Environmental Assessment for the Proposed Rule, 10 CFR Part 433 and 10 CFR Part 435, "Fossil Fuel-Generated Energy Consumption Reduction for New Federal Buildings and Major Renovations of Federal Buildings (DOE/EA-1778)

SUMMARY

The U.S. Department of Energy (DOE) has prepared this Environmental Assessment (EA) for DOE's Supplemental Notice of Proposed Rulemaking (SNOPR), 10 CFR Part 433 and 10 CFR 435, "Fossil Fuel-Generated Energy Consumption Reduction for New Federal Buildings and Major Renovations of Federal Buildings. Section 433 of the Energy Independence and Security Act (EISA) of 2007 (Pub. L. 110-140) modifies section 305 of ECPA by adding a new section 305(a)(3)(D) which requires DOE, through regulation, to update the energy efficiency requirements for new Federal buildings and Federal buildings undergoing major renovations by requiring that two categories of Federal buildings be designed to reduce their fossil-fuel generated energy consumption. Section 433 of EISA also requires that sustainable design principles be applied in the siting, design, and construction of Federal buildings. In addition, DOE is directed by section 523 of EISA to establish regulations that require solar water heaters be installed to the extent they are life-cycle cost-effective. (42 U.S.C. 6834(a)(3)(A)(iii)). However, this Environmental Assessment only addresses the fossil fuel-generated reduction requirements contained in the Proposed Rule. The sustainable design requirements from Section 433 of EISA are being addressed in a parallel but separate rulemaking.

On October 15, 2010, DOE published a Notice of Proposed Rulemaking (NOPR) proposing fossil fuel-generated energy consumption reduction requirements similar to those in the SNOPR. 75 FR 63404 DOE held a public meeting during which the Department took comments on the NOPR and also received comments via a 60 day comment period. The SNOPR reflects many of the comments made on the NOPR. The SNOPR summarizes these comments and the differences between the original NOPR and SNOPR.

The EA examines the potential incremental environmental impacts of the Proposed Rule on building habitability and the outdoor environment. To identify the potential environmental impacts that may result from implementing the Proposed Rule for new Federal buildings, DOE compared the Proposed Rule with the "no-action alternative" of using the current Federal building energy efficiency standards found at 10 CFR Part 433 and 10 CFR Part 435 (referred to as the "no-action alternative"). The no-action alternative requires new Federal commercial and multi-family high-rise residential buildings to achieve a level of energy consumption 30 percent below that of the ANSI/ASHRAE/IESNA Standard 90.1-2010, or the IECC 2009 Edition (2009 IECC) for new Federal low-rise residential buildings, when life-cycle cost-effective. Note that some federal buildings may not be required to meet the 30 percent requirement if it is not found to be life-cycle cost-effective. At a minimum, however, new Federal commercial or low-rise residential buildings are required to meet ASHRAE 90.1-2010 or the IECC 2009, respectively. Though individual building efficiency levels will vary, DOE has determined that it would be useful to compare the Proposed Rule to both ASHRAE 90.1-2010 and a level 30% below ASHRAE 90.1-2010 for new Federal commercial and multi-family high-rise residential buildings, and to the 2009 IECC for new Federal low-rise residential buildings.

There are two aspects of the Proposed Rule that should also be noted. The first aspect is that the Proposed Rule addresses both new Federal construction and major renovations of existing Federal buildings. The current regulations (in 10 CFR Part 433 and 10 CFR Part 435) only address new Federal construction. The second aspect is that the Proposed Rule has a minimum cost-threshold of $2.5 million (in 2007$). This threshold means that it is very unlikely that Federal low-rise residential buildings will be likely meet the threshold and therefore the impacts of the Proposed Rule on low-rise residential construction covered in 10 CFR Part 435 is not addressed in this EA.

Building Habitability (Indoor Air) Impacts

The Proposed Rule would not change mechanical ventilation rates or affect sources of indoor air pollutants from the no-action alternative. The Proposed Rule does not require specific mechanical ventilation rates and the rule does not require any changes in mechanical ventilation rates. The Proposed Rule does not require any changes for sealing of the building envelope and therefore natural ventilation through leaks and cracks in the building envelope is not expected to increase or decrease. Accordingly, indoor air pollutant levels are not expected to increase under the Proposed Rule.

Outdoor-Air Environmental Impacts

Table S-1 summarizes the estimated emissions impacts for each of the alternatives for the Federal building energy efficiency standard. It shows cumulative changes in emissions for CO2, NOx, mercury, and SO2 for 30 years of construction (2015 through 2044) and 30 years of energy reduction for each building built during that period. Cumulative CO2, NOx, and mercury emissions are reduced compared to the Reference case for all alternatives. Emission reductions for SO2 are negligible.

Table S-1. 30 Year Cumulative Emissions of CO2, NOX, Mercury, and SO2

Baseline (no-action alternative)	Proposed Rule	Carbon Dioxide	Nitrogen Oxides	Mercury	Sulfur Dioxide
ASHRAE 90.1-2010	FF SNOPR	94,494,338	88,348	1.16	Negligible
30% Below ASHRAE 90.1-2010	FF SNOPR	64,009,348	58,447	0.76	Negligible

Table S-2 summarizes the estimated emissions impacts for six additional pollutants – methane, nitrous oxide (NO), halocarbons, carbon monoxide (CO), particulate matter (PM), and lead. It shows cumulative changes in emissions for a thirty year period for each of the alternatives. Cumulative emissions are reduced compared to

the Reference case for all alternatives. Emissions impacts for all but methane are negligible.

