Environmental Assessment for Proposed Rule, 10 CFR 433, "Sustainable Design and Energy Efficiency Standards for New Federal Commercial and High-Rise Multi-Family Residential Buildings" and 10 CFR 435, "Sustainable Design and Energy Efficiency Standards for New Federal Residential Low-Rise Residential Buildings"

(DOE/EA-1463)

SUMMARY

The U.S. Department of Energy (DOE) has prepared this Environmental Assessment (EA) for DOE's Proposed Rule, 10 CFR 433, "Sustainable Design and Energy Efficiency Standards for the Design and Construction of New Federal Commercial and High-Rise Multi-Family Residential Buildings" and 10 CFR 435, "Sustainable Design and Energy Efficiency Standards for New Federal Residential Low-Rise Residential Buildings". Section 305(a) of the Energy Conservation and Production Act (ECPA) as revised by Section 109 of the Energy Policy Act of 2005 (Pub. L. 109-58) requires that DOE establish by rule performance standards for all Federal buildings. (42 U.S.C. 6834(a)(3)(A)). Section 433 of the Energy Independence and Security Act of 2007 (EISA; Pub. L. No. 110-140) further amended section 305 of ECPA to apply sustainable design principles to certain new Federal buildings and major renovations of Federal buildings without specifying consideration of life-cycle cost effectiveness. (42 U.S.C. 6834(a)(3)(D)(i)(III)) In addition, DOE is directed to establish regulations that require water conservation technologies and solar hot water heaters be applied to the extent life-cycle cost effective. (42 U.S.C. 6834 (a)(3)(A)(ii) and (a)(3)(D)(vii)). Section 433 of EISA also adds fossil fuel-based energy consumption reductions to Section 305 of ECPA. DOE has already addressed the energy efficiency requirements of Section 305 of ECPA from Section 109 of EPACT in a separate rulemaking published on December 21, 2007 (72 FR 72565). DOE is addressing the fossil fuel-based energy consumption reduction requirements in Section 433 of EISA in a separate rulemaking that will be

published in 2010. This Environmental Assessment addresses the sustainable design requirements (excluding energy efficiency) contained in the Proposed Rule.

The Proposed Rule is applicable to new Federal buildings, which are defined as any building to be constructed by, or for the use of, any Federal agency including buildings built for the purpose of being leased by a Federal agency, and privatized military housing. The Proposed Rule also applies to buildings undergoing major renovations, which are defined as changes to a building that provide significant opportunities for substantial improvement in the sustainable design elements covered in this rule, including energy efficiency. DOE has also included in the definition of major renovation the statement that any renovation that exceeds 25% of the replacement value of the building would be considered a major renovation. The Proposed Rule does not apply to existing buildings that have already been constructed and that are not undergoing major renovation or new buildings for which design for which construction has begun prior to the effective date.

The EA summarizes the potential incremental environmental impacts of the Proposed Rule. To identify the potential environmental impacts that may result from implementing the rules for new Federal buildings and Federal buildings undergoing major renovation, DOE compared the Proposed Rule with the "no-action alternative" of the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings as required by Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance" (Federal Register, October 5, 2009).

The Proposed Rule is by its fundamental intent beneficial to the environment. The Proposed Rule is not expected to cause any adverse health effects, and thus would have no environmental justice impacts affecting low-income or minority populations. The Proposed Rule will be beneficial and have no significant impact on sensitive environmental resources, including wetlands/floodplains, prime agricultural lands, endangered species, and sensitive ecosystems. The Proposed Rule would not have an adverse effect on historic or archaeological sites, and would not be affected by a terrorist act.

ABBREVIATIONS AND ACRONYMS

Act or ECPA	Energy Conservation and Production Act (42 U.S.C. 6831 et seq.)
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CO	carbon monoxide
DOE	Department of Energy
EPA	Environmental Protection Agency
FR	Federal Register

HFC	hydro fluorocarbon
IESNA	Illuminating Engineering Society of North America
LCC	life-cycle cost
NEPA	National Environmental Policy Act of 1969
NO_2	nitrogen dioxide
PFC	perfluorocarbon
SF_6	sulfur hexafluoride
SO_2	sulfur dioxide
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 NEPA (10 CFR Part 1021).

