CHAPTER 15. EMISSIONS ANALYSIS

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CHAPTER 15. EMISSIONS ANALYSIS

15.1 INTRODUCTION

This chapter describes potential changes to emissions of carbon dioxide (CO_2) and three air pollutants that may result from amended energy conservation standards for standby power in microwave ovens.

15.2 AIR EMISSIONS DESCRIPTIONS AND REGULATION

This analysis considers three air pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_X), and mercury (Hg). An air pollutant is any substance in the air that can cause harm to humans or the environment. Pollutants may take the form of solid particles (i.e., particulates or particulate matter), liquid droplets, or gases.[a] DOE's analysis also considers carbon dioxide (CO_2), which is of interest because of its classification as a greenhouse gas (GHG).

Sulfur Dioxide. Sulfur dioxide, or SO_2, belongs to the family of sulfur oxide gases (SOx). These gases dissolve easily in water. Sulfur is prevalent in all raw materials, including crude oil, coal, and ore that contains common metals like aluminum, copper, zinc, lead, and iron. SOx gases are formed when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore. SO_2 dissolves in water vapor to form acid, and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and their environment.[1]

Nitrogen Oxides. Nitrogen oxides, or NO_X, is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many of the nitrogen oxides are colorless and odorless. However, one common pollutant, nitrogen dioxide (NO_2), along with particles in the air can often be seen as a reddish-brown layer over many urban areas. NO_2 is the specific form of NO_X reported in this document. NO_X is one of the main ingredients involved in the formation of ground-level ozone, which can trigger serious respiratory problems. It can contribute to the formation of acid rain, and can impair visibility in areas such as national parks. NO_X also contributes to the formation of fine particles that can impair human health.[2]

Nitrogen oxides form when fossil fuel is burned at high temperatures, as in a combustion process. The primary manmade sources of NO_X are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fossil fuels. NO_X can also be formed naturally. Electric utilities account for about 22 percent of NO_X emissions in the United States.[2]

Mercury. Coal-fired power plants emit mercury (Hg) found in coal during the burning process. While coal-fired power plants are the largest remaining source of human-generated Hg emissions in the United States, they contribute very little to the global Hg pool or to contamination of U.S. waters.[3] U.S. coal-fired power plants emit Hg in three different forms:

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[a] More information on air pollution characteristics and regulations is available on the U.S. Environment Protection Agent (EPA)'s website at www.epa.gov.

oxidized Hg (likely to deposit within the United States); elemental Hg, which can travel thousands of miles before depositing to land and water; and Hg that is in particulate form. Atmospheric Hg is then deposited on land, lakes, rivers, and estuaries through rain, snow, and dry deposition. Once there, it can transform into methylmercury and accumulate in fish tissue through bioaccumulation.

Americans are exposed to methylmercury primarily by eating contaminated fish. Because the developing fetus is the most sensitive to the toxic effects of methylmercury, women of childbearing age are regarded as the population of greatest concern. Children exposed to methylmercury before birth may be at increased risk of poor performance on neurobehavioral tasks, such as those measuring attention, fine motor function, language skills, visual-spatial abilities, and verbal memory.[4]

Carbon Dioxide. Carbon dioxide (CO_2) is of interest because of its classification as a greenhouse gas (GHG). GHGs trap the sun's radiation inside the Earth's atmosphere and either occur naturally in the atmosphere or result from human activities. Naturally occurring GHGs include water vapor, CO_2, methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Human activities, however, add to the levels of most of these naturally occurring gases. For example, CO_2 is emitted to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), wood, and wood products are burned. In 2007, over 90 percent of anthropogenic (i.e., human-made) CO_2 emissions resulted from burning fossil fuels.[5]

Concentrations of CO_2 in the atmosphere are naturally regulated by numerous processes, collectively known as the "carbon cycle." The movement of carbon between the atmosphere and the land and oceans is dominated by natural processes, such as plant photosynthesis. While these natural processes can absorb some of the anthropogenic CO_2 emissions produced each year, billions of metric tons are added to the atmosphere annually. In the United States, in 2007, CO_2 emissions from electricity generation accounted for 39 percent of total U.S. GHG emissions.[5]

Particulate Matter. Particulate matter (PM), also known as particle pollution, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.