Table S-2. 30 Year Cumulative Emissions of Methane, Nitrous Oxide, Halocarbons, Carbon Monoxide, Particulate Matter, and Lead

Baseline (no-action alternative)	Proposed Rule	Methane	Nitrous Oxide and Halocarbons	Carbon Monoxide, Particulate Matter, and Lead
ASHRAE 90.1-2010	FF SNOPR	936,016	Negligible	Negligible
30% Below ASHRAE 90.1-2010	FF SNOPR	629,181	Negligible	Negligible

ABBREVIATIONS AND ACRONYMS

ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
CAIR	Clean Air Interstate Rule
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO_2	carbon dioxide
CO	carbon monoxide
D.C.	District of Columbia
DOE	Department of Energy
EA	environmental assessment
ECPA	Energy Conservation and Production Act
EGU	electric generating unit
EPA	Environmental Protection Agency
EUI	Energy use intensity, kBtu/ft2-yr
FR	Federal Register
ft^2	square feet
GHG	greenhouse gas
HVAC	heating, ventilation, and air conditioning
IPCC	Intergovernmental Panel on Climate Change
IESNA	Illuminating Engineering Society of North America
kBtu	one thousand British thermal units
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act of 1969
NESHAP	national emissions standards for hazardous air pollutants
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NRC	National Research Council
O_3	ozone
PM	particulate matter
SO_2	sulfur dioxide
SO_x	sulfur oxide gases
UNEP	United Nations Environment Programme
U.S.C.	United States Code
VOC	volatile organic compounds

CONTENTS

TABLES

1 PURPOSE AND NEED FOR AGENCY ACTION

This Environmental Assessment (EA) complies with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), the implementing regulations of the Council on Environmental Quality (40 CFR Parts 1500-1508), and DOE's regulations for implementing the National Environmental Policy Act of 1969 (NEPA) (10 CFR Part 1021). Section 433 of the Energy Independence and Security Act (EISA) of 2007 (Pub. L. 110-140) modifies section 305 of ECPA by adding a new section 305(a)(3)(D) which requires DOE, through regulation, to update the energy efficiency requirements such that:

> (i) For new Federal buildings and Federal buildings undergoing major renovations, with respect to which the Administrator of General Services is required to transmit a prospectus to Congress under section 3307 of title 40, United States Code, in the case of public buildings (as defined in section 3301 of title 40, United States Code), or of at least $2,500,000 in costs adjusted annually for inflation for other buildings: (I) The buildings shall be designed so that the fossil fuel-generated energy consumption of the buildings is reduced, as compared with such energy consumption by a similar building in fiscal year 2003 (as measured by Commercial Buildings Energy Consumption Survey (CBECS) or Residential Energy Consumption Survey (RECS) data from the Energy Information Agency), by the percentage specified in the following table:
>
> | Fiscal Year | Percentage Reduction |
> |---|---|
> | 2010 | 55 |
> | 2015 | 65 |
> | 2020 | 80 |
> | 2025 | 90 |
> | 2030 | 100. |

There are two aspects of the Proposed Rule that should also be noted. The first aspect is that the Proposed Rule addresses both new Federal construction and major renovations of existing Federal buildings. The current regulations (in 10 CFR Part 433 and 10 CFR Part 435) address only new Federal construction. The second aspect is that the Proposed Rule has a minimum cost-threshold of $2.5 million (in 2007$). This threshold means that it is very unlikely that Federal low-rise residential buildings will be likely meet the threshold and therefore the impacts of the Proposed Rule on low-rise residential construction covered in 10 CFR Part 435 is not addressed in this EA.

This EA is in support of a Supplemental Proposed Rulemaking to continue DOE's efforts to comply with section 305(a)(3)(D) of ECPA. The EA identifies possible incremental environmental effects of the Supplemental Proposed Rule on Federal buildings.

2 THE PROPOSED RULE AND ALTERNATIVES

In accordance with NEPA, this section discusses the elements of the Proposed Rule itself, as well as alternative actions that may be taken in place of the Proposed Rule. Section 2.1 describes the Proposed Rule, the no-action alternatives (meeting or exceeding ASHRAE 90.1-2010) for commercial and multi-family high-rise residential buildings. Section 2.2 describes the Proposed Rule, the no-action alternatives (meeting or exceeding 2009 IECC) for low-rise residential buildings. Section 2.3 provides some details about how the Proposed Rule and no-action alternatives differ.

2.1 Commercial and Multi-Family High-Rise Residential Buildings

The potential environmental impacts that would result from implementing the Proposed Rule for new Federal commercial and multi-family high-rise residential buildings (over three stories in height above ground) were examined by comparing the Proposed Rule with the existing 10 CFR Part 433, which requires federal buildings to meet ASHRAE 90.1-2010 at a minimum, and exceed it by up to 30% if life-cycle cost-effective.[1] Though the baseline will vary based on what efficiency levels are found to be life-cycle cost-effective, DOE believes that using both 90.1-2010 and a level 30% better than 90.1-2010, will be instructive for the purposes of this EA.

2.1.1 The Proposed Rule (Commercial and High-Rise Residential Buildings)

The Proposed Rule requires that, for new Federal commercial and multi-family high-rise residential buildings and Federal commercial and high-rise residential buildings undergoing major renovations, the buildings shall be designed so that the fossil fuel-generated energy consumption of the buildings is reduced, as compared with such energy consumption by a similar building in fiscal year 2003 (as measured by Commercial Buildings Energy Consumption Survey (CBECS) data from the Energy Information Agency), by the percentage specified in the following table:

Fiscal Year	Percentage Reduction
2010	55
2015	65
2020	80
2025	90
2030	100

[1] As of August 2013, the current requirements in 10 CFR 433 are to meet ASHRAE Standard 90.1-2007 and to exceed that by 30% if life-cycle cost-effective. On July 9, 2013, DOE published an update to the baseline standard for 10 CFR 433 changing the baseline standard from Standard 90.1-2007 to Standard 90.1-2010, with the new baseline applying to building whose design for construction starts on or after July 9, 2014. In the expectation that the Supplemental Proposed Rule will not go into effect until after July 9, 2014, DOE has chosen to use Standard 90.1-2010 as the baseline for 10 CFR 433 for this EA.

