DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket Number EE–2006–STD–0131]

RIN 1904–AA92

Energy Conservation Program: Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Final rule.

SUMMARY: The Department of Energy (DOE) is announcing that pursuant to the Energy Policy and Conservation Act (EPCA), it is amending the energy conservation standards for certain general service fluorescent lamps and incandescent reflector lamps. DOE is also adopting new energy conservation standards and amendments to its test procedures for certain general service fluorescent lamps not currently covered by standards. Additionally, DOE is amending the definitions of certain terms found in the general provisions. It has determined that energy conservation standards for these products would result in significant conservation of energy, and are technologically feasible and economically justified.

DATES: The effective date of this rule is September 14, 2009. Compliance with the standards established in today's final rule is required starting on July 14, 2012. The incorporation by reference of certain publications listed in this rule was approved by the Director of the Federal Register on September 14, 2009.

ADDRESSES: For access to the docket to read background documents, the technical support document, transcripts of the public meetings in this proceeding, or comments received, visit the U.S. Department of Energy, Resource Room of the Building Technologies Program, 950 L'Enfant Plaza, SW., 6th Floor, Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Please call Ms. Brenda Edwards at the above telephone number for additional information regarding visiting the Resource Room. You may also obtain copies of certain previous rulemaking documents in this proceeding (*i.e.*, framework document, advance notice of proposed rulemaking, notice of proposed rulemaking), draft analyses, public meeting materials, and related test procedure documents from the Office of Energy Efficiency and Renewable Energy's Web site at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/incandescent_lamps.html.*

FOR FURTHER INFORMATION CONTACT:

Ms. Linda Graves, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. *Telephone:* (202) 586–1851. *E-mail: Linda.Graves@ee.doe.gov.*

Mr. Eric Stas, U.S. Department of Energy, Office of the General Counsel, GC–72, 1000 Independence Avenue, SW., Washington, DC 20585–0121. *Telephone:* (202) 586–9507. *E-mail: Eric.Stas@hq.doe.gov.*

SUPPLEMENTARY INFORMATION:

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Acronyms and Abbreviations

ACEEE American Council for an Energy Efficient Economy
ACG Applied Coatings Group
ADLT Advanced Lighting Technologies, Inc.
AEO Annual Energy Outlook
ANOPR advance notice of proposed rulemaking
ANSI American National Standards Institute
ASAP Appliance Standards Awareness Project
BEF ballast efficacy factor
BF ballast factor
BR bulged reflector (reflector lamp shape)
BT Building Technologies Program
Btu British thermal units
CAIR Clean Air Interstate Rule
CAMR Clean Air Mercury Rule
CBECS Commercial Buildings Energy Consumption Survey
CCT correlated color temperature
CEC California Energy Commission
CEE Consortium for Energy Efficiency
CFR Code of Federal Regulations
CFL compact fluorescent lamp
CIE International Commission on Illumination
CO_2 carbon dioxide
CRI color rendering index
CSL candidate standard level
DOE U.S. Department of Energy
DOJ U.S. Department of Justice
E26 Medium screw-base (incandescent lamp base type)
EEI Edison Electric Institute
EIA Energy Information Administration
EISA 2007 Energy Independence and Security Act of 2007
EL efficacy level
E.O. Executive Order
EPA U.S. Environmental Protection Agency
EPACT 1992 Energy Policy Act of 1992
EPACT 2005 Energy Policy Act of 2005
EPCA Energy Policy and Conservation Act
ER elliptical reflector (reflector lamp shape)
EU European Union
EuP Energy-Using Product
FEMP Federal Energy Management Program
FR Federal Register
FTC U.S. Federal Trade Commission
GE General Electric Lighting and Industrial
GRIM Government Regulatory Impact Model
GSFL general service fluorescent lamp
GSIL general service incandescent lamp
GW gigawatt
Hg mercury
HID high-intensity discharge
HIR halogen infrared reflector
HO high output
HVAC heating, ventilating and air-conditioning
IALD International Association of Lighting Designers
IESNA Illuminating Engineering Society of North America
ImSET Impact of Sector Energy Technologies
INPV industry net present value
IPCC Intergovernmental Panel on Climate Change
I–O input-output
IR infrared
IRL incandescent reflector lamp
K Kelvin
kt kilotons
LCC life-cycle cost
LED light-emitting diode
lm lumens
LMC U.S. Lighting Market Characterization Volume I
lm/W lumens per watt
MBP medium bipin
MECS Manufacturer Energy Consumption Survey (MECS)
MIA manufacturer impact analysis
miniBP miniature bipin
MMt million metric tons
Mt metric tons
MW megawatts
NAICS North American Industry Classification System
NEEP Northeast Energy Efficiency Partnership
NEMA National Electrical Manufacturers Association
NEMS National Energy Modeling System
NEMS–BT National Energy Modeling System—Building Technologies
NES national energy savings
NIA national impact analysis
NIST National Institute of Standards and Technology
NOPR notice of proposed rulemaking
NO_X nitrogen oxides
NPV net present value
NRDC Natural Resources Defense Council
NVLAP National Voluntary Laboratory Accreditation Program
OEM original equipment manufacturer
OIRA Office of Information and Regulatory Affairs
OMB U.S. Office of Management and Budget
PAR parabolic aluminized reflector (reflector lamp shape)
PBP payback period
PG&E Pacific Gas and Electric
PSI Product Stewardship Institute
quad quadrillion (10^{15}) Btu
R reflector (reflector lamp shape)
R–CFL reflector compact fluorescent lamp
R&D research and development
RDC recessed double contact
RECS Residential Energy Consumption Survey
RIA regulatory impact analysis
SBA U.S. Small Business Administration
SO standard output
SO_2 sulfur dioxide
SP single pin

T5, T8, T10, T12 tubular fluorescent lamps, diameters of 0.625, 1, 1.25 or 1.5 inches, respectively
TSD technical support document
TSL trial standard level
TWh terawatt-hour
UMRA Unfunded Mandates Reform Act
U.S.C. United States Code
UV ultraviolet
V volts
VHO very high output
W watts

I. Summary of the Final Rule

A. The Standard Levels

The Energy Policy and Conservation Act, as amended (42 U.S.C. 6291 *et seq.*; EPCA), provides that any new or amended energy conservation standard that the Department of Energy prescribes for covered consumer and/or commercial products, including general service fluorescent lamps (GSFL) and incandescent reflector lamps (IRL), must be designed to ''achieve the maximum improvement in energy efficiency * * * which the Secretary determines is technologically feasible and economically justified.'' (42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must ''result in significant conservation of energy.'' (42 U.S.C. 6295(o)(3)(B)) The energy conservation standards in today's final rule, which apply to certain types of types of GSFL and IRL, satisfy these requirements, as well as all other applicable statutory provisions discussed in this notice.

Table I.1 and Table I.2 present the energy conservation standard levels DOE is adopting today. These standards will apply to GSFL and IRL listed in those tables that are manufactured for sale in the United States, or imported into the United States, on or after July 14, 2012.

TABLE I.1—SUMMARY OF THE AMENDED ENERGY CONSERVATIONS STANDARDS FOR GENERAL SERVICE FLUORESCENT LAMPS

Lamp type	Correlated color temperature	Energy conservation standard (lm/W)
4-Foot Medium Bipin	≤4,500K	89
	>4,500K and ≤7,000K	88
2-Foot U-Shaped	≤4,500K	84
	>4,500K and ≤7,000K	81
8-Foot Slimline	≤4,500K	97
	>4,500K and ≤7,000K	93
8-Foot High Output	≤4,500K	92
	>4,500K and ≤7,000K	88
4-Foot Miniature Bipin Standard Output	≤4,500K	86
	>4,500K and ≤7,000K	81
4-Foot Miniature Bipin High Output	≤4,500K	76
	>4,500K and ≤7,000K	72

TABLE I.2—SUMMARY OF THE ENERGY CONSERVATION STANDARDS FOR INCANDESCENT REFLECTOR LAMPS

Lamp wattage	Lamp type	Diameter (inches)	Voltage	Energy conservation standard (lm/W)
40W–205W	Standard Spectrum	>2.5	≥125	$6.8*P^{0.27}$
			<125	$5.9*P^{0.27}$
		≤2.5	≥125	$5.7*P^{0.27}$
			<125	$5.0*P^{0.27}$
40W–205W	Modified Spectrum	>2.5	≥125	$5.8*P^{0.27}$
			<125	$5.0*P^{0.27}$
		≤2.5	≥125	$4.9*P^{0.27}$
			<125	$4.2*P^{0.27}$

Note 1: P is equal to the rated lamp wattage, in watts.
Note 2: Standard Spectrum means any incandescent reflector lamp that does not meet the definition of ''modified spectrum'' in 430.2.

B. Current Federal Standards for General Service Fluorescent Lamps and Incandescent Reflector Lamps

Table I.3 and Table I.4 present the current statutorily-prescribed Federal energy conservation standards for GSFL and IRL. The standards set requirements for minimum efficacy and color rendering index (CRI) levels for certain GSFL, and minimum efficacy levels for certain IRL. (42 U.S.C. 6295(i)(1); 10 CFR 430.32(n))

TABLE I.3—EPCA STANDARD LEVELS FOR GSFL

Lamp type	Nominal lamp wattage	Minimum CRI	Minimum average efficacy (lm/W)
4-Foot Medium Bipin	>35W	69	75.0
	≤35W	45	75.0
2-Foot U-Shaped	>35W	69	68.0
	≤35W	45	64.0
8-Foot Slimline	>65W	69	80.0
	≤65W	45	80.0

TABLE I.3—EPCA STANDARD LEVELS FOR GSFL—Continued

Lamp type	Nominal lamp wattage	Minimum CRI	Minimum average efficacy (lm/W)
8-Foot High Output	>100W	69	80.0
	≤100W	45	80.0

TABLE I.4—EPCA STANDARD LEVELS FOR IRL

Wattage	Minimum average efficacy (lm/W)
40–50	10.5
51–66	11.0
67–85	12.5
86–115	14.0
116–155	14.5
156–205	15.0

C. Benefits and Burdens to Purchasers of General Service Fluorescent Lamps and Incandescent Reflector Lamps

In the April 2009 notice of proposed rulemaking (NOPR), DOE considered the impacts on consumers of several trial standard levels (TSLs) related to the efficiency of GSFL and IRL. 74 FR 16920 (April 13, 2009). In the April 2009 NOPR, DOE tentatively concluded that the economic impacts on most consumers (*i.e.*, the average life-cycle cost (LCC) savings) of amended standards for GSFL and IRL would be positive. DOE has reached the same conclusion in today's final rule, as explained below.

The economic impacts on consumers, *i.e.*, the average life-cycle cost savings, are generally positive in this final rule. DOE's analyses indicate that on average residential and commercial consumers would see benefits from the proposed standards. DOE expects that under the standards presented in this final rule, the purchase price of high-efficacy GSFL would be higher (up to thirteen times higher, including the purchase of new lamps and a new ballast) than the average price of these products today; the energy efficiency gains, however, would result in lower energy costs that more than offset such higher costs for the majority of consumers analyzed in this final rule. When the potential savings due to efficiency gains are summed over the lifetime of the high-efficacy products, consumers would be expected to save up to $67.06 (depending on the lamp type), on average, compared to their expenditures over the lives of today's baseline GSFL. The results of DOE's analyses for IRL follow a similar pattern. Although DOE expects the purchase price of the higher-efficacy IRL to be 47 to 64 percent higher than the average price of these products today, the energy efficiency gains would result in lower energy costs that more than offset the higher costs for the majority of consumers analyzed in this final rule. When these potential savings due to efficiency gains are summed over the lifetime of the higher-efficacy IRL, it is estimated that consumers would save up to $7.95 per lamp (depending on the wattage and operating sector), on average, compared to their expenditures over the lives of today's baseline IRL.

D. Impact on Manufacturers

Using a real corporate discount rate of 10.0 percent, DOE estimates the net present value (NPV) of the GSFL and IRL industries to be $527–639 million and $221–301 million in 2008$, respectively. DOE expects the impact of today's standards on the industry net present value (INPV) of manufacturers of GSFL to be between a 0.6 percent loss and a 30.7 percent loss (−$4 million to −$162 million), and between a 6.8 percent loss and a 44.4 percent loss (−$21 million to −$98 million) for IRL manufacturers. Based on DOE's interviews with GSFL and IRL manufacturers, DOE expects minimal plant closings or loss of employment as a result of the standards.

E. National Benefits

DOE estimates the GSFL standards will save approximately 3.83 to 9.94 quads (quadrillion (10^{15}) British thermal units (Btu)) of energy over 30 years (2012–2042). Over the same time period, DOE estimates IRL standards will save approximately 0.94 to 2.39 quads. By 2042, DOE expects the energy savings from the GSFL and IRL standards to eliminate the need for approximately 1.8 to 6.2 and 0.2 to 1.1 gigawatts of generating capacity, respectively.

These energy savings from GSFL will result in cumulative (undiscounted) greenhouse gas emission reductions of 175 to 488 million tons (Mt) of carbon dioxide (CO_2); for IRL, DOE estimates these reductions will be 44 to 106 million tons (Mt) of CO_2. Cumulative for GSFL and IRL, DOE estimates that the range of the monetized value of CO_2 emission reductions is between $0.2 billion to $24.8 billion, at a 7-percent discount rate, and between $0.5 billion to $49.8 billion at a 3-percent discount rate. The mid-range of the CO_2 value (using $33 per ton) is $3.9 to $10.2 billion and $7.6 to $20.6 billion at 7-percent and 3-percent discount rates, respectively.

Additionally, the GSFL standards will help alleviate air pollution by resulting in between approximately 11,000 to 36,780 tons (11.0 and 36.8 kilotons (kt)) of nitrogen oxides (NO_X) cumulative emission reductions from 2012 through 2042; the IRL standards will result in NO_X cumulative emission reductions of 6.4 to 8.4 kt. Mercury (Hg) cumulative emissions reductions over the same time period will be reduced by up to 7.3 metric tons due to GSFL standards and 1.65 metric tons from IRL standards. The monetized values of these emissions reductions, cumulative for both GSFL and IRL, are estimated at $6.0 to $131.5 million for NO_X and up to $82.6 million for Hg at a 7-percent discount rate. Using a 3-percent discount rate, the monetized values of these emission reductions are $6.9 to $162.3 million for NO_X and up to $153.7 million for Hg.

The national NPV of the GSFL and IRL standards is between $10.02 and $26.31 billion and $1.83 and $9.06 billion, respectively, using a 7-percent discount rate cumulative from 2012 to 2042 in 2008$. Using a 3-percent discount rate, the national NPV of the GSFL and IRL standards is between $21.84 and $53.53 billion and $3.78 and $17.81 billion, respectively, cumulative from 2012 to 2042 in 2008$. This is the estimated total value of future savings minus the estimated increased costs of purchasing GSFL and IRL, discounted to 2009.

The benefits and costs of today's final rule can also be expressed in terms of annualized 2008$ values over the forecast period 2012 through 2042. Using a 7-percent discount rate for the annualized cost analysis, the cost of the standards established in today's final rule is $700 million per year in increased product and installation costs, while the annualized benefits are $2.95 billion per year in reduced product operating costs. Using a 3-percent discount rate, the cost of the standards established in today's final rule is $531 million per year, while the benefits of today's standards are $3.12 billion per year. The following tables depict these annualized benefits and costs for the adopted standards for GSFL and IRL.

TABLE I.5—ANNUALIZED BENEFITS AND COSTS FOR GSFL

Category	Primary estimate	Low estimate	High estimate	Units		
				Year dollars	Disc (%)	Period covered
Benefits						
Annualized Monetized $millions/year.	2302	1329	3275	2008	7	31
	2420	1387	3452	2008	3	31
Annualized Quantified	10.48 CO_2 (Mt)	5.76 CO_2 (Mt)	15.2 CO_2 (Mt)		7	31
	1.78 NO_X (kt)	1.03 NO_X (kt)	2.54 NO_X (kt)		7	31
	0.11 Hg (t)	0 Hg (t)	0.22 Hg (t)		7	31
	10.6 CO_2 (Mt)	5.69 CO_2 (Mt)	15.52 CO_2 (Mt)		3	31
	1.19 NO_X (kt)	0.63 NO_X (kt)	1.76 NO_X (kt)		3	31
	0.11 Hg (t)	0 Hg (t)	0.23 Hg (t)		3	31
Qualitative						
Costs						
Annualized Monetized $millions/year.	582	378	786	2008	7	31
	425	230	621	2008	3	31
Qualitative						
Net Benefits/Costs						
Annualized Monetized $millions/year.	1720	951	2489	2008	7	31
	1994	1158	2831	2008	3	31
Qualitative						

TABLE I.6—ANNUALIZED BENEFITS AND COSTS FOR IRL

Category	Primary estimate	Low estimate	High estimate	Units		
				Year dollars	Disc (%)	Period covered
Benefits						
Annualized Monetized $millions/year.	650	406	894	2008	7	31
	696	424	968	2008	3	31
Annualized Quantified	2.39 CO_2 (Mt)	1.51 CO_2 (Mt)	3.28 CO_2 (Mt)		7	31
	0.51 NO_X (kt)	0.45 NO_X (kt)	0.58 NO_X (kt)		7	31
	0.02 Hg (t)	0 Hg (t)	0.05 Hg (t)		7	31
	2.4 CO_2 (Mt)	1.45 CO_2 (Mt)	3.35 CO_2 (Mt)		3	31
	0.35 NO_X (kt)	0.31 NO_X (kt)	0.4 NO_X (kt)		3	31
	0.02 Hg (t)	0 Hg (t)	0.05 Hg (t)		3	31
Costs						
Annualized Monetized $millions/year.	118	227	9	2008	7	31
	106	218	−6	2008	3	31
Qualitative						
Net Benefits/Costs						
Annualized Monetized $millions/year.	532	179	885	2008	7	31
	590	207	973	2008	3	31

F. Conclusion

DOE has evaluated the benefits (energy savings, consumer LCC savings, positive national NPV, and emissions reductions) to the Nation of today's new and amended energy conservation standards for certain GSFL and IRL, as well as the costs (loss of manufacturer INPV and consumer LCC increases for some users of GSFL and IRL). Based upon all available information, DOE has determined that the benefits to the Nation of the standards for GSFL and IRL outweigh their costs. Today's standards also represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and will result in significant energy savings. At present, GSFL and IRL that meet the new standard levels are commercially available.

II. Introduction

A. Authority

Title III of EPCA sets forth a variety of provisions designed to improve energy efficiency. Part A[1] of Title III (42 U.S.C. 6291–6309) provides for the Energy Conservation Program for Consumer Products Other Than Automobiles. The program covers consumer products and certain commercial products (all of which are referred to hereafter as ''covered products''), including GSFL and IRL. (42 U.S.C. 6292(a)(14) and 6292(i)) DOE publishes today's final rule pursuant to Part A of Title III, which provides for test procedures, labeling, and energy conservation standards for GSFL and IRL and certain other types of products, and authorizes DOE to require information and reports from manufacturers. The test procedures for GSFL and IRL appear at title 10 of the Code of Federal Regulations (CFR) part 430, subpart B, appendix R.

The scope of coverage of these provisions for GSFL and IRL is dictated by EPCA's definitions of these and related terms, as further discussed below. EPCA defines ''general service fluorescent lamp'' as follows:

* * * [F]luorescent lamps which can be used to satisfy the majority of fluorescent applications, but does not include any lamp designed and marketed for the following non-general lighting applications:

(i) Fluorescent lamps designed to promote plant growth.

(ii) Fluorescent lamps specifically designed for cold temperature installations.

(iii) Colored fluorescent lamps.

(iv) Impact-resistant fluorescent lamps.

(v) Reflectorized or aperture lamps.

(vi) Fluorescent lamps designed for use in reprographic equipment.

(vii) Lamps primarily designed to produce radiation in the ultra-violet region of the spectrum.

(viii) Lamps with a color rendering index of 87 or greater.

(42 U.S.C. 6291(30)(B))

EPCA defines ''incandescent reflector lamp'' as follows:

* * * [A] lamp in which light is produced by a filament heated to incandescence by an electric current * * * [and] (commonly referred to as a reflector lamp) which is not colored or designed for rough or vibration service applications, that contains an inner reflective coating on the outer bulb to direct the light, an R, PAR, ER, BR, BPAR, or similar bulb shapes with E26 medium screw bases, a rated voltage or voltage range that lies at least partially within 115 and 130 volts, a diameter which exceeds 2.25 inches, and has a rated wattage that is 40 watts or higher.

(42 U.S.C. 6291(30)(C), (C)(ii) and (F))

EPCA further clarifies this definition of IRL by defining lamp types excluded from the definition, including ''rough service lamp,'' ''vibration service lamp,'' and ''colored incandescent lamp.'' (42 U.S.C. 6291(30)(X), (AA), and (EE)) EPCA prescribes specific energy conservation standards for certain GSFL and IRL. (42 U.S.C. 6295(i)(1)) The statute further directs DOE to conduct two cycles of rulemakings to determine whether to amend these standards, and to initiate a rulemaking to determine whether to adopt standards for additional types of GSFL. (42 U.S.C. 6295(i)(3)–(5)) This rulemaking represents the first round of amendments to the GSFL and IRL energy conservation standards as directed by 42 U.S.C. 6295(i)(3), and it also implements the requirement for DOE to consider energy conservation standards for additional GSFL under 42 U.S.C. 6295(i)(5). The advance notice of proposed rulemaking (ANOPR) in this proceeding, 73 FR 13620, 13622, 13625, 13628–29 (March 13, 2008) (the March 2008 ANOPR), the notice of proposed rulemaking (NOPR) in this proceeding, 74 FR 16920, 16924–26 (April 13, 2009) (the April 2009 NOPR), and subsections II.B.2 and III.B.2 below provide additional detail on the nature and statutory history of EPCA's requirements for GSFL and IRL.

EPCA provides criteria for prescribing new or amended standards for covered products, including GSFL and IRL. As indicated above, any such new or amended standard must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Further, DOE may not prescribe an amended or new standard if DOE determines by rule that such standard would not result in ''significant conservation of energy,'' or ''is not technologically feasible or economically justified.'' (42 U.S.C. 6295(o)(3)(B)) Additionally, DOE may not prescribe an amended or new standard for any GSFL or IRL for which DOE has not established a test procedure. (42 U.S.C. 6295(o)(3)(A))

EPCA also provides that in deciding whether such a standard is economically justified for covered products, DOE must, after receiving comments on the proposed standard, determine whether the benefits of the standard exceed its burdens by considering, to the greatest extent practicable, the following seven factors:

(1) The economic impact of the standard on manufacturers and consumers of the products subject to the standard;

(2) The savings in operating costs throughout the estimated average life of products in the type (or class) compared to any increase in the price, initial charges, or maintenance expenses for the covered products that are likely to result from the imposition of the standard;

(3) The total projected amount of energy savings likely to result directly from the imposition of the standard;

(4) Any lessening of the utility or the performance of the covered products likely to result from the imposition of the standard;

(5) The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard;

(6) The need for national energy conservation; and

(7) Other factors the Secretary considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i))

In addition under (42 U.S.C. 6295(o)(2)(B)(iii)), EPCA, as amended, establishes a rebuttable presumption that a standard for covered products is economically justified if the Secretary finds that ''the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy, and as applicable, water, savings during the first year that the consumer will receive as a result of the standard, as calculated under the test procedure * * *'' in place for that standard.

EPCA also contains what is commonly known as an ''anti-backsliding'' provision. (42 U.S.C. 6295(o)(1)) This provision mandates that the Secretary not prescribe any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered product. EPCA further provides that the Secretary may not prescribe an amended or new standard if interested persons have established by a preponderance of the evidence that the standard is ''likely to result in the unavailability in the United States of any product type (or class) with performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States * * *.'' (42 U.S.C. 6295(o)(4))

[1] This part was originally titled Part B; however, it was redesignated Part A after Part B was repealed by Public Law 109–58.

Section 325(q)(1) of EPCA sets forth additional requirements applicable to promulgating standards for any type or class of covered product that has two or more subcategories. (42 U.S.C. 6295(q)(1)) Under this provision, DOE must specify a different standard level than that which applies generally to such type or class of product ''for any group of covered products which have the same function or intended use, if * * * products within such group—(A) consume a different kind of energy from that consumed by other covered products within such type (or class); or (B) have a capacity or other performance-related feature which other products within such type (or class) do not have and such feature justifies a higher or lower standard'' than applies or will apply to the other products. (42 U.S.C. 6295(q)(1)(A) and (B)) In determining whether a performance-related feature justifies such a different standard for a group of products, DOE must ''consider such factors as the utility to the consumer of such a feature'' and other factors DOE deems appropriate. (42 U.S.C. 6295(q)(1)) Any rule prescribing such a standard must include an explanation of the basis on which DOE established such higher or lower level. (42 U.S.C. 6295(q)(2))

Federal energy conservation requirements for covered products generally supersede State laws or regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)–(c)) DOE can, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions of section 327(d) of EPCA. (42 U.S.C. 6297(d))

B. Background

1. Current Standards

The energy conservation standards that EPCA prescribes for GSFL and IRL, and that are currently in force, set efficacy levels and color rendering index (CRI) levels for certain GSFL, and efficacy standards for certain IRL. (42 U.S.C. 6295(i)(1); 10 CFR 430.32(n)) These standard levels are set forth in Table I.3 and Table I.4 above.

2. History of Standards Rulemaking for General Service Fluorescent Lamps, Incandescent Reflector Lamps, and General Service Incandescent Lamps

This rulemaking represents the first round of amendments to these GSFL and IRL standards, and it also addresses the adoption of standards for additional GSFL, as directed by 42 U.S.C. 6295(i)(3) and (5), respectively. Initially, this rulemaking also included consideration of energy conservation standards for general service incandescent lamps (GSIL). However, as explained in the April 2009 NOPR, amendments to EPCA in the Energy Independence and Security Act of 2007 [2] (EISA 2007) eliminated DOE's authority to regulate additional GSIL and statutorily prescribed standards for GSIL; therefore this rulemaking no longer addresses GSIL. 74 FR 16920, 16926 (April 13, 2009).

DOE commenced this rulemaking on May 31, 2006, by publishing its framework document for the rulemaking, and by giving notice of a public meeting and of the availability of the document for review and public comment. 71 FR 30834 (May 31, 2006). The framework document described the procedural and analytical approaches DOE anticipated using and issues to be resolved in the rulemaking. DOE held a public meeting on June 15, 2006, to present the framework document, describe the analyses DOE planned to conduct during the rulemaking, obtain public comment on these subjects, and facilitate the public's involvement in the rulemaking. DOE also allowed the submission of written statements after the public meeting, and in response received 10 written statements.

On February 21, 2008, DOE issued the March 2008 ANOPR in this proceeding. 73 FR 13620 (March 13, 2008). In the March 2008 ANOPR, DOE described and sought comment on the analytical framework, models, and tools that DOE was using to analyze the impacts of energy conservation standards for the two appliance products. In conjunction with issuance of the March 2008 ANOPR, DOE published on its Web site the complete ANOPR technical support document (TSD), which included the results of DOE's various preliminary analyses in this rulemaking. In the March 2008 ANOPR, DOE requested oral and written comments on these results, and on a range of other issues. DOE held a public meeting in Washington, DC, on March 10, 2008, to present the methodology and results of the ANOPR analyses, and to receive oral comments from those who attended. In the March 2008 ANOPR, DOE invited comment in particular on the following issues: (1) Consideration of additional GSFL; (2) amended definitions; (3) product classes; (4) scaling to product classes not analyzed; (5) screening of design options; (6) lamp operating hours; (7) energy consumption of GSFL; (8) LCC calculation; (9) installation costs; (10) base-case market-share matrices; (11) shipment forecasts; (12) base-case and standards-case forecasted efficiencies; (13) trial standard levels; and (14) period for lamp production equipment conversion. 73 FR 13620, 13686–88 (March 13, 2008). In addition, subsequent to the public meeting and the close of the ANOPR comment period, DOE and the National Electrical Manufacturers Association (NEMA) met on June 26, 2008 at NEMA's request to discuss appropriate standards for high correlated color temperature (CCT) fluorescent lamps. 74 FR 16920, 16926 (April 13, 2009). DOE addressed in detail the comments it received in response to the ANOPR, including NEMA's presentation at the June 2008 meeting, in the April 2009 NOPR.