Section 305 of the Energy Conservation and Production Act (ECPA), as amended by the Energy Policy Act of 1992 (Pub. L. 102-486) requires DOE to establish building performance standards for all new Federal buildings and for Federal buildings that are undergoing major renovation. (42 U.S.C. 6834) Section 305(a)(2) requires that cost effective energy efficiency requirements and sustainable design principles be applied to all new and replacement buildings and that water conservation technologies be applied if water is used to achieve energy efficiency. (42 U.S.C. 6834(a) (2)) Section 305(a)(2)(C) of ECPA requires that DOE consider, in consultation with the Environmental Protection Agency and other Federal agencies, and where appropriate, measures regarding radon and other indoor air pollutants. Section 433 of the Energy Independence and Security Act of 2007 (EISA; Pub. L. No. 110-140) further amended section 305 of ECPA to apply sustainable design principles to certain new Federal buildings and major renovations of Federal buildings without specifying consideration of life-cycle cost effectiveness. (42 U.S.C. 6834(a)(3)(D)(i)(III)) In addition, DOE is directed to establish regulations that require water conservation technologies and solar hot water heaters be applied to the extent life-cycle cost effective. (42 U.S.C. 6834 (a)(3)(A)(ii) and (a)(3)(D)(vii)). Section

433 of EISA also adds fossil fuel-based energy consumption reductions to Section 305 of ECPA.

On December 21, 2007 (72 FR 72565), the Department issued a Final Rule establishing energy conservation standards for new Federal commercial and multi-family high rise residential buildings (10 CFR part 433) and new Federal low-rise residential buildings (10 CFR part 435, subpart A). DOE is addressing the fossil fuel-based energy consumption reduction requirements in Section 433 of EISA in a separate rulemaking that will be published in 2010. This environmental assessment is in support of a Notice of Proposed Rulemaking specifying sustainable design and water conservation requirements for new buildings constructed for the Federal sector and for Federal buildings undergoing major renovation.

2 THE PROPOSED RULE AND ALTERNATIVES

Section 2.1 describes the Proposed Rule and Section 2.2 describes the no-action alternative.

2.1 The Proposed Action - The Proposed Rule

The Proposed Rule requires Federal agencies to construct new Federal building and Federal buildings undergoing major renovation using sustainable design principles. These requirements are adapted from the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (referred to here as the Guiding Principles).

The major sustainable design elements of the Proposed Rule are:

- Siting
- Commissioning
- Water conservation
- Indoor environmental quality
- Environmental impact of materials

Energy efficiency is a key component of sustainable building design, but has already been addressed in a previous environmental assessment (U.S. DOE 2007) and therefore is not covered here.

2.2 “No-Action” Alternative – The Guiding Principles

The no-action alternative is defined as the current practice for new Federal buildings and Federal buildings that are undergoing major renovation. Current practice for Federal buildings is the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings as required by Executive Order 13514. Additionally, Federal agencies may have their own policies and procedures related to sustainability in their buildings and other Federal regulations may overlap with the requirements in the Proposed Rule in certain cases. For example, the U.S Department of Energy requires a U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED®) Gold certification for all of its new construction, and major building renovations in excess of $5 million.

2.3 Differences between the Proposed Rule and the No-Action alternative

The Proposed Rule is not identical to the Guiding Principles. In some places, the Proposed Rule has more specific language necessary for a code that specifies exactly what must be done rather than provides advice and general information. .

The Proposed Rule contains the same general elements as the Guiding Principles but also include provisions related to the siting of buildings. There requirements are intended to protect environmentally sensitive sites and enable the effective utilization of existing infrastructure, including locating buildings in central business districts well

served by transit wherever possible. The Proposed Rule and the Guiding Principles contain identical solar hot water requirements.

The Guiding Principles do not have explicit requirements for residential buildings. However, most of the requirements in the Guiding Principles are equally beneficial for all building types and so the Guiding Principles may be used as the no-action alternative for Federal residential buildings as well. The most notable addition to the Proposed Rule for residential buildings is the requirement for radon control measures in regions with high radon potential.

3 ENVIRONMENTAL IMPACTS

The Proposed Rule contains requirements that impact on building habitability (indoor environment), the outdoor environment, the nation's economy, and the Federal agencies that procure commercial and residential buildings. The impacts of the Proposed Rule are described in more detail in this section.

3.1 Indoor Habitability

The Proposed Rule should lead to improvement in indoor air quality. 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 (CO_2), nitrogen dioxide (NO_2), radon, formaldehyde, volatile organic compounds, and biological contaminants.