PM impacts are of concern due to human exposures that can impact health. Particle pollution - especially fine particles - contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, for example; decreased lung function; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease.

Power plant emissions can have either direct or indirect impacts on PM. A portion of the pollutants emitted by a power plant are in the form of particulates as they leave the smoke stack. These are direct, or primary, PM emissions. However, the great majority of PM emissions associated with power plants are in the form of secondary sulfates, which are produced at a significant distance from power plants by complex atmospheric chemical reactions that often involve the gaseous (non-particulate) emissions of power plants, mainly SO_2 and NO_x. The quantity of the secondary sulfates produced is determined by a very complex set of factors including the atmospheric quantities of SO_2 and NO_x, and other atmospheric constituents and conditions. Because these highly complex chemical reactions produce PM comprised of different constituents from different sources, EPA does not distinguish direct PM emissions from power plants from the secondary sulfate particulates in its ambient air quality requirements, PM monitoring of ambient air quality, or PM emissions inventories. Further, as described below, it is uncertain whether efficiency standards will result in a net decrease in power plant emissions of $SO_{2,}$ and of NO_x in many States, since those pollutants are now largely regulated by cap and trade systems. For these reasons, it is not currently possible to determine how the standards impact either direct or indirect PM emissions.

Air Quality Regulation. The Clean Air Act Amendments of 1990 list 188 toxic air pollutants that EPA is required to control.[6] EPA has set national air quality standards for six common pollutants (also referred to as "criteria" pollutants), two of which are SO_2 and NO_X. Also, the Clean Air Act Amendments of 1990 gave EPA the authority to control acidification and to require operators of electric power plants to reduce emissions of SO_2 and NO_X. Title IV of the 1990 amendments established a cap-and-trade program for SO_2, in all 50 states and the District of Columbia (D.C.), intended to help control acid rain.[6] This cap-and-trade program serves as a model for more recent programs with similar features.

In 2005, EPA issued the Clean Air Interstate Rule (CAIR) under sections 110 and 111 of the Clean Air Act (40 CFR Parts 51, 96, and 97).[b] 70 FR 25162–25405 (May 12, 2005). CAIR limited emissions from 28 eastern States and D.C. by capping emissions and creating an allowance-based trading program. Although, CAIR was remanded to EPA by the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit), (see *North Carolina v. EPA*, 550 F.3d 1176 (D.C. Cir. 2008),) it remained in effect temporarily, consistent with the D.C. Circuit's earlier opinion in *North Carolina v. EPA*, 531 F.3d 896 (D.C. Cir. 2008).

On July 6, 2011, EPA promulgated a replacement for CAIR, entitled "Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals," but commonly referred to as the Cross-State Air Pollution Rule or the Transport Rule. 76 FR 48208 (Aug. 8, 2011). On December 30, 2011, however, the D.C. Circuit stayed the new rules while a panel of judges reviews them, and told EPA to continue enforcing CAIR (see *EME Homer City Generation v. EPA*, No. 11-1302, Order at *2 (D.C. Cir. Dec. 30, 2011)).

On December 21, 2011, EPA announced national emissions standards for hazardous air pollutants (NESHAPs) for mercury and certain other pollutants emitted from coal and oil-fired EGUs. (http://epa.gov/mats/pdfs/20111216MATSfinal.pdf) The NESHAPs do not include a

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[b] See http://www.epa.gov/cleanairinterstaterule/.

trading program and, as such, DOE's energy conservation standards would likely reduce Hg emissions.

15.3 GLOBAL CLIMATE CHANGE

Climate change has evolved into a matter of global concern because it is expected to have widespread, adverse effects on natural resources and systems. A growing body of evidence points to anthropogenic sources of greenhouse gases, such as carbon dioxide (CO_2), as major contributors to climate change. Because this rule, if finalized, will likely decrease CO_2 emission rates from the fossil fuel sector in the United States, the Department here examines the impacts and causes of climate change.