In the April 2009 NOPR, DOE proposed amended and new energy conservation standards for GSFL and IRL. In conjunction with the NOPR, DOE also published on its Web site the complete TSD for the proposed rule, which incorporated the final analyses DOE conducted and technical documentation for each analysis. The TSD included the engineering analysis spreadsheets, the LCC spreadsheet, the national impact analysis spreadsheet, and the MIA spreadsheet-all of which are available on DOE's Web site.[3] The proposed standards were as shown in Table II.1 and Table II.2, as presented in the April 2009 NOPR. 74 FR 16920, 17027 (April 13, 2009).

TABLE II.1—PROPOSED GSFL STANDARD LEVELS IN APRIL 2009 NOPR

Lamp type	Correlated color temperature	Proposed level (lm/W)
4-Foot Medium Bipin	≤4,500K	84
	>4,500K	78

[2] Public Law 110–140 (enacted Dec. 19, 2007).

[3] The Web site address for all the spreadsheets developed for this rulemaking proceeding are available at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/incandescent_lamps.html.*

TABLE II.1—PROPOSED GSFL STANDARD LEVELS IN APRIL 2009 NOPR—Continued

Lamp type	Correlated color temperature	Proposed level (lm/W)
2-Foot U-Shaped	≤4,500K	78
	>4,500K	73
8-Foot Slimline	≤4,500K	95
	>4,500K	91
8-Foot High Output	≤4,500K	88
	>4,500K	84
4-Foot Miniature Bipin Standard Output	≤4,500K	103
	>4,500K	97
4-Foot Miniature Bipin High Output	≤4,500K	89
	>4,500K	85

* For these product classes, EPCA has different efficacy standards for lamps with wattages less than 35W and greater than or equal to 35W.

TABLE II.2—PROPOSED IRL STANDARDS IN APRIL 2009 NOPR

Lamp type	Diameter (inches)	Voltage	Proposed level (lm/W)
Standard Spectrum 40W–205W	>2.5	≤125	$7.1P^{0.27}$
		<125	$6.2P^{0.27}$
	≤2.5	≥125	$6.3P^{0.27}$
		<125	$5.5P^{0.27}$
Modified Spectrum 40W–205W	>2.5	≥125	$5.8P^{0.27}$
		<125	$5.0P^{0.27}$
	≤2.5	≥125	$5.1P^{0.27}$
		<125	$4.4P^{0.27}$

Note: P is equal to the rated lamp wattage, in watts.

DOE held a public meeting in Washington, DC, on February 3, 2009, to hear oral comments on and solicit information relevant to the proposed rule. At the public meeting and in the April 2009 NOPR, DOE invited comment in particular on the following issues: (1) The scope of covered products; (2) the amended definition of ''colored fluorescent lamp''; (3) product classes for IRL; (4) product classes for T5 lamps; (5) the 4-foot MBP residential engineering analysis; (6) performance characteristics of model lamps used in the engineering analysis; (7) the efficacy levels for IRL; (8) the efficacy levels for GSFL; (9) scaling to product classes not analyzed; (10) ballast operating hours in all sectors and GSFL operating hours in the residential sector; (11) growth rates and market penetration in the shipments analysis; (12) base-case and standards-case market-share matrices; (13) the manufacturer impact analysis; (14) the determination of environmental impacts; (15) the selected trial standard levels; (16) the proposed standard levels; (17) alternative scenarios to achieve greater energy savings for GSFL; (18) other technology pathways to meet IRL TSL5. 74 FR 16920, 17025–26 (April 13, 2009). The April 2009 NOPR also included additional background information on the history of this rulemaking. 74 FR 16920, 16925–26 (April 13, 2009).

III. Issues Affecting the Scope of This Rulemaking

A. Additional General Service Fluorescent Lamps for Which DOE Is Adopting Standards

1. Scope of EPCA Requirement That DOE Consider Standards for Additional Lamps

As discussed above, EPCA established energy conservation standards for certain general service fluorescent lamps (42 U.S.C. 6295(i)(1)) and directed the Secretary to ''initiate a rulemaking procedure to determine if the standards in effect for fluorescent lamps * * * should be amended so that they would be applicable to additional general service fluorescent [lamps] * * *.'' (42 U.S.C. 6295(i)(5)) Thus, EPCA directs DOE to consider whether to adopt energy efficacy standards for additional GSFL beyond those already covered by standards prescribed in the statute.

However, as set forth in greater detail in the March 2008 ANOPR and the April 2009 NOPR, although many GSFL not currently subject to standards are potential candidates for coverage, it could be argued that EPCA's definitions of ''general service fluorescent lamp'' and ''fluorescent lamp'' conflict with (and negate) the requirement of 42 U.S.C. 6295(i)(5) that DOE consider standards for additional GSFL. 73 FR 13620, 13628–29 (March 13, 2008); 74 FR 16920, 16920, 16926–27 (April 13, 2009). Specifically, EPCA defines ''general service fluorescent lamp'' as ''fluorescent lamps'' that can satisfy the majority of fluorescent lamp applications and that are not designed and marketed for certain specified, nongeneral lighting applications. (42 U.S.C. 6291(30)(B)) Furthermore, EPCA defines ''fluorescent lamp'' as ''a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light,'' *and* as including ''only'' the four enumerated types of fluorescent lamps for which EPCA already prescribes standards. (42 U.S.C. 6291(30)(A); 42 U.S.C. 6295(i)(1)(B)) Thus, to construe ''general service fluorescent lamp'' in 42 U.S.C. 6295(i)(5) as being limited by all elements of the EPCA definition of ''fluorescent lamp,'' would mean there are no GSFL that are not already subject to standards, and hence, there would be no ''additional'' GSFL for which DOE could consider standards. Such an interpretation would conflict with the directive in 42 U.S.C. 6295(i)(5) that DOE consider standards for ''additional'' GSFL, thereby rendering that provision a nullity.

For the reasons below, DOE has concluded that the term ''additional general service fluorescent lamps'' in 42 U.S.C. 6295(i)(5) should be construed as not being limited to the four enumerated lamp types specified in the EPCA definition of ''fluorescent lamp,'' thereby giving effect to the directive in 42 U.S.C. 6295(i)(5) that DOE consider standards for additional GSFL. First, DOE added this directive to EPCA at the same time it added the definitions for ''general service fluorescent lamps'' and ''fluorescent lamps,'' as part of the Energy Policy Act of 1992 (EPACT 1992; Pub. L. 102–486). DOE does not believe Congress would intentionally insert a legislative provision that, when read in conjunction with simultaneously added definitions, amounts to a nullity. Second, reading the definition of ''fluorescent lamp'' to preclude consideration of standards for additional GSFL would run counter to the energy-saving purposes of EPCA. It is reasonable to assume that, when Congress incorporated this directive into EPCA, it sought to have DOE consider whether standards would be warranted for generally available products for which EPCA did not prescribe standards. Also, it is assumed that Congress would not have intended for DOE to limit itself to consideration of energy conservation standards only for those products utilizing technologies available in 1992, but instead, it would seek to cast a broader net that would achieve energy efficiency improvements in lighting products incorporating newer technologies.

In addition, DOE understands that the industry routinely refers to ''fluorescent lamps'' as including products in addition to the four enumerated in the statutory definition of that term. In fact, in the March 2008 ANOPR, DOE presented its plan for including additional GSFL for coverage, and DOE did not receive adverse comment. 73 FR 13620, 13628–29 (March 13, 2008)

For these reasons, and as further explained in the March 2008 ANOPR, 73 FR 13620, 13629 (March 13, 2008), and in the April 2009 NOPR, 74 FR 16920, 16926–27 (April 13, 2009), DOE has concluded that, in addressing general service fluorescent lamps in 42 U.S.C. 6295(i)(5), Congress intended to refer to ''fluorescent lamps'' in a broader, more generic sense than as expressed in the EPCA definition for that term. Consequently, as set forth in the April 2009 NOPR, 74 FR 16920, 16927 (April 13, 2009), DOE views ''additional'' GSFL, as that term is used in 42 U.S.C. 6295(i)(5), as lamps that: (1) Meet the technical portion of the statutory definition of ''fluorescent lamp'' (*i.e.*, a low-pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light) (42 U.S.C. 6291(30)(A)) without restriction to the four lamp types specified in that definition; (2) can be used to satisfy the majority of fluorescent lighting applications (42 U.S.C. 6291(30)(B)); (3) are not within the exclusions from the definition of GSFL specified in 42 U.S.C. 6291(30)(B); and (4) are ones for which EPCA does not prescribe standards. Such an interpretation does not alter the existing statutory provision or standards for ''fluorescent lamps,'' but it does permit DOE to give effect to section 6295(i)(5) of EPCA by adopting energy conservation standards for a wide variety of GSFL that are not currently covered by standards. DOE notes that it received no adverse comments on this interpretation in response to the April 2009 NOPR.

2. Determination of the Additional Lamps to Which Standards Will Apply

To determine the additional GSFL to which energy conservation standards should apply, DOE first comprehensively reviewed the fluorescent lighting market and identified the following types of lamps as ''additional'' GSFL for consideration pursuant to 42 U.S.C. 6295 (i)(5), based on the four criteria above:

- 4-foot, medium bipin (MBP), straight-shaped lamps, rated wattage of less than 28W;
- 2-foot, medium bipin, U-shaped lamps, rated wattage of less than 28W;
- 8-foot, recessed double contact (RDC), rapid start, high-output (HO) lamps not defined in ANSI Standard C78.1–1991 [4] or with current other than 0.800 nominal amperes;
- 8-foot single pin (SP), instant start, slimline lamps with a rated wattage greater than or equal to 52, not defined in ANSI Standard C78.3–1991; [5]
- Very high output (VHO) straight-shaped lamps;
- T5 [6] miniature bipin (miniBP) straight-shaped lamps;
- Additional straight-shaped and U-shaped lamps other than those listed above (*e.g.*, alternate lengths, diameters, or bases); and
- Additional fluorescent lamps with alternate shapes (*e.g.*, circline lamps and pin-based compact fluorescent lamps (CFL)).

73 FR 13620, 13630 (March 13, 2008); 74 FR 16920, 16927–28 (April 13, 2009).

For each of these categories of GSFL, DOE assessed whether standards had the potential to result in energy savings. For each category for which it appeared that standards could save significant amounts of energy, DOE then performed a preliminary analysis of whether potential standards appeared to be technologically feasible and economically justified. Finally, for GSFL that met that test, DOE did an in-depth analysis of whether, and at what levels, standards would be warranted under the EPCA criteria in 42 U.S.C. 6295(o), pertaining to energy savings, technological feasibility, economic justification, and certain other factors. Based on this analysis, as summarized in the April 2009 NOPR, DOE proposed to cover the following additional GSFL:

- 2-foot, medium bipin U-shaped lamps with a rated wattage greater than or equal to 25 and less than 28;
- 4-foot, medium bipin lamps with a rated wattage greater than or equal to 25 and less than 28;
- 4-foot T5, miniature bipin, straight-shaped, standard output lamps with rated wattage greater than or equal to 26;
- 4-foot T5, miniature bipin, straight-shaped, high output lamps with rated wattage ≥51;
- 8-foot recessed double contact, rapid start, HO lamps other than those defined in ANSI Standard C78.1–1991;
- 8-foot recessed double contact, rapid start, HO lamps (other than 0.800 nominal amperes) defined in ANSI Standard C78.1–1991; and
- 8-foot single pin instant start slimline lamps, with a rated wattage greater than or equal to 52, not defined in ANSI Standard C78.3–1991

74 FR 16920, 16930 (April 13, 2009).

DOE received several comments regarding the additional GSFL proposed for coverage. In terms of methodology, the Green Lighting Campaign questioned the criteria DOE used in determining whether to include additional fluorescent lamps in coverage. Specifically, the Green Lighting Campaign argued that just because a product is low-volume, and, therefore, does not represent significant energy savings, does not indicate that it should not be subject to standards. According to the commenter, many low-volume products are some of the least-efficient products on the market. (Green Lighting Campaign, No. 74 at p. 3)

In response, as described in more detail for each lamp described below for which coverage was not extended, DOE concluded that coverage was inappropriate given the small market share of these lamps. DOE emphasizes that it will vigilantly monitor the market

[4] Titled ''for Fluorescent Lamps—Rapid-Start Types—Dimensional and Electrical Characteristics.''

[5] Titled ''for Fluorescent Lamps—Instant-Start and Cold-Cathode Types—Dimensional and Electrical Characteristics''

[6] T5, T8, T10, and T12 are nomenclature used to refer to tubular fluorescent lamps with diameters of 0.625, 1, 1.25, and 1.5 inches respectively.

shares and other relevant information for these lamps and consider whether to extend coverage in a future rulemaking.

NEMA and EEI agreed with the scope of coverage proposed in the April 2009 NOPR. (NEMA, Public Meeting Transcript, No. 38.4 at p. 43; EEI, No. 45 at p. 3) However, the Green Lighting Campaign disagreed with DOE's proposed scope of coverage, expressing concern that DOE's proposed standards in the April 2009 NOPR would allow a significant amount of outdated lighting equipment to be sold in the U.S. even though more efficient replacement technologies exist. Specifically, the Green Lighting Campaign requested that two-pin compact fluorescent lamps, high-intensity discharge (HID) lamps, ballasts, luminaires, and fluorescent lamps of other shapes and sizes be included in coverage. (Green Lighting Campaign, No. 74 at pp. 1–4)

In response, DOE considered two-pin compact fluorescent lamps and fluorescent lamps of other shapes and sizes for coverage but concluded that they did not meet the statutory criteria defined by EPCA, because these lamps represent relatively small market shares and do not possess the ability to serve as substitutes for most covered GSFL. See section III.A.2.g for more details. Additionally, this rulemaking only amends standards for GSFL and IRL, as described in section III. DOE is addressing standards for ballasts and HID lamps in separate rulemakings, and DOE currently does not have the authority to set energy conservation standards for luminaires. Please consult the Web site of DOE's Appliances and Commercial Equipment Standards Program for further detail.[7]

Earthjustice and the Green Lighting Campaign disagreed with DOE's proposed covered wattage ranges. In the April 2009 NOPR, DOE determined the wattage range for covered products based on commercially-available products. 74 FR 16920, 16929–30 (April 13, 2009). This approach allowed DOE to confirm that an energy conservation standard would be technologically feasible and economically justified for any covered product. In comments on the March 2008 ANOPR, stakeholders stated that instead of determining a covered wattage range based on commercially-available products, DOE should substantially lower covered wattage ranges and use narrowly-drawn exemptions for those products that did not meet the EPCA criteria for inclusion as a covered product. 74 FR 16920, 16929–30 (April 13, 2009). The stakeholders believed that this approach ensured that energy conservation standards would achieve largest potential energy savings. DOE responded in the April 2009 NOPR and agreed that current covered wattage ranges should be extended when commercially-available product exists, but disagreed that they should be extended when no products are available. DOE is required to consider energy conservation standards that are technologically feasible. If a lower wattage lamp does not yet exist, DOE cannot confirm that it would be technologically feasible or economically justified for such a lamp to meet a set energy conservation standard. Furthermore, DOE encourages the introduction of lamps at lower wattages. Thus, DOE decided to only lower the wattage range of a covered product if a commercially available product existed at a lower wattage. 74 FR 16920, 16929–30 (April 13, 2009).

In commenting on the April 2009 NOPR, Earthjustice again disagreed with DOE's approach and urged DOE to be proactive in extending the standards' covered wattage range so as to eliminate potential loopholes. Earthjustice argued that DOE should cover all wattages of the designated product classes that are lower than the existing covered wattage range unless DOE can prove that standards are not technologically feasible or economically justified. In not doing so, Earthjustice claims DOE is not meeting its obligations under EPCA to consider standards for all GSFL, including those that do not currently exist, but might be popular at the time the standard takes effect. (Earthjustice, No. 60 at p. 4) The Green Lighting Campaign asserted that the covered wattage ranges proposed in the April 2009 NOPR ''seem arbitrary and unjustified,'' commenting that the European Union's (EU) energy efficiency standards for lighting cover a much larger range of rated wattages. (Green Lighting Campaign, No. 74 at pp. 2–3)

In seeking to advance the energy-saving goals of EPCA, DOE understands stakeholders' concerns that new products may emerge that are outside of the covered wattage range. However, in setting up the statutory structure, Congress was very careful to ensure that any standards set would be based upon the best available data, particularly in terms of what standards would be technologically feasible and economically justified. Furthermore, given the anti-backsliding provision of 42 U.S.C. 6295(o)(1), DOE must exercise great care so as to set an appropriate standard in the first instance. Contrary to EPCA's direction that DOE set standards for products that the data show to be technologically feasible and economically justified, Earthjustice would have DOE broaden coverage without data, unless DOE can prove a negative (*i.e.*, that such standards are not economically feasible and economically justified). DOE concludes that such an approach would violate the statute. Accordingly, DOE maintains that it is inappropriate to lower the covered wattage range to include products that do not exist. Without knowing the performance characteristics of a lamp, DOE cannot know how energy conservation standards will affect it. It is not possible for DOE to set standards for lower-wattage lamps that currently do not exist because DOE cannot prove that standards for such lamps are technologically feasible and economically justified. Therefore, DOE maintains the covered wattage range proposed in the April 2009 NOPR in this final rule. It is further noted that if low-wattage products do subsequently enter the market, DOE would address the appropriateness of energy conservation standards for such products in considering periodic amendments to the GSFL and IRL standards pursuant to 42 U.S.C. 6295(m).

In response to comments on the EU's lighting efficiency standards, DOE notes that these standards are not directly comparable, because they are applied to a larger scope of products than what is covered in this rulemaking. Thus, the cited EU standards encompass a broader range of covered wattages (*i.e.*, include lower wattage levels) than those proposed by DOE, because the EU standard covers lamps with shorter lengths.

ACEEE and the CA Stakeholders suggested that DOE should lower the wattage range of covered products by one watt in order to account for imprecision in how lamps are rated. (ACEEE, Public Meeting Transcript, No. 38.4 at p. 44–45; CA Stakeholders, No. 63 at p. 11) ACEEE argued that because a lamp's rated wattage and its ''actual'' wattage often differ, lowering the wattage range would prevent manufacturers from circumventing standards by rating lamps at artificially low wattages. For example, a manufacturer could rerate a 25 watt lamp as a 24 watt lamp, which would then not be covered by standards.

While DOE understands the stakeholders' concerns, DOE believes that the definition of ''rated wattage'' sufficiently addresses the issue of potential circumvention. As discussed in further detail in section III.C.1 below,

[7] Available at: *http://www1.eere.energy.gov/buildings/appliance_standards/index.html.*

for lamps currently commercially-available and listed in ANSI C78.81–2005 or ANSI C78.901–2005, ''rated wattage'' (as defined in amended 10 CFR 430.2) is specified for each lamp on its corresponding datasheet in the same industry standard. Therefore, for these lamps, manufacturers may not arbitrarily lower the rated wattage of lamps listed in the ANSI standards. However, due to the emergence of new products on the market after publication of the ANSI standards, not all currently commercially-available lamps are listed in ANSI C78.81–2005 or ANSI C78.901–2005. For lamps not listed in either standard, the rated wattage corresponds to the wattage measured when operating the lamp on an appropriate ballast, as specified by part 1(iii) of the revised definition of ''rated wattage.'' In such a case, the ''actual'' wattage would be equivalent to the rated wattage, thereby preventing circumvention of the standard. Thus, for all covered lamps, DOE believes that the definition of ''rated wattage'' adopted in this final rule prevents manufacturers from artificially raising or lowering the rated wattage of a lamp, thereby addressing any potential loopholes.

The following sections discuss each additional GSFL category DOE considered throughout this rulemaking and summarize the analysis performed to determine to which lamps DOE should extend coverage.

a. Four-Foot Medium Bipin Lamps

DOE found that there are no 4-foot medium bipin lamps with a rated wattage below 25W currently on the market, but that manufacturers do market and sell 25W 4-foot medium bipin T8 fluorescent lamps as replacements for higher-wattage 4-foot bipin T8 lamps. Thus, DOE initially concluded that standards for these lamps that are 25W or higher, but less than 28W, would mitigate the risk of unregulated 25W lamps becoming a loophole, and would maximize potential energy savings. In addition, because the technology and incremental costs associated with increased efficacy of 25W lamps are similar to their already regulated 28W counterparts, DOE tentatively concluded that standards for these lamps would be technologically feasible and economically justified. 73 FR 13620, 13630 (March 13, 2008) and 74 FR 16920, 16928 (April 13, 2009). As explained in the April 2009 NOPR and as set forth below in section VII, DOE has now determined that standards for 4-foot medium bipin lamps with a rated wattage at or above 25W, and below 28W, would save significant amounts of energy and are technologically feasible and economically justified, and includes such standards in today's rule. DOE has not, however, pursued standards for 4-foot medium bipin lamps with a rated wattage below 25W. The lack of existence of such lamps precludes DOE from assessing whether standards for them are technologically feasible and economically justified, and the inability to make such an assessment could also result in the adoption of standards that would reduce the utility of such a product or even preclude its development. 74 FR 16920, 16929–30 (April 13, 2009). Therefore, in this final rule, DOE extends coverage to 4-foot medium bipin lamps with a rated wattage greater than or equal to 25W and less than 28W.

b. Two-Foot Medium Bipin, U-Shaped Lamps

DOE initially decided not to consider standards for 2-foot U-shaped lamps less than 28W, based on its understanding that no such products are commercially available. NEMA provided information, however, that such lamps have been introduced at 25W. Therefore, consistent with its approach just described for 4-foot medium bipin lamps, DOE evaluated for standards 2-foot U-shaped lamps of 25W or more, but less than 28W. 74 FR 16920, 16929–30 (April 13, 2009). As set forth below in section VII, DOE has now determined that standards for these lamps would save significant amounts of energy and are technologically feasible and economically justified, and includes such standards in today's rule. In addition, DOE has not pursued standards for 2-foot U-shaped lamps with a rated wattage below 25W, for the same reasons that it has declined to pursue standards for 4-foot medium bipin lamps with a rated wattage below 25W. Therefore, in this final rule, DOE extends coverage to 2-foot U-shaped lamps with a rated wattage greater than or equal to 25W and less than 28W.

c. Eight-Foot Recessed, Double-Contact Lamps

As indicated above, DOE examined 8-foot recessed double-contact (RDC) rapid-start HO lamps, including those not defined in ANSI Standard C78.1–1991 as well as those defined in ANSI Standard C78.1–1991, but with other than 0.800 nominal amperes. These are T8 8-foot lamps, and neither is currently subject to standards. DOE concluded that these lamps serve or could serve as substitutes for GSFL currently subject to standards, and, therefore, coverage of these lamps would maximize energy savings from standards. DOE also tentatively concluded that energy conservation standards for these T8 lamps would be: (1) Technologically feasible because they use technologies similar to the technologies used by their already-regulated T12 counterparts; and (2) economically justified because preliminary analysis indicated such standards would result in substantial economic savings. 73 FR 13620, 13630–31 (March 13, 2008) and 74 FR 16920, 16928 (April 13, 2009). As set forth below in section VII, DOE has now determined that standards for these lamps would save significant amounts of energy and are technologically feasible and economically justified, and includes such standards in today's rule. Therefore, in this final rule, DOE extends coverage to the following 8-foot recessed double contact, rapid start, HO lamps: (1) Ones other than those defined in ANSI Standard C78.1–1991; and (2) those defined in ANSI Standard C78.1–1991 with other than 0.800 nominal amperes.

d. Eight-Foot Single Pin Slimline Lamps

As with 8-foot recessed double contact, rapid start, HO lamps, DOE concluded that 8-foot, single pin, instant start, slimline lamps not included in ANSI Standard C78.3–1991, with a rated wattage greater than or equal to 52W, could serve as substitutes for GSFL currently subject to standards. Therefore, DOE tentatively concluded that regulation of these lamps has the potential to achieve substantial energy savings. DOE's preliminary analysis also indicated that energy conservation standards for these 8-foot single pin lamps would be: (1) Technologically feasible because they use technologies similar to the technologies used by their already-regulated T12 counterparts; and (2) economically justified because preliminary analysis indicated such standards would result in substantial economic savings. 73 FR 13620, 13631–32 (March 13, 2008) and 74 FR 16920, 16929 (April 13, 2009). As set forth below in section VII, DOE has now determined that standards for these lamps would save significant amounts of energy and are technologically feasible and economically justified, and includes such standards in today's rule. Therefore, in this final rule, DOE extends coverage to 8-foot single pin instant start slimline lamps, with a rated wattage greater than or equal to 52W that are not defined in ANSI Standard C78.3–1991.

e. Very High Output Straight-Shaped Lamps

Although individual VHO T12 lamps consume relatively large amounts of energy, they are commonly used in outdoor applications where high-intensity discharge (HID) lamps are rapidly gaining market share, and shipments of VHO lamps are declining rapidly. Therefore, the total energy savings that would result from standards for these lamps would be small and would likely decrease over time. In response to the April 2009 NOPR, DOE received no adverse comment regarding its decision to not cover VHO lamps. Accordingly, DOE has not pursued standards for VHO lamps and does not extend them coverage in this final rule. 73 FR 13620, 13632 (March 13, 2008) and 74 FR 16920, 16928 (April 13, 2009). As emphasized above, DOE will vigilantly monitor the market shares and other relevant information for these lamps and consider whether to extend coverage in a future rulemaking.

f. T5 Lamps

DOE initially decided not to consider standards for T5 lamps because it believed that standards for these lamps would have limited potential to result in energy savings. First, these lamps have a relatively small market share. Second, although T5 lamps can substitute for T8 or T12 lamps, T5 lamps tend to have higher efficacies than T8s or T12s. Therefore, DOE inferred that a lack of standards for T5 lamps would be unlikely to undermine energy savings resulting from a T12 and T8 standard, even if the standard caused increased sales of T5 systems. 73 FR 13620, 13632 (March 13, 2008).