The caveat to this rule is that it only applies to "new Federal buildings and Federal buildings undergoing major renovations, with respect to which the Administrator of General Services is required to transmit a prospectus to Congress under section 3307 of title 40, United States Code, in the case of public buildings (as defined in section 3301 of title 40, United States Code), or of at least $2,500,000 in costs adjusted annually for inflation for other buildings…"

For commercial and multi-family high-rise residential buildings constructed by the Federal government, it is assumed that virtually all these buildings will be impacted by the Proposed Rule.

2.1.2 The "No-Action" Alternative One – ASHRAE 90.1-2010 (Commercial and Multi-Family High-Rise Residential Buildings)

The no-action alternative is defined as the current practice for new Federal buildings. Current practice for Federal buildings is prescribed by the energy efficiency requirements found in 10 CFR Part 433. 10 CFR 433.4(a)(1) requires that at a minimum, new Federal buildings must meet ASHRAE 90.1-2010.

2.1.3 The "No-Action" Alternative Two – Exceed ASHRAE 90.1-2010 by 30% (Commercial and Multi-Family High-Rise Residential Buildings)

The second no-action alternative is also described in 10 CFR Part 433. Under the current regulations, Federal buildings must achieve a level of efficiency 30% better than ASHRAE 90.1-2010, if life-cycle cost-effective. If a 30% reduction is not life-cycle cost-effective, the highest level of efficiency that is found to be life-cycle cost-effective must be used, with 90.1-2010 as a minimum. However, for the purposes of this EA, the "No-action" Alternative Two will assume a level of efficiency 30% better than 90.1-2010.

2.2 Low-Rise Residential Buildings

The potential environmental impacts that would result from implementing the Proposed Rule for new Federal low-rise residential buildings (three stories or less in height above ground) were examined by comparing the Proposed Rule with the current regulations at 10 CFR Part 435. Under these regulations, new buildings must be 30% more efficient than the 2009 IECC, if life-cycle cost-effective. If a level of efficiency 30% below the 2009 IECC is not found to be life-cycle cost-effective, the highest level of efficiency that is found to be life-cycle cost-effective must be used. As a minimum, the buildings must meet the 2009 IECC. As such, the level of efficiency for each building under the Proposed Rule will vary significantly. However, for the purposes of this EA, the Proposed Rule is compared to both the minimum requirement under the existing rule (to meet the 2009 IECC) and a level of efficiency 30% better than the 2009 IECC.

2.2.1 The Proposed Rule (Low-Rise Residential Buildings)

The Proposed Rule would require that for new Federal low-rise residential buildings and major renovations of Federal low-rise residential buildings, the buildings shall be designed so that the fossil fuel-generated energy consumption of the buildings is reduced, as compared with such energy consumption by a similar building in fiscal year 2003 (as measured by Residential Energy Consumption Survey data from the Energy Information Agency), by the percentage specified in the following table:

Fiscal Year	Percentage Reduction
2010	55
2015	65
2020	80
2025	90
2030	100.

The caveat to this rule is that it only applies to "new Federal buildings and Federal buildings undergoing major renovations, with respect to which the Administrator of General Services is required to transmit a prospectus to Congress under section 3307 of title 40, United States Code, in the case of public buildings (as defined in section 3301 of title 40, United States Code), or of at least $2,500,000 in costs adjusted annually for inflation for other buildings…"

Since the Proposed Rule only effectively pertains to buildings that cost at least $2.5 million, DOE believes that very few (if any) low-rise residential buildings will be affected by this rule. For this reason, the remainder of this report focuses solely on Federal commercial and multi-family high-rise residential buildings.

3 ENVIRONMENTAL IMPACTS

The Proposed Rule would establish requirements that may impact building habitability (indoor environment), the outdoor environment, and the Federal agencies that procure commercial and residential buildings. Section 3.1 addresses air emissions that can affect indoor-air quality and related human health effects. Section 3.2 addresses air emissions in the outdoor environment.

3.1 Indoor Habitability

Energy efficiency codes can potentially affect indoor-air quality, either adversely or beneficially. The primary indoor-air emissions that can adversely affect human health in typical commercial and residential buildings are particulate matter, carbon monoxide (CO), carbon dioxide (CO2), nitrogen dioxide (NO2), radon, formaldehyde, volatile organic compounds, and biological contaminants.

Building energy code requirements could influence the concentration levels of indoor-air emissions in several ways. First, they could increase or decrease the ventilation and/or infiltration of fresh air from outdoors, which generally could reduce or increase indoor-generated pollutant concentration levels, respectively. The Proposed Rule would not change ventilation or infiltration relative to the no-action alternatives for commercial and high-rise multi-family residential buildings. Therefore, there should be no impact on overall building infiltration from use of the Proposed Rule.

Second, requirements in energy efficiency codes have the potential to impact internally generated indoor emissions by changing the materials or equipment used within the buildings. Various emissions can be continuously or intermittently released within commercial and residential buildings. These emissions can originate from furnishings within a building (e.g., carpet, furniture), from building materials (e.g., insulation material, particle board), from the ground (e.g., radon), from the building occupants' indoor activities (e.g., tobacco smoking, painting), or from the mechanical equipment (e.g., fossil-fuel appliances). Potential combustion emissions include CO, CO2, nitrogen oxides, and sulfur dioxide (SO2). Fossil-fuel-burning (including gas stoves/ovens) equipment and, if allowed, tobacco smoke, are the main sources of combustion products. In addition, sources from outside the building (particularly vehicle exhaust) can be drawn into the building. The Proposed Rule is not expected to change pollutant rates from indoor sources of air pollution compared to the no-action alternatives.