Impacts of Climate Change on the Environment. Climate is usually defined as the average weather, over a period ranging from months to many years. Climate change refers to a change in the state of the climate, which is identifiable through changes in the mean and/or the variability of its properties (e.g., temperature or precipitation) over an extended period, typically decades or longer.

The World Meteorological Organization and United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) to provide an objective source of information about climate change. According to the IPCC Fourth Assessment Report (IPCC Report), published in 2007, climate change is consistent with observed changes to the world's natural systems; the IPCC expects these changes to continue. [7]

Changes that are consistent with warming include warming of the world's oceans to a depth of 3000 meters; global average sea level rise at an average rate of 1.8 mm per year from 1961 to 2003; loss of annual average Arctic sea ice at a rate of 2.7 percent per decade, changes in wind patterns that affect extra-tropical storm tracks and temperature patterns, increases in intense precipitation in some parts of the world, as well as increased drought and more frequent heat waves in many locations worldwide, and numerous ecological changes.[8]

Looking forward, the IPCC describes continued global warming of about 0.2 °C per decade for the next two decades under a wide range of emission scenarios for carbon dioxide (CO_2), other greenhouse gases (GHGs), and aerosols. After that period, the rate of increase is less certain. The IPCC Report describes increases in average global temperatures of about 1.1 °C to 6.4 °C at the end of the century relative to today. These increases vary depending on the model and emissions scenarios.[8]

The IPCC Report describes incremental impacts associated with the rise in temperature. At ranges of incremental increases to the global average temperature, IPCC reports, with either high or very high confidence, that there is likely to be an increasing degree of impacts such as coral reef bleaching, loss of wildlife habitat, loss to specific ecosystems, and negative yield impacts for major cereal crops in the tropics, but also projects that there likely will be some beneficial impacts on crop yields in temperate regions.

Causes of Climate Change. The IPCC Report states that the world has warmed by about 0.74 °C in the last 100 years. The IPCC Report finds that most of the temperature increase since the mid-20th century is very likely due to the increase in anthropogenic concentrations of CO_2 and other long-lived greenhouse gases such as methane and nitrous oxide in the atmosphere, rather than from natural causes.

Increasing the CO_2 concentration partially blocks the earth's re-radiation of captured solar energy in the infrared band, inhibits the radiant cooling of the earth, and thereby alters the energy balance of the planet, which gradually increases its average temperature. The IPCC Report estimates that currently, CO_2 makes up about 77 percent of the total CO_2-equivalent[c] global warming potential in GHGs emitted from human activities, with the vast majority (74 percent) of the CO_2 attributable to fossil fuel use.[8] For the future, the IPCC Report describes a wide range of GHG emissions scenarios, but under each scenario CO_2 would continue to comprise above 70 percent of the total global warming potential.[9]

Stabilization of CO_2 Concentrations. Unlike many traditional air pollutants, CO_2 mixes thoroughly in the entire atmosphere and is long-lived. The residence time of CO_2 in the atmosphere is long compared to the emission processes. Therefore, the global cumulative emissions of CO_2 over long periods determine CO_2 concentrations because it takes hundreds of years for natural processes to remove the CO_2. Globally, 49 billion metric tons of CO_2 – equivalent of anthropogenic (man-made) greenhouse gases are emitted every year.[d] Of this annual total, fossil fuels contribute about 29 billion metric tons of CO_2.[9]

Researchers have focused on considering atmospheric CO_2 concentrations that likely will result in some level of global climate stabilization, and the emission rates associated with achieving the "stabilizing" concentrations by particular dates. They associate these stabilized CO_2 concentrations with temperature increases that plateau in a defined range. For example, at the low end, the IPCC Report scenarios target CO_2 stabilized concentrations range between 350 ppm and 400 ppm (essentially today's value)—because of climate inertia, concentrations in this low-end range would still result in temperatures projected to increase 2.0 °C to 2.4 °C above pre-industrial levels[e] (about 1.3 °C to 1.7 °C above today's levels). To achieve concentrations between 350 ppm to 400 ppm, the IPCC scenarios present that there would have to be a rapid downward trend in total annual global emissions of greenhouse gases to levels that are 50 to 85 percent below today's annual emission rates by no later than 2050. Since it is assumed that there would continue to be growth in global population and substantial increases in economic production, the scenarios identify required reductions in greenhouse gas emissions intensity (emissions per unit of output) of more than 90 percent. However, even at these rates, the