However, after receiving comments on this issue in response to the March 2008 ANOPR, including comments advocating energy conservation standards for T5 lamps, DOE decided it should reconsider whether such standards are warranted. Specifically, DOE concluded that, absent standards for T5 lamps, less-efficient T5 lamps could enter the market and be substituted for T8 and T12 lamps that are subject to standards. Thus, a lack of standards for T5 lamps could potentially reduce the energy savings that could result from the standards for T8 and T12 lamps. Accordingly, in the NOPR, DOE tentatively concluded that regulation of T5 lamps has the potential to achieve substantial energy savings. Furthermore, DOE research indicated that: (1) The primary driver of T5 market share growth is substitution for currently regulated 4-foot MBP lamps; (2) standard-output (approximately 28W) and high-output (approximately 54W) lamps are the highest volume T5 miniature bipin lamps; and (3) reduced-wattage versions of these lamps (26W and 51W, respectively) are available. Therefore, DOE evaluated for standards 4-foot nominal, straight-shaped, T5 miniature bipin standard output lamps with rated wattages ≥26W and 4-foot nominal, straight-shaped, T5 miniature bipin high output lamps with rated wattages ≥51W, as they present the greatest potential for energy savings. DOE also tentatively concluded that energy conservation standards for these T5 lamps would be: (1) Technologically feasible because higher-efficacy versions of some of these lamps are already present in the market; and (2) economically justified because preliminary analysis indicated such standards would result in substantial economic savings. 74 FR 16920, 16929 (April 13, 2009). Both NEMA and ACEEE supported the extension of coverage to T5 lamps. (NEMA, Public Meeting Transcript, No. 38.4 at p. 43; ACEEE, Public Meeting Transcript, No. 38.4 at p. 44; NEMA, No. 81 at p. 7)

Since the publication of the NOPR, DOE has learned that a 49W T5 miniature bipin high-output lamp has been introduced to the market. As this lamp is very similar to a 51W T5 miniature bipin high-output lamp, DOE concludes that standards for these lamps would be technologically feasible and economically justified for the reasons listed above. Therefore, as set forth in more detail in section VII, DOE has determined that standards for T5 lamps would save significant amounts of energy and are technologically feasible and economically justified. Thus, in this final rule, DOE extends coverage to 4-foot T5, miniature bipin, straight-shaped, standard output lamps with rated wattage greater than or equal to 26W and 4-foot T5, miniature bipin, straight-shaped, high output lamps with rated wattage greater than or equal to 49W.

g. Various Other Fluorescent Lamps

In addition to the GSFL already covered by standards and those just discussed, there exist straight-shaped and U-shaped fluorescent lamps that have, for example, alternate lengths, diameters, or bases, as well as fluorescent lamps with alternative shapes (*e.g.*, circline lamps and pin-based compact fluorescent lamps (CFL)). In this rulemaking, DOE has not pursued standards for these additional fluorescent lamps. The GSFL already covered and those DOE included in this rulemaking represent a significant majority of the GSFL market, and, thus, the bulk of the potential energy savings from amended or new standards. Furthermore, there is limited potential for lamps with miscellaneous lengths and bases to grow in market share, given the constraints of fixture lengths and socket compatibility. 73 FR 13620, 13632 (March 13, 2008) and 74 FR 16920, 16928 (April 13, 2009). Given the relatively low shipments and limited potential for growth in shipments, DOE does not extend coverage to GSFL with alternate lengths, diameters, bases, or shapes. DOE again emphasizes that it will vigilantly monitor the market shares and other relevant information for these lamps and consider whether to extend coverage in a future rulemaking.

Magnaray, a luminaire manufacturer, commented that the amended standards should not eliminate existing "twin T5" fluorescent lamps from the market. Magnaray stated that "twin T5" lamps have demonstrated significant energy savings relative to their replacements. The luminaire manufacturer further requested that DOE recommend these lamps for use in all outdoor lighting applications. (Magnaray, No. 58 at p. 1) DOE research indicates that "twin T5" lamps are actually high-lumen-output single-ended twin-tube T5 pin-based CFL. In general, these lamps are offered with wattages between 18W and 80W, CCTs between 3000K and 5000K, lengths between 9 and 22.6 inches, and CRIs of 82. As discussed above, based on their relatively low market-share and the low potential energy savings associated with their regulation, DOE is not extending coverage to pin-based CFL. DOE reiterates that it will vigilantly monitor the market shares and other relevant information for these lamps and consider whether to extend coverage in a future rulemaking. In addition, it should be noted that DOE does not endorse particular products or recommend that consumers adopt particular technologies in the energy conservation standards rulemaking.

3. Summary of GSFL for Which DOE Has Adopted Standards

DOE has determined that energy conservation standards are technologically feasible and economically justified, and would result in significant energy savings, for all of the "additional" GSFL for which DOE proposed standards in the April 2009 NOPR. Therefore, DOE is adopting standards today for the following additional GSFL:

• 2-foot, medium bipin U-shaped lamps with a rated wattage greater than or equal to 25 and less than 28;
• 4-foot, medium bipin lamps with a rated wattage greater than or equal to 25 and less than 28;
• 4-foot T5, miniature bipin, straight-shaped, standard output lamps with rated wattage greater than or equal to 26;

• 4-foot T5, miniature bipin, straight-shaped, high output lamps with rated wattage greater than or equal to 49;
• 8-foot recessed double contact, rapid start, HO lamps other than those defined in ANSI Standard C78.1–1991;
• 8-foot recessed double contact, rapid start, HO lamps (other than 0.800 nominal amperes) defined in ANSI Standard C78.1–1991; and
• 8-foot single pin instant start slimline lamps, with a rated wattage greater than or equal to 52, not defined in ANSI Standard C78.3–1991.

B. Incandescent Reflector Lamp Scope of Coverage

The April 2009 NOPR proposed amended energy conservations standards for incandescent reflector lamps with a rated wattage from 40W to 205W, other than those exempted from standards under 42 U.S.C. 6295(i)(1)(C). 74 FR 16920, 16924–25, 16930–31, 17017–18 (April 13, 2009) In response to the April 2009 NOPR, DOE received several comments regarding the proposed incandescent reflector lamp scope coverage. These comments are discussed below.

1. Covered Wattage Range

In response to the April 2009 NOPR, the Edison Electric Institute (EEI) expressed concern that the scope of coverage for IRL is too limited, specifically with regard to the proposed covered wattage range (*i.e.*, 40W–205W). EEI suggested that manufacturers could easily produce lamps at 39W or 206W to circumvent energy conservation standards. Because IRL exist in the market at wattages as low as 35W and as high as 500W, EEI recommended that the covered wattage range for IRL be extended to include lamps as low as 20W and as high as 505W. (EEI, No. 45 at p. 2)

In amending energy conservation standards for IRL, DOE is limited to the definition prescribed by EISA 2007, which defines IRL as a lamp that ''has a rated wattage that is 40 watts or higher.'' (42 U.S.C. 6291(30)(C), (C)(ii), and (F)) Given this definition, DOE does not have the authority to decrease the lower wattage limit of covered IRL below 40W. DOE does, however, have the authority to alter the upper limit of the wattage range for covered IRL. In response to EEI's comment, DOE analyzed commercially-available product in manufacturer catalogs to assess the prevalence of products with wattages greater than 205W. Based on this research, DOE believes that IRL with rated wattages greater than 205W comprise a very small portion of the market and, therefore, do not represent substantial potential energy savings. For these reasons, DOE has decided, in this final rule, to adopt standards for IRL with a rated wattage greater than or equal to 40W and less than or equal to 205W.

2. Exempted Incandescent Reflector Lamps

As discussed in more detail in the April 2009 NOPR, 74 FR 16920, 16930 (April 13, 2009), section 332(b) of EISA 2007 amended EPCA to expand its definition of ''incandescent reflector lamp'' to include lamps with a diameter between 2.25 and 2.75 inches, as well as ER, BR, BPAR, or similar bulb shapes (42 U.S.C. 6291(30)(C)(ii)) and also to exempt certain of these lamps from EPCA's standards for IRL (42 U.S.C. 6295(i)(1)(C)). As discussed in section II.B.2, DOE issued and posted on its Web site the January 2009 NOPR in which DOE adhered to its conclusion that these exemptions, read in conjunction with other language in 42 U.S.C. 6295(i)(1)(C) and 42 U.S.C. 6295(i)(3), precluded DOE from adopting energy conservation standards for lamps covered by the exemptions. DOE subsequently held a public meeting where stakeholders commented on the contents of the January 2009 NOPR.

At the February 3, 2009 NOPR public meeting, NEMA stated its agreement with DOE's interpretation of the statute regarding the exempted IRL. (NEMA, Public Meeting Transcript, No. 38.4 at p. 323) However, stakeholders presented comments disagreeing with DOE's conclusion and urging DOE to set standards for the exempted lamps. Several commenters stated that exempted lamps comprise a substantial portion of the market and, therefore, represent significant potential energy savings. (ASAP, Public Meeting Transcript, No. 38.4 at p. 27–28; EEI, No. 45 at p. 3; Woolsey, No. 46 at p. 1) Furthermore, ASAP argued that DOE's interpretation that these lamps are exempt from DOE regulation, does not accurately reflect what Congress intended when making these lamps covered products in EISA 2007. According to the commenter, because States are preempted from setting standards for covered products, these exempted IRL would remain beyond the reach of any energy conservation standards. Several stakeholders urged DOE to draft and publish a supplementary NOPR to address the exempted ER and BR lamps. (ASAP, Public Meeting Transcript, No. 38.4 at pp. 33, 52–53, 322–323; Woolsey, No. 46 at p. 2)

After carefully considering the testimony of the February 3, 2009 NOPR public meeting and reexamining the ANOPR public comments on this issue, DOE has reexamined its authority under EPCA to amend standards for ER, BR, and small-diameter lamps and concluded that its earlier view may have been in error. As discussed in more detail in the April 2009 NOPR, DOE is reconsidering whether, under 42 U.S.C 6295(i)(3), the directive to amend the standards in paragraph (1) encompasses both the statutory levels and the exemptions to those standards. Regardless of the outcome of that decision, DOE has not considered such lamps as part of the present rulemaking because it had not conducted the requisite analyses to adopt appropriate standard levels. At the same time, DOE did not wish to delay the present rulemaking (and the accompanying energy savings to the Nation) for the sole reason of considering this subset of ER, BR, and small-diameter lamps. Therefore, as explained in the April 2009 NOPR, DOE has decided to proceed with setting energy conservation standards for the lamps that are the subject of the present rulemaking and to commence a separate rulemaking for ER, BR, and small-diameter lamps. 74 FR 16920, 16930–31 (April 13, 2009).

Following the publication of the April 2009 NOPR, several stakeholders supported DOE's decision to address the exempted lamps in a separate rulemaking and urged DOE to act quickly to set these new standards. (Earthjustice, No. 60 at p. 2; NEEP, No. 61 at p. 5; Joint Comment, No. 62 at pp. 2–3; ACEEE, No. 76 at p. 5; NRDC, No. 82 at p. 4) Commenters encouraged DOE to establish energy conservation standards for the exempted lamps with the same effective date as those adopted in this rulemaking in order to minimize market distortions and potential shifting from regulated products to unregulated products. (EEI, No. 45 at p. 3; NEEP, No. 61 at p. 5; EEI, No. 78 at p. 2) DOE will consider these comments in its separate rulemaking assessing energy conservation standards for the exempted ER, BR, and small diameter lamps.

3. Museum Lighting

DOE received a comment from The J Paul Getty Museum requesting that museum lighting, and particularly art museum lighting, be exempt from standards. The comment stated that HIR lamps do not provide the same quality of light as the halogen lamps that would be eliminated by the proposed standard. (The J Paul Getty Museum, No. 56 at p. 1) In response, DOE is unaware of any specific light quality of halogen lamps that would necessitate their usage instead of halogen infrared reflector lamps for museum applications. In addition, the commenter did not provide any further details on the unique utility of current lamps in museum settings that could not be provided by substitute lamps that would meet the requirements of the energy conservation standards under consideration. Although the infrared reflector coating causes a reduction in the infrared region of the electromagnetic spectrum, these wavelengths of light are largely invisible to the human eye. Therefore, DOE does not believe that halogen lamps represent a distinct utility. In addition, given the identical nature of halogen PAR lamps used in museum settings and non-museum settings, it would be potentially easy for any consumer to purchase and install a lamp meant for museum use. Accordingly, DOE is concerned that failure to regulate this type of lamp could significantly undermine the energy savings potential of the IRL standard. In light of this concern and the lack of information to substantiate a unique utility of halogen IRL, DOE has decided not to create an exemption from IRL standards for museum lighting.

C. Amended Definitions

1. ''Rated Wattage''

To implement the expanded scope of EPCA's coverage of GSFL and IRL, and of standards adopted for GSIL in EISA 2007, DOE proposed to revise its definitions of ''rated wattage'' and ''colored fluorescent lamp.'' 74 FR 16920, 16931–32 (April 13, 2009). As to ''rated wattage,'' one element of EPCA's definitions for both ''fluorescent lamp'' and ''incandescent reflector lamp'' is a lamp's rated wattage. (42 U.S.C. 6291(30)(A), (C)(ii), and (F)) Also, EPCA prescribes maximum rated wattages as part of its energy conservation standards for GSIL. (42 U.S.C. 6295(i)(1)) Although EPCA does not define the term ''rated wattage,'' DOE's regulations do, but the current DOE definition covers only 4-foot medium bipin T8, T10, and T12 fluorescent lamps. 10 CFR 430.2.

Therefore, DOE proposed a revised and updated definition of ''rated wattage.'' This definition included references to the current versions of applicable ANSI standards, clarified and improved the definition, and applied it to those lamps for which rated wattage is a key characteristic but to which DOE's current definition does not apply. 74 FR 16920, 16931 (April 13, 2009). DOE did not receive any comments in response to this proposed change. However, because ''electrical power'' is appropriately defined in paragraph 2.8 or Appendix R of Subpart B, DOE note that it has decided to replace the term ''wattage'' in parts (1)(ii) and (1)(iii) of the definition of ''rated wattage'' with ''electrical power.'' Therefore, for the reasons explained above and in the April 2009 NOPR, DOE adopts the definition of ''rated wattage'' as set out in the regulatory text of this final rule.

2. ''Colored Fluorescent Lamp''

With respect to the definition of ''colored fluorescent lamp,'' DOE first notes that EPCA defines general service fluorescent lamps as fluorescent lamps ''which can be used to satisfy the majority of fluorescent [lighting] applications,'' but which are not designed and marketed for certain specifically listed ''nongeneral lighting applications,'' including ''colored fluorescent lamps.'' (42 U.S.C. 6291(30)(B)) As with ''rated wattage,'' EPCA does not define the term ''colored fluorescent lamp,'' but DOE's regulations do. The DOE regulations currently define the term as ''a fluorescent lamp designated and marketed as a colored lamp'' and having a CRI less than 40 or a CCT less than 2500 K or greater than 6600 K. 10 CFR 430.2. Because lamps meeting this definition are not GSFL under EPCA, they are not covered by the standards applicable to GSFL.

After becoming aware of a lamp on the European market that is intended for general illumination applications but has a CCT of 17000 K and might meet DOE's definition of ''colored fluorescent lamp,'' DOE became concerned that some new products with general service applications might be excluded from the coverage of standards applicable to GSFL. 73 FR 13620, 13634 (March 13, 2008). To avoid this possibility, DOE considered adding the following phrase to its definition of ''colored fluorescent lamp'': ''* * * and not designed or marketed for general illumination applications.'' *Id.*

Following publication of the March 2008 ANOPR, DOE obtained information indicating that, instead, it should amend the definition of ''colored fluorescent lamp'' both to: (1) Exclude from the definition, and thereby place under energy conservation standards, lamps with CCTs from 6600 K to 7000 K; and (2) include in the definition, and thereby place outside the coverage of standards, *all* lamps with a CCT greater than 7000 K (*i.e.*, regardless of how the lamp is designated and marketed). Although lamps with CCTs greater than 6600 K and less than or equal to 7000 K are not prevalent in the market, such lamps are commercially available and becoming increasingly popular. Furthermore, manufacturers would likely be able to produce a lamp at 7000 K using the same materials as a 6500 K lamp (a commonly sold lamp). Thus, DOE tentatively concluded that covering such lamps would maintain the coverage under DOE's energy conservation standards of GSFL serving general application purposes, and that the technological similarity between 6500 K and 7000 K lamps makes it possible to establish technologically feasible efficacy levels for 7000 K lamps. However, very few lamps with a CCT greater than 7000 K exist in the market, and the inherently ''blue'' color of these high-CCT lamps appears to prevent their widespread adoption as substitutes for standard CCT lamps (*e.g.*, 4100 K). In addition, the materials used in the manufacture of such lamps, as well as the design trade-offs in developing them, would differ from those applicable to current products serving this market. Thus, DOE tentatively concluded that it could not determine whether a particular standard level would be technologically feasible for lamps with a higher CCT, and that these lamps would not be expected to be a potential loophole to standards it was considering in this rulemaking. For these reasons, which DOE discussed in greater detail in the April 2009 NOPR, DOE proposed to modify the definition of ''colored fluorescent lamp'' by raising the upper CCT limit for lamps excluded from that term from 6600 K to 7000 K, and including in that term all lamps (regardless how the lamp is designated and marketed) with a CCT greater than 7000 K. 74 FR 16920, 16931–32 (April 13, 2009).

Both EEI and NEMA agreed with the proposed definition of ''colored fluorescent lamp.'' (EEI, No. 45 at p. 2, NEMA, Public Meeting Transcript, No. 38.4 at p. 46–47; NEMA, No. 81 at p. 7) However, ACEEE pointed out that at an earlier stage of the rulemaking process, NEMA had identified an 8000 K lamp and claimed that lamps at high CCT values were capturing an increasing market share of general service applications. ACEEE argued that, if this is true, lamps with a CCT up through 8000 K should be included in coverage. (ACEEE, Public Meeting Transcript, No. 38.4 at p. 48). NEMA responded that it is not aware of an 8000 K lamp gaining market share in the general service lighting market because such a lamp would be too blue and not suitable for general service applications. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 49–50)

ACEEE also suggested that DOE should reinsert the phrase ''and not designed or marketed for general illumination applications'' in the definition of ''colored fluorescent lamp'' to ensure that only specialty lamps are excluded from the definition of ''general service fluorescent lamp.'' (ACEEE, Public Meeting Transcript, No. 38.4 at pp. 48–49; ACEEE, No. 76 at p. 4) In response, DOE agrees that the intention of the exemption for colored fluorescent lamps is to exclude only specialty lamps from standards. DOE believes that the amended definition of ''colored fluorescent lamp'' should not become a loophole for fluorescent lamps that are used in general service applications, and, therefore, should be subject to energy conservation standards. However, DOE also maintains that there are enough lamps available with CCTs greater than 7000 K to determine technologically feasible energy conservation standards. In addition, DOE believes that the inherently ''blue'' color of these lamps may prevent widespread adoption as substitutes for standard CCT lamps (*e.g.*, 4100 K).

Therefore, in this final rule, DOE is modifying the definition of ''colored fluorescent lamp'' as follows. DOE has decided to incorporate the phrase ''and not designed or marketed for general illumination applications'' into the definition of ''colored fluorescent lamp.'' This phrase will apply to those lamps with CCTs greater than 7000 K, as well as lamps with a CRI less than 40 and lamps with a CCT under 2500 K. However, because DOE believes that there are insufficient data to determine whether amended standards for lamps with CCTs greater than 7000 K would be technologically feasible, DOE is modifying the range of CCTs for which it is adopting standards. As a result, lamps referred to as possessing high CCTs in this standard-setting rulemaking are now being classified as those with a CCT greater than 4500 K and less than or equal to 7000 K (rather than simply greater than 4500 K).

DOE is implementing these changes in this manner because of the anti-backsliding provision in EPCA. Because lamps with CCTs greater than 7000K that are not designated and marketed as colored lamps are currently subject to energy conservation standards, exempting all lamps with a CCT above 7000 K through inclusion in the definition of ''colored fluorescent lamp'' would prescribe a standard which impermissibly ''decreases the minimum required energy efficiency, of a covered product.'' (42 U.S.C. 6295 (o)(1)) Thus, if lamps with CCTs greater than 7000 K are used in general service applications, they will not be covered by the standards adopted by this final rule, although they will continue to be subject to the existing energy conservation standards (which have not been eliminated, despite being superseded in terms of efficacy levels for most—but not all, as demonstrated here—of those lamps upon the effective date of the updated GSFL standards). In conclusion, DOE adopts the following definition for ''colored fluorescent lamp'' as set out in the regulatory text of this final rule.

D. Off Mode and Standby Mode Energy Consumption Standards

Section 310(3) of EISA 2007 amended EPCA to require energy conservation standards adopted for a covered product after July 1, 2010 to address standby mode and off mode energy use. (42 U.S.C. 6295(gg)(3)) Although the final rule in this standards rulemaking is scheduled for publication by June 2009 (*i.e.*, before this statutory deadline), DOE nonetheless did a preliminary analysis of the potential for energy savings associated with the regulation of standby mode and off mode energy use in covered lamps. DOE tentatively determined that current technologies for the GSFL and IRL that are the subjects of this rulemaking do not use a standby mode or off mode, so it is neither feasible nor necessary to incorporate energy use in these modes into the energy conservation standards for GSFL and IRL. Therefore, DOE did not propose amendments to the standards to address lamp operation in such modes. 73 FR 13620, 13627 (March 13, 2008); 74 FR 16920, 16932–33 (April 13, 2009). DOE did not receive any comments regarding this subject, so DOE concludes that standby mode and off mode are not applicable to these products. Therefore, in this final rule, DOE is not adopting provisions to address lamp operation in off mode or standby mode as part of the energy conservation standards that are the subject of this rulemaking.

E. Color Rendering Index Standards for General Service Fluorescent Lamps

EPCA specifies minimum levels of both lumens per watt and CRI that GSFL must meet. (42 U.S.C. 6295(i)(1)) However, EPCA authorizes DOE to consider and adopt only energy conservation standards that consist of energy performance requirements. (42 U.S.C. 6291(6)) In the March 2008 ANOPR, commenters suggested that it may be necessary for DOE to amend the existing CRI standards to prevent the possible emergence of loopholes in the product class structure and standards levels. In the April 2009 NOPR, DOE concluded that it does not have the authority to change the CRI standard because CRI is not a measure of energy consumption or efficacy, but rather a measure of the color quality of the light. 74 FR 16920, 16933 (April 13, 2009).

In written comments, Earthjustice argued that DOE has the authority to amend EPCA's Color Rendering Index (CRI) for GSFL, stating that DOE ignored the context of the duties that Congress imposed in 42 U.S.C. § 6295(i)(3). Earthjustice correctly noted that Congress included a table specifying both lamp efficacy and CRI standards for GSFL. (42 U.S.C. 6295(i)(1)(B)). The commenter also correctly stated that Congress provided that all GSFL ''shall meet or exceed the [specified] lamp efficacy and CRI standards'' (42 U.S.C. 6295(i)(1)(B)), and directed DOE to ''determine if the standards in paragraph (1) should be amended.'' (42 U.S.C. 6295(i)(3)). From there, Earthjustice took the position that Congress did not intend to require DOE to assess only the ''energy conservation standards'' established in 42 U.S.C. 6295(i)(1), but instead to review all ''standards'' established in that paragraph, which include both lamp efficacy and CRI standards. (Earthjustice, No. 60 at pp. 3–4) The Green Lighting Campaign also argued that DOE should place restrictions on the CRI of covered GSFL because CRI can be used to enhance a lamp's visual acuity, thereby enabling substitution of lower-wattage lamps in a given lamp application without sacrificing utility. Therefore, the commenter argued that CRI affects energy efficiency and that DOE should screen out lamps with a CRI below 80. (Green Lighting Campaign, No. 74 at p. 2, 4)

Furthermore, Earthjustice stated that the relevant discussion in the preamble of DOE's April 2009 NOPR did not clarify whether DOE believes that amendment of the CRI standards is foreclosed by EPCA's plain language (which Earthjustice disputed for the reasons above), or that is DOE's interpretation of an ''allegedly ambiguous provision'' (which Earthjustice asserted would be arbitrary and capricious). Earthjustice also commented that DOE's rationale on this point in the April 2009 NOPR explanation cannot be reconciled with the purposes of the statute and the intent of Congress, which enacted EPCA to ''conserve energy supplies through energy conservation programs'' and ''provide for improved energy efficiency of * * * consumer products.'' 42 U.S.C.

6201(4) and (5). Finally, Earthjustice argued that DOE must consider amending EPCA's CRI standards if an efficacy-only standard is not sufficient to capture all technologically feasible and economically justified energy savings. (Earthjustice, No. 60 at pp. 3–4)

In response, DOE disagrees with the Green Lighting Campaign and Earthjustice's interpretation of the relevant statutory language. Despite the overarching energy-savings purposes of EPCA, Congress promulgated a highly detailed statute (both initially and through subsequent amendments) with numerous provisions specifying (or restricting) DOE's authority. In general, Congress did not provide DOE unfettered discretion to set standards, but instead established detailed criteria, definitions, and other limitations on DOE's authority. Consequently, when DOE faces specific provisions which limit its authority, it seems clear that Congress did not intend the general energy-savings provisions of EPCA to override such limitations. Instead, DOE interprets its mandate as to maximize energy savings within the confines of its statutory authority. With that said, DOE continues to believe that it does not have the authority to regulate CRI standards for the reasons discussed in the NOPR. 74 FR 16920, 16933 (April 13, 2009). That is, the language in the statute does not provide DOE with the authority to amend the CRI standard because it is not an energy performance standard. In implementing the amended standards rulemaking required under 42 U.S.C. 6295(i)(3), DOE must abide by the criteria for prescribing new or amended standards set forth in 42 U.S.C. 6295(o). In relevant part, 42 U.S.C. 6295(o)(2)(A) provides that any new or amended ''energy conservation standard'' must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. More specifically, as discussed in the NOPR, according to 42 U.S.C. 6291(6), ''energy conservation standard'' means either: (1) A performance standard which prescribes a minimum level of energy efficiency or a maximum quantity of energy use; or (2) a design requirement (only for specifically enumerated products). Although CRI is a performance requirement, it is not an energy performance requirement within the meaning of the term ''energy conservation standard.'' Because, in the case of GSFL, DOE has the authority to regulate only energy conservation standards (*i.e.*, energy performance requirements), DOE is not amending the existing minimum CRI requirements in this final rule.

Even if DOE did have authority to amend the minimum CRI requirements, DOE does not believe any modification would have impacted the potential energy savings of this final rule. CRI does not affect energy consumption or efficacy and, therefore, would not affect any of the results of DOE's analysis that are summarized in section VII.

IV. General Discussion

A. Test Procedures

DOE's test procedures for fluorescent and incandescent lamps are set forth at 10 CFR part 430, subpart B, appendix R.[8] These test procedures provide detailed instructions for measuring GSFL and IRL performance, as well as performance attributes of GSIL, largely by incorporating several industry standards. As explained in the April 2009 NOPR (74 FR 16920, 16933 (April 13, 2009)), DOE published a test procedure NOPR that proposed to update the current test procedure's references to industry standards for fluorescent and incandescent lamps, as well as to propose adoption of test procedure amendments to address lamps to which coverage was extended by EISA 2007 or to which DOE was considering extending coverage through rulemaking. 73 FR 13465, 13467–68 (March 13, 2008)(the test procedure NOPR). The test procedure NOPR also proposed the following: (1) A small number of definitional and procedural modifications to the test procedure to accommodate technological migrations in the GSFL market and approaches DOE has considered in this standards rulemaking; (2) revision of the reporting requirements for GSFL, such that all covered lamp efficacies would be reported with an accuracy to the tenths decimal place; and (3) adoption of a testing and calculation method for measuring the CCT of fluorescent and incandescent lamps. *Id.* at 13472–74. The March 2008 ANOPR also contains a detailed discussion of these proposals and related matters. 73 FR 13620, 13627–28 (March 13, 2008).

In response to the test procedure NOPR, NEMA commented that it strongly opposed establishing test procedures for lamps to which coverage has not yet been extended by the energy conservation standards rulemaking. NEMA was concerned that specifying mandatory test conditions prior to inclusion of coverage would inadvertently prevent new, high-efficient lamp designs from entering the market. (NEMA, No. 25 at p. 6–8)[9] In response, in the June 2009 test procedure Final Rule previously published (hereafter the test procedure Final Rule)), DOE agreed with NEMA's suggestion and proceeded to finalize all other aspects of the lamps test procedure amendments but deferred consideration of test procedures for potentially new covered products until DOE establishes, by final rule, the lamps to which it is extending energy conservation standards coverage. Therefore, today's final rule simultaneously adopts both energy conservation standards and test procedures for these ''additional'' GSFL. In setting test procedures for these additional GSFL, DOE is also responding to the public comments on that topic submitted in response to the March 2008 test procedure NOPR, as discussed below.

