic Growth Reference Case						**Difference from AEO99 Reference**						
Carbon (Mt/a)[1,3]	586.1	596.3	632.4	670.1	694.6	-1.8	-17	-21	-34.5	-50		
NO_x (kt/a)[2,3]	4182	3465.4	3601.5	3701.3	3737.6	-9	-82	-64	-118	-145		
MEF = 1.04 in 2004 & 1.26 in 2007 Low Economic Growth												
Carbon (Mt/a)	586.1	596.1	631	667.8	691.3	Carbon (Mt/a)	0	-0.2	-1.4	-2.3	-3.3	-3.3	-3.3
NO_x (kt/a)	4182.1	3464.6	3593.7	3693.3	3728.9	NOx (kt/a)	0	-0.8	-7.8	-8	-8.7	-8.7	-8.7

[1] Comparable to Table B19 of AEO99: Electric Generators
[2] Comparable to Table B8 of AEO99: Emissions
[3] All results to metric tons (t), equivalent to 1.1 short tons

Table 9. High and Low Price Elasticity Scenarios: Annual Power Sector Emissions for Proposed Standard (Trial Standard Level 3)

NEMS-BRS Results						Difference from AEO99 Reference							
	2000	2005	2010	2015	2020		2000	2005	2010	201	2020	2025	2030
MEF = 1.04 in 2004 & 1.26 in 2007 Level with Low Price Elasticity													
Carbon (Mt/a)	588.9	612.7	652.1	702.2	741	Carbon (Mt/a)	0	-0.2	-1.1	-2.4	-3.6	-3.6	-3.6
NO_x (kt/a)	4191.2	3545.5	3661.2	3811.4	3876.1	NO_x (kt/a)	0	-1.6	-3.9	-7.8	-6.6	-6.6	-6.6
MEF = 1.04 in 2004 & 1.26 in 2007 Level with High Price Elasticity													
Carbon (Mt/a)	588.9	612.7	652.2	702.3	741	Carbon (Mt/a)	0	-0.2	-1	-2.3	-3.6	-3.6	-3.6
NO_x (kt/a)	4191.2	3545.8	3661.2	3811.4	3875.5	NO_x (kt/a)	0	-1.3	-3.9	-7.8	-7.2	-7.2	-7.2

Table 10. High and Low Economic Growth: Change in Annual Household Emissions for Proposed Standard (Trial Standard Level 3)

Results							
	2000	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
MEF = 1.04 in 2004 & 1.26 in 2007 High Economic Growth							
Carbon (Mt/a)	0	-0.12	-0.6	-1.12	-1.54	-1.54	-1.54
NO_x (kt/a)	0	-0.35	-1.88	-3.66	-4.97	-4.97	-4.97
SO_2 (kt/a)	0	-0.11	-0.56	-1.1	-1.49	-1.49	-1.49
MEF = 1.04 in 2004 & 1.26 in 2007 Low Economic Growth							
Carbon (Mt/a)	0	-0.11	-0.6	-1.18	-1.62	-1.62	-1.62
NO_x (kt/a)	0	-0.35	-1.87	-3.66	-4.97	-4.97	-4.97
SO_2 (kt/a)	0	-0.11	-0.56	-1.1	-1.49	-1.49	-1.49

Table 11. High and Low Price Elasticity: Change in Annual Household Emissions for Proposed Standard (Trial Standard Level 3)

Results							
	2000	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
MEF = 1.04 in 2004 & 1.26 in 2007 Level with Low Price Elasticity[c]							
Carbon (Mt/a)	0	-0.12	-0.61	-1.19	-1.6	-1.6	-1.6
NO_x (kt/a)	0	-0.36	-1.94	-3.78	-5.04	-5.04	-5.04
SO_2 (kt/a)	0	-0.11	-0.58	-1.13	-1.51	-1.51	-1.51
MEF = 1.04 in 2004 & 1.26 in 2007 Level with High Price Elasticity							
Carbon (Mt/a)	0	-0.12	-0.56	-1.11	-1.58	-1.58	-1.58
NO_x (kt/a)	0	-0.35	-1.78	-3.52	-4.95	-4.95	-4.95
SO_2 (kt/a)	0	-0.11	-0.53	-1.06	-1.48	-1.48	-1.48

[c]As used here , low price elasticity means the medium price/income elasticity option in the Shipment/NES spreadsheet model discussed in Chapter 9 of the TSD.