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[c] GHGs differ in their warming influence (radiative forcing) on a global climate system due to their different radiative properties and lifetimes in the atmosphere. These warming influences may be expressed through a common metric based on the radiative forcing of CO_2, i.e., CO_2-equivalent. CO_2 equivalent emission is the amount of CO_2 emission that would cause the same- time integrated radiative forcing, over a given time horizon, as an emitted amount of other long- lived GHG or mixture of GHGs.

[d] Other non-fossil fuel contributors include CO_2 emissions from deforestation and decay from agriculture biomass; agricultural and industrial emissions of methane; and emissions of nitrous oxide and fluorocarbons.

[e] IPCC Working Group 3 Table TS 2

scenarios describe some warming and some climate change is projected due to already accumulated CO_2 and GHGs in the atmosphere.[10]

It is difficult to correlate specific emission rates with atmospheric concentrations of CO_2 and specific atmospheric concentrations with future temperatures because the IPCC Report describes a clear lag in the climate system between any given concentration of CO_2 (even if maintained for long periods) and the subsequent average worldwide and regional temperature, precipitation, and extreme weather regimes. For example, a major determinant of climate response is "equilibrium climate sensitivity", a measure of the climate system response to sustained radioactive forcing. It is defined as the global average surface warming following a doubling of carbon dioxide concentrations. The IPCC Report describes its estimated, numeric value as about 3 °C, but the likely range of that value is 2 °C to 4.5 °C, with cloud feedbacks the largest source of uncertainty. Further, as illustrated above, the IPCC Report scenarios for stabilization rates are presented in terms of a range of concentrations, which then correlates to a range of temperature changes. Thus, climate sensitivity is a key uncertainty for CO_2 mitigation scenarios that aim to meet specific temperature levels.

15.4 ANALYTICAL METHODS FOR AIR EMISSIONS

For each of the considered TSLs, DOE calculated total power-sector emissions based on output from the NEMS-BT model (see chapter 14 for description of the model).

Coal-fired electric generation is the single largest source of electricity in the United States. Because the mix of coals used significantly affects the emissions produced, the model includes a detailed representation of coal supply. The model considers the rank of the coal as well as the sulfur contents of the fuel used when determining optimal dispatch.

Within the NEMS-BT model, planning options for achieving emissions restrictions in the Clean Air Act Amendments include installing pollution control equipment on existing power plants and building new power plants with low emission rates. These methods for reducing emission are compared to dispatching options such as fuel switching and allowance trading. Environmental regulations also affect capacity expansion decisions. For instance, new plants are not allocated SO_2 emissions allowances according to the Clean Air Act Amendments. Consequently, the decision to build a particular capacity type must consider the cost (if any) of obtaining sufficient allowances. This could involve purchasing allowances or over-complying at an existing unit.

For this analysis, DOE used the version of NEMS-BT based on *AEO 2010*, which assumes the implementation of CAIR. Thus, DOE's analysis assumes the presence of nationwide emission caps on SO_2 and caps on NO_X emissions in the 28 States covered by CAIR.

SO_2 emissions from affected Electric Generating Units (EGUs) are subject to nationwide and regional emissions cap and trading programs, which create uncertainty about the impact of energy efficiency standards on SO_2 emissions. The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the imposition of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by any regulated EGU. However, if the standard resulted in a permanent increase in the quantity of unused emissions allowances, there would be an overall reduction in SO_2 emissions from the standards. While there remains some uncertainty about the ultimate effects of efficiency standards on SO_2 emissions covered by the existing cap and trade system, the NEMS-BT model that DOE uses to forecast emissions reductions currently indicates that no physical reductions in power sector emissions would occur for SO_2.[f]

The CAIR established a cap on NO_x emissions in 28 eastern states and the District of Columbia. All these States and D.C. have elected to reduce their NOx emissions by participating in cap-and-trade programs for EGUs. Therefore, energy conservation standards may have little or no physical effect on these emissions in the 28 eastern States and the D.C. for the same reasons that they may have little or no physical effect on SO_2 emissions.