As discussed in section III.A, DOE has decided to adopted standards for the following additional GSFL: (1) 2-foot U-shaped; (2) 4-foot MBP; (3) 8-foot SP slimline; (4) 8-foot RDC HO; (5) 4-foot MiniBP SO; and (6) 4-foot MiniBP HO lamps. For the additional 2-foot U-shaped and 4-foot MBP lamps, 10 CFR part 430, subpart B, appendix R already contains adequate test procedures (either through existing test procedures or those newly adopted in the test procedure final rule). Therefore, in this final rule, DOE is not adopting new test procedures for those lamps. However, for the added 8-foot SP slimline, 8-foot RDC HO, 4-foot MiniBP SO, and 4-foot MiniBP HO lamps, DOE has determined that several new provisions need to be added to the existing test procedures for GSFL.

These provisions pertain to the adoption of reference ballast settings for lamps not listed in ANSI C78.81–2005 nor in ANSI C78.901–2005, as proposed in the test procedure NOPR. In response to that test procedure proposal, NEMA stated that instituting generic test conditions, particularly reference ballast settings, without knowing the specific GSFL to which the conditions may apply could have unexpected consequences. In particular, NEMA argued that such test procedures could constrain innovation by affecting the introduction of new lamps into the market. NEMA also committed to developing standardized test conditions that DOE could consider for several covered lamp types for which no test

[8] ''Uniform Test Method for Measuring Average Lamp Efficiency (LE) and Color Rendering Index (CRI) of Electric Lamps.''

[9] Energy Conservation Program: Test Procedures for General Service Fluorescent Lamps, Incandescent Reflector Lamps, and General Service Incandescent Lamps; Docket No. EERE–2007–BT–TP–0013; RIN number 1904–AB72.

conditions currently exist. (NEMA, No. 25 at p. 6–8) [10]

DOE does not agree that imposing test conditions for future covered products would limit innovation in the lighting industry. DOE maintains a test procedure waiver process specifically for this reason. Under 10 CFR 430.27, DOE's regulations state, ''Any interested person may submit a petition to waive for a particular basic model any requirements of § 430.23, or of any appendix to this subpart, upon the grounds that the basic model contains one or more design characteristics which either prevent testing of the basic model according to the prescribed test procedures, or the prescribed test procedures may evaluate the basic model in a manner so unrepresentative of its true energy consumption characteristics, or water consumption characteristics (in the case of faucets, showerheads, water closets, and urinals) as to provide materially inaccurate comparative data.'' (10 CFR 430.27(a)(1)) This waiver process exists to avoid constraining innovation in the industry. Thus, DOE believes it is not preventing the introduction of future products into the market by specifying generic test conditions in this final rule.

While DOE appreciates NEMA's offer to develop additional standardized test procedure provisions, the organization did not set a timeframe for developing the new test conditions, and DOE believes that this final rule needs to establish test conditions for all lamps subject to energy conservation standards. In addition, DOE believes that the test conditions set forth in the March 2008 NOPR are appropriate for most commercially-available lamps. DOE arrived at the ballast settings for these lamps by determining the appropriate lamp replacement that exists in the relevant industry standard and using the corresponding reference ballast settings for all lamps that fall into that category. However, if NEMA supplies test conditions for industry standards, DOE will consider incorporating them into its test procedure regulations in a subsequent rulemaking.

Thus, in this final rule, DOE is adopting the following reference ballast settings for those additional GSFL for which it is setting standards, as proposed in the test procedure NOPR:

For any 8-foot SP slimline lamp not listed in the updated ANSI C78.81–2005, the lamp should be tested using the following reference ballast settings:

T12 lamps: 625 volts, 0.425 amps, and 1280 ohms.

T8 lamps: 625 volts, 0.260 amps, and 1960 ohms.

For any 8-foot RDC HO lamp not listed in the updated ANSI C78.81–2005, the lamp should be tested using the following reference ballast settings:

T12 lamps: 400 volts, 0.800 amps, and 415 ohms. &

T8 lamps: 450 volts, 0.395 amps, and 595 ohms.

For any 4-foot MiniBP standard output or high output lamp that is not listed in ANSI C78.81–2005, the lamp should be tested using the following reference ballast settings:

Standard Output: 329 volts, 0.170 amps, and 950 ohms.

High Output: 235 volts, 0.460 amps, and 255 ohms.

B. Technological Feasibility

1. General

As stated above, any standards that DOE establishes for GSFL and IRL must be technologically feasible. (42 U.S.C. 6295(o)(2)(A) and (o)(3)(B)) DOE considers a design option to be technologically feasible if it is in use by the respective industry or if research has progressed to the development of a working prototype. ''Technologies incorporated in commercial products or in working prototypes will be considered technologically feasible.'' 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(i).

This final rule considers the same design options as those evaluated in the April 2009 NOPR. 74 FR 16920, 16933–34 (April 13, 2009) As discussed in section VI.B.2.c, DOE additionally considers integrally-ballasted low voltage IRL as a design option to improve IRL efficacy. (*See* the final rule TSD accompanying this notice, chapter 3.) Except for trial standard level (TSL) 1 for IRL, products are commercially available in the market at all of the TSLs evaluated for today's rule. As to TSL1 for IRL, DOE used a design option (*i.e.*, higher-efficiency gas fills) to model the performance of lamps that would meet this TSL, and received input from manufacturers to verify that such a design option is technologically feasible. Therefore, DOE determined that all of the efficacy levels evaluated in this notice are technologically feasible.

2. Maximum Technologically Feasible Levels

As required under 42 U.S.C. 6295(p)(1), in developing the April 2009 NOPR, DOE identified the efficacy levels that would achieve the maximum improvements in energy efficiency that are technologically feasible (max-tech levels) for GSFL and IRL. 74 FR 16920, 16933–35 (April 13, 2009). (*See* chapter 5 of the TSD)

For GSFL, DOE considered five TSLs in the April 2009 NOPR, with TSL5 being the most stringent level for which DOE performed full analyses. 74 FR 16920, 16979–82 (April 13, 2009). It is noted that DOE also considered the potential for a standard level beyond TSL5 that would require GSFL to use a higher-efficiency gas fill composition, which would have been the maximum technologically feasible level. Although more-efficient fill gases (often including higher molecular weight gases) are appropriate for and are currently used in some lamp applications, DOE is also aware employing this technology can cause lamp instability resulting in striations or flickering in some circumstances. DOE's research indicated that a potential standard level that would require the use of higher-efficiency fill gases would significantly reduce (or in some cases eliminate) the utility and performance of the covered GSFL, DOE concluded on this basis that a level with such an adverse impact on product utility would not be economically justified.[11] (42 U.S.C. 6295(o)(2)(B)(i)(IV) and (3)(B)) Having made this determination, there was no need or benefits to performing additional analyses relevant to the other statutory criteria. (*See* section I.A.2 for additional detail.) Consequently, TSL5 represents the most-efficient level analyzed for GSFL.

For IRL, as explained in the April 2009 NOPR, DOE believes that the maximum technologically feasible efficacy level incorporates the highest-efficiency technologically feasible reflector, halogen infrared coating, and filament design. *Id.* Combining all three of these high-efficiency technologies simultaneously results in the maximum technologically feasible level. However, this level is dependent on the use of a silver reflector, which is a proprietary technology. Because DOE is unaware of any alternate technology pathways to achieve this efficacy level, DOE did not consider it in its analysis.

Instead, in the April 2009 NOPR, DOE based the highest efficacy level analyzed for IRL on a commercially-available IRL which employs a silver reflector, an improved (but not most efficient) IR

[10] Energy Conservation Program: Test Procedures for General Service Fluorescent Lamps, Incandescent Reflector Lamps, and General Service Incandescent Lamps; Docket No. EERE–2007–BT–TP–0013; RIN number 1904–AB72.

[11] DOE notes that it did not eliminate higher-efficiency fill gases from further consideration as a technology under the screening analysis, because that technology may be appropriate for low-wattage lamp applications.

coating, and a filament design that results in a lifetime of 4,200 hours. Although this commercially-available lamp uses silver technology, DOE believes that there are alternate pathways to achieve this level. A combination of redesigning the filament to achieve higher temperature operation (and thus reducing lifetime to 3,000 hours), employing other non-proprietary high-efficiency reflectors, and applying a higher-efficiency IR coating has the potential to result in an IRL that meets an equivalent efficacy level (for more information regarding these technologies, see chapter 3 of the TSD). Therefore, in the April 2009 NOPR, DOE concluded that TSL5 is the maximum technologically feasible level for IRL that is not dependent on the use of a proprietary technology. *Id*.

In response to the April 2009 NOPR, DOE received several comments on the efficiency levels analyzed and the maximum technologically feasible levels. For further discussion of these comments see section VI.B. For today's final rule, the max-tech levels are provided in Table IV.1 and Table IV.2 below.

TABLE IV.1—MAX-TECH LEVELS FOR GSFL

Lamp type	CCT	Max-tech efficacy lm/W
4-foot medium bipin	≤4,500K	93
	>4,500K and ≤7,000K	92
2-foot U-shaped	≤4,500K	87
	>4,500K and ≤7,000K	85
8-foot single pin slimline	≤4,500K	98
	>4,500K and ≤7,000K	94
8-foot recessed double contact HO	≤4,500K	95
	>4,500K and ≤7,000K	91
4-foot T5 miniature bipin SO	≤4,500K	90
	>4,500K and ≤7,000K	85
4-foot T5 miniature bipin HO	≤4,500K	76
	>4,500K and ≤7,000K	72

TABLE IV.2—MAX-TECH LEVELS FOR IRL

Lamp wattage	Lamp type	Diameter (in inches)	Voltage	Max-tech efficacy lm/W
40W–205W	Standard–spectrum	>2.5	≥125V	$7.4P^{0.27}$
			<125V	$6.4P^{0.27}$
		≤2.5	≥125V	$6.2P^{0.27}$
			<125V	$5.4P^{0.27}$
40W–205W	Modified-spectrum	>2.5	≥125V	$6.3P^{0.27}$
			<125V	$5.4P^{0.27}$
		≤2.5	≥125V	$5.3P^{0.27}$
			<125V	$4.6P^{0.27}$

Note 1: P is equal to the rated lamp wattage, in watts.
Note 2: Standard Spectrum means any incandescent reflector lamp that does not meet the definition of "modified spectrum" in 430.2.

C. Energy Savings

DOE forecasted energy savings in its national impact analysis (NIA) through the use of an NIA spreadsheet tool, as discussed in the April 2009 NOPR. 74 FR 16920, 16935, 16958–72 (April 13, 2009).

One of the criteria that governs DOE's adoption of standards for covered products is that the standard must result in ''significant conservation of energy.'' (42 U.S.C. 6295(o)(3)(B)) While EPCA does not define the term ''significant,'' a U.S. Court of Appeals, in *Natural Resources Defense Council* v. *Herrington*, 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended ''significant'' energy savings in this context to be savings that were not ''genuinely trivial.'' DOE's estimates of the energy savings for energy conservation standards at each of the TSLs considered for GSFL and IRL for today's rule indicate that the energy savings each would achieve are nontrivial. Therefore, DOE considers these savings ''significant'' within the meaning of Section 325 of EPCA.

D. Economic Justification

1. Specific Criteria

As noted earlier, EPCA provides seven factors to evaluate in determining whether an energy conservation standard for covered products is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)) The following sections discuss how DOE has addressed each of those seven factors in evaluating efficiency standards for GSFL and IRL.

a. Economic Impact on Consumers and Manufacturers

DOE considered the economic impact of potential standards on consumers and manufacturers of GSFL and IRL. For consumers, DOE measured the economic impact on consumers as the change in installed cost and life-cycle operating costs (*i.e.*, the LCC). (See sections V.C and VII.C.1.a, and chapter 8 of the TSD accompanying this notice.) DOE investigated the impacts on manufacturers through the manufacturer impact analysis (MIA). (See section VII.C.2, and chapter 13 of the TSD accompanying this notice.) The MIA is discussed in detail in the April 2009 NOPR. 74 FR 16920, 16972–77 (April 13, 2009).

b. Life-Cycle Costs

DOE considered life-cycle costs of GSFL and IRL, as discussed in the April 2009 NOPR. 74 FR 16920, 16950–58 (April 13, 2009). DOE calculated the sum of the purchase price and the operating expense—discounted over the lifetime of the equipment—to estimate the range in LCC benefits that consumers would expect to achieve due to standards.

c. Energy Savings

Although significant conservation of energy is a separate statutory requirement for adopting an energy conservation standard, EPCA also requires DOE, in determining the economic justification of a proposed standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6295(o)(2)(B)(i)(III)) As in the April 2009 NOPR (74 FR 16920, 16936 (April 13, 2009)), for today's final rule DOE used the NIA spreadsheet results in its consideration of total projected savings that are directly attributable to the standard levels DOE considered.

d. Lessening of Utility or Performance of Products

In considering standard levels, DOE sought to avoid new standards for GSFL and IRL that would lessen the utility or performance of such products. (42 U.S.C. 6295(o)(2)(B)(i)(IV)); 74 FR 16920, 16936 (April 13, 2009)).

e. Impact of Any Lessening of Competition

DOE considers any lessening of competition that is likely to result from standards. Accordingly, as discussed in the April 2009 NOPR (74 FR 16920, 16936 (April 13, 2009)) and as required under EPCA, DOE requested that the Attorney General transmit to the Secretary a written determination of the impact, if any, of any lessening of competition likely to result from the standards proposed in the April 2009 NOPR, together with an analysis of the nature and extent of such impact. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii)) Note also that the National Impact Analysis does not consider the possibility of lessened competition effects, and so, depending on their magnitude, such effects may negatively impact the Net Present Value of the standards.

To assist the Attorney General in making such a determination, DOE provided the Department of Justice (DOJ) with copies of the April 2009 NOPR and the TSD for review. The Attorney General's response is discussed in section VII.C.5 below, and is reprinted at the end of this rule. For IRLs, DOJ concluded that the proposed TSL 4 could adversely affect competition. DOJ requested that DOE consider the possibility of new technology for IRLs as it settles on standards in this field (DOJ, No. 77 at pp. 1–2). Although DOJ did not evaluate the impacts on competition of TSL 4 for GSFL, DOE believes that TSL 4 does not raise competitive issues.

f. Need of the Nation to Conserve Energy

In considering standards for GSFL and IRL, the Secretary must consider the need of the Nation to conserve energy. (42 U.S.C. 6295(o)(2)(B)(i)(VI)) The Secretary recognizes that energy conservation benefits the Nation in several important ways. The non-monetary benefits of standards are likely to be reflected in improvements to the security and reliability of the Nation's energy system. As discussed in the April 2009 NOPR and in section VII.C.6 of this final rule, DOE has considered these factors in considering whether to adopt standards for GSFL and IRL. 74 FR 16920, 16936 (April 13, 2009).

g. Other Factors

The Secretary of Energy, in determining whether a standard is economically justified, considers any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) In adopting today's standards, the Secretary considered the potential for GSFL and IRL standards to adversely affect low-income consumers, institutions of religious worship, historical facilities, institutions that serve low-income populations, and consumers of T12 electronic ballasts. In considering these subgroups, DOE analyzed variations on electricity prices, operating hours, discount rates, and baseline lamps. 74 FR 16920, 16936 (April 13, 2009). The impact on these subgroups is summarized in section VII.C.1.b.

2. Rebuttable Presumption

Section 325(o)(2)(B)(iii) of EPCA states that there is a rebuttable presumption that an energy conservation standard is economically justified if the increased installed cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard, as calculated under the applicable DOE test procedure. (42 U.S.C. 6295(o)(2)(B)(iii)) DOE's LCC and payback period (PBP) analyses generate values that calculate the payback period for consumers of potential energy conservation standards, which includes, but is not limited to, the three-year payback period contemplated under the rebuttable presumption test discussed above. However, DOE routinely conducts a full economic analysis that considers the full range of impacts, including those to the consumer, manufacturer, Nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification).

V. Methodology and Discussion of Comments on Methodology

DOE used several analytical tools that it developed previously and adapted for use in this rulemaking. One is a spreadsheet that calculates LCC and PBP. Another tool calculates national energy savings and national NPV that would result from the adoption of energy conservation standards. DOE also used the Government Regulatory Impact Model (GRIM), along with other methods, in its MIA to determine the impacts of standards on manufacturers in light of other cumulative regulatory requirements. Finally, DOE developed an approach using the National Energy Modeling System (NEMS) to estimate impacts of standards for GSFL and IRL on utilities and the environment. The April 2009 NOPR discusses each of these analytical tools in detail. 74 FR 16920, 16958, 16972, 16978–79, 16982 (April 13, 2009).

As a basis for this final rule, DOE has continued to use the spreadsheets and approaches explained in the April 2009 NOPR. DOE used the same general methodology as applied in the NOPR, but revised some of the assumptions and inputs for the final rule in response to public comments. The following paragraphs discuss these revisions.

A. Market and Technology Assessment

When beginning an energy conservation standards rulemaking, DOE develops information that provides an overall picture of the market for the products concerned, including the purpose of the products, the industry structure, and market characteristics. This activity includes both quantitative and qualitative assessments based primarily on publicly available information. DOE presented various subjects in the market and technology assessment for this rulemaking. (*See* chapter 3 of the NOPR TSD.) These include product definitions, product classes, manufacturers, quantities and types of products sold and offered for sale, retail market trends, and regulatory and nonregulatory programs. As discussed below, commenters raised a variety of issues related to the market and technology assessment, to which DOE responds in the following sections.

1. Product Classes

In general, in evaluating and establishing energy conservation standards, DOE divides covered products into classes by the type of energy used, capacity, or other performance-related features that affect efficiency, and factors such as the utility of the product to users. (42 U.S.C. 6295(q))

a. General Service Fluorescent Lamps

In the April 2009 NOPR, DOE proposed to establish product classes for GSFL based on the following three attributes that have differential utility and affect efficacy: (1) Physical constraints of lamps (*i.e.*, lamp shape and length); (2) lumen package (*i.e.*, standard versus high output); and (3) correlated color temperature. 74 FR 16920, 16936 (April 13, 2009). Based on these criteria, DOE proposed to separate coverage into six lamp types: (1) 4-foot medium bipin; (2) 2-foot U-shaped; (3) 8-foot single pin slimline; (4) 8-foot recessed double contact high output; (5) 4-foot miniature bipin T5 standard output; and (6) 4-foot miniature bipin T5 high output. DOE also proposed to establish separate product classes for those lamps with CCT less than or equal to 4,500 kelvin (K) and lamps with CCT greater than 4,500 K. In total, therefore, DOE proposed 12 product classes for GSFL. In general stakeholders expressed overall agreement with the GSFL product class structure proposed in the April 2009 NOPR. However, DOE did receive several comments requesting additional product classes for specific lamps or lamp types, as discussed below.

i. Modified-Spectrum Fluorescent Lamps

In response to the April 2009 NOPR, GE commented that it is currently researching and developing a 4-foot MBP modified-spectrum fluorescent lamp that imitates the color quality of modified-spectrum incandescent lighting. Although not yet commercially-available, GE expects to release such a product before 2012, the effective date of the energy conservation standard that is being established by this final rule. Expecting that these lamps may not be able to meet minimum efficacy requirements as amended by this rulemaking, GE recommended that DOE either set separate lower efficacy standards for ''modified-spectrum fluorescent lamps'' or exempt these lamps from standards altogether. (GE, No. 80 at pp. 3–6)

In response, DOE believes that it does not have the authority to exempt modified spectrum fluorescent lamps from standards. Pursuant to 42 U.S.C. 6295(o)(1), DOE cannot prescribe an amended standard which ''decreases the minimum required energy efficiency, of a covered product.'' Although no such product currently exists, DOE notes that if they did, modified-spectrum fluorescent lamps fall under the definition of ''general service fluorescent lamp,'' so they would already be subject to the statutory minimum efficacy requirements. Therefore, if DOE were to exempt these lamps from any standards, this would constitute backsliding from the minimum efficacy requirements, which is impermissible, as noted above.

With regard to setting lower minimum efficacy requirements for modified-spectrum fluorescent lamps, DOE generally sets separate efficiency standards for products deemed to be in separate product classes. While these lamps may in the future provide a distinct utility to consumers (a basis on which product classes may be established under 42 U.S.C. 6295(q)), at this time, DOE has no evidence that this utility in fact exists or is even required of the general service fluorescent market, because there is no such product yet developed. Therefore, in this final rule, DOE is not establishing a separate product class for modified-spectrum fluorescent lamps. However, DOE notes that if the company successfully develops its modified-spectrum fluorescent lamp and believes that it warrants exemption from DOE's amended standards, it may be possible for GE to seek exception relief from DOE's Office of Hearings and Appeals (OHA) pursuant to 10 CFR Part 1003.

i. 25 Watt 4-Foot MBP Lamps

In the April 2009 NOPR, DOE established one product class for 4-foot MBP lamps (of a single CCT category) that spanned the full range of covered lamp wattages (*i.e.*, greater than or equal to 25W). The effects of doing this were such that at TSL5, as considered in the NOPR, the 25W 4-foot MBP T8 lamp was expected to be eliminated from the market, as it would not meet the minimum efficacy requirements. In response to the April 2009 NORP, the California Stakeholders and ACEEE suggested DOE should establish a separate product class for the 25W 4-foot T8 MBP because it represents a significant energy-savings opportunity. While DOE recognizes that the availability of the 25W 4-foot T8 MBP lamp provides additional energy savings opportunities to consumers, DOE does not believe that this alone is a basis to establish a separate product class for this lamp. As noted above, DOE establishes product classes only when a product type either: (1) Consumes a different type of energy, or (2) has a capacity or other performance-related feature which justifies a higher or lower standard level. In making such a determination, DOE considers whether there is a differential utility which affects efficacy. To DOE's knowledge, the 25W 4-foot MBP lamp does not provide any additional utility over that which its 32W full-wattage counterpart provides. Therefore, DOE has not established a different product classes for 25W lamps.

ii. Summary of GSFL Product Classes

Because DOE received no other comments on the GSFL product classes proposed in the April 2009 NOPR, DOE is not making any changes in this final rule related to GSFL product classes. Table V.1 summarizes the GSFL product classes for this final rule.

TABLE V.1—FINAL RULE PRODUCT CLASSES FOR GSFL

Lamp type	CCT
4-Foot Medium Bipin	≤4500 K
	>4500 K
2-Foot U-Shaped	≤4500 K
	>4500 K
8-Foot Single Pin Slimline	≤4500 K
	>4500 K
8-Foot RDC HO	≤4500 K
	>4500 K
4-Foot Miniature Bipin SO	≤4500 K
	>4500 K
4-Foot Miniature Bipin HO	≤4500 K
	>4500 K

b. Incandescent Reflector Lamps

For incandescent reflector lamps, in the April 2009 NOPR, DOE proposed to base its product class structure on: (1) Lamp spectrum (modified versus standard spectrum); (2) lamp diameter (greater than 2.5 inches or less than or equal to 2.5 inches); and (3) rated voltage (less than 125V or greater than or equal to 125V). DOE received several comments on these product classes. The following sections summarize and address those public comments.

i. Modified-Spectrum Lamps

Modified-spectrum lamps provide a unique performance-related feature to consumers, in that they offer a different spectrum of light from the typical incandescent lamp. These lamps offer benefits such as ensuring better color discrimination and often appearing more similar to natural daylight, possibly resulting in psychological benefits. In addition to providing a unique performance feature, DOE also understands that the technologies that modify the spectral emission from these lamps also decrease their efficacy, because a portion of the light emission is absorbed by the coating. Therefore, in the April 2009 NOPR, DOE proposed to establish a separate product class for modified-spectrum lamps based on their unique performance feature and the impact of this performance feature on product efficacy. 74 FR 16920, 16938–39 (April 13, 2009).

NEMA supported DOE's proposal for separate product classes based on modified spectrum. (GE, Public Meeting Transcript, No. 38.4 at p. 60; NEMA, No. 81 at p. 12) Conversely, ASAP, ACEEE, and the California Stakeholders commented that separate product classes based on spectrum are unnecessary because existing technologies such as LEDs and phosphor-based lamps (*e.g.*, CFLs) can deliver the same utility to consumers that modified-spectrum IRL offer. ASAP stated that DOE should evaluate the unique utility of a product rather than the technology providing it. (ASAP, Public Meeting Transcript, No. 38.4, at pp. 68–69; California Stakeholders, No. 63 at pp. 2, 25)

In response, DOE agrees that other technologies could produce modified spectrum light. However, DOE reiterates the point it made in the NOPR that the governing statutory provision directs DOE to maintain performance-related features for a covered product type. (42 U.S.C. 6295(o)(4)) If DOE were to regulate modified-spectrum lamps within the same product class as standard-spectrum lamps, this could result in an energy conservation standard that would eliminate the modified-spectrum utility from the IRL market. Furthermore, DOE believes some consumers may find a unique utility in modified-spectrum IRL that does not exist in CFL or LED lamps that emit modified spectra. For example, modified-spectrum IRL have a higher CRI than many of their potential substitutes (*e.g.*, CFL), thereby providing a different, and in some cases a preferable, quality of light. In addition, DOE cannot confirm that a full range of lumen outputs are currently commercially available from LED reflector lamps. This could potentially eliminate the modified spectrum utility for some consumers requiring specific lumen packages (*e.g.*, high-lumen lamps).

PG&E, NRDC, ASAP, and the California Stakeholders also commented that no efficacy allowance is necessary for modified-spectrum lamps for two main reasons. First, they argued that incandescent reflector technology that results in modified-spectrum efficacies greater that the highest standard-spectrum standard level (TSL5) already exists. They demonstrated these efficacies in prototypes utilizing advanced IR coatings and silver reflectors. Second, the stakeholders argued that there are other means (beyond the use of absorptive elements within the glass cover) to produce modified-spectrum lamps. They suggested that reflective coatings, similar to the infrared ones that already exist, could, in principle, be used to create a modified spectrum in a much more efficient way. (California Stakeholders, No. 63 at pp. 2, 25; PG&E, NRDC, ASAP, No. 59 at p. 15–16; NRDC, No. 82 at pp. 2, 4)

DOE reiterates that it establishes product classes based on whether a given product has unique performance features that affect the efficacy of the product, not on whether it is technologically feasible for the product to meet another product class's efficacy levels. Therefore, the absolute efficacy of a given modified-spectrum IRL does not play a role in whether DOE should or should not establish a distinct product class. Then once it is determined that a separate class is appropriate under the statute, an appropriate level is set based upon examination of lamps within that class, rather than a comparison to different types of lamps. What is relevant is whether there is a change in efficacy that is caused by a unique performance feature. DOE maintains that at this time modified spectrum IRL cannot achieve an equivalent maximum technologically feasible level as standard-spectrum IRL. To this point, the stakeholders themselves acknowledge in their comments that lenses used to modify the spectrum of IRL result in at least a 10 percent decrease in efficacy as compared to standard-spectrum lamps. (PG&E, NRDC, ASAP, No. 59 at p. 2) Although the stakeholders have demonstrated that modified-spectrum IRL might potentially be able to achieve efficacies exceeding that of the highest efficacy level analyzed for standard-spectrum lamps, DOE believes that there is considerable uncertainty surrounding the efficacies of the prototypes provided. Therefore, DOE is not establishing minimum efficacy requirements based solely on these prototype efficacies. DOE further addresses its consideration of these prototype efficacies in section VI.B.2.

On the stakeholders' second point, DOE agrees that, in principle, there may be other means of producing modified-spectrum lamps. However, at present, DOE is unaware of any commercially-available IRL or working IRL prototype using the alternative methods suggested by stakeholders. For all of the above reasons, DOE has decided to establish a separate product class for modified-spectrum incandescent reflector lamps.