Table 1 summarizes the principal indoor air emissions that can potentially be of concern within buildings.

Table 1 Indoor-Air Emissions

Pollutant	Health Impacts	Sources
Particulate Matter	Lung cancer, bronchitis and respiratory infections. Eye, nose, and throat irritations.	Fossil fuel combustion, dust, smoking.
Carbon Monoxide	CO is an odorless and colorless gas that is an asphyxiate and disrupts oxygen transport. At high concentration levels, CO causes loss of consciousness and death.	Unvented kerosene and gas space heaters; leaking chimneys and furnaces; back drafting from furnaces, gas water heaters, wood stoves, and fireplaces; gas stoves; and automobile exhaust from attached garages.
Carbon Dioxide	An excessive concentration of CO_2 triggers increased breathing to maintain the proper exchange of oxygen and CO_2. Concentrations above 3 percent can cause headaches, dizziness, and nausea. Concentrations above 6 percent can cause death (NRC 1981)	Sources include human respiration, tobacco smoking, gas stoves, and gas ovens.
Nitrogen Dioxide	NO_2 acts mainly as an irritant, affecting the eyes, nose, throat, and respiratory tract. Extremely high-dose exposure to NO_2 (as in a building fire) may result in pulmonary edema and diffuse lung injury. Continued exposure to high NO_2 levels can lead to acute bronchitis (EPA 1994)	Sources include kerosene heaters, gas stoves, ovens, and tobacco smoke.
Radon	Radon decay products in breathed air can deposit and stay in the lungs, sometimes contributing to lung cancer. The National Academy of Sciences (NAS) estimates that 15,400 to 21,800 people in the United States die from lung cancer attributable to radon, although the number could be as low as 3,000 or as high as 32,000 (NAS 1998). A large majority of the deaths happen to cigarette smokers. Radon is much less of a concern in commercial buildings than in residential buildings because these buildings usually have mechanical ventilation and occupants are typically not in the buildings as many hours a week as they are in their homes.	Radon is a radioactive gas that occurs in nature. The greatest single source of radon is from the soil. It can be found in soils and rocks containing uranium, granite, shale, phosphate, and pitchblende (Moffat 1997).

Pollutant	Health Impacts	Sources
Formaldehyde	The Environmental Protection Agency (EPA) has classified formaldehyde as a "probable human carcinogen" (EPA 1989). In low concentration levels, formaldehyde irritates the eyes and mucous membranes of the nose and throat (NRC 1981). Formaldehyde can cause watery eyes; burning sensations in the eyes, nose, and throat; nausea; coughing; chest tightness; wheezing; skin rashes; and allergic reactions (CPSC 1997).	Various pressed-wood products can emit formaldehyde, including particle board, plywood, pressed wood, paneling, some carpeting and backing, some furniture and dyed materials, urea-formaldehyde insulating foam, and pressed textiles (CPSC 1997). Cigarette smoke also produces formaldehyde.
Volatile organic compounds (VOCs)	VOCs can cause a wide variety of health problems. Some examples of potential health effects include increased cancer risks, depression of the central nervous system, irritation to the eyes and respiratory tract, and liver and kidney damage. Some evidence exists that VOCs can provoke some of the symptoms typical of sick-building syndrome and cause severe reactions for individuals who appear to demonstrate multiple chemical sensitivities (EPA 1991).	VOCs contain carbon and exist as vapors at room temperatures. Over 900 VOCs have been identified in indoor air (EPA 1991). Formaldehyde is one type of VOC. Many products give off VOCs as they dry, cure, set, or otherwise age (Moffat 1997).
Biological Contaminants	Biological agents in indoor air are known to cause three types of human disease: infections, where pathogens invade human tissue; hypersensitivity diseases, where specific activation of the immune system causes diseases; and toxicosis, where biologically produced chemical toxins cause direct toxic effects (EPA 1994). Evidence is available showing that some episodes of sick-building syndrome may be related to microbial contamination of buildings (EPA 1994).	Sources include outdoor air and human occupants who shed viruses and bacteria, animal occupants (insects and other arthropods, mammals) that shed allergens, and indoor surfaces and water reservoirs such as humidifiers where fungi and bacteria can grow (EPA 1994).

3.2 Outdoor Air

The Proposed Rule would reduce energy consumption, and therefore, impact pollutant emissions associated with energy consumption.

3.2.1 Air Emissions Descriptions and Regulation

This analysis first 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.[2] DOE's analysis also considers carbon dioxide (CO_2), which is of interest because of its classification as a greenhouse gas (GHG). Seven additional pollutants – methane, nitrous oxide, halocarbons, carbon monoxide, particulate matter, and lead – are also analyzed.

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 (EPA 2009).

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.[3]

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 (EPA 2011b).

[2] More information on air pollution characteristics and regulations is available on EPA's website at www.epa.gov.
[3] IPCC Working Group 3, Table TS2.

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.

Mercury. Coal-fired power plants emit mercury (Hg) found in coal during the burning process. Coal-fired power plants are the largest remaining source of human-generated Hg emissions in the United States (EPA 2011c). U.S. coal-fired power plants emit Hg in three different forms: 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 (Trasande et al. 2006).

Sulfur Dioxide. Sulfur dioxide, or SO_2, belongs to the family of sulfur oxide gases (SO_x). 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. SO_x 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 (EPA 2011a).