DOE estimated mercury emissions reductions using NEMS-BT based on *AEO2010*, which does not incorporate the NESHAPs. DOE expects that future versions of the NEMS-BT model will reflect the implementation of the NESHAPs.

As noted in chapter 14, NEMS-BT model forecasts end in year 2035. Rather than extrapolate beyond this year, DOE assumes that emissions impacts beyond 2035 are equal to the impacts in 2035.

15.5 EFFECTS ON POWER PLANT EMISSIONS

Table 15.5.1 shows *AEO2010* reference case power plant emissions in selected years. The Reference Case emissions are the emissions shown by the NEMS-BT model to result if none of the TSLs are promulgated (the base case).

Table 15.5.1 Power Sector Emissions Forecast from *AEO2010* Reference Case

NEMS-BT Results	2010	2015	2020	2025	2030	2035
CO_2 (million metric tons)	2,218	2,278	2,341	2,421	2,534	2,636
NO_X (million tons)	2.24	2.06	2.02	2.03	2.06	2.07
Hg (tons)	40.6	30.6	30.1	30.0	30.2	30.3

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[f] In contrast to the modeling forecasts of NEMS-BT that SO_2 emissions will remain at the cap, during the years 2007 and 2008, SO_2 emissions were below the trading cap. This raises the possibility that standards could cause some reduction in SO_2 emissions. However, because DOE does not have a method to predict when emissions will be below the trading cap, it continues to reply on NEMS-BT and thus does not estimate SO_2 emissions reductions at this time.

Table 15.5.2 shows the estimated changes in power plant emissions by TSL for standby power in microwave ovens. The tables display changes in CO_2, NO_x, and Hg emissions in selected years for each of the TSLs. "Mt" refers to "million metric tons."

Table 15.5.2 Power Sector Emissions Impacts Forecasts for Microwave Oven Standby Power TSLs

NEMS-BT Results*	**Difference from AEO2010 Reference Case**								
							Extrapolation		**Total**
	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2043**	**2014-2043**
Standard Level 1									
CO_2 (Mt/yr)	0.04	0.02	-0.42	-0.72	-0.67	-0.60	-0.60	-0.60	**-15.8**
NOx (1,000 tons/yr)	0.04	0.02	-0.36	-0.61	-0.55	-0.47	-0.47	-0.47	**-12.9**
Hg (ton/yr)	0.000	0.000	-0.003	-0.003	-0.004	-0.003	-0.003	-0.003	**-0.074**
Sandard Level 2									
CO_2 (Mt/yr)	0.06	0.03	-0.61	-1.04	-0.97	-0.87	-0.87	-0.87	**-22.9**
NOx (1,000 tons/yr)	0.06	0.03	-0.52	-0.87	-0.79	-0.68	-0.68	-0.68	**-18.6**
Hg (ton/yr)	0.000	0.001	-0.004	-0.004	-0.005	-0.004	-0.004	-0.004	**-0.107**
Standard Level 3									
CO_2 (Mt/yr)	0.09	0.05	-0.84	-1.43	-1.34	-1.19	-1.19	-1.19	**-31.5**
NOx (1,000 tons/yr)	0.09	0.04	-0.72	-1.20	-1.09	-0.94	-0.94	-0.94	**-25.6**
Hg (ton/yr)	0.000	0.001	-0.006	-0.006	-0.007	-0.005	-0.005	-0.005	**-0.147**
Standard Level 4									
CO_2 (Mt/yr)	0.14	0.07	-1.29	-2.20	-2.06	-1.84	-1.84	-1.84	**-48.5**
NOx (1,000 tons/yr)	0.14	0.07	-1.11	-1.85	-1.67	-1.44	-1.44	-1.44	**-39.4**
Hg (ton/yr)	0.000	0.001	-0.009	-0.009	-0.011	-0.008	-0.008	-0.008	**-0.226**

*CO_2 results are in metric tons, NO_X and Hg results are in short tons.