Table 12. Cumulative Power Sector and Household Emission Reductions for High & Low Economic Growth Sensitivities to 2030

Shipment Drop	AEO99 Low Economic Growth	AEO99 Reference Economic Growth	AEO99 High Economic Growth
MEF = 1.04 in 2004 & 1.26 in 2007 (PROPOSED MEF)			
Carbon (Mt)	93.8	95.1	98.6
NO_x (kt)	292.7	253.5	248.5
SO_2 (kt)	28.1	28.1	28.1

Table 13. Cumulative Power Sector and Household Emission Reduction with Elasticity Sensitivities to 2030

Shipment Drop	Sensitivity Price / Income = medium Price Elasticity = none	Reference Case Price Elasticity = medium Price / Income = none	Sensitivity Price Elasticity = high Price / Income = none
MEF = 1.04 in 2004 & 1.26 in 2007 (PROPOSED MEF)			
Carbon (Mt)	97.3	95.1	94.4
NO_x (kt)	256.2	253.5	254.3
SO_2 (kt)	28.7	28.1	27.6

5.2 Water Resources

The measurement of the MEF and the DOE minimum efficiency level do not have as a condition a set maximum water usage. However, energy savings are often achieved by reducing the hot water consumption and in some cases the total water consumption for a wash cycle. Table 14 lists the cumulative reduction in water use through 2020 for each of the efficiency levels. Water savings are based on the results of a manufacturer questionnaire detailing energy and water use of clothes washers under the various efficiency standard scenarios.

Table 14. Cumulative Reduction in Water Use to 2030

Parameter	MEF									
	0.86	0.908	0.961	1.021 TSL 1	1.089 TSL 2	1.257 TSL 4	1.362 TSL 5	1.485	1.634 TSL 6	1.04 in 2004 1.26 in 2007 TSL 3 (PROPOSED MEF)
Trillion Gallons	0.41	0.41	0.41	0.53	9.09	12.9	12.9	10.9	10.9	11.59

The proposed standard would result in significant water savings which amounts to 11.59 trillion gallons through the period 2004 - 2030. This means less water needs to be pumped from U.S. aquifers and rivers, and less strain on many of the nation's overtaxed water and sewer systems. The standards will save enough in less use water to supply the needs of 7.3 million households for 25 years (based on indoor water use). Results of a sensitivity analysis for high and low economic growth and high and low forecasts of price elasticity (i.e., number of washer shipments) are shown below in Tables 15 and 16.

Table 15. Cumulative Water Reduction for High & Low Economic Growth Sensitivities to 2030

Shipment Drop	AEO99 Low Economic Growth	AEO99 Reference Economic Growth	AEO99 High Economic Growth
MEF = 1.04 in 2004 & 1.26 in 2007 (PROPOSED MEF)			
Trillion Gals Water	11.58	11.59	11.59

Table 16. Cumulative Water Reduction with Elasticity Sensitivities to 2030

Shipment Drop	Price / Income = medium Price Elasticity = none	Reference Case Price Elasticity = medium Price / Income = none	Price Elasticity = high Price / Income = none
MEF = 1.04 in 2004 & 1.26 in 2007 (PROPOSED MEF)			
Trillion Gals Water	11.8	11.59	11.5

5.3 Wetlands / Endangered and Threatened Species / Cultural Resources

As this action is not a site-specific action, nor would it change land disturbance due to clothes washer placement, impacts to these resources are not expected. Therefore, this action is not expected to impact the quality of wetlands, or threatened or endangered species, although lowered national water use and reduced air pollution could have a positive impact, if any at all. This action is not expected to impact cultural resources such as historical or archaeological sites.