The Proposed Rule influences the concentration levels of indoor air emissions in several ways. First, they require mechanical ventilation of fresh air from outdoors for most buildings, which generally reduces indoor-generated pollutant concentration levels. The Proposed Rule utilizes American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standards 62.1 (commercial buildings) and 62.2 (residential buildings). As the Guiding Principles also reference Standard 62.1, the change from the no-action alternative to the Proposed Rule is to expand the scope to cover residential buildings with Standard 62.2.

Second, the Proposed Rule contains “source control” requirements intended to reduce sources of potentially harmful emissions within 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, CO_2, nitrogen oxides, and sulfur dioxide (SO_2). 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 does not change pollutant rates from indoor sources of air pollution compared to the no-action alternative other than the expansion of scope to cover residential buildings.

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 to 8 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.

Table 1. (continued)		
Pollutant	**Health Impacts**	**Sources**
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 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.	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).

Table 1. (continued)		
Pollutant	**Health Impacts**	**Sources**
Formaldehyde	The 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 heath 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).

Table 1. (cont'd)		
Pollutant	**Health Impacts**	**Sources**
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 Water Conservation

The U.S. Government Accounting Office estimated in 2003 that 36 states will face water shortages by 2013 (General Accounting Office 2003). The Federal Government uses an estimated 244-256 billion gallons of water annually. This is equal to the water use of a state the size of Michigan or almost 10 million people (http://www1.eere.energy.gov/femp/water/water_basics.html). 78% of the Federal water

use is by the Department of Defense (PNNL 2005). In the Federal sector, approximately half of the potable water consumed is used for domestic purposes, with the remaining balance attributed to engineered related uses (FEMP 2008). Engineered related uses include, but are not limited to, boiler systems, steam and condensate systems, cooling tower and chiller systems, irrigation systems, single-pass cooling systems, water and waste water treatment plants, and comprehensive leak detection strategies.

The Proposed Rule adopts the water saving targets from the Guiding Principles: a 20% reduction of indoor potable water usage and a 50% reduction in outdoor potable water usage. Since the savings requirements are the same as the no-action alternative for commercial buildings, the only expected savings will be for residential buildings.

A recent report (PNNL, 2005) estimates the total life-cycle cost-effective water conservation potential today in the Federal sector, assuming 100% penetration of efficient technology, based on appropriate "off the shelf" domestic water technologies is estimated to be between 35 and 50 billion gallons/year. This represents approximately 17% to 24% of the total Federal water use.

3.3 Materials

The Proposed Rule contains four elements addressing the environmental impacts of materials:

(1) Recycled Content. The Proposed Rule requires the use EPA's recycled content recommendations or a recycled content of at least 10%.

Federal agencies are already required to purchase “designated products” with the maximum recovered material content practicable under EPA’s Comprehensive Procurement Guidelines (http://www.epa.gov/cpg/products.htm). Examples of designated products include building insulation materials, carpet cushion, and roofing materials.

(2) Biobased Content. The Proposed Rule requires compliance with USDA's biobased content recommendations or use biobased products made from rapidly renewable resources and certified sustainable wood products.

The Farm Security and Rural Investment Act (FSRIA) of 2002 included a directive to all federal agencies to increase their purchase and use of "preferred" biobased products. As defined by FSRIA, "biobased products" are products determined by the U.S. Secretary of Agriculture to be commercial or industrial goods (other than food or feed) composed in whole or in significant part of biological products, forestry materials, or renewable domestic agricultural materials, including plant, animal, or marine materials. Made from renewable plant and animal sources, biobased products are generally safer for the environment than their petroleum-based counterparts. They are usually biodegradable or recyclable. Federal agencies are required by FSRIA to purchase biobased products over their petroleum-based counterparts, as long as the biobased

materials are reasonably available, reasonably priced, and comparable in performance. (http://www.biopreferred.gov/aboutus.aspx?SMSESSION=NO)

Not all biobased products are USDA-designated, in which case the Proposed Rule requires either the use of rapidly renewable resources or certified sustainable wood products. "Rapidly renewable" refers to materials and products made from plants that are harvested within a ten-year cycle or shorter (for example: bamboo). Certified wood products may not be rapidly renewable, but rather are developed under sustainable forestry practices

(3) Construction Waste. The Proposed Rule requires new Federal buildings and Federal buildings undergoing major renovation to be designed to recycle or salvage at least 50 percent construction, demolition and land clearing waste, excluding soil.