Also related to modified-spectrum IRL, Tailored Lighting, a specialty lighting company, commented that it produces specialty lamps that alter the spectrum, differently than modified-spectrum lamps, which the commenter claims better simulates daylight. Due to the different spectra of light that are filtered in Tailored Lighting's lamps relative to modified-spectrum lamps, Tailored Lighting argued that their product would not qualify under the statutory definition of ''modified spectrum.'' Therefore, Tailored Lighting recommended that DOE should either specifically exempt their product from regulation or amend the definition of ''modified spectrum'' so as to include their products, thereby allowing them to have reduced minimum efficacy requirements. (Tailored Lighting, No. 73 at p. 11) Eiko Ltd, a manufacturer of Tailored Lighting's products supported the same amendments to the definition of ''modified spectrum.'' (Eiko, No. 79 at p. 1)

While DOE acknowledges that many of Tailored Lighting's products may not fall under the definition of ''modified spectrum,'' DOE notes that ''modified spectrum'' is a statutory definition, defined by EISA 2007 for incandescent lamps, which includes both general service incandescent lamps and incandescent reflector lamps. (42 U.S.C. 6291(30)(W); 42 U.S.C. 6291(30)(F)) Therefore, DOE lacks the authority to amend the definition of ''modified spectrum.'' In addition, adopting Tailored Lighting's recommended amendment would not only affect minimum efficacy requirements for IRL, but would also result in an amendment to the general service incandescent lamp standards prescribed by Congress. For these reasons, DOE is leaving the definition of ''modified spectrum'' unchanged from that presented in the April 2009 NOPR.

In addition, DOE notes that according to the comment, even though Tailored Lighting also sells 12-volt MR–16 lamps with these special daylight qualities, these lamps do not fall under the definition of ''incandescent reflector lamp.'' Tailored Lighting requested an exemption (or lowered minimum efficacy requirement) for its forthcoming PAR lamp, that would fall under the definition of ''incandescent reflector lamp'' and is currently under development. (Tailored Lighting, No. 73 at p. 4)) However, according to interviews and Tailored Lighting's Web site, this lamp is not yet for sale.

In response, DOE generally sets separate efficiency standards for products deemed to be in separate product classes. While PAR-shaped Tailor Lighting lamps may in the future provide a distinct utility to consumers (a basis on which product classes are established), at this time, because there is no product yet developed, DOE has no evidence that this utility in fact exists or is even required of the incandescent reflector lamp (or PAR-shaped) market. Therefore, in this final rule, DOE is not establishing a separate product class for Tailored Lighting's products. However, DOE notes that if Tailored Lighting successfully develops its PAR lamp and believes that it warrants exemption from DOE's amended standards, it may be possible for Tailored Lighting to seek exception relief from DOE's OHA pursuant to 10 CFR Part 1003.

ii. Lamp Diameter

As mentioned above, DOE also proposed separate product classes for smaller-diameter lamps (*i.e.*, lamps with a diameter less than or equal to 2.5 inches). Such lamps provide a distinct utility (such as the ability to be installed in smaller fixtures) which generally results in lower efficacy because they have an inherently lower optical efficiency than larger-diameter lamps of similar filament size. Both NEMA and the California Stakeholders supported DOE's proposal to establish a separate product class for small-diameter lamps. (NEMA, No. 81 at p. 7, p. 12; GE Lighting, Public Meeting Transcript, No. 38.4 at p. 60; California Stakeholders, No. 63 at p. 22) Because DOE received no other comments on this issue, DOE continues to set separate product classes for lamps of diameter less than or equal to 2.5 inches.

iii. Voltage

Current DOE test procedures provide for lamps rated at 130 volts (V) to be tested at 130 V and for lamps rated at 120 V to be tested at 120 V. However, DOE is aware that a large number of consumers actually operate 130 V lamps at 120 V, which results in longer lifetime but lower efficacy. With a single efficacy level for lamps rated at each voltage, this situation would effectively lead to a lower efficacy requirement for these 130 V lamps that are run at 120 V, compared to 120 V lamps run at 120 V. These 130V lamps would not require the same level of technology as 120 V-rated lamps to meet the same standard, and, thus, they would be cheaper to produce. Therefore, setting higher standards for IRL without accounting for voltage differences could result in increased migration to the 130 V lamps and possible lost energy savings. For these reasons, in the April 2009 NOPR, DOE proposed to set separate standards for 130 V lamps. Specifically, DOE proposed to establish two separate product classes: (1) Lamps with a rated voltage less than 125 V, and (2) lamps with a rated voltage greater than or equal to 125 V. 74 FR 16920, 16940 (April 13, 2009). DOE also requested comment on the alternative approach of having all IRL be tested at 120 V, the most common application voltage in the market. *Id.*

Philips commented that setting a 130 V-lamp efficacy level that was 15 percent higher than the level for 120 V lamps, as DOE proposed in the NOPR, would drive 130 V lamps from the market because such a level would be technologically infeasible. In addition, Philips and GE stated that it is not uncommon for consumers to run lamps at 130 V in certain regions of the country. Therefore, NEMA and Philips stated, with 130 V lamps gone from the marketplace, some consumers may be forced to run 120 V lamps at 130 V, which could cut lamp lifetime in half and cause a loss of utility for these consumers. For those reasons, manufacturers argued, there should be no separate product class for voltage. Instead, manufacturers argued that DOE should test IRL at their rated voltages and subject the lamps to the same standard. Supporting this idea, GE noted that even if one operates a 130 V lamp at 120 V, power is reduced proportionally, meaning there would be lower energy consumption. (GE and Philips, Public Meeting Transcript, No. 38.4 at pp. 61–62, 67; NEMA, No. 81 at pp. 4, 7–8)

Conversely, the California Stakeholders, EEI and ACEEE argued that 130 V lines are very rare. EEI stated that many utilities must follow agreements to maintain voltages in the residential sector within a 5 percent range of 120 V (114 V to 126 V) and agreed with DOE's approach. The California Stakeholders commented that utilities are trending toward lower line voltage to minimize transmission losses. In addition, they stated that FTC labeling requirements already require manufacturers to provide power and light output for 120 V, even if the lamps are designed to be run at 130 V. Therefore, the California Stakeholders argued, all lamps should be regulated based on testing at 120 V. (ACEEE and EEI, Public Meeting Transcript, No. 38.4 at pp. 63–64, 66; EEI, No. 45 at p. 3; California Stakeholders, No. 63 at p. 25–26)

GE argued that while utilities do face line voltage regulation, there are cases in which the voltage is higher than that prescribed in ANSI C–84.1, ''American National Standard for Electric Power Systems and Equipment-Voltage Ratings (60 Hertz),'' (the source of the prescribed voltage range that EEI referenced in the above comment). Therefore, the 130 V lamps have utility for consumers in these cases. (GE, Public Meeting Transcript, No. 38.4 at p. 67)

In response, DOE remains concerned that the operation of 130 V lamps at 120 V has the potential to significantly affect energy savings. As discussed above, when operated under 120 V conditions, lamps rated at 130 V and in compliance with existing IRL efficacy standards are generally less efficacious than lamps using equivalent technology rated at 120 V. Because of this inherent difference in efficacy, it may be less costly to manufacture a lamp rated and tested at 130 V that complies with a standard than a similar 120 V lamp complying with the same standard. If DOE does not establish a separate product class and standard for lamps rated at 130 V, more consumers may purchase 130 V lamps because they may be less expensive, as they would require less costly technology. When consumers operate these lamps at 120 V, in order to obtain sufficient light output, they may migrate to higher wattages and use more energy than standards-compliant 120 V lamps.

DOE also believes, as commenters pointed out, that 130 V conditions in the residential sector are very rare. Indeed, in many cases such sustained voltages would violate electrical codes. As NEMA commented earlier, 130 V lamps ''are almost always used by customers to achieve 'double life' by operating them at 120 V, resulting in performance below 1992 EPACT levels.'' (NEMA, No. 21 at p. 16) DOE acknowledges that in very rare cases, some consumers with 130 V power may be forced to realize shorter lifetimes. However, based on stakeholder comments and research into electrical codes, DOE does not believe the rare instances of consumers with 130 V power experiencing shortened lifetimes offsets the benefit in energy savings from closing this potential loophole. In addition, as discussed in the April 2009 NOPR, because DOE considers lifetime an economic issue rather than a utility issue, DOE does not believe it is eliminating any unique utility of feature from the market by setting increased efficacy requirements for lamps rated greater than or equal to 125 V. 74 FR 16920, 16939 (April 13, 2009)

Finally, stakeholders have not provided any compelling arguments for why DOE should amend the test procedure to test all lamps at 120 V rather than set higher efficacy standards for these lamps. Therefore, in this final rule DOE is maintaining separate product classes for lamps with rated voltages less than 125 V and lamps with rated voltages greater than or equal to 125 V.

iv. IRL Summary

In summary, DOE is not making any changes in this final rule related to IRL product classes from those proposed in the April 2009 NOPR. 74 FR 16920, 17027 (April 13, 2009). Table V.2 summarizes the IRL product classes for this final rule.

TABLE V.2—FINAL RULE PRODUCT CLASSES FOR IRL

Spectrum	Diameter (in inches)	Voltage
Standard Spectrum ...	>2.5	≥125 V
		<125 V
	≤2.5	≥125 V
		<125 V
Modified Spectrum	>2.5	≥125 V
		<125 V
	≤2.5	≥125 V
		<125 V

B. Engineering Analysis

For each product class, the engineering analysis identifies potential, increasing efficacy levels above the level of the baseline model. Those technologies not eliminated in the screening analysis (design options) are inputs to this process. Design options consist of discrete technologies (*e.g.*, infrared reflective coatings, rare-earth phosphor mixes). As detailed in the April 2009 NOPR, to ensure that efficacy levels analyzed are technologically feasible, DOE concentrated its efforts in the engineering analysis on developing product efficacy levels associated with ''lamp designs,'' based upon commercially-available lamps that incorporate a range of design options. 74 FR 16920, 16941 (April 13, 2009). However, when necessary, DOE supplemented commercially-available product information with an examination of the incremental costs and improved performance attributable to discrete technologies so that a substitute lamp at each efficacy level would be available for each baseline lamp.

In energy conservation standard rulemakings for other products, DOE often develops cost-efficiency relationships in the engineering analysis. However, for this rulemaking, DOE derived efficacy levels in the engineering analysis and end-user prices in the product price determination. By combining the results of the engineering analysis and the product price determination, DOE derived typical inputs for use in the LCC and NIA. *See* chapter 7 of the TSD for further details on the product price determination.

1. Approach

For the final rule, DOE is using the same methodology for the engineering analysis that was detailed in the April 2009 NOPR. 74 FR 16920, 16941–47 (April 13, 2009). The following is a summary of the steps taken in the engineering analysis:

- Step 1: Select Representative Product Classes
- Step 2: Select Baseline Lamps
- Step 3: Identify Lamp or Lamp-and-Ballast Designs
- Step 4: Develop Efficacy Levels.

A more detailed discussion of the methodology DOE followed to perform the engineering analysis can be found in the engineering analysis chapter of the TSD (chapter 5).

2. Representative Product Classes

As discussed in section V.A.1 of this notice, DOE is establishing twelve product classes for GSFL and eight product classes for IRL. As detailed in the April 2009 NOPR, DOE did not analyze each and every product class. 74 FR 16920, 16941–42 (April 13, 2009). Instead, DOE selected certain product classes to analyze, and then scaled its analytical findings for those representative product classes to other product classes that were not analyzed. While DOE received several stakeholder comments regarding methods of scaling to product classes not analyzed (discussed in section V.C.7), DOE did not receive objections to the decision to scale to certain product classes or the representative product classes proposed in the April 2009 NOPR. *Id.* at 16941–42. Therefore, for this final rule, DOE analyzed the same product classes proposed for direct analysis in the April 2009 NOPR.

For GSFL, the analyzed product classes included 4-foot medium bipin, 8-foot single pin slimline, 8-foot recessed double-contact high output, 4-foot MiniBP standard output, and 4-foot MiniBP high output GSFL product classes, all with CCTs less than or equal to 4,500K. DOE did not explicitly analyze U-shaped lamps, but instead scaled the results of the 4-foot medium bipin class analysis, as discussed in section V.B.5.a. For IRL, the representative product class DOE analyzed was IRL with standard spectrum, voltage less than 125 V, and diameter greater than 2.5 inches. For further information on representative product classes, *see* chapter 5 of the TSD.

3. Baseline Models

Once DOE identified the representative product classes for analysis, DOE selected the representative units for analysis (*i.e.*, baseline lamps) from within each product class. These representative units are generally what DOE believes to be the most common, least efficacious lamps in their respective product classes. For further discussion on baseline lamps and lamp-and-ballast systems chosen for analysis, see the April 2009 NOPR (74 FR 16920, 16942–45 (April 13, 2009)) and Chapter 5 of the TSD.

In general, DOE decided to maintain the baseline models proposed in the April 2009 NOPR. However, DOE did receive a comment on its selection of the baseline model for 4-foot MiniBP lamps, as discussed and responded to below. In the April 2009 NOPR, DOE developed model T5 halophosphor lamps as the baselines for the 4-foot MiniBP SO and 4-foot MiniBP HO product classes. To create these model T5 lamps, DOE used efficacy data from short halophosphor fluorescent T5 lamps currently available and developed a relationship between length and efficacy. DOE validated this relationship by comparing it to previous industry research and efficacies of other halophosphor lamps. DOE then used this relationship to determine the efficacies of a halophosphor 4-foot miniature bipin standard output lamp and a halophosphor 4-foot halophosphor T5 miniature bipin HO lamp. The resulting baseline efficacies for 4-foot MiniBP SO and 4-foot MiniBP HO lamps were 86.0 lm/W and 76.6 lm/W. 74 FR 16920, 16943 (April 13, 2009)

In response to the April 2009 NOPR, NEMA and GE commented that baseline efficacies and efficacy levels for 4-foot MiniBP lamps should reflect testing at an ambient temperature of 25 °C rather than 35 °C, the temperature at which standards for 4-foot MiniBP lamps in the April 2009 NOPR were based. GE also stated that manufacturers test 4-foot

MiniBP lamps at 25 °C and then use a relative measurement to estimate performance at 35 °C. This additional information is provided in catalogs because many T5 lamps are operated in higher-temperature environments. (GE, Public Meeting Transcript, No. 38.4 at pp. 72–73, 76–78, NEMA, No. 81 at p. 3, 7, 8, 9, 22)

DOE has confirmed that test procedures for 4-foot MiniBP lamps in fact specify that the test should be performed at 25 °C. While DOE agrees that the minimum efficacy standards (and therefore efficacy levels) should be based on this testing condition, DOE believes that the efficacies and lumen outputs of lamps analyzed in the engineering analysis (and thus LCC and NIA) should reflect typical operating conditions. It is DOE's understanding that 4-foot MiniBP lamps most often operate at 35 °C. Therefore DOE bases all lamp efficacies and lumen outputs used in the engineering, LCC, and national impacts analyses on this operating condition. DOE discusses its approach to establishing 4-foot MiniBP efficacy levels based on testing at 25 °C in section V.B.4.b.

NEMA also commented that a more accurate and straightforward approach to modeling the 4-foot MiniBP halophosphor baseline lamp efficacies would be to base it on the ratio of halophosphor to triphosphor lamp efficacies in 4-foot T8 MBP lamps (0.78). (NEMA, No. 81 at p. 9) DOE believes that NEMA's suggested approach is valid. However, when using efficacies of commercially-available 4-foot MBP halophosphor lamps (77.9 lm/W) and triphosphor lamps (95.4 lm/W), DOE calculated an efficacy ratio of 0.82. Applying this ratio to 35 °C catalog lamp efficacies results in baseline efficacies of 4-foot MiniBP SO and 4-foot MiniBP HO lamps of 85.5 lm/W and 76.1 lm/W. Because these efficacies are within an acceptable margin of uncertainty relative to the baseline efficacies used in the April 2009 NOPR, DOE has not changed its 4-foot MiniBP baseline lamps.

For more information about these and other baseline lamps, see chapter 5 and appendix 5B of the TSD.

4. Efficacy Levels

a. GSFL Compliance Reports

For the March 2008 ANOPR, DOE developed candidate standards levels for GSFL by dividing initial lumen output by the ANSI rated wattages of commercially-available lamps, thereby resulting in rated lamp efficacies.[12] 74 FR 16920, 16945 (April 13, 2009). In response to the potential GSFL efficacy levels presented in the March 2008 ANOPR, NEMA commented on several reasons why the association believes that the efficacy levels need to be revised, including (1) the appropriateness of using ANSI rated wattages in the calculation of lumens per watt; (2) consideration of variability in production of GSFL; (3) manufacturing process limitations related to specialty products; (4) consideration of adjustments to photometry calibrations; and (5) the appropriateness of establishing efficacy levels to the nearest tenth of a lumen per watt. 74 FR 16920, 16945–46 (April 13, 2009).

After considering NEMA's comments, DOE agreed that tolerances incorporated into ANSI rated wattages and variability in production of GSFL warranted changes to the efficacy levels presented in the March 2008 ANOPR. Therefore, in the April 2009 NOPR, DOE revised the efficacy levels for GSFL by using lamp efficacy values submitted to DOE over the past 10 years for the purpose of compliance with existing energy conservation standards. Using compliance reports as a basis for efficacy standards allowed DOE to more accurately characterize the tested performance of GSFL, by accounting for the measured wattage effects and wattage and lumen output variability. 74 FR 16920, 16946–47 (April 13, 2009).

DOE received several comments on its proposed efficacy levels in the NOPR. NEMA commented that the range of efficacy levels considered was appropriate. (NEMA, No. 81 at p. 21) Both ACEEE and NEMA supported DOE's usage of compliance reports to establish efficacy levels. However, NEMA commented that it has additional data on variability that has been observed in lamp production. (ACEEE, Public Meeting Transcript, No. 38.4 at p. 79–80; NEMA, Public Meeting Transcript, No. 38.4 at pp. 89–90) NEMA recommended a slight lowering of certain GSFL efficacy levels so that an assessment of multiple lamps in a product line would find that the lamps were in conformance when tested under the DOE GSFL test procedure. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 90–91) NEMA also claimed that required adjustments to photometry facilities used for NIST and NVLAP testing over time have resulted in a reduction of reported lumens for some products, which DOE did not account for in the April 2009 NOPR. NEMA therefore advised DOE to use only "sufficiently current" compliance data to determine efficacy levels. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 75–76; NEMA, No. 81 at p.10–11) To account for all of these factors, NEMA stated that DOE should adopt the efficacy levels NEMA recommended in response to the March 2008 ANOPR. These levels recommended by NEMA achieve the desired technology goals as outlined by DOE. (NEMA, No. 81 at pp. 1–2, 10–11, 23) ACEEE opposed a further downward adjustment of the efficiency levels, as it would allow less-efficacious products to remain on the market. (ACEEE, Public Meeting Transcript, No. 38.4 at p. 80)

While DOE is aware that manufacturers may have additional data on production variability, NEMA has not provided such data to DOE. Therefore, DOE has maintained its approach (as presented in the April 2009 NOPR) to develop GSFL efficacy levels. Additionally, DOE believes that by using the compliance reports it is accounting for variability in production as it exists today, for the reasons that follow. First, the product efficacy reported for compliance purposes is related to the lower limit of the 95-percent confidence interval. As explained in DOE's May 1997 lamps test procedure final rule, this interval represents variation over the whole population of production, not only the sample size. 62 FR 29222, 29230 (May 29, 1997). In addition, regarding any changes in calibration requirements that may have occurred that could affect reported lamp efficacy, DOE has reevaluated its efficacy levels based on the latest compliance reports, many of which were submitted to DOE after the NOPR analysis had been completed. Following the same methodology as presented in the April 2009 NOPR, DOE compared the efficacy values for each product class to all available compliance report data and assessed whether the April 2009 NOPR levels achieved the technology goals outlined in chapter 5 of the TSD. For 4-foot MBP lamps, DOE determined that the efficacy levels proposed in the April 2009 NOPR must be revised to accurately represent those goals. For 4-foot MBP lamps with CCTs less than or equal to 4500K, DOE adjusted the efficacy values because new compliance reports: (1) Provided recent data for an existing basic model; (2) provided data for a new basic model; or (3) provided 12-month average production data whereas only initial data had been previously reported.

[12] DOE used rated wattages listed in ANSI C78.81–2005 to determine lamp efficacies. DOE proposed a definition of "rated wattage" in section III.C.1 that referred to an ANSI standard to prevent manufacturers from circumventing standards by rating lamps at artificially low wattages.

NEMA also did not believe it was necessary to raise EL3 for 4-foot MBP lamps from their recommended 83 lumens per watt to 84 lumens per watt as proposed in the April 2009 NOPR. NEMA stated that this increase was not required to achieve the technology goal specified for TSL3 and, furthermore, would have significant consequences for the residential consumer because it eliminated nearly all T12 lamps. (NEMA, No. 81 at p. 2)

In response, DOE reassessed its efficacy levels based compliance report data from 2008 and 2009. As a result of this analysis, DOE determined that the efficacy values for 4-foot MBP low CCT EL3 and EL5 required adjustments. DOE also does not believe that the value for EL3 will have significant consequences for the residential consumer. See section V.C.8 for a discussion of this topic.

For 8-foot SP slimline lamps and 8-foot RDC HO lamps, DOE analyzed recent compliance reports and determined that not enough data existed in those reports to maintain all of the levels proposed in the April 2009 NOPR. Therefore, DOE modified ELs 1, 2, and 5 for 8-foot SP Slimline lamps and EL2 for 8-foot RDC HO lamps to reflect the levels that NEMA recommended. The revised efficacy levels are shown in section VII.A.1.

b. 4-Foot MiniBP Efficacy Levels

As discussed in the April 2009 NOPR, DOE established efficacy levels for 4-foot MiniBP SO and 4-foot MiniBP HO lamps based on catalog rated efficacies. 74 FR 16920, 16947 (April 13, 2009). Then, in order to account for manufacturer variation, DOE used the average reductions in efficacy values due to manufacturer variation calculated for the highest-efficacy 4-foot T8 medium bipin lamps, and applied those same reductions to the 4-foot miniature bipin rated efficacy values. DOE was unable to directly use 4-foot MiniBP lamp compliance data because these products have not been regulated in the past.

As mentioned earlier, NEMA and GE commented that efficacy levels for these 4-foot MiniBP lamps should reflect testing at an ambient temperature of 25 °C rather than 35 °C, the temperature at which standards for 4-foot MiniBP lamps in the April 2009 NOPR were based. (NEMA, No. 81 at pp. 3, 7, 8, 9, 22; GE, Public Meeting Transcript, No. 38.4 at pp. 72–73) ACEEE agreed that 4-foot MiniBP lamps should be tested at 25 °C. (ACEEE, Public Meeting Transcript, No. 38.4 at p. 79) As stated earlier, DOE agrees that 4-foot MiniBP efficacy levels should be based on testing at 25 °C and notes that based on catalog data, efficacies at 25 °C are 10 percent lower than efficacies at 35 °C. Therefore, in this final rule, DOE has revised the efficacy levels for the 4-foot MiniBP product classes accordingly.

In addition, NEMA commented that reductions applied to the 4-foot MiniBP efficacy levels in the April 2009 NOPR were insufficient to fully account for variability in production. (NEMA, No. 81 at pp. 3, 9, 22) NEMA recommended that DOE adopt 86 lm/W and 76 lm/W as EL1 for the 4-foot MiniBP SO and HO product classes, respectively. DOE recognizes that because it does not have compliance report information for 4-foot MiniBP lamps, it may not be able to accurately assess the manufacturing tolerance required for these lamps. Based on DOE's calculations, NEMA's recommended efficacy levels represent manufacturer tolerances within the range required by other lamp types. Therefore, in this final rule, DOE has revised EL1 for 4-foot MiniBP SO and HO lamps to be 86 lm/W and 76 lm/W respectively. For consistency with those allowed manufacturer tolerances DOE has also revised EL2 for 4-foot MiniBP SO lamps to be 90 lm/W. For the purposes of comparison, DOE estimates that 4-foot MiniBP SO and HO halophosphor lamps would have efficacies of 77 lm/W and 69 lm/W when tested at 25 °C. See Chapter 5 of the TSD for further detail on 4-foot MiniBP efficacy levels.

c. IRL Manufacturing Variability

For incandescent reflector lamps, in the April 2009 NOPR, DOE established efficacy levels based on commercially-available and prototype IRL technologies. 73 FR 16920, 16944 (April 13, 2009). In response to those efficacy levels, Philips commented that DOE did not account for manufacturing variability when developing the efficacy levels for incandescent reflector lamps and stressed the importance of accounting for this variability when setting minimum efficacy standards. (Philips, Public Meeting Transcript, No. 38.4 at p. 102–103) Similarly, the International Association of Lighting Designers (IALD) wrote that there are currently IRL on the market that meet TSL4 but only by very small amounts; these products could be eliminated if TSL4 is not carefully set. (IALD, No. 71 at p. 2) Philips also wrote that it is in support of TSL4 for IRL once it is lowered to account for manufacturing variability. (Philips, No. 75 at pp. 1–2) DOE supports the consideration of manufacturing variability in the development of efficacy requirements. In response, DOE examined IRL compliance reports submitted by manufacturers and discovered that reported efficacies of IRL do in fact vary from the catalog efficacies. Similar to GSFL, the efficacy reported for IRL product compliance is related to the lower limit of the 95-percent confidence interval. 62 FR 29222, 29230 (May 29, 1997). Therefore, in some cases, given significant variability in production, the reported efficacy of IRL may be lower than the long-term mean efficacy presented in lamp catalogs. The compliance reports also indicated that different efficacy levels (or technologies) require different efficacy reductions. Thus, similar to the approach taken in developing revised GSFL efficacy levels, DOE used IRL compliance report data to adjust the efficacy levels presented in the April 2009 NOPR downward to better reflect the observed efficacies of commercially-available lamps that feature the described technologies of each EL as discussed in chapter 5 of the TSD. Table VII.2 shows the final rule coefficients A in the equation $A*P\wedge0.27$, which represents the efficacy level requirement for IRL. P is the rated wattage of the lamp. See chapter 5 of the TSD for further detail on the compliance reports used in the analysis.

5. Scaling to Product Classes Not Analyzed

a. 2-Foot U-Shaped Lamps

For the April 2009 NOPR, DOE developed efficacy levels for 2-foot U-shaped GSFL by assessing the catalog efficacies of U-shaped lamps that utilize the same design options used for the 4-foot medium bipin GSFL lamps that DOE analyzed. 74 FR 16920, 16948 (April 13, 2009). To develop the April 2009 NOPR ELs for U-shaped lamps while taking into account manufacturing variability, DOE assessed compliance reports of U-shaped lamps. Where U-shaped lamp compliance report data was unavailable, DOE augmented its assessment of manufacturing variability with compliance report data for 4-foot medium bipin lamps due to the technological similarities between U-shaped and 4-foot medium bipin lamps. In the April 2009 NOPR, the maximum reduction in efficacy requirements for U-shaped lamps in comparison with the 4-foot medium bipin ELs was 7.7 percent at EL1 (the 4-foot medium bipin EL1 requirement of 78 lm/W vs. the U-shaped EL1 requirement of 72 lm/W).

At the public meeting, GE commented that it is in general agreement with the approach that DOE used to develop the efficacy levels for 2-foot U-shaped lamps for the April 2009 NOPR. (GE, Public Meeting Transcript, No. 38.4 at p.