Methane. Methane emissions are primarily from human-related sources, not natural sources. U.S. methane emissions are from three categories of sources, each accounting for about one-third of total emissions: (1) energy sources, (2) emissions from domestic livestock, and (3) decomposition of solid waste in landfills. The methane emitted from energy sources occurs primarily during the production and processing of natural gas, coal, and oil; not in the actual use (combustion) of these fuels. Methane is the primary ingredient in natural gas, and production, processing, storage, and transmission of natural gas account for 56 percent of the energy source emissions (or 25 percent of all methane emissions). (DOE 2005)

Nitrous Oxide. Nitrous oxide emission rates are more uncertain than those for CO_2 and methane, with nitrogen fertilization of agricultural soils being the primary human-related source. Fuel combustion is also a source of nitrous oxide; however, in the commercial and residential sector total emissions are a negligible amount of all U.S. emissions. (DOE 2005)

Halocarbons and Other Gases. One group of human-made greenhouse gases consists of halocarbons and other engineered gases not usually found in nature. Three of these gases are hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6). HFCs are compounds containing carbon, hydrogen, and fluorine. HFCs do not reach the stratosphere to destroy ozone so are, therefore, considered more environmentally benign than ozone-depleting substances such as chlorofluoro-carbons (CFCs), even though HFCs are greenhouse gases. HFCs are used as refrigerants and are becoming more common as ozone-depleting refrigerants are phased out. PFCs are compounds containing carbon and fluorine. PFC emissions result as a byproduct of aluminum smelting and semiconductor manufacturing. SF_6 is used an insulator for electric equipment. Energy used in buildings contributes a negligible amount of emissions of these greenhouse gases. (DOE 2005)

Carbon Monoxide. The main source of CO is the incomplete burning of fossil fuels such as gasoline. Exhaust from 'highway vehicles' contributes about 55 percent of all CO emissions. The CO produced from energy use related to buildings is 3 percent of all emissions, but most of this is from wood burning in residential buildings, which should not be impacted by these rules. 0.7% of CO emissions come from fuel combustion for electrical generation by utilities. (EPA 2007)

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 because 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.

Lead Exposure to lead can cause a variety of health problems. Lead can adversely affect the brain, kidneys, liver, nervous system, and other organs. Today, metals processing is the major source of lead emissions to the atmosphere. Combustion from electric utilities is less than 2 percent of all lead emissions, with most of the combustion emissions are from coal, not natural gas or oil. Lead emissions directly from buildings are a negligible share of national total emissions (EPA 2001).

Air Quality Regulation. The Clean Air Act Amendments of 1990 list 188 toxic air pollutants that EPA is required to control (EPA 1990). 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.[4] 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)[5] 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)).

[4] In contrast to the modeling forecasts of NEMS-BT that SO_2 emissions will remain at the cap, during the years 2007 and 2008, SO2 emissions were below the trading cap. This raises the possibility that standards would 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 rely on NEMS-BT and thus does not estimate SO_2 emissions reductions at this time.

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

On February 16, 2012, EPA issued national emissions standards for hazardous air pollutants (NESHAPs) for mercury and certain other pollutants emitted from coal and oil-fired electric generating units (EGUs) 77 FR 9304. The NESHAPs do not include emissions caps and, as such, DOE's energy conservation standards would likely reduce Hg emissions.

3.2.2 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 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 (IPCC WGI 2007a).

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. (IPCC WGI 2007b)

Looking forward, the IPCC describes continued global warming of about 0.2°C per decade for the next 2 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. (IPCC WGI 2007b)

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 of 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 caused by 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[6] global warming potential in GHGs emitted from human activities, with the vast majority (74 percent) of the CO_2 attributable to fossil fuel use (IPCC 2007b). 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. (IPCC 2000)

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.[7] Of this annual total, fossil fuels contribute about 29 billion metric tons of CO_2 (IPCC 2000).

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

[6] 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.

[7] 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.

in temperatures projected to increase 2.0°C to 2.4°C above pre-industrial levels[8] (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. Because 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 scenarios describe some warming and some climate change is projected because of already accumulated CO_2 and GHGs in the atmosphere (IPCC 2007c).

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 radiative 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.

[8] IPCC Working Group 3, Table TS 2.

4 CALCULATING ENERGY SAVINGS BY BUILDING TYPE

4.1 Commercial and Multi-Family High-Rise Residential Buildings

In order to determine emissions reductions estimates for the Proposed Rule, it was necessary to compare energy use of buildings meeting the fossil fuel reduction requirement to buildings meeting the no action alternative. The Proposed Rule was compared with two baselines: buildings meeting ASHRAE 90.1-2010 and buildings that exceed ASHRAE 90.1-2010. The baseline consumption levels were determined with Energy Plus simulations perfumed by Pacific Northwest National Laboratory. A weighted average of fifteen climate zones was used to compute national energy use for each building type. Assumptions used in this analysis are described below. For this EA, the calculations made were coordinated with a companion Regulatory Impact Analysis (RIA) for the Proposed Rule. See Halverson and Belzer (2013) for more information on the RIA.

4.2 Commercial Building Types Used to Estimate Energy Savings

Since building energy use and savings vary by building type, a weighted average of the energy savings for each building type was used. The weights used for each building type were proportional to annual new square footage for a given building type. For this analysis, the same assumptions were made as for the Regulatory Impact Analysis done for the Fossil Fuel Rule (Halverson and Belzer 2013). The assumptions are summarized here. For more details on the origin of these assumptions, see Halverson and Belzer 2013.

- New Federal commercial and multi-family high-rise residential building construction volume per year – 42 million square feet per year. Fraction of that construction that falls above the $2.5 million threshold for applicability of this rule – 97%.