15.6 EFFECTS ON UPSTREAM FUEL-CYCLE EMISSIONS

Upstream fuel-cycle emissions refer to the emissions associated with the amount of energy used in the upstream production and downstream consumption of electricity, including energy used at the power plant.[17] Upstream processes include the mining of coal or extraction of natural gas, physical preparatory and cleaning processes, and transportation to the power plant. The NEMS-BT does a thorough accounting of emissions at the power plant due to downstream energy consumption, but does not account for upstream emissions (i.e., emissions from energy losses during coal and natural gas production). Thus, this analysis reports only power plant emissions.

However, previous DOE environmental assessment documents have developed approximate estimates of effects on upstream fuel-cycle emissions. These emissions factors provide the reader with a sense of the possible magnitude of upstream effects. These upstream emissions would be in addition to emissions from direct combustion.

Relative to the entire fuel cycle, estimates based on the work of Dr. Mark DeLuchi, and reported in earlier DOE environmental assessment documents, find that an amount approximately equal to eight percent, by mass, of emissions (including SO_2) from coal production are due to mining, preparation that includes cleaning the coal, and transportation from the mine to the power plant.[18] Transportation emissions include emissions from the fuel used by the mode of transportation that moves the coal from the mine to the power plant. In addition, based on Dr. DeLuchi's work, DOE estimated that an amount equal to approximately 14 percent of emissions from natural gas production result from upstream processes.

Emission factor estimates and corresponding percentages of contributions of upstream emissions from coal and natural gas production, relative to power plant emissions, are shown in Table 15.6.1 for CO_2 and NO_X. The percentages provide a means to estimate upstream emission savings based on changes in emissions from power plants. This approach does not address Hg emissions.

Table 15.6.1 Estimated Upstream Emissions of Air Pollutants as a Percentage of Direct Power Plant Combustion Emissions

Pollutant	Percent of Coal Combustion Emissions	Percent of Natural Gas Combustion Emissions
CO_2	2.7	11.9
NO_X	5.8	40

15.7 SUMMARY OF EMISSIONS IMPACTS

Table 15.7.1 summarizes the estimated emissions impacts for each of the TSLs for standby power in microwave ovens. It shows cumulative changes in emissions for CO_2, NO_X, and Hg for 2014 through 2043 for each of the TSLs. Cumulative CO_2, NO_X, and Hg emissions are reduced compared to the Reference case for all TSLs. For comparison, the cumulative power sector emissions in the *AEO2010* Reference case, over the period 2014 through 2043, are 74,571 Mt for CO_2, 61,625 kt for NOx, and 917 tons for Hg.

Upstream fuel cycle emission of CO_2 and NO_X are described but not quantified in section 15.2.6. The text describes potential reductions in fuel cycle emissions as percentage of decreases in power plant emissions. This approach suggests that upstream fuel cycle emissions would decrease and provides a sense for the magnitude of effects; however DOE does not report actual estimates of the effects.

For subgroups of low-income and senior consumers that purchase microwave ovens, DOE determined that the average LCC impact of the standards is similar to that for the full sample of consumers. Therefore, DOE concludes that the proposed standards would have no significant adverse socioeconomic impact.

No impacts are anticipated in the areas of environmental justice, wetlands, endangered and threatened species, and cultural resources; or noise and aesthetics.

Table 15.7.1 Cumulative Emissions Reductions Under Microwave Oven Standby Power TSLs*

	TSL 1	**TSL 2**	**TSL 3**	**TSL 4**
Microwave Oven Standby Power				
CO_2 (Mt)	15.8	22.9	31.5	48.5
NO_X (1,000 tons)	12.9	18.6	25.6	39.4
Hg (ton)	0.074	0.107	0.147	0.226

*CO_2 results are in million metric tons; NO_X and Hg results are in short tons.

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