119–120) GE indicated, however, that the reduction in efficacy for U-shaped lamps compared to 4-foot medium bipin lamps should be approximately 8 percent, as the production of the bend in U-shaped lamps adds additional manufacturing variability. (GE, Public Meeting Transcript, No. 38.4 at pp. 123–124) In writing, NEMA then commented that the assumptions that DOE used to develop U-shaped lamp reduction factors were incorrect; NEMA proposed that DOE set EL3 at 76 lm/W for U-shaped lamps with CCTs less than or equal to 4500K and 71 lm/W for U-shaped lamps with CCTs greater than 4500K. NEMA warned that an EL3 efficacy requirement higher than these would remove all T12 U-shaped lamps from the market and that the setting of EL4 or higher as a standard would negatively impact competition; according to comment, the setting of EL5 would eliminate from the market all energy-efficient U-shaped lamps that feature a 6-inch spacing and the ability to fit into 2x2-foot luminaires. (NEMA, No. 81 at pp. 2–3, 11)

In response, DOE grouped U-shaped lamp compliance data sent to DOE in 2007 and 2008 into efficacy levels based on the design options featured in the 4-foot medium bipin lamps that DOE analyzed for the April 2009 NOPR, as follows: 700-series U-shaped 40W T12 lamps were grouped into EL1, and 800-series U-shaped 32W T8 lamps were grouped into either EL3, EL4, or EL5 based on catalog efficacy. DOE did not have any compliance reports from 2007 and 2008 for U-shaped 34W T12 lamps. DOE found that it did not have enough data at ELs 1 through 5 to confidently assess the manufacturing variability of U-shaped lamps on the market. For EL1 through EL3, DOE thus selected the levels proposed by NEMA in response to the March 2008 ANOPR. (NEMA, No. 26 at p. 7) For EL4 and EL5, NEMA did not propose levels for U-shaped lamps. Thus, DOE used NEMA's suggested 8-percent value as a scaling factor from the linear 4-foot medium bipin efficacy levels. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 123–124). The efficacy levels for low-CCT U-shaped lamps for this final rule are shown in chapter 5 of the TSD.

DOE notes that two manufacturers currently produce U-shaped lamps that meet the EL4 proposed in the April 2009 NOPR and retained by DOE in this final rule. DOE acknowledges that currently, only one manufacturer produces U-shaped lamps that meet EL5. DOE is not aware of technological barriers or legal barriers (such as the utilization of a proprietary technology by this manufacturer) that would prevent other manufacturers from producing U-shaped lamps at EL5. For this reason, DOE is using 87 lm/W as the EL5 efficacy level requirement for U-shaped lamps in this final rule.

b. Lamps With Higher CCTs

Because DOE received a number of comments related to its determination of efficacy levels based on compliance reports, DOE decided to reevaluate its efficacy levels at higher CCT levels using the latest compliance report data. For 4-foot MBP lamps with CCTs greater than 4500K, DOE discovered that the efficacy values proposed in the April 2009 NOPR required significant revision to achieve the technology goals outlined in chapter 5 of the TSD. Therefore, to determine efficacy values for these lamps, DOE employed the same methodology as was used to determine efficacy values for 4-foot MBP lamps with CCTs less than or equal to 4500K. Thus, as summarized in section V.B.4.a, DOE selected commercially available lamps for each efficacy level that represented that level's desired technology goal. These revised efficacy levels are supported by data contained in compliance reports submitted in 2008. The updated efficacy values for these lamps are shown in chapter 5 of the TSD.

DOE also compared NEMA's proposed efficacy levels for 8-foot lamps against its proposed efficacy levels in the April 2009 NOPR. For 8-foot SP Slimline lamps with CCTs greater than 4500 K, efficacy levels 1, 2, and 5 were higher than those levels proposed by NEMA. For 8-foot RDC HO lamps with high CCTs, only efficacy level 2 was greater than what NEMA proposed. DOE analyzed recent compliance reports submitted and determined that not enough data existed in those reports to maintain the levels proposed in the April 2009 NOPR for these lamps. Therefore, DOE modified ELs 1, 2, and 5 for 8-foot SP Slimline lamps and EL2 for 8-foot RDC HO lamps to reflect the levels that NEMA proposed. The revised efficacy levels are shown in section VII.A.1.

For U-shaped lamps, NEMA proposed that DOE set EL1, EL2, and EL3 at 65, 67, and 71 lm/W, respectively, for U-shaped lamps with CCTs greater than 4500K. (NEMA, No. 26 at p. 7; NEMA, No. 81 at p. 2) DOE did not have enough recent compliance report data for U-shaped lamps with CCTs above 4500K to accurately assess the manufacturing variability of U-shaped lamps on the market. For this reason, DOE adopted NEMA's proposed requirements for this final rule. NEMA did not propose efficacy level requirements at EL4 and EL5. To develop requirements at these levels for U-shaped lamps with CCTs above 4500K, DOE used NEMA's suggested 8-percent value as a scaling factor and applied the factor to the high-CCT linear 4-foot medium bipin efficacy levels. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 123–124). The efficacy levels for high-CCT U-shaped lamps for the April 2009 NOPR and for this final rule are shown in section VII.A.1.

c. Modified Spectrum IRL

DOE received a number of comments on the reduction factor that DOE applied to the standard-spectrum IRL efficacy levels in order to develop efficacy levels for the modified-spectrum IRL product class. At the public meeting, NEMA commented that industry uses an efficacy reduction of 20 to 25 percent for modified-spectrum IRL (in comparison with standard-spectrum IRL of otherwise identical characteristics) and that the typical efficacy reduction is closer to 20 percent than 25 percent. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 128–129) After publication of the April 2009 NOPR, however, NEMA commented in writing that DOE's April 2009 NOPR analysis was based only on 50W modified-spectrum lamps and that DOE should choose a reduction factor of 25 percent for the modified-spectrum IRL product class in order to retain a diversity of modified-spectrum products on the market. (NEMA, No. 81 at p. 12) On the other hand, PG&E, ASAP, ACEEE, and NRDC commented in writing that if DOE does retain a modified-spectrum IRL product class for the final rule, the class should feature an efficacy reduction of no greater than 10 percent from the standard-spectrum IRL efficacy requirements so that manufacturers cannot produce modified-spectrum IRL using technologies that are cheaper than technologies that would be needed to produced a standard-spectrum IRL of the same efficacy level, creating a loophole. (PG&E, ASAP, NRDC, No. 59 at p. 1–2; NRDC, No. 82 at pp. 2, 4–5; ACEEE, No. 76 at p. 5) DOE generally does not believe that a modified-spectrum IRL product class will be utilized by manufacturers as a loophole that ultimately undermines energy savings. This is because DOE expects that designers of modified-spectrum IRL will likely utilize the same design options featured in standard-spectrum IRL that meet a particular efficacy requirement (such as improved HIR technologies at EL4). Thus, in response to the comments of EEI, PG&E, ASAP, and NRDC, DOE expects modified-spectrum IRL to have a similar cost as standard-spectrum IRL that comply with standards, minimizing migration to modified-spectrum IRL on a first-cost basis. In addition, modified-spectrum IRL are of lower lumen output than standard-spectrum IRL that otherwise have the same characteristics (particularly rated wattage) due to the subtractive filtering that is employed for spectrum modification. Consumers replacing standard-spectrum IRL with modified-spectrum IRL of the same rated wattage are likely to experience lower light levels, further discouraging migration.

DOE acknowledges, however, that some manufacturers may attempt to produce modified-spectrum IRL using cheaper technologies if the efficacy reduction for modified-spectrum IRL permits this to occur. For the April 2009 NOPR, DOE analyzed two modified-spectrum IRL and found an average efficacy reduction of approximately 19 percent, in general support of NEMA's comment concerning a 20 to 25 percent efficacy reduction utilized by industry. PG&E commented, however, that DOE should analyze more than two modified-spectrum IRL in order to determine an appropriate efficacy reduction for the product class. (PG&E, Public Meeting Transcript, No. 38.4 at p. 132–133) PG&E, ASAP, and NRDC commented in writing that it tested commercially-available modified-spectrum cover glasses with a variety of commercially-available IRL burner/reflector assemblies and found that one assembly produced a MacAdam step shift of more than six MacAdam steps, which is more than necessary to meet the modified-spectrum definition requirement of a four-MacAdam-step shift. The interested parties suggested that a smaller MacAdam-step shift would enable a more-efficacious lamp that still provides modified-spectrum utility. (PG&E, ASAP, NRDC, No. 59 at p. 2)

DOE supports the notion that additional information could enable a more accurate determination of the average efficacy reduction featured by modified-spectrum lamps and prevent a possible loophole. DOE also agrees that greater MacAdam-step shifts inherently reduce lamp efficacy by greater amounts, as more subtractive filtering is necessary to produce a larger shift in color point; the setting of a standard that can be met by commercially-available technologies that produce color points near the four-MacAdam-step boundary would thus preserve modified-spectrum utility on the IRL market while reducing the chance of a loophole. However, DOE was unable to find more modified-spectrum lamps on the market than those already found and utilized for the April 2009 NOPR analysis. Thus, to assess the impact of varying degrees of spectrum modification through neodymium (which DOE found to be the most common method of modifying IRL spectra) in IRL cover glasses, DOE developed a model that correlated cover glass neodymium concentration with cover glass light output reduction and MacAdam-step shift in color point. Increasing neodymium concentrations produce greater light output reduction. DOE found that a 15-percent light output reduction correlated with a MacAdam-step shift slightly greater than four steps. To validate the model, DOE then obtained five commercially-available HIR IRL capsules and then assembled reflector lamps utilizing the capsules in combination with either standard-spectrum or modified-spectrum commercially-available IRL cover glasses and reflectors. DOE then tested the lamps with the two cover glass types and determined their efficacies. The reduction in efficacy between the standard-spectrum and modified-spectrum lamps utilizing the five commercially-available HIR capsules obtained by DOE, averaged across the lamps, was approximately 16 percent. DOE believes that this value is in line with the output of the neodymium concentration model that it developed for the analysis. DOE also believes that manufacturers will be able to vary the neodymium concentration for cover glasses associated with a variety of lamp shapes such that modified-spectrum utility is preserved while standards are met. Thus, DOE is implementing a 15-percent reduction in efficacy levels for the modified-spectrum IRL product class in this final rule.

While PG&E, ASAP, and NRDC mentioned that no more than a 10 percent reduction would be necessary for a modified-spectrum product class, DOE believes that this value is specific to the IRL featuring prototype (not commercially-available) technologies that these interested parties tested with a modified-spectrum cover glass. In writing, the three interested parties acknowledged that commercially-available IRL burner/reflector assemblies tested with the same cover glass did not meet the modified-spectrum definition. (PG&E, ASAP, NRDC, Appendix 1, No. 63 at pp. 11–12) Because PG&E, ASAP, and NRDC did not indicate the filament temperature of the prototype IRL nor specify color point data, DOE could not determine the color of the IRL lumen output when operated with either the standard-spectrum or the modified-spectrum glasses. Thus, DOE has insufficient data to determine whether a 10-percent efficacy reduction could be achieved by manufacturers producing currently-available modified-spectrum lamps or if such a reduction would instead eliminate currently-available modified-spectrum lamps from the market. For this reason, DOE has chosen to use an efficacy reduction of 15 percent for the modified-spectrum IRL product class in this final rule, based on commercially-available IRL technologies.

d. Small Diameter IRL

In the April 2009 NOPR, DOE recognized that the size of small-diameter (PAR20) lamps vs. PAR30 and PAR38 lamps provides a specific utility to consumers (*e.g.* the ability to fit into smaller fixtures) but also results in an inherent efficacy reduction. Thus, DOE established a separate product class for small-diameter lamps in order to preserve the small-diameter utility in the IRL marketplace in the face of standards. 74 FR 16920, 16939 (April 13, 2009). Based on a comparison between the efficacies of commercially-available PAR20 lamps and their PAR30 and PAR38 counterparts, DOE selected an efficacy reduction factor of 12 percent vs. the large-diameter IRL product class and utilized this factor to develop the efficacy levels for the small-diameter IRL product class.

DOE received a number of comments on its choice of a 12-percent efficacy reduction factor for the small-diameter IRL product class. The California Stakeholders expressed that a 12-percent factor adequately describes the observed efficacy differences due to optics between PAR20 and larger-diameter lamps; the California Stakeholders also warned DOE that the selection of a larger reduction factor would allow small-diameter IRL to meet DOE's standards using less-efficient components, undermining DOE's energy savings goals. (California Stakeholders, No. 63 at pp. 2, 22) NEMA and GE, on the other hand, commented that the 12-percent reduction factor is inappropriate for the product class because 75W and 50W PAR20 lamps utilize single-ended halogen burner technologies and a double-ended burner (which is more efficacious than a single-ended burner) will not fit into a PAR20 lamp, thus eliminating PAR20 lamps from the market in the face of a TSL4 or TSL5 standard. (NEMA, No. 81 at p. 7, pp. 12–13; GE, No. 80 at p. 6–7; GE, Public Meeting Transcript, No. 38.4 at pp. 60–61) Philips acknowledged that a 12-percent factor describes the observed efficacy differences between PAR20 lamps and larger-diameter lamps, but the interested party concurred with GE and NEMA concerning technical limitations that prevent double-ended burners from being installed into PAR20 lamps. (Philips, Public Meeting Transcript, No. 38.4 at p. 135–136, p. 138) NEMA also commented that the smaller envelope featured on small-diameter lamps limits heat dissipation, which would cause such lamps to run hotter and increase the susceptibility to early failure if the highest-efficacy halogen IR burners were installed. (NEMA, No. 81 at p. 13) In writing, NEMA recommended that DOE employ a reduction factor of 15 percent to 25 percent from the large-diameter efficacy levels for small-diameter lamps; the range represents the range of efficacies observed across small-diameter lamps on the market (considering a variety of manufacturers). (NEMA, No. 81 at p. 4) The California Stakeholders then commented in writing that PAR20 lamps will be able to accommodate double-ended burners by utilizing bent burner leads or cover glasses with a greater bulge and thus reach TSL5, as illustrated by two sources: A Philips MR16 lamp (which has a smaller diameter than a PAR20 lamp) on the European market that features a double-ended burner and bulged cover glass, and drawings from a lighting company that show the potential for a double-ended burner with a bent lead to be fitted into a PAR20 without a bulged cover glass. (California Stakeholders, No. 63 at pp. 22–24)

Based on comments, DOE acknowledges that the installation of double-ended burners into small-diameter lamps could be problematic. DOE notes that the outer dimensions of a PAR20 lamp, including the shape of the bulge, are dictated by ANSI Standard C78.21 (most recently updated in 2003). DOE notes that it is unaware of any standard dictating the inner dimensions of a PAR20 lamp, nor is DOE aware of a standard dictating the dimensions of double-ended burners. Thus, DOE believes that some technical innovations may make the installation of a double-ended burner into a PAR20 lamp feasible. Interested parties did not provide additional data to DOE indicating the efficacy impacts of bending the lead of a double-ended burner so that it can be installed into a PAR20 lamp, however; DOE also could not obtain other data addressing these impacts. Also, DOE believes that manufacturers would not be able to position a double-ended burner at the optimum position for maximum efficacy in a PAR20 lamp due to the lamp's reduced size; thus, DOE believes that a greater reduction factor than 12 percent is warranted for PAR20 lamps at EL4 and EL5 even if a double-ended burner could be fitted into a PAR20 lamp.

DOE acknowledges the Philips MR16 lamp that features a double-ended burner and also acknowledges that the MR16 format is smaller than the PAR20 format. The MR16 format, however, is a low-voltage format, and low-voltage lamps have different inherent characteristics than lamps designed for line-voltage operation. DOE thus does not believe that it can make assumptions about line-voltage small-diameter lamp designs by assessing low-voltage lamps. The California Stakeholders provided information showing a prototype low-voltage lamp with integrated transformer that can meet the April 2009 NOPR level of EL5 for IRL, but this interested party did not provide details about the lifetime of the lamp or the impacts of the transformer on efficacy. (CA Stakeholders, Appendix 4, No. 63 at pp. 1–5) While DOE is aware of low-voltage PAR20 lamps utilizing integrated transformers for direct connection to line-voltage sources, DOE does not have the data required to assess the impacts of such transformers on IRL efficacy; DOE thus could not confidently develop an efficacy level based on an IRL with an integrated transformer. See section VI.B.2.c for a further discussion of the integrated-transformer IRL design option. Because DOE cannot assess the effects of bent burner leads on lamp efficacy, acknowledges that double-ended burners cannot be optimally positioned in PAR20 lamps, cannot make design assumptions for line-voltage lamps based on low-voltage lamps, and cannot assess the impacts of an integrated transformer on lamp efficacy, DOE is revising its PAR20 EL4 and EL5 efficacy requirements in this final rule so that PAR20 lamps will not require double-ended burners to meet a standard established at EL4 or EL5.

In order to determine the efficacy reduction that would result from using a single-ended burner instead of a double-ended burner in a lamp, DOE obtained a commercially-available single-ended HIR capsule and measured the location and dimensions of the lead wire inside of the capsule, which prevents a certain amount of energy from reaching the capsule wall and being reflected back to the capsule filament. (A double-ended burner features a lead wire outside of the capsule, where it does not interfere with the reflectance of energy from the capsule wall back to the capsule filament.) DOE then created a model to determine the efficacy impacts of the lead wire's presence inside of the capsule. DOE also simulated manufacturing variability by modeling the effects of changing the capsule dimensions and lead wire positioning. With the resulting data from the model, DOE determined the reduction in efficacy that results from the presence of the lead wire inside of a single-ended HIR capsule in comparison with a double-ended capsule, which features an external lead wire. This reduction was determined to be approximately 3.5 percent. For EL4 and EL5, DOE is thus changing the reduction factor for small-diameter lamps from the April 2009 NOPR value of 12 percent to the value of 15.5 percent for this final rule. This is within the reduction factor range proposed by NEMA for small-diameter IRL. (NEMA, No. 81 at p. 4) The small-diameter IRL reduction factors in the April 2009 NOPR and in this final rule are shown in Table V.3. 74 FR 16920, 16950 (April 13, 2009).

TABLE V.3—SMALL-DIAMETER IRL REDUCTION FACTORS IN THE APRIL 2009 NOPR AND IN THIS FINAL RULE

Efficacy level	NOPR	Final rule
EL1	12%	12%
EL2	12%	12%
EL3	12%	12%
EL4	12%	15.5%
EL5	12%	15.5%

Concerning heat dissipation, DOE acknowledges that the smaller size of a PAR20 in comparison with larger-diameter lamps limits heat dissipation, which would cause a given filament to operate at a higher temperature if simply transplanted from a larger-diameter lamp to a PAR20 lamp without any other changes. DOE notes, however, that HIR R20 lamps currently exist on the market, thus proving that high temperature-HIR technology in small-diameter lamps is technologically feasible. In addition, in its research, DOE found no ANSI standard that indicated a required seal temperature. In fact on product specifications, DOE found that commercially-available lamps have a variety of seal temperatures. In consideration of all of these factors, DOE believes that the 15.5 percent reduction for EL4 and EL5 is appropriate for small-diameter lamps.

e. IRL With Rated Voltages Greater Than or Equal to 125 Volts

In the April 2009 NOPR, DOE proposed that covered IRL with rated voltages greater than or equal to 125V must be 15 percent more efficacious than covered IRL with rated voltages less than 125V. At the public meeting, DOE received numerous comments on this proposal. NEMA commented that the proposed standard for 130V would not be technically feasible to achieve; 130V IRL are less efficacious than 120V IRL so that lifetime is preserved, and the effective elimination of 130V IRL would reduce utility for certain regions of the country with line voltages near 130V (since 120V IRL operated at 130V have reduced lifetimes). (NEMA, Public Meeting Transcript, No. 38.4 at pp. 60–62, 66–67, 139–140) NEMA instead requested the elimination of a 130V IRL product class and the development of standards based strictly upon lamps' rated voltages. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 61–62, 67; NEMA, No. 81 at pp. 7, 24) On the other hand, EEI commented in writing on its support of higher efficacy standards for lamps with rated voltages higher than 125V, while ACEEE commented at the public meeting that many 130V IRL are used on 120V lines as longer-life lamps. (EEI, No. 39 at p. 3; ACEEE, Public Meeting Transcript, No. 38.4 at pp. 65–66) Philips acknowledged that 130V IRL lose 15 percent in efficacy when operated at 120V but commented that there were other ways apart from separate product classes to prevent the usage of 130V IRL on 120V lines. (Philips, Public Meeting Transcript, No. 38.4 at pp. 62, 139–140)

DOE shares ACEEE's concern that without a more-stringent 130V IRL product class, 130V IRL that meet a particular IRL efficacy requirement will be purchased and used on 120V lines as longer-life lamps that no longer meet the efficacy requirement. While DOE agrees with NEMA's comment that 130V lamps use less power than their rated power when operated at 120V, DOE also supports NEMA's comments that 130V lamps are less efficacious than 120V lamps. (NEMA, Public Meeting Transcript, No. 38.4 at p. 67; NEMA, No. 81 at p. 13) Specifically, a 130V lamp with a specific rated power, rated lumen output, efficacy, and rated lifetime will have lower power consumption, lower lumen output, lower efficacy, and longer lifetime when operated at 120V. By maintaining a separate product class for 130V IRL with a 15 percent increase in stringency relative to 120V IRL standards, DOE ensures that 130V IRL operated on 120V lines will be as efficacious during operation as 120V IRL that comply with standards. DOE acknowledges that designers of 130V IRL may have to make certain tradeoffs to meet the efficacy requirements, but DOE also believes that there are a number of ways to make compliant 130V IRL (such as by adjusting lamp lifetime). Therefore, DOE has kept the 130V IRL product class and its associated 15-percent stringency increase for the Final Rule.

In writing, EEI also asked for clarification that the efficacy requirements shown in the April 2009 NOPR for IRL with rated voltages greater than or equal to 125V apply when the IRL are tested at 120V. (EEI, No. 39 at p. 3) In response, DOE notes that IRL must be tested for compliance according to the test procedure in section 4.3 of Appendix R to Subpart B of 10 CFR 430, which states in part that ''[l]amps shall be operated at the rated voltage.'' Thus, IRL rated at 130V should be operated at 130V during the efficacy measurement process. DOE believes that IRL operated at 130V are generally 15 percent more efficacious than when they are operated at 120V; thus, retaining a separate product class for 130V IRL, with a 15-percent increase over 120V IRL standards, allows DOE to take into account the efficacy reduction that 130V IRL will experience when operated at 120V.

C. Life-Cycle Cost and Payback Period Analysis

This section describes the LCC and payback period analyses and the spreadsheet model DOE used for analyzing the economic impacts of possible standards on individual consumers. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 and appendix 8A of the TSD. DOE conducted the LCC and PBP analyses using a spreadsheet model developed in Microsoft Excel. When combined with Crystal Ball (a commercially-available software program), the LCC and PBP model generates a Monte Carlo simulation [13] to perform the analysis by incorporating uncertainty and variability considerations. For further details on the LCC and PBP Monte Carlo simulations, see the TSD appendix 8B, in which probable ranges of LCC results are presented.

The LCC analysis estimates the impact of a standard on consumers by calculating the net cost of a lamp (or lamp-and-ballast system) under a base-case scenario (in which no new energy conservation standard is in effect) and under a standards-case scenario (in which the proposed energy conservation regulation is applied). As part of the LCC and PBP analyses, DOE developed data that it used to establish product prices, sales taxes, installation costs, disposal costs, operating hours, product energy consumption, energy prices, product lifetime, and discount rates.

As discussed in the April 2009 NOPR, the life-cycle cost of a particular lamp design is a function of the total installed cost (which includes manufacturer selling price, sales taxes, distribution chain mark-ups, and any installation cost), operating expenses (due to purchases of energy as well as repair and maintenance costs), product lifetime, and discount rate. 74 FR 16920, 16950 (April 13, 2009). DOE also incorporated a residual value calculation to account for any remaining lifetime of lamps (or ballasts) at the end of the analysis period. 74 FR 16920, 16950 (April 13, 2009). The residual value is an estimate of the product's value to the consumer at the end of the life-cycle cost analysis period, which embodies the assumption that a lamp system continues to function beyond the end of the analysis period. DOE calculates the residual value by linearly prorating the product's initial cost consistent with the methodology described in the *Life-Cycle Costing Manual for the Federal Energy Management Program*.[14]

DOE also calculates a payback period for each standards-case lamp or lamp-and-ballast system. The payback period is the change in total installed cost of the more-efficient product compared to the baseline product, divided by the change in annual operating cost of that product compared to the baseline product. Stated more simply, the payback period is the time period for which a consumer must operate a more-efficient product to recoup the assumed increased total installed cost (compared to the baseline product) through savings from reduced operating costs. DOE expresses this period in years.

In addition, in the April 2009 NOPR and in today's final rule, DOE analyzes five types of events that would prompt a consumer to purchase a fluorescent lamp. These events account for the various economic impacts incurred by consumers depending upon the situations under which they are

[13] Monte Carlo simulations model uncertainty by utilizing probability distributions instead of single values for certain inputs and variables.

[14] Fuller, Sieglinde K. and Stephen R. Peterson, National Institute of Standards and Technology Handbook 135 (1996 Edition); Life-Cycle Costing Manual for the Federal Energy Management Program (Prepared for U.S. Department of Energy, Federal Energy Management Program, Office of the Assistant Secretary for Conservation and Renewable Energy) (Feb. 1996). Available at: *http://fire.nist.gov/fire/firedocs/build96/PDF/b96121.pdf*.

purchasing a lamp., Described in detail in the April 2009 NOPR, these events are: Lamp Failure (Event I), Standards-Induced Retrofit (Event II), Ballast Failure (Event III), Ballast Retrofit (Event IV), and New Construction and Renovation (Event V). 74 FR 16920, 16958 (April 13, 2009). Although described primarily in the context of GSFL, lamp purchase events can be applied to IRL as well. However, considering that IRL are generally not used with a ballast, the only lamp purchase events applicable to IRL are lamp failure (Event I) and new construction and renovation (Event V).

Table V.4 summarizes the approach and data that DOE used to derive the inputs to the LCC and PBP calculations for the April 2009 NOPR and the changes made for today's final rule. The following sections discuss the comments DOE received regarding its presentation of the LCC and PBP analyses in the April 2009 NOPR and the responses and changes DOE made to these analyses as a result.