- Renovation of existing Federal commercial and multi-family high-rise residential buildings volume – 14.6 million square feet per year. Fraction of this construction that falls above the $2.5 million threshold for applicability of this rule – 88%

- Buildings were categorized as office, education, dormitory/barracks, and other. Since it is hard to break out other, new Federal construction was assumed to have the following building type distribution:
  - Office - 63%
  - Education - 8.3%
  - Dormitory/Barracks - 9%
  - Warehouse - 15%
  - Hospital - 4%

Table 2 compares the nationally-averaged fossil fuel energy end use intensity (EUI) in kBtu/ft^2-yr for the two no-action alternatives plus the proposed rule based on the above assumptions. EUI is the energy consumed by a building per square foot per year. Fossil fuel EUI is similar to source energy except that the source energy associated with site electrical energy is multiplied by 0.71 to account for the fact that 71% of the electrical energy consumed in the United States is generated by combustion of fossil fuels. (Other ways of expressing energy include site energy which is energy used only at the building site and source energy which includes energy used at the building site and energy lost in producing and delivering the energy to the site.)

Table 2 shows the two no-action alternatives and the proposed rule for the years 2013 through 2044, which is a thirty-two year period. The period 2015 to 2044 was chosen as the thirty-year analysis period for this EA and the year 2015 was chosen as the first year for which this Proposed Rule may go into effect.

Table 2 Comparison of Fossil Fuel EUIs by Year for Proposed Rule and Alternatives (kBtu/ft^2-yr)

Year	No Action Alternative One - Standard 90.1-2010	No Action Alternative Two - 30% Below Standard 90.1-2010	Proposed Rule
2013	77	54	58
2014	77	54	58
2015	77	54	45
2016	77	54	45
2017	77	54	45
2018	77	54	45
2019	77	54	45
2020	77	54	26
2021	77	54	26
2022	77	54	26
2023	77	54	26
2024	77	54	26

2025	77	54	13
2026	77	54	13
2027	77	54	13
2028	77	54	13
2029	77	54	13
2030	77	54	0
2031	77	54	0
2032	77	54	0
2033	77	54	0
2034	77	54	0
2035	77	54	0
2036	77	54	0
2037	77	54	0
2038	77	54	0
2039	77	54	0
2040	77	54	0
2041	77	54	0
2042	77	54	0
2043	77	54	0
2044	77	54	0

As can be seen in Table 2, the proposed rule offers considerable EUI savings over either no-action alternative, especially in later years of the thirty-year analysis period. Also of interest in Table 2 is the fact that the Proposed Rule does not offer savings over no-action alternative two in the years 2013 and 2014. For these two years only, the proposed rule may not have been as stringent as the existing 10 CFR Part 433.

4.3 Low-Rise Residential Buildings

Under the Proposed Rule, outdoor air emissions from new Federal residential low-rise buildings are expected to decrease. However, since the Proposed Rule only effectively pertains to buildings that cost at least $2.5 million, DOE believes that very few (if any) residential buildings will be affected. As such, the outdoor air environmental impacts of new Federal residential buildings were assumed to be insignificant relative to new commercial buildings and were not included in this analysis.

5 ENVIRONMENTAL IMPACTS

5.1 Commercial and Multi-Family High-Rise Residential

This section provides the potential environmental impacts that may result from implementing the Proposed Rule, which is evaluated at each of the fossil fuel percentage reduction requirements. These values are then compared to the no-action alternatives. The improved energy efficiency of the Proposed Rule would reduce the use of fossil fuels, and therefore would reduce air emissions.

5.1.1 Building Habitability (Indoor Air) Impacts

The Proposed Rule is not expected to have any impact on indoor air quality relative to the no-action alternatives, as the changes between the codes do not alter ventilation rates or sources of indoor emissions. This does not imply that a potential for health-related problems does not or will not exist in new Federal commercial buildings. The Proposed Rule would not address the potential for indoor air quality-related health problems, such as "sick-building syndrome." Sick-building syndrome can result from insufficient building air exchange. For example, if the ventilation system that brings in fresh outside air breaks down, the air will get stale and occupants in the building may get sick. The Proposed Rule would not impact exactly how a building is operated (e.g., how a ventilation system is controlled) nor does it impact materials (e.g., type of paint used, or if occupants are exposed to fumes from painting) used in the buildings. The Proposed Rule and the no-action alternatives would not have any requirements specifically for radon control or control of other indoor air emissions. As noted in Table 1, “radon is much less of a concern in commercial buildings than in residential buildings, as these buildings usually have mechanical ventilation and occupants are typically not in the buildings as many hours a week as they are in their homes.” DOE has previously consulted with the U.S. Environmental Protection Agency (EPA) on the issue of radon in commercial buildings and determined that radon standards are not applicable to commercial and multi-family high-rise residential buildings.

5.1.2 Outdoor Air

In general, under all the alternatives examined in this EA, carbon dioxide, nitrogen oxides, and mercury emissions would be reduced because more energy efficient buildings consume less fossil fuels. The emissions reductions described in this section represent the annual savings from only 1 year of Federal commercial building construction (40 million ft^2 of new construction plus 14.6 million ft2 of renovation) and over the 30-year time period of 2015 to 2044.

Electricity production ultimately used in Federal commercial buildings is assumed to have the same distribution of fuel/energy sources (e.g., coal, nuclear) as overall

national electricity production. The emissions coefficients were calculated using data from the EIA's Electric Power Annual (DOE 2010a).

Table 3 shows the estimated first-year reduction in emissions for one year of Federal construction.