5.4 Socioeconomic Impacts

Analysis has shown that the possible increase in the first cost of purchasing a more efficient clothes washer is on average offset by a reduction in the life-cycle cost of owning a more efficient washer. This is true for every standard level considered. Although the proposed standard may increase the initial cost of a clothes washer, the proposed standard level has a decrease in life-cycle cost (due to reduced energy and water costs) for 90% of consumers at the first stage in 2004 and for 80% of consumers at the second level of the standard becoming effective in 2007. See chapter 7 and Appendix G of the TSD for details.

5.5 Environmental Justice Impacts

The proposed action, a new minimum efficiency standard for clothes washers, would not cause any adverse environmental impacts, and therefore would not cause any disproportionately high and adverse human health or environmental impacts. Positive impacts, such as decreased air emissions and water conservation, would be equally shared among all populations. However, the department did conduct a consumer utility analysis that looked at economic impacts to low-income and elderly populations. For a complete discussion see chapter 8 and Appendix K of the TSD at the DOE internet site at http://www.eren.doe.gov/buildings/codes_standards/applbrf/clwasher.html.

5.6 Energy Consumption Impacts

The proposed standard level of a 1.04 MEF in 2004 and a second higher level of 1.26 MEF in 2007 (TSL 3) would result in the energy savings through the year 2030 shown in Table 17, when compared against the no-action alternative.

Table 17. Cumulative Energy Savings for Trial Standard Level 3 (Proposed MEF)

	Cumulative Energy Savings in Quads				
	Total	**Electric**	**Gas**	**Oil**	**LPG**
from 2004					
to 2010	0.39	0.23	0.14	0.01	0.01
to 2020	2.51	1.47	0.93	0.06	0.05
To 2030	5.52	3.23	2.05	0.14	0.1

5.7 Summary of Environmental Impacts

This EA provides information on the effects new clothes washer standards would have on pollutants and other emissions as well as on water use. Analysis of carbon and NO_x emissions from the power sector and households indicates that each of the proposed trial standard levels would have a positive impact on the environment. Cumulative power sector and household emissions reductions through 2020 for the proposed standards range from 2.5-65 Mt for carbon and 8.4-210 kt for NO_x. Through 2030, the cumulative emissions reductions range from 5.1-135 Mt for carbon and 14.4-364 kt of NO_x. The reduction in SO_2 emissions ranges from 0.6-15.5 kt through 2020 and from 1.2-31.4 kt through 2030. The corresponding reduction in water use through 2030 ranges from 0.41-12.94 trillion gallons of water.

The major stakeholders, including manufacturers and energy efficiency advocates, have jointly submitted a proposed clothes washer efficiency standard to DOE that they both feel is technically feasible and economically justified. The proposed standard, which is the Department's proposed action for purposes of this EA, would go into effect in two stages. The proposed standard level of a 1.04 MEF (Modified Energy Factor) in 2004 and a second higher level of 1.26 MEF in 2007 would have the following cumulative reductions in emissions. By the year 2025, the annual reduction in fuel needed to generate electricity will be equivalent to the amount needed to run five large coal-fired power plants. (This is equivalent to an annual savings of 0.18 quads of source energy, 0.086 quads of site energy or 24 Tera watt-hours (TWh) of electricity sales). The proposed standard will save enough electricity to light 16 million U.S. homes for 25 years, while cutting greenhouse gas emissions by an amount equal to that produced by three million cars every year. The proposed standard has significant environmental benefits. Cumulative emissions reductions through 2030 are 95.1 Mt (million metric tons) for carbon, 253.5 kt (thousand metric tons) for NO_x, 28.1 kt for SO_2. Water use reductions are 11.59 trillion gallons cumulative to 2030. This means less water needs to be pumped from America's aquifers and rivers, and less strain on many of the nation's overtaxed water and sewer systems. The standards will save enough water to supply the indoor water usage needs of 7.3 million households for 25 years.

REFERENCES

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