TABLE V.4—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE NOPR AND FINAL RULE LCC ANALYSES

Inputs	April 2009 NOPR	Changes for the final rule
Consumer Product Price	Applied discounts to manufacturer catalog ("blue-book") pricing in order to represent low, medium, and high prices for all lamp categories. Discounts were also applied to develop a price for ballasts.	No change.
Sales Tax	Derived weighted-average tax values for each Census division and four large States from data provided by the Sales Tax Clearinghouse.[2]	Updated the sales tax using the latest information from the Sales Tax Clearinghouse.[3] Updated population estimates using 2008 U.S. Census Bureau data.[4]
Installation Cost	Derived costs using the RS Means Electrical Cost Data, 2007[5] to obtain average labor times for installation, as well as labor rates for electricians and helpers based on wage rates, benefits, and training costs. For GSFL, included 2.5 minutes of installation time to the new construction, major retrofit, and renovation events in the commercial and industrial sectors to capture the time needed to install luminaire disconnects.	No change.
Disposal Cost	GSFL: Included a recycling cost of 10 cents per linear foot in the commercial and industrial sectors. IRL: Not included.	No change.
Annual Operating Hours	Determined operating hours by associating building-type-specific operating hours data with regional distributions of various building types using the 2002 U.S. Lighting Market Characterization[6] and the Energy Information Administration's (EIA) 2003 Commercial Building Energy Consumption Survey (CBECS),[7] 2001 Residential Energy Consumption Survey,[8] and 2002 Manufacturing Energy Consumption Survey.[9]	Updated the regional distribution of residential buildings using the 2005 Residential Energy Consumption Survey.[10]
Product Energy Consumption Rate.	Determined lamp input power (or lamp-and-ballast system input power for GSFL) based on published manufacturer literature. Used a linear fit of GSFL system power on several different ballasts with varying ballast factors in order to derive GSFL system power for all of the ballasts used in the analysis.	No change.
Electricity Prices	Price: Based on EIA's 2006 Form EIA–861 data.[11] Variability: Regional energy prices determined for 13 regions.	Updated with EIA's 2007 Form EIA–861.[12]
Electricity Price Trends	Forecasted with EIA's *Annual Energy Outlook (AEO) 2008*.[13]	Updated with EIA's April 2009 *AEO2009*, which includes the impacts of the American Recovery and Reinvestment Act of February 2009.[14]
Lifetime	Commercial and industrial sector ballast lifetime based on average ballast life of 49,054 from 2000 Ballast Rule;[15] developed separate ballast lifetime estimate for the residential sector using measured life reports. Lamp lifetime based on published manufacturer literature where available. DOE assumed a lamp operating time of 3 hours per start. Where manufacturer literature was not available, DOE derived lamp lifetimes as part of the engineering analysis. Residential GSFL: 4-foot medium bipin lamp lifetime is dependent on the fixture lifetime (*i.e.*, for average residential lamp operating hours, the fixture reaches end of life before the lamp reaches end of life, and, thus, the lamp is retired before it fails.)	DOE added residential sector GSFL LCC analysis scenarios where a consumer preserves the lamp during a fixture replacement and installs the preserved lamp on a new fixture. The analysis periods for these scenarios are based on the full lifetime of the baseline lamp.
Discount Rate	Residential: Approach based on the finance cost of raising funds to purchase lamps either through the financial cost of any debt incurred to purchase product or the opportunity cost of any equity used to purchase equipment, based on the Federal Reserve's Survey of Consumer Finances data[16] for 1989, 1992, 1995, 1998, 2001, and 2004. Commercial and industrial: Derived discount rates using the cost of capital of publicly-traded firms in the sectors that purchase lamps, based on data in the 2003 CBECS,[17] Damodaran Online,[18] Ibbotson's Associates,[19] the 2007 Value Line Investment survey,[20] Office of Management and Budget (OMB) Circular No. A–94,[21] 2008 State and local bond interest rates,[22] and the U.S. Bureau of Economic Analysis.[23]	For the residential sector, included data from the 2007 Survey of Consumer Finances and the Cost of Savings Index dataset covering 1984 to 2008.[24]

TABLE V.4—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE NOPR AND FINAL RULE LCC ANALYSES—Continued

Inputs	April 2009 NOPR	Changes for the final rule
Analysis Period	Commercial and industrial GSFL: Based on the longest baseline lamp life in a product class divided by the annual operating hours of that lamp. Residential GSFL: Based on the useful lifetime of the baseline lamp.	No change.
Lamp Purchasing Events.	Commercial and industrial sectors: DOE assessed five events: lamp failure, standards-induced retrofit, ballast failure (GSFL only), ballast retrofit (GSFL only), and new construction/renovation. Residential sector: DOE assessed three events: lamp failure, ballast failure (GSFL only), and new construction/renovation.	No change.

[1] U.S. Bureau of Labor Statistics, Table Containing History of CPI–U U.S. All Items Indexes and Annual Percent Changes from 1913 to Present (Last accessed Feb. 20, 2009). Available at: *ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt.*

[2] The four large States are New York, California, Texas, and Florida.

[3] Sales Tax Clearinghouse, Aggregate State Tax Rates (2009) (Last accessed Feb. 20, 2009). Available at: *http://thestc.com/STrates.stm.* The February 20, 2009 material from this Web site is available in Docket # EE–2006–STD–0131. For more information, contact Brenda Edwards at (202) 586–2945.

[4] U.S. Census Bureau, Population change: April 1, 2000 to July 1, 2008 (NST–EST2008–popchg2000–2008). Last accessed February 20, 2009. Available at: *http://www.census.gov/popest/states/files/NST-EST2008-popchg2000-2008.csv.*

[5] R. S. Means Company, Inc., *2007 RS Means Electrical Cost Data* (2007).

[6] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Energy Conservation Program for Consumer Products: Final Report: U.S. Lighting Market Characterization, Volume I: National Lighting Inventory and Energy Consumption Estimate (2002). Available at: *http://www.eere.energy.gov/buildings/info/documents/pdfs/lmc_vol1_final.pdf.*

[7] U.S. Department of Energy, Energy Information Administration, Commercial Building Energy Consumption Survey: Micro-level data, file 2 Building Activities, Special Measures of Size, and Multi-building Facilities (2003). Available at: *http://www.eia.doe.gov/emeu/cbecs/public_use.html.*

[8] U.S. Department of Energy, Energy Information Administration, Residential Energy Consumption Survey: File 1: Housing Unit Characteristic (2006). Available at: *http://www.eia.doe.gov/emeu/recs/recs2001/publicuse2001.html.*

[9] U.S. Department of Energy, Energy Information Administration, Manufacturing Energy Consumption Survey, Table 1.4: Number of Establishments by First Use of Energy for All Purposes (Fuel and Nonfuel) (2002). Available at: *http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html.*

[10] U.S. Department of Energy, Energy Information Administration, Residential Energy Consumption Survey: File 1: Housing Unit Characteristics (2008). Available at: *http://www.eia.doe.gov/emeu/recs/recspubuse05/datafiles/RECS05file1.csv.*

[11] U.S. Department of Energy, Energy Information Administration, Form EIA–861 for 2006 (2006). Available at: *http://www.eia.doe.gov/cneaf/electricity/page/eia861.html.*

[12] U.S. Department of Energy, Energy Information Administration, Form EIA–861 for 2007 (2007). Available at: *http://www.eia.doe.gov/cneaf/electricity/page/eia861.html.*

[13] U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2008 with Projections to 2030* (June 2008). Available at: *http://www.eia.doe.gov/oiaf/archive/aeo08/index.html.*

[14] U.S. Department of Energy, Energy Information Administration, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook* (April 2009). Available at: *http://www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html.*

[15] U.S. Department of Energy, Energy Efficiency and Renewable Energy, Office of Building Research and Standards, Technical Support Document: Energy Efficiency Standards for Consumer Products: Fluorescent Lamps Ballast Final Rule (Sept. 2000). Available at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/gs_fluorescent_0100_r.html.*

[16] The Federal Reserve Board, Survey of Consumer Finances. Available at: *http://www.federalreserve.gov/PUBS/oss/oss2/scfindex.html.*

[17] U.S. Department of Energy, Energy Information Administration, Commercial Building Energy Consumption Survey (2003). Available at: *http://www.eia.doe.gov/emeu/cbecs/.*

[18] Damodaran Online, *The Data Page: Historical Returns on Stocks, Bonds, and Bills—United States* (2006) (Last accessed Sept. 12, 2007). Available at: *http://pages.stern.nyu.edu/~adamodar.* The September 12, 2007 material from this Web site is available in Docket # EE–2006–STD–0131. For more information, contact Brenda Edwards at (202) 586–2945.

[19] Ibbotson's Associates, Stocks, Bonds, Bills, and Inflation, Valuation Edition, 2001 Yearbook (2001).

[20] Value Line, Value Line Investment Survey (2007). Available at: *http://www.valueline.com.*

[21] U.S. Office of Management and Budget, Circular No. A–94 Appendix C (2008). Available at: *http://www.whitehouse.gov/omb/circulars/a094/a094.html.*

[22] Federal Reserve Board, Statistics: Releases and Historical Data—Selected Interest Rates—State and Local Bonds (2008). Available at: *http://www.federalreserve.gov/releases/h15/data/Monthly/H15_SL_Y20.txt.*

[23] U.S. Department of Commerce, Bureau of Economic Analysis, Table 1.1.9 Implicit Price Deflators for Gross Domestic Product (2008). Available at: *http://www.bea.gov/national/nipaweb/SelectTable.asp?Selected=N.*

[24] Mortgage-X, Mortgage Information Service. Cost of Savings Index (COSI), Index History. 2009. Last accessed, February 25, 2009. *http://mortgage-x.com/general/indexes/default.asp.*

1. Consumer Product Price

In the April 2009 NOPR, DOE used a variety of sources to develop consumer equipment prices, including lamp and ballast prices in manufacturers' suggested retail price lists (''blue books''), State procurement contracts, large electrical supply distributors, hardware and home improvement stores, Internet retailers, and other similar sources. DOE then developed low, medium, and high prices based on its findings. 74 FR 16920, 16952 (April 13, 2009).

At the public meeting, Philips commented that DOE's estimated costs of IRL in the residential sector reported in the proposed rule appear too low in comparison with the costs of commercial IRL. (Philips, Public Meeting Transcript, No. 38.4 at pp. 179–181) In response, DOE notes that the costs of all commercial IRL in the LCC and PBP analyses include $1.10 to account for the labor cost of a four-minute installation time at a labor rate of $16.55 per hour. (Using the consumer price index for 2008, the labor rate for this final rule was inflated to 2008 dollars, as compared to the April 2009 NOPR value of $15.94 per hour in 2007 dollars.) Conversely, DOE assumes that consumers in the residential sector will replace their own lamps and, therefore, does not model labor costs for IRL in the residential sector; this difference in methodology contributes to the relative price difference between commercial and residential IRL. In addition, DOE acknowledges that lamps sold through various distribution chains may have differing end-user prices. For this reason, DOE conducts the LCC analysis on the high and low lamp prices as sensitivities, DOE believes that the sources and methodologies used to develop IRL prices for the April 2009 NOPR reflect the variety of IRL prices encountered by consumers in the residential and commercial sectors. The results of the IRL price sensitivities analysis can be found in Appendix 8B of the TSD.

Philips also commented that the incremental price differential for more-efficacious IRL appears too small. (Philips, Public Meeting Transcript, No. 38.4 at pp. 179–181) Additionally NEMA and Philips stated that the prices of IRL will be uncertain due to expected capacity constraints in 2012. (NEMA, Philips, Public Meeting Transcript, No. 38.4 at pp. 286–287)

DOE recognizes that the imposition of a standard will commoditize higher-efficacy IRL that may be sold today as premium products at higher markups (from manufacturing costs to end-user prices) than lower-efficacy IRL. Prices of IRL in DOE's analysis are meant to reflect commoditization of these higher-efficacy products in the face of standards. DOE assessed discounts between blue book prices and end-user prices of currently-available lower-efficacy IRL to obtain information about how commoditization affects IRL price. DOE took this information into account during the development of prices for the IRL that comply with each EL shown in today's final rule. Furthermore, although DOE recognizes that there may be uncertainty regarding future IRL prices, interested parties did not provide additional data to DOE as would cast doubt on its overall pricing methodology or as would support an alternative methodology. For these reasons, DOE has not changed the April 2009 NOPR IRL methodologies or prices for this final rule. For further information on the development of IRL prices, see chapter 7 of the final rule TSD.

2. Sales Tax

In the April 2009 NOPR, DOE obtained State and local sales tax data from the Sales Tax Clearinghouse. (April 2009 NOPR TSD chapter 7) The data represented weighted averages that include county and city rates. DOE used the data to compute population-weighted average tax values for each Census division and four large States (New York, California, Texas, and Florida). For the final rule, DOE retained this methodology and used updated sales tax data from the Sales Tax Clearinghouse [15] and updated population estimates from the U.S. Census Bureau.[16]

3. Annual Operating Hours

As discussed in the April 2009 NOPR, DOE developed annual operating hours for IRL and GSFL by combining building type-specific operating hours data from the 2002 U.S. Lighting Market Characterization (LMC) [17] with data in the 2003 Commercial Building Energy Consumption Survey (CBECS),[18] the 2001 Residential Energy Consumption Survey (RECS),[19] and the 2002 Manufacturing Energy Consumption Survey (MECS),[20] which describe the probability that a particular building type exists in a particular region. 74 FR 16920, 16954–55 (April 13, 2009). For this final rule, DOE updated the residential annual operating hours estimates using the 2005 RECS.[21] Residential-sector average operating hours changed from 789 to 791 hours per year for GSFL and from 884 hours per year in the April 2009 NOPR to 889 hours per year for this final rule for IRL. DOE did not receive any further comments on residential-sector operating hours. For further details on the annual operating hours used in the analyses, see chapter 6 of the TSD.

4. Electricity Prices and Electricity Price Trends

As explained in the April 2009 NOPR, DOE determined energy prices by deriving regional average prices for 13 geographic areas consisting of the nine U.S. Census divisions, with four large States (New York, Florida, Texas, and California) treated separately. 74 FR 16920, 16955–56 (April 13, 2009). For the April 2009 NOPR, DOE derived electricity prices based on data from the 2006 publication of EIA Form 861. *Id.* At the public meeting, ACEEE commented that DOE should use the latest available electricity prices and electricity price trends in its analysis for the final rule. (ACEEE, Public Meeting Transcript, No. 38.4 at pp. 154–155)

DOE agrees with ACEEE and has updated the related electricity price and electricity price trend sources for the final rule analysis. For electricity price data, the analysis now utilizes EIA's Form 861 electricity price data from the year 2007.[22] DOE obtained electricity price trend data from EIA's latest *AEO2009*,[23] which was published in April 2009 and is a special update of the March 2009 *AEO2009* (the initial release of EIA's *AEO2009*) [24] that includes the impacts of the American Recovery and Reinvestment Act (ARRA) of February 2009 (Pub. L. 111–5). To project electricity prices to the end of the LCC analysis period, DOE used the reference economic growth projection in the April *AEO2009*. As done for the April 2009 NOPR, DOE used the price trend average rate of change during 2020–2030 to estimate the price trends after 2030. See chapter 8 of the April 2009 NOPR TSD [25] as well as chapter 8 of the final rule TSD. The spreadsheet tools and LCC sensitivity scenarios featured in the April 2009 NOPR also included high-economic-growth and low-economic-growth electricity price trend

[15] Sales Tax Clearinghouse, ''Aggregate State Tax Rates'' (2009) (Last accessed February 20, 2009). Available at: *http://thestc.com/STrates.stm.* The February 20, 2009, material from this Web site is available in Docket #EE–2006–STD–0131. For more information, contact Brenda Edwards at (202) 586 2945.

[16] U.S. Census Bureau, ''Population Change: April 1, 2000 to July 1, 2008'' (July 2008). Available at: *http://www.census.gov/popest/states/files/NST-EST2008-popchg2000-2008.csv.*

[17] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, ''U.S. Lighting Market Characterization. Volume I: National Lighting Inventory and Energy Consumption Estimate (2002).'' Available at: *http://www.netl.doe.gov/ssl/PDFs/lmc_vol1_final.pdf.*

[18] U.S. Department of Energy, Energy Information Agency, ''Commercial Building Energy Consumption Survey: Micro-Level Data, File 2 Building Activities, Special Measures of Size, and Multi-building Facilities (2003).'' Available at: *www.eia.doe.gov/emeu/cbecs/public_use.html.*

[19] U.S. Department of Energy, Energy Information Administration, Residential Energy Consumption Survey: File 1: Housing Unit Characteristic (2006). Available at: *http://www.eia.doe.gov/emeu/recs/recs2001/publicuse2001.html.*

[20] U.S. Department of Energy, Energy Information Agency, ''Manufacturing Energy Consumption Survey, Table 1.4: Number of Establishments by First Use of Energy for All Purposes (Fuel and Nonfuel) (2002).'' Available at: *www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html.*

[21] U.S. Department of Energy, Energy Information Administration, Residential Energy Consumption Survey: File 1: Housing Unit Characteristic (2009). Available at: *http://www.eia.doe.gov/emeu/recs/recspubuse05/pubuse05.html.*

[22] U.S. Department of Energy, Energy Information Administration, Form EIA–861 for 2007 (2007). Available at: *http://www.eia.doe.gov/cneaf/electricity/page/eia861.html.*

[23] U.S. Department of Energy, Energy Information Administration, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook* (April 2009). Available at: *http://www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html.*

[24] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2009 with Projections to 2030 (March 2009). Available at: *http://www.eia.doe.gov/oiaf/aeo/.*

[25] U.S. Department of Energy. Chapter 8: Life-Cycle Cost and Payback Period Analyses. Available at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/ch_8_lamps_standards_nopr_tsd.pdf.*

cases from EIA. The April 2009 *AEO2009* did not include these cases, however. To generate them, DOE utilized the difference between the reference economic-growth case and the high- and low-economic-growth cases in the March 2009 *AEO2009* as scaling factors to produce high- and low-economic-growth estimates for the spreadsheet tools and LCC sensitivity scenarios addressed in this final rule.

The results of DOE's analysis using the reference economic-growth projections are presented in this notice, with a full set of results displayed in chapter 8 of the TSD. DOE also presents LCC and PBP results for the low-economic-growth and high-economic-growth cases from *AEO2009* in appendix 8B of the final rule TSD.

5. Ballast Lifetime

For the April 2009 NOPR, DOE used a commercial and industrial sector ballast lifetime of approximately 50,000 hours, which is the average ballast life used in the 2000 final rule for fluorescent lamp ballasts (2000 Ballast Rule).[26] 65 FR 56740 (Sept. 19, 2000). In the primary commercial sector LCC and PBP analysis, this is equivalent to a lifetime of approximately 14.2 years (based on an average of 3,435 operating hours per year in the commercial sector).

At the public meeting, Lutron Electronics agreed that a ballast lifetime of 50,000 hours is common, and a 14.2 year lifetime is appropriate for a ballast that is operated approximately 3,500 hours per year. However, Lutron Electronics also commented that the ballast service life (in years) will change as operating hours change. (Lutron Electronics, Public Meeting Transcript, No. 38.4 at pp. 152–153) DOE agrees with Lutron Electronics and verifies that in its commercial and industrial LCC analyses, for the Monte Carlo simulations (that analyze a distribution of operating hours) and for the consumer subgroup analyses, DOE varies ballast service life as operating hours change.

For the residential sector LCC and PBP analysis in the April 2009 NOPR, DOE used a ballast lifetime of 15 years, based on measure life reports that discuss ballast lifetime in terms of years.[27] [28] 74 FR 16920, 16959 (April 13, 2009). In other words, DOE assumed that a ballast installed in the residential sector would remain in place for an average of 15 years, regardless of its annual operating hours. The measure life reports, published in 2005 and 2007, incorporate both magnetic and electronic ballasts. DOE used the measure life reports because DOE believes they best capture the true service life of ballasts in the residential sector.

At the NOPR public meeting, ACEEE stated that in 2005, the vast majority of ballasts were magnetic, suggesting that the measure life that DOE assumed may not be appropriate. ACEEE also commented that the ballast lifetimes, when expressed in hours (15 years in place is equivalent to 11,869 hours of life based on average residential GSFL operating hours), appeared too low for the residential sector. (ACEEE, Public Meeting Transcript, No. 38.4 at pp. 154, 169–170) In response, DOE notes that it did not receive any data that indicate the measure life of electronic ballasts differs from magnetic ballasts. Thus, DOE does not believe there is a difference in the lifetimes of the two ballast types that is substantial enough to affect the results of the analyses. First, it is worth noting that the 2000 Ballast Rule assumes no difference between the two ballast lifetimes.[29] Second, manufacturer product literature does not generally suggest or market a difference in lifetimes between magnetic and electronic ballasts. Third, in interviews, manufacturers mentioned that there was no substantial difference in reliability (a proxy for service life) between magnetic and electronic ballasts. Finally, DOE understands that most ballasts are rated for longer lifetimes (in hours) than the lifetimes that DOE used in its analyses. DOE reiterates, however, that the measure life reports estimate the lifetimes of actual ballasts in the field, accounting for not only ballast failure at its rated life, but also premature failure, fixture removal, and replacement during renovation. For all of these reasons, DOE continues to use the measure life reports to determine ballast service life in the residential sector.

6. Lamp Lifetime

When possible, for the April 2009 NOPR, DOE used manufacturer literature to determine lamp lifetimes. 74 FR 16920, 16956–57 (April 13, 2009). When published manufacturer literature was not available—as was the case for some IRL—DOE derived lamp lifetimes as part of the engineering analysis. DOE also considered the impact of group re-lamping practices on GSFL lifetimes in the commercial and industrial sectors in this final rule. 74 FR 16920, 16954 (April 13, 2009). For details, see chapter 5 of the final rule TSD.

For GSFL, DOE based its lamp lifetimes on lamp start cycles of 3 hours per start. At the public meeting, Southern California Edison commented that residential GSFL may experience much shorter start cycles than 3 hours per start, thereby lowering their lifetimes from rated values. (Southern California Edison, Public Meeting Transcript, No. 38.4 at pp. 166–167) DOE acknowledges that some residential GSFL may indeed experience shorter start cycles than 3 hours per start, thereby reducing lamp lifetime due to increased electrode degradation. Research indicated to DOE that the effective lifetimes of lamps operated at start cycles other than 3 hours per start is highly variable and depends directly on the lamp type as well as the type of ballast (*i.e.*, program start, instant start, or rapid start) to which the lamp is connected. Southern California Edison did not provide data to illustrate the expected lifetimes of any of the residential GSFL (either base-case or standards-case) featured on any of the ballasts that DOE presents in the LCC analysis, nor did it provide data indicating the prevalence of various start cycles in the residential sector. In response to these comments, DOE conducted research but was unable to find data sources for the residential sector that specified any of this information. For this reason, DOE has chosen to maintain the usage of rated lamp lifetimes based on 3 hour start cycles for this final rule.

7. Discount Rates

In the April 2009 NOPR, DOE derived residential discount rates by identifying all possible debt or asset classes that might be used to purchase replacement products, including household assets that might be affected indirectly. DOE estimated the average proportions of the various debt and equity classes in the average U.S. household equity and debt portfolios using data from the Survey of Consumer Finances (SCF) sources from 1989 to 2004. DOE used the mean share of each class across the six sample years as a basis for estimating the effective financing rate for replacement equipment. DOE estimated interest or

[26] U.S. Department of Energy. April 2009 NOPR Technical Support Document. Chapter 4. Life-Cycle Costs and Payback Periods. Available at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/chap4.pdf.*

[27] GDS Associates, Inc., Engineers and Consultants, *Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures* (The New England State Program Working Group) (2007).

[28] Economic Research Associates, Inc., and Quantec, LLC, Revised/Updated EULs Based On Retention And Persistence Studies Results (Southern California Edison) (2005).

[29] U.S. Department of Energy. Chapter 4. Life-Cycle Costs and Payback Periods. Available at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/chap4.pdf.*

return rates associated with each type of equity and debt using SCF data and other sources. The mean real effective rate across the classes of household debt and equity, weighted by the shares of each class, was 5.6 percent for the April 2009 NOPR. 74 FR 16920, 16957 (April 13, 2009). For this final rule, DOE updated the sources used to compute the discount rate in the residential sector. The analysis now features data from the 2007 Survey of Consumer Finances and the Cost of Savings Index dataset covering 1984 to 2008. Based on these updates, the residential sector average discount rate for the final rule is 4.8 percent.

For the commercial sector and industrial sector, DOE derived the discount rate from the cost of capital of publicly-traded firms in the sectors that purchase lamps, as done for the April 2009 NOPR 74 FR 16920, 16957 (April 13, 2009). Because DOE received no comments on its commercial and industrial sector discount rates and all sources used remain the most current sources available, for this final rule, DOE has continued to use discount rates of 7.0 percent and 7.6 percent for the commercial and industrial sectors, respectively.

8. Residential Fluorescent Lamp Analysis

In the April 2009 NOPR, DOE produced a residential sector GSFL life-cycle cost and payback period analysis based upon measure life reports that indicated an average residential GSFL fixture lifetime of 15 years. 74 FR 16920, 16956 (April 13, 2009). Under average operating hours (791 hours per year), DOE determined that a 4-foot MBP lamp would live approximately 19 years. In the April 2009 NOPR LCC analysis, DOE assumed that consumers would discard their lamps during fixture replacement, effectively ending the life of the lamps, thus resulting in no lamp-only replacements in the residential sector under average operating hours. The 2.5-year analysis period used by DOE for the residential GSFL lamp failure events represented DOE's belief that under high operating hours (1,210 hours per year), if a baseline lamp and fixture were purchased at the same time, the baseline lamp would fail after approximately 12.5 years and the fixture would be replaced 2.5 years after the lamp failure (for a total fixture life of 15 years). Thus, after a lamp failure, the replacement lamp would have 2.5 years in which to operate before the fixture is replaced. DOE's analysis period for calculating the LCC savings for residential consumers responding to a lamp failure was therefore 2.5 years.

Both Southern California Edison and the California Stakeholders commented that the 2.5-year analysis period utilized by DOE in the NOPR to model the residential GSFL lamp failure events is too short and that the energy savings should be considered over the full life of the replacement lamp, in other words 12.5 years. In their suggested revisions to the LCC analysis, the stakeholders imply that upon fixture replacement, consumers will retain their previously-installed replacement lamp and reinstall it on a new fixture. According to the comments, analyzing such a scenario under high operating hours results in significant life-cycle cost savings for the residential lamp failure event when consumers are forced to retrofit their T12 systems with T8 systems. (Southern California Edison, No. 53 at p. 1–7; California Stakeholders, No. 63 at p. 9)

DOE acknowledges that in the residential sector, consumers may choose to preserve a lamp instead of discarding it upon fixture replacement, though in its research, DOE was unable to determine which situation was more likely. DOE recognizes that retaining a lamp beyond the fixture or ballast life would extend the useful lamp life, and, thus, the analysis period. Modeling this scenario would take into account operating cost savings over a longer period of time and additional equipment costs to the consumer, who in the base case is replacing their T12 lamp and will need to purchase a new ballast at some point in the future. Therefore, for this final rule, DOE has analyzed an additional scenario in the residential sector LCC analysis modeling this preservation of lamp behavior. This analysis shows that some residential consumers with T12 systems do in fact obtain LCC savings when forced to retrofit their T12 ballast with a T8 system. However, DOE also notes that the results of this analysis are highly dependent on the remaining years of lifetime left on the T12 ballast when the lamp is replaced. DOE presents the LCC results for this additional scenario in section VII.C.1.a of this final rule as well as in chapter 8 and appendix 8B of the TSD.

In contrast to Southern California Edison and the California Stakeholders who implied that DOE's analysis understated the consumer economic savings to the residential sector of retrofitting from a T12 to T8 system, GE commented that such a retrofit presents a best-case estimate of a 50-year payback period, and, therefore, is not economically justified. (GE, No. 80 at pp. 1–3; GE, Public Meeting Transcript, No. 38 at p. 81)

While DOE acknowledges that the standards presented in this final rule place some burden on some residential T12 GSFL users, DOE believes that the LCC analysis performed for this final rule accurately reflects this burden. DOE notes that as discussed below, payback period calculations do not account for expenses incurred by consumers who purchase new fixtures in the middle of the analysis period. In addition, DOE notes that the assumptions of electricity prices, labor rates, system energy savings, and operating hours that GE used to produce the payback estimate in its written comment do not align with the inputs that DOE presented in the April 2009 NOPR and updated for this final rule. DOE recognizes that there may be some variability in these inputs, but believes that DOE estimates represent those experienced for the average consumer. In addition, DOE notes that it did not receive specific adverse comments on these inputs themselves.

9. Rebuttable Payback Period Presumption

The payback period (PBP) is the amount of time it takes a consumer to recoup the assumed incremental costs of a more-efficient product through lower operating costs. In the April 2009 NOPR and today's final rule, DOE used a ''simple'' PBP, so named because the PBP does not take into account other changes in operating expenses over time or the time value of money. 74 FR 16920, 16957–58 (April 13, 2009). As inputs to the PBP analysis, DOE used the total installed cost of the product to the consumer for each efficacy level, as well as the first year annual operating costs for each efficacy level. The calculation requires the same inputs as the LCC, except for energy price trends and discount rates; only energy prices for the year the standard takes effect (2012 in this case) are needed.