As can be seen from Table 3, if buildings meets the new minimum requirement rather than the previous requirement (ASHRAE Standard 90.1-2010 versus 90.1-2007), an estimated 99,876 metric tons of carbon dioxide emission will be eliminated in the first year of the Final Rule for the estimated 22 million ft^2 of new construction. These emission reductions compare to 5,835 million metric tons of total carbon dioxide emissions for the U.S. in 2008 (DOE 2010a), or about one-half of one-thousandth of 1 percent of the national total.

Table 3 First-Year Greenhouse Gas Emission Reductions in Metric Tons

Baseline (no-action alternative)	Proposed Rule	Carbon Dioxide	Nitrogen Oxides	Mercury	Sulfur Dioxide
One - ASHRAE 90.1-2010	FF SNOPR	128,618	119	0.002	Negligible
Two - 30% Below ASHRAE 90.1-2010	FF SNOPR	63,059	55	0.001	Negligible

As can be seen from Table 3, if buildings meet the Proposed Rule rather than the previous requirements, an estimated 63,059 to 128,618 metric tons of carbon dioxide emission will be eliminated in the first year of the Proposed Rule. These emission reductions compare to 5,835 million metric tons of total carbon dioxide emissions for the U.S. in 2008 (DOE 2010a), or about 0.002% of the national total.

Estimated reductions for 30 years of construction (2013 through 2042) and 30 years of energy reduction for each building built during that period are shown in Table 4.

Table 4 Thirty-Year Greenhouse Gas Emission Reductions in Metric Tons

Baseline (no-action alternative)	Proposed Rule	Carbon Dioxide	Nitrogen Oxides	Mercury	Sulfur Dioxide
One - ASHRAE 90.1-2010	FF SNOPR	94,494,338	88,348	1.16	Negligible
Two - 30% Below ASHRAE 90.1-2010	FF SNOPR	64,009,348	58,447	0.76	Negligible

SO_2 emissions were also considered in this analysis. 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 National Energy Modeling System (NEMS) [NEMS 2003] model that DOE uses to forecast emissions reductions for many other analyses indicates that no physical reductions in power sector emissions would occur for SO_2. Therefore, no reductions in SO_2 emissions are assumed for this analysis.

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 NO_x 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 D.C. for the same reasons that they may have little or no effect on SO_2 emissions.

DOE also considered the emission impacts for methane, nitrous oxide, halocarbons, carbon monoxide, particulate matter, and lead. Tables 5 and 6 show the one-year and 30-year cumulative air emission reductions for these pollutants. The Proposed Rule shows savings over both baselines.

Table 5 Other Air Emission Reductions in Metric Tons (One Year of Commercial Construction)

Baseline (no-action alternative)	Proposed Rule	Methane	Nitrous Oxide and Halocarbons	Carbon Monoxide, Particulate Matter, and Lead
One - ASHRAE 90.1-2010	FF SNOPR	1,269	Negligible	Negligible
Two - 30% Below ASHRAE 90.1-2010	FF SNOPR	610	Negligible	Negligible

Table 6 Other Air Emission Reductions in Metric Tons (30-Years of Commercial Construction)

Baseline (no-action alternative)	Proposed Rule	Methane	Nitrous Oxide and Halocarbons	Carbon Monoxide, Particulate Matter, and Lead
One- ASHRAE 90.1-2010	FF SNOPR	936,016	Negligible	Negligible
Two - 30% Below ASHRAE 90.1-2010	FF SNOPR	629,181	Negligible	Negligible

6 PERSONS/AGENCIES CONSULTED DURING THIS RULEMAKING

In accordance with the Council on Environmental Quality (CEQ) regulations in 40 CFR 1508.9(b), a list of persons and agencies consulted during the development of this rulemaking and environmental assessment is provided below.

DOE and Contractor Staff

- U.S. Department of Energy – Margo Appel, Chris Calamita, Ami Grace-Tardy, Matt Gray, Sarah Jensen, Mohammed Khan, Ryan Meres, Cyrus Nasseri and Tim Unruh.
- Pacific Northwest National Laboratory (DOE contractor) – Dave Belzer, James Hand, Mark Halverson, John Kaufman, Bing Liu, Robert Lucas, Michelle Niemeyer, and Sriram Somasundaram.

7 REFERENCES

10 CFR Part 433. 2013. U.S. Department of Energy, "Energy Conservation and Fossil Fuel-Generated Energy Consumption Reduction Standards for the Design and Construction of New Federal Commercial and Multi-Family High-Rise Residential Buildings." U.S. Code of Federal Regulations.

10 CFR Part 435. 2013. U.S. Department of Energy, "Energy Conservation and Fossil Fuel-Generated Energy Consumption Reduction Standards for the Design and Construction of New Federal Low-Rise Residential Buildings." U.S. Code of Federal Regulations.

10 CFR 1021. 2000. U.S. Department of Energy, "National Environmental Policy Act Implementing Procedures." U.S. Code of Federal Regulations.

40 CFR Parts 1500-1508. July 1, 1986. Council on Environmental Quality, "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act." U.S. Code of Federal Regulations.

42 U.S.C. 4321 et seq. National Environmental Policy Act. Available at http://energy.gov/nepa/downloads/national-environmental-policy-act-1969,

42 U.S.C 6834. Federal Building Energy Efficiency Standards. Available at http://us-code.vlex.com/vid/building-energy-efficiency-standards-19247704.

70 FR 25162. Rule To Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule); Revisions to Acid Rain Program; Revisions to the NOX. Available at http://www.gpo.gov/fdsys/search/pagedetails.action?granuleId=05-5723&packageId=FR-2005-05-12&acCode=FR.