In 1998, an EPA report found 10.8 million tons of waste was generated from new building construction (EPA 1998). Information on how to reduce construction waste is provided at: http://www.wbdg.org/resources/cwmgmt.php. Table 2 shows the breakdown of overall building construction and demolition waste by material based on studies of existing buildings (source: http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/BMOE5XLKDG/$File/Analyzing_C_D_Debris.pdf). New construction produces only 8% of all building-related construction and demolition waste, with renovations and demolitions contributing 44% and 48%, respectively (Franklin Associates 1998). Estimated total construction

waste for new buildings is about 4 pounds per square foot of floor area (Franklin Associates 1998).

Table 2 Buildings Related Construction and Demolition Percentages by Material

Material	Estimated Debris
Concrete and Mixed Rubble	40-50%
Wood	20-30%
Drywall	5-15%
Asphalt Roofing	1-10%
Metals	1-5%
Bricks	1-5%
Plastics	1-5%

(4) Ozone Depleting Compounds. The Proposed Rule requires that new Federal buildings and major renovations to federal buildings not use ozone depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with either the Montreal Protocol or Title VI of the Clean Air Act Amendments of 1990.

The EPA defines Ozone-Depleting Substance(s) (ODS) as a compound that contributes to stratospheric ozone depletion. ODS include CFCs, HCFCs, halons, methyl bromide, carbon tetrachloride, and methyl chloroform. ODS are generally very stable in

the troposphere and only degrade under intense ultraviolet light in the stratosphere. When they break down, they release chlorine or bromine atoms, which then deplete ozone. The Proposed Rule instructs agencies to not use ozone depleting compounds if an environmentally preferable material is available.

Ozone depletion can cause increased amounts of UV radiation to reach the Earth which can lead to more cases of skin cancer, cataracts, and impaired immune systems. Overexposure to UV is believed to be contributing to the increase in melanoma, the most fatal of all skin cancers. Since 1990, the risk of developing melanoma has more than doubled. UV can also damage sensitive crops, such as soybeans, and reduce crop yields. Some scientists suggest that marine phytoplankton, which are the base of the ocean food chain, are already under stress from UV radiation. This stress could have adverse consequences for human food supplies from the oceans (http://www.epa.gov/airprogm/oar/airtrends/aqtrnd96/brochure/stratoz.html).

For construction materials, the Proposed Rule will have minimal impacts compared to the no-action alternative as they both have the same fundamental requirements.

3.4 Siting

The building site selection (siting) requirements in the Proposed Rule are straightforward. The rules briefly touch upon where construction should and should not be located. Specifically, Federal buildings should be centrally located and be near public transportation, and should not be located in sensitive land resources, to the extent practicable.

The placements of buildings near public transportation sources will help reduce transportation energy use and associated greenhouse gas emissions, though this savings is difficult to quantify. A recent study examined the benefits of public transportation on a national scale (Bailey et al. 2008). This study concluded public transportation reduces U.S. travel by an estimated 102.2 billion vehicle miles traveled (VMT) each year, or 3.4 percent of the annual U.S. total in 2007. The total energy saved, less the energy used by public transportation and adding fuel savings from reduced congestion, is equivalent to 4.2 billion gallons of gasoline a year. The total effects reduce greenhouse gas emissions from automobile travel by 37 million metric tons.

The no-action alternative of the Guiding Principles do not address site selection, though various federal regulations and policies cover many aspects of where facilities can and cannot be located (Endangered Species Act, etc.). Therefore, the impacts of the siting restrictions in the Proposed Rule are expected to be minimal.

3.5 Environmental Justice

A consideration of Environmental Justice is made pursuant to Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The Executive Order requires Federal agencies to address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on low-income or minority populations. The Proposed Rule would not result in any adverse health effects and therefore does not have the potential for disproportionately high and adverse health effects on minorities and low income population.

3.6 Other Impacts

The Proposed Rule will be beneficial and have no significant impact on sensitive environmental resources, including wetlands/floodplains, prime agricultural lands, endangered species, and sensitive ecosystems. The Proposed Rule will not impact historic or archaeological sites. There are no aspects of the Proposed Rule that would be affected by a terrorist act.

4 AGENCIES AND PERSON CONSULTED DURING THIS RULEMAKING

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

DOE and Contractor Staff

US DOE Federal Energy Management Program - Cyrus Nasseri

Pacific Northwest National Laboratory (DOE contractor) - Mark Halverson , Robert Lucas, and Kim Fowler

The rulemaking was also presented to a variety of Federal agency representatives at the following forums:

Interagency Working Group on Sustainability

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