76 FR 43299. Building Energy Standards Program: Preliminary Determination Regarding Energy Efficiency Improvements in the Energy Standard for Buildings, Except Low-Rise Residential Buildings, ANSI/ASHRAE/IESNA Standard 90.1-2010. July 20, 2011. Available at http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201110&RIN=1904-AC42.

76 FR 64904. Building Energy Standards Program: Final Determination Regarding Energy Efficiency Improvements in the Energy Standard for Buildings, Except Low-Rise Residential Buildings, ANSI/ASHRAE/IESNA Standard 90.1-2010. October 19, 2011. Available at http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201110&RIN=1904-AC42.

77 FR 9304. National Emission Standards for Hazardous Air Pollutants From Coal- and

Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Final Rule. Available at http://www.gpo.gov/fdsys/pkg/FR-2012-02-16/html/2012-806.htm.

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE). 2007. ANSI/ASHRAE/IESNA Standard 90.1-2007, "Energy Standard for Buildings Except Low-Rise Residential Buildings." Atlanta, Georgia.

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE). 2010. ANSI/ASHRAE/IESNA Standard 90.1-2010, "Energy Standard for Buildings Except Low-Rise Residential Buildings." Atlanta, Georgia.

Consumer Product Safety Commission (CPSC). 1997. An Update on Formaldehyde--1997 Revision. Washington, D.C.

Energy Conservation and Production Act (ECPA). 42 U.S.C. 6801 et seq., as amended.

Halverson, MA and DB Belzer. 2013. Draft Report. "Regulatory Impact Analysis for Fossil Fuel Reduction Rule". Pacific Northwest National Laboratory, Richland, Washington.

International Code Council (ICC). 2009. International Energy Conservation Code 2009. Falls Church, Virginia.

Intergovernmental Panel On Climate Change. 2000. *IPCC Special Report on Land Use, Land-Use Change And Forestry*. Geneva, Switzerland. http://www.grida.no/publications/other/ipcc_sr/?src=/Climate/ipcc/land_use/index.htm

Intergovernmental Panel On Climate Change. 2007a. *IPCC WGI Fourth Assessment Report: Climate Change 2007: The Physical Science Basis*. Geneva, Switzerland. http://ipcc-wg1.ucar.edu/wg1/docs/WG1AR4_SPM_PlenaryApproved.pdf

Intergovernmental Panel On Climate Change. 2007b. *Climate Change 2007 – Impacts, Adaptation and Vulnerability*. Geneva, Switzerland. http://www.ipcc-wg2.gov

Intergovernmental Panel On Climate Change. 2007c. *IPCC Fourth Assessment Report Climate Change 2007: Working Group III Report "Mitigation of Climate Change"*. Geneva, Switzerland. http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-ts.pdf

Moffat, D.W. 1997. Handbook of Indoor Air Quality Management. Prentice Hall, Englewood Cliffs, New Jersey.

National Academy of Sciences (NAS). 1998. Biological Effects of Ionizing Radiation (BEIR) VI Report: The Health Effects of Exposure to Indoor Radon. National Academy Press, Washington, D.C.

National Energy Modeling System (NEMS). 2009. For more information on NEMS, a useful summary is National Energy Modeling System: An Overview 2003, DOE/EIA-0581(2009). Available at http://www.eia.gov/oiaf/aeo/overview/overview.html.

National Research Council (NRC). 1981. Indoor Pollutants. National Academy Press, Washington, D.C.

Trasande L, C Schechter, KA Haynes, and PJ Landrigan. 2006. Applying Cost Analyses to Drive Policy That Protects Children: Mercury as a Case Study. *Annals of the New York Academy of Sciences*.

U.S. Department of Energy (DOE). 2005. Emissions of Greenhouse Gases in the United States. DOE/EIA-0573(2005), Washington, D.C.

U.S. Department of Energy (DOE). 2010a. Annual Energy Review. DOE/EIA-0384(2009), Washington, D.C. Available at http://www.eia.gov/totalenergy/data/annual/.

U.S. Department of Energy (DOE). 2010b. EnergyPlus Energy Simulation Software. Version 6.0.0. Updated October 18, 2010. http://apps1.eere.energy.gov/buildings/energyplus/

U.S. Department of Energy (DOE). 2011. Annual Energy Outlook. DOE/EIA-0383(2011), Washington, D.C. Available at http://www.eia.gov/forecasts/archive/aeo11/.

U.S. Environmental Protection Agency (EPA). 1989. Report to Congress on Indoor Air Quality, Volume II: Assessment and Control of Indoor Air Pollution. EPA-400-I-89-001C, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1990. *Clean Air Act. 1990*. http://www.epa.gov/air/caa/

U.S. Environmental Protection Agency (EPA). 1991. Introduction to Indoor Air Quality--A Reference Manual. EPA/400/3-91/003, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1994. Indoor Air Pollution--An Update for Health Professionals. Washington, D.C.

U.S. Environmental Protection Agency (EPA). 2001. National Air Quality Emissions Trend Report, 1999. EPA-454/R-0.1-004. Washington, D.C.

U.S. Environmental Protection Agency (EPA). 2007. National Emissions Inventory. Washington D.C. Available URL: http://www.epa.gov/ttn/chief/trends/index.html

U.S. Environmental Protection Agency (EPA). 2009. *U.S. Greenhouse Gas Inventory Report*, 2009. http://www.epa.gov/climatechange/emissions/usinventoryreport.html

U.S. Environmental Protection Agency (EPA). 2011a. *Sulfur dioxide*, http://www.epa.gov/airquality/urbanair/

U.S. Environmental Protection Agency (EPA). 2011b. *Nitrogen dioxide*, http://www.epa.gov/air/nitrogenoxides/

U.S. Environmental Protection Agency (EPA). 2011c. *Mercury*, http://www.epa.gov/mercury/