At the public meeting, Earthjustice commented that there is a presumption that an energy conservation standard is economically justified if the payback period of products that comply with the standard is less than three years. (Earthjustice, Public Meeting Transcript, No. 38.4 at pp. 186–187) Earthjustice further stated that DOE did not calculate a rebuttable presumption payback period for each trial standard level presented in the April 2009 NOPR and that DOE cannot ignore the rebuttable presumption payback period out of preference for the seven-factor test described in 42 U.S.C. 6295(o)(2)(B)(i). ACEEE similarly commented in writing that ''[a] higher burden of proof is required to overcome the rebuttable presumption.'' (Earthjustice, No. 60 at p. 6; ACEEE, No. 76 at p. 6) DOE is aware of the rebuttable presumption payback period test in 42 U.S.C 6295(o)(B)(iii), which states that ''[i]f the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy * * * savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure, there shall be a rebuttable presumption that such standard level is economically justified.'' While DOE acknowledges that the rebuttable presumption payback period computation can have value, DOE emphasizes that the presumption is rebuttable, specifically because DOE is required by law to consider the specific criteria in 42 U.S.C. 6295(o)(2)(B)(i) when prescribing new standards, such as impacts on utility, competition, and the Nation as a whole. Thus, DOE's analyses of these criteria serve to either support or rebut any initial determination that a standard is economically justified based on the rebuttable payback period presumption. There is no statutory provision that requires DOE to emphasize the rebuttable presumption payback period test over the specific criteria that must be considered according to 42 U.S.C. 6295(o)(2)(B)(i); thus, DOE disagrees that ''[a] higher burden of proof is required to overcome the rebuttable presumption.'' There is also no statutory requirement for DOE to present a single rebuttable presumption payback period for each trial standard level. DOE has conducted the full set of economic analyses required by 42 U.S.C. 6295(o)(B)(i) for this final rule. The results of this analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level.

The payback periods shown in chapter 8 and appendix 8B of the final rule TSD are ''simple payback periods'' computed using the same methodology that would be utilized to compute payback periods for a rebuttable presumption payback period test; DOE's seven-factor analysis serves to confirm or rebut any assumption of economic justification based on payback periods that are shorter than three years. DOE stresses, however, that there are several factors for which the LCC analysis accounts, but the payback period analysis does not. For example, the LCC analysis includes financing effects and utilizes energy costs that vary over time. In addition, DOE notes that the simple payback period values computed for some lamp purchase events and scenarios do not fully express the equipment costs experienced by consumers in these scenarios. Payback period calculations take into account only the installed costs incurred at the very beginning of the analysis period. Thus, the calculation excludes the economic impacts of any additional costs (*e.g.*, a new ballast purchase, recycling costs) that may be incurred in the middle or at the end of the analysis period. For these reasons, DOE believes that the LCC analysis and other analyses performed for this final rule serve as a higher-fidelity assessment of economic impacts than the computation of payback periods alone. In other words, the LCC results serve to support or rebut the results of the PBP analysis. Therefore, DOE is continuing to utilize these higher-fidelity analyses as a definitive evaluation of the economic impacts of the standards presented and chosen in this final rule.

D. National Impact Analysis—National Energy Savings and Net Present Value Analysis

DOE's NIA assesses the national energy savings (NES) and the national net present value (NPV) of total customer costs and savings that would be expected to result from new standards at specific efficacy levels.

For the final rule analysis, DOE used the same spreadsheet model (with updated inputs as discussed below) described and used in the NOPR to calculate the NES and NPV based on the annual energy consumption and total installed cost data employed in the LCC analysis. 74 FR 16920, 16958–71 (April 13, 2009). DOE forecasts energy savings, energy cost savings, equipment costs, and NPV for each product class from 2012 through 2042. The forecasts provide annual and cumulative values for all four output parameters. DOE also examines impact sensitivities by analyzing various lamp shipment scenarios (such as Roll-up and Shift).

To arrive at these output parameters, DOE first develops a base-case forecast for each analyzed lamp type. This forecast characterizes energy use and consumer costs (lamp purchase and operation) in the absence of new or revised energy conservation standards. To evaluate the impacts of such standards on these lamps, DOE compares this base-case projection with projections characterizing the market if DOE were to promulgate new or amended standards (*i.e.*, the standards case). In characterizing the base and standards cases, DOE considers historical shipments, its shipment projections, emerging technologies, the mix of efficacies sold in the absence of any new standards, and how that mix might change over time. Inputs and issues associated with the NIA and any changes made in this final rule are discussed in more detail immediately below.

1. Overview of NIA Changes in This Notice

Based on the comments it received regarding the April 2009 NOPR, DOE made a number of changes to the NIA. Table V.5 summarizes the approach and data DOE used to derive the inputs to the NES and NPV analyses for the April 2009 NOPR, as well as the changes it made for this final rule in response to comments and updated information. As demonstrated by the table, DOE changed several inputs due to the availability of updated sources. For example, DOE updated projected electricity prices from EIA's *AEO2008* estimates to *AEO2009.* In addition, DOE calculated new annual marginal site-to-source conversion factors based on the version of the National Energy Modeling System (NEMS) that corresponds to *AEO2009.* Following the table, DOE details additional inputs and changes, and summarizes and responds to each of the NIA-related comments it received at the public meeting and in written comments. *See* TSD chapters 10 and 11 for further details.

TABLE V.5—APPROACH AND DATA USED TO DERIVE THE INPUTS TO THE NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE ANALYSES

Inputs	April 2009 NOPR description	Changes for the final rule
Shipments	Annual shipments from shipments model	*See* Table V.6 and Table V.7.
Effective date of standard	2012	No change.
Analysis period	2012 to 2042	No change.

TABLE V.5—APPROACH AND DATA USED TO DERIVE THE INPUTS TO THE NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE ANALYSES—Continued

Inputs	April 2009 NOPR description	Changes for the final rule
Unit energy consumption (kWh/yr).	Established in the energy-use characterization, TSD chapter 6, by lamp or lamp-and-ballast design and sector.	Residential operating hours updated based on RECS 2005 (from RECS 2001).
Total installed cost	Established in the product price determination, TSD chapter 7 and the LCC analysis, chapter 8, by lamp-and-ballast designs.	No change.
Electricity price forecast	Based on *AEO2008* forecasts (to 2030) and an extrapolation for beyond 2030. (See TSD chapter 8).	Updated for *AEO2009* (used version informed by impacts of the American Reinvestment and Recovery Act).
Energy site-to-source conversion.	Conversion varies yearly and was generated by DOE/EIA's NEMS program (a time-series conversion factor; includes electric generation, transmission, and distribution losses). Conversion factors for beyond 2030 are held constant.	Updated for *AEO2009* (used version informed by impacts of the American Reinvestment and Recovery Act).
HVAC interaction savings	6.25% of total energy savings in all sectors	No change.
Rebound effect	1% of total energy savings in the commercial and industrial sectors. 8.5% of total energy savings in the residential sector.	No change.
Discount rate	3% and 7% real	No change.
Present year	Future costs and savings are discounted to 2007	Future costs and savings are discounted to 2009.

2. Shipments Analysis

Lamp shipments are an important input to the NIA. In the April 2009 NOPR, DOE explained how it developed separate shipment models for GSFL and IRL. 74 FR 16920, 16959–70 (April 13, 2009). In general, to forecast shipments for these two categories of lamps, DOE followed a four-step process. First, DOE used 2001-to-2005 historical shipment data from NEMA and other publicly-available sources to estimate the total historical shipments (*i.e.*, NEMA member and non-NEMA member shipments) of each lamp type analyzed. Second, based on these historical shipments and the average service lifetime of each lamp type, DOE calculated the installed stock of lamps for each lamp type in 2005. Third, by modeling lamp purchasing events, and applying growth rate, replacement rate, and emerging technologies penetration rate assumptions, DOE developed annual shipment projections from 2006 to 2042. (NEMA had not provided publically-available data for years after 2005). Specifically, DOE modeled lamp (and ballast for GSFL) shipments based on four lamp-purchasing market events: (1) New construction; (2) ballast failure (GSFL only); (3) lamp replacement; and (4) standards-induced retrofit (for the standards case). DOE also calibrated its shipments model to reflect confidential shipment data provided by NEMA for 2006 and 2007. Finally, because the shipments of lamp designs and lamp-and-ballast designs (for GSFL) often depend on their properties (*e.g.*, ballast factor and efficacy), DOE developed base-case and standards-case market-share matrices as another model input. The market-share matrices characterize the efficacy, power rating, light output, and lifetime of the lamp and lamp-and-ballast designs. The matrices input the percentage market share of each design into the shipment model. DOE used these market-share matrices to forecast lamp stock and shipments, taking into account each design's respective lifetime.

Table V.6 and Table V.7 summarize the approach and data DOE used for GSFL and IRL, respectively, to derive the inputs to the shipments analysis for the April 2009 NOPR, as well as the changes DOE made for the final rule. A discussion of comments DOE received on these inputs and of the changes implemented for the final rule follows.

TABLE V.6—APPROACH AND DATA USED TO DERIVE THE INPUTS TO GSFL SHIPMENTS ANALYSIS

Inputs	2009 NOPR description	Changes for the final rule
Historical shipments	2001–2005 shipment data provided publicly by NEMA (except for T5 lamps; see NOPR TSD chapter 10). Assumed NEMA data represented 90 percent of GSFL shipments. Calibrated 2006–2007 forecasted shipments based on confidential historical shipment data NEMA provided for those years.	No change.
Lamp inventory	Calculated stock in 2005. Then used growth, emerging technologies, and shipment assumptions to establish lamp inventory from 2006 to 2042.	No change.
Growth	Based commercial and residential growth on *AEO2008* estimates for future floor space growth. For the residential sector, modeled variations in number of lamps per new home. For the industrial sector, projected floor space growth using the 2002 Manufacturer Energy Consumption Survey (MECS 2002).	Updated commercial and residential growth for *AEO2009* (used version informed by impacts of the American Reinvestment and Recovery Act).
Base-case scenarios	Developed two base-case scenarios, one of which modeled the market penetration of LEDs based on projected payback period.	Updated LED prices and performance projections for DOE's Solid State Lighting Research and Development Multi-Year Program Plan FY'09–FY'15.

TABLE V.6—APPROACH AND DATA USED TO DERIVE THE INPUTS TO GSFL SHIPMENTS ANALYSIS—Continued

Inputs	2009 NOPR description	Changes for the final rule
Market-share matrices	Developed product distributions based on comments, interviews, and catalog research. Matrices apportion a share of shipments for each lamp-and-ballast design option.	Revised product distributions based on comments, NEMA survey data and further research.
Standards-case scenarios	Considered two sets of scenarios to characterize consumer behavior in response to standards: the Shift and Roll-up scenarios and the High and Market Segment-Based Lighting Expertise scenarios.	No change

TABLE V.7—APPROACH AND DATA USED TO DERIVE THE INPUTS TO IRL SHIPMENTS ANALYSIS

Inputs	2009 NOPR description	Changes for the final rule
Historical shipments	2001–2005 shipment data provided publicly by NEMA. Assumed NEMA data represented 85 percent of IRL shipments. Calibrated 2006–2007 projected shipments based on confidential historical shipment data NEMA provided for those years.	Received additional historical shipments (2004–2008) from NEMA with which DOE verified growth, projected shipments, and emerging technologies assumptions.
Lamp inventory	Calculated stock in 2005 based on average lifetime and historical shipments. Then used growth, replacement rate, and emerging technologies assumptions to establish lamp inventory from 2006 to 2042.	No change.
Growth	Shipment growth driven by socket growth. Socket growth based on *AEO2008* estimates for future commercial floor space and residential buildings. Also accounted for trend of increasing sockets per home.	Updated for *AEO2009* (used version informed by impacts of the American Reinvestment and Recovery Act).
Base-case R–CFL and emerging technologies.	Developed two base-case scenarios modeling the market penetration of light emitting diodes (LEDs), ceramic metal halides (CMH), and reflector compact fluorescent lamps (R-CFL) based on projected payback period.	Updated LED prices and performance projections for DOE's Solid State Lighting Research and Development Multi-Year Program Plan FY'09–FY'15.
Market-share matrices	Considered mix of technologies consumers select in the base case and standards case, as well as each of the scenarios analyzed.	No change.
Standards-case scenarios	Modeled both Roll-up and Shift scenarios.	
	Revised BR lamp sensitivity scenario, creating two new standards-case scenarios also accounting for additional migration to R–CFL: "Product Substitution" and "No Product Substitution."	Modeled migration to only exempted BR lamps in the new "BR Product Substitution" scenario, which replaced the "No Product Substitution" scenario. Modeled migration to only R–CFL in the new "R–CFL Product Substitution," which replaced the "Product Substitution" scenario. Added the "Baseline Lifetime" scenarios modeling sale of lamps with lifetimes similar to the baseline lamps in the standards case. (See section VI.C)

3. Macroeconomic Effects on Growth

In the April 2009 NOPR, as part of its shipments forecasts, DOE established commercial floor space and residential buildings growth based on *AEO2008.* Because *AEO2008* does not provide industrial floor space forecasts, DOE used historical MECS floor space values to establish a growth rate for the industrial sector. 74 FR 16920, 16961 (April 13, 2009). OSI stated that growth will be subject to economic shocks over time, and pointed to the current decline in the commercial market as evidence to that fact. (OSI, Public Meeting Transcript, No. 38.4 at p. 213–214) Southern California Edison commented that DOE should look at past economic dislocations to better forecast lamp shipments through 2042. (Southern California Edison, Public Meeting Transcript, No. 38.4 at p. 214) The California Stakeholders urged DOE not to change its NIA assumptions with respect to the recent macroeconomic downturn reasoning that such a modification would add no value to DOE's analysis because no one can accurately predict the timing and extent of an economic recovery. An attempt by DOE to do so would unduly burden its efforts to publish a final rule by the deadline. (California Stakeholders, No. 63 at p. 8)

While DOE agrees that future shipments will be subject to general economic shocks over time, DOE believes there is no practical way of projecting the timing of those shocks throughout the analysis period. DOE's projections (of sockets and thus shipment growth) incorporate *AEO2009*'s assumption of average gross domestic product (GDP) growth of 2.5 percent annually. That is consistent with historical growth, which has averaged 2.85 percent annually over the last 30 years, covering both recessionary and expansionary cycles.[30] Because of this consistency with historical trends and the incorporation of future economic growth considerations, DOE believes its approach of using *AEO*'s projections is superior to extrapolating from specific historical economic events.

[30] National Economic Accounts, Bureau of Economic Analysis, U.S. Department of Commerce (Last accessed on Feb. 28, 2009). Available at: *http://www.bea.gov/national/nipaweb/Index.asp.*

4. Reflector Market Growth

To establish IRL shipment forecasts in the April 2009 NOPR, DOE first modeled the projected growth in the total reflector lamp market. To do this, DOE utilized the year-to-year commercial floor space and residential building growth projections in *AEO2008.* DOE also accounted for a trend toward more fixtures in new and renovated homes. To do this, DOE obtained historical California data[31] on recessed cans per home, categorized by home age. Using this data, DOE estimated the average number of recessed cans per home to grow from 4.82 in 2005 to 8.52 in 2042. To estimate the growth rate in each year, DOE multiplied this growth in the number of recessed cans in homes by the projected stock of homes according to *AEO2008.* Combining these two sources, DOE predicted an average growth rate of sockets of 2.6 percent between 2006 and 2042. 74 FR 16920, 16961 (April 13, 2009).

In response to DOE's shipment forecasts, NEMA commented that DOE's stated average annual growth rate of 2.6 percent for IRL was not realistic. NEMA also provided additional historical IRL shipment data from 2004 to 2008 that show shipments of PAR38 lamps decreasing approximately 8 percent per year and shipments of PAR30 and PAR20 lamps only marginally increasing. (NEMA, No. 81 at p. 14–15) In response, DOE notes that the 2.6 percent growth rate in sockets presented in the April 2009 NOPR does not represent growth in overall IRL shipments. DOE used that growth in sockets and then applied varying penetrations of non-IRL technologies into those sockets to determine IRL shipment forecasts, as discussed in section V.D.5. In fact, after accounting for these non-IRL technologies, DOE's resulting 2004 to 2008 IRL shipments decline at a rate consistent with NEMA's historical shipments.

At the NOPR public meeting, EEI commented that data from RECS show that California homes historically have been smaller than the national average. Therefore, using the California study as a proxy for the nation as a whole may not be appropriate. Additionally, in recent years, EEI stated that new U.S. homes have stopped growing in terms of average floor space. EEI suggested that DOE research other State studies and regional studies from the National Association of Home Builders to obtain more values for growth rates of lighting fixtures. Philips agreed and stated a preference for much more pessimistic IRL growth projections than those used by DOE, due to the economic slowdown, houses getting smaller, and the penetration of CFLs and other emerging technologies. (EEI, Public Meeting Transcript, No. 38.4 at p. 196; Philips, Public Meeting Transcript, No. 38.4 at p. 197; EEI, No. 38.4 at pp. 3,4)

In response, DOE agrees that RECS data shows that the average home in California is smaller than the average home in the U.S. However, that fact does not mean DOE's extrapolation of the California trend (showing increasing number of light sources per home) to the nation is inappropriate. As discussed above and in TSD chapter 10, DOE used the growth rate of sockets per California home as an input into its national shipment projections, not the absolute number of sockets per home. It is the growth in the size of California homes relative to the growth of all U.S. homes that is important to the analysis, not the absolute size of the homes. Therefore, as long as the floor space growth rate of new homes in California is consistent with rest of the country, the trend toward more sockets in California is applicable in this instance to the country as a whole. To that point, Census data from 1973 to 2008 show that average floor space of new homes in the West has grown at roughly the same rate as in the nation overall—1.11 percent versus 1.20 percent. Therefore, DOE believes the application of the California data to the rest of the country is appropriate in this instance and has not changed its methodology for the final rule.

With regard to the comment that homes are no longer growing in size, DOE's analysis of census housing data shows positive annual single-family home floor space growth in each year from 1994 to 2007. In 2008, the overall U.S. average did indeed decline by 0.5 percent. However, while year-to-year average growth has varied over 35 years, the long-term trend is clearly upward—as mentioned above, the average floor space of new homes has grown at a compounded annual rate of 1.2 percent since 1973. *AEO2009* projections for average residential square footage, which incorporate macroeconomic effects, also predict a long-term trend of positive floor space growth. Therefore, DOE believes projecting continued growth in the number of sockets per home is appropriate and has not changed its methodology for the final rule. This enables DOE to continue to use *AEO* forecasts, which capture macroeconomic conditions—as many comments have urged DOE to do—in its socket and shipment growth projections. With regard to the comment suggesting DOE obtain more regional housing data, DOE notes that *AEO2009* projections for residential housing stock growth are based off Census data on the nine Census Divisions. *AEO* projects housing stocks separately for each Census Division. Given the purposes of this analysis and the nationwide applicability of standards, DOE believes this methodology incorporates a sufficient level of geographic granularity.

5. Penetration of R–CFLs and Emerging Technologies

As discussed in more detail in the April 2009 NOPR (74 FR 16920, 16962–63 (April 13, 2009)) DOE developed and analyzed two base-case shipment scenarios for IRL that estimated varying penetrations of non-IRL technologies into the reflector market. For the Existing Technologies scenario, DOE only considered the market penetration of technologies that are currently readily available and have reached maturation in terms of price and efficacy, namely R–CFL. In the Emerging Technologies scenario, DOE attempted to forecast the market penetration of mature technologies *and* those technologies that are still undergoing significant changes in price and efficacy. Specifically, DOE considered the market penetration of R–CFL, LED lamps, and CMH lamps in the Emerging Technologies scenario. Because the lamps employing emerging technologies are beyond the scope of the rulemaking, DOE did not consider them design options for improving IRL or GSFL efficacy. Instead, DOE considered these technologies potential substitutes for the lamps covered in this rulemaking. DOE assumed that the price of emerging technologies relative to covered technologies is related to the likelihood that a consumer will buy an emerging technology instead of a covered lamp.

DOE developed price, performance, and efficacy forecasts for each of the analyzed R–CFL and emerging technologies. For the LED forecasts, DOE used data from its Solid State Lighting Multi-Year Program Plan. (For this final rule, DOE updated its LED forecasts for DOE's latest Multi-Year Program Plan.)[32] With these inputs, DOE calculated the payback period (PBP) of each technology in the relevant

[31] RLW Analytics, Inc., ''California Statewide Residential Lighting and Appliance Efficiency Saturation Survey'' (August 2005) (Last accessed on Sept. 29, 2008). Available at: *www.calresest.com/docs/2005CLASSREPORT.pdf.*

[32] Multi-Year Program Plan FY'09 to FY'15: Solid-State Lighting Research and Development (March 2009). Available at: *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_mypp2009_web.pdf.*

sector using the difference between its purchase price, annual electricity cost, and annual lamp replacement cost relative to the lamp it replaces. (See TSD chapter 10 for further details.) DOE then used a relationship between PBP and market penetration to predict the market penetration of each technology in the relevant sector in every year from 2006 to 2042. DOE received several comments on how it estimated R–CFL and emerging technologies penetrations into the IRL market, as discussed below.

At the public meeting, EEI commented that dimmable CFLs could dramatically impact IRL growth if the dimmable technology improves. (EEI, Public Meeting Transcript, No. 38.4 at p. 202) In contrast, ADLT commented that DOE overestimated the penetration of R–CFLs in the commercial market in its April 2009 NOPR analysis. ADLT stated that many commercial lighting applications require directional lighting for which R–CFLs are ineffective. (ADLT, No. 72 at p. 5)

In response to EEI's comment, DOE agrees that enhanced utility features of various emerging technologies may change the rate at which they are adopted. DOE also acknowledges that there is considerable uncertainty in predicting the penetration of non-IRL technologies into the IRL market. It is for this very reason that DOE models two base-case scenarios that encompasses a large range of potential penetrations. DOE believes that its Emerging Technologies forecast adequately captures the effects of any increased penetration of R–CFLs through advances in dimming technology. As discussed in TSD chapter 10, based on payback period calculations, in the Emerging Technologies forecast, DOE predicts that R–CFLs will have a significant impact on IRL shipments only in the first few years of the analysis period. Thereafter, LEDs, which have dimming capability (and thus can provide the utility at issue in the comment), become more cost-effective and dominate the emerging technologies forecast, despite any potential future improvement in R–CFL dimming capabilities.

With regard to ADLT's comment, DOE recognizes that there are several qualities of R–CFLs (such as form factor, beam spread, color quality, directionality, and dimming capability) which may result in consumers' unwillingness to purchase them for IRL applications. DOE has attempted account for these factors by reducing the penetration of R–CFLs by approximately 40 percent relative to the penetrations predicted by the payback period-penetration calculations. However, considering the significant uncertainty regarding these penetrations, DOE verified its R–CFL penetration by comparing its modeled shipments from 2005 to 2008 to NEMA's historical shipments. As discussed earlier, DOE found that during this time period, the rate of decline in historical IRL shipments (which is primarily due to R–CFL penetration) is consistent with DOE's modeled shipments. For this reason, DOE does not feel it necessary or that there is an analytical basis and data to modify its R–CFL penetration estimates.

Pertaining to the Emerging Technology forecasts, NEMA commented that the April 2009 NOPR analysis incorrectly projected IRL shipments to increase after reaching a minimum level. NEMA asserted that DOE should remodel its expected energy savings with a continued decline in IRL shipments after 2024. (NEMA, No. 81, p. 15) DOE believes that its IRL forecasts are reasonable. As emerging technologies continue to improve and their prices continue to decrease, DOE agrees that IRL shipments will further decline as market share shifts from IRL to LED. However, as these emerging technologies reach maturation, DOE believes that their relative market share will stabilize, consistent with their mature cost and performance features. Thus, as the total number of reflector lamp sockets continues to increase (due to new construction), it is reasonable to predict that IRL shipments will experience a moderate increase as well. However, as DOE acknowledges that there is considerable uncertainty regarding its forecasts, DOE performed a sensitivity analysis for the Emerging Technologies scenario in which IRL shipments continue to decline until emerging technologies reach a maximum market penetration, which is upheld for the rest of the analysis period. This sensitivity analysis results in approximately a 6 percent decrease in energy savings over the analysis period.

6. Building Codes

In response to the April 2009 NOPR, GE commented that increasingly-stringent building codes will most likely be phased in over time, causing IRL growth to slow and decline. (GE, Public Meeting Transcript, No. 38.4 at pp. 205–206) EEI also stated that the most recent model building codes would have an effect on lighting technologies and efficiencies. EEI added that the 2009 International Energy Conservation Code (IECC) for residential construction calls for 50 percent of lighting to be high-efficiency. Once DOE certifies the IECC, EEI stated, States have one year to update their codes to meet or exceed the IECC 2009, which will alter the growth of IRL. (EEI, Public Meeting Transcript, No. 38.4, pp. 206–207, 315; EEI, No. 45 at pp. 5–6).

In response, to evaluate the effects of more-stringent building codes being phased in over the analysis period, DOE identified and evaluated three of the most influential building codes across the country. These included: (1) California's Title 24,[33] which is mandatory in the State; (2) the latest International Energy Conservation Code (IECC 2009), which is a model energy code and which some States voluntarily incorporate by reference into their building codes, and (3) *ASHRAE/IESNA Standard 90.1–2004.* Each code has sections that pertain to residential and commercial lighting. For example, IECC 2009 requires that high-efficacy light bulbs be installed in at least 50 percent of permanent lighting fixtures in new residential homes. ''High-efficacy'' is defined as:

''A lighting fixture that does not contain a medium screw base socket (E24/E26) and whose lamps have a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts,
2. 50 lumens per watt for lamps over 15 watts to 40 watts,
3. 40 lumens per watt for lamps 15 watts or less.'' [34]

The California Building Standards Code (Title 24) requires that all luminaires that are permanently installed via new construction, alterations, or additions (including replacements) be high-efficacy. Title 24's definition of ''high-efficacy'' is very similar to that in IECC 2009.

DOE also researched *ASHRAE/IESNA Standard 90.1–2004,* a commonly-referenced code for commercial buildings. Although it rarely references lumen-per-watt metrics directly, the code does impose lighting power density requirements and requires controls for many building types and sizes, while providing various allowances and exemptions for many applications.

When evaluating how such codes will affect lamp shipments, it is important to note that DOE does not have the authority to mandate that States enact

[33] California Energy Commission, ''Residential Compliance Manual For California's Energy Efficiency Standards,'' Chapter 6 (April 2005) (Last accessed: June 18, 2009). Available at: *http://www.energy.ca.gov/2005publications/CEC-400-2005-005/chapters_4/q/6_Lighting.pdf.*

[34] International Code Council, ''International Energy Conservation Code: Excerpt From the 2007 Supplement'' (July 2007) (Last accessed: June 18, 2009). Available at: *http://www.iccsafe.org/cs/codes/2007-08cycle/2007Supplement/IECC07S.pdf.*

residential building codes, as EEI suggested (although for commercial codes DOE can require the adoption of a certain code it determines will improve the energy efficiency of the nation's commercial building stock). (42 U.S.C. 6833(b)(2)(A)) To clarify, EPCA requires DOE to determine whether updates to IECC's residential energy efficiency code will improve the energy efficiency of the nation's residential housing stock. When DOE makes such a positive determination, States are required to review (but not necessarily adopt) the energy provisions of the code and to determine whether it would be appropriate to revise residential building codes to meet or exceed the model code on which DOE made a positive determination. (42 U.S.C. 6833(b)(1)). States must complete their review within two years of DOE's positive determination. Given a variety of policy considerations and the absence of a direct mandate under EPCA that States adopt such building codes, currently, the stringency of residential codes adopted varies widely throughout the country.[35] The most recent and stringent codes are not necessarily adopted by States. Furthermore, in some States, local governments have authority over their building codes (known as ''Home Rule''), making it even more likely that the stringency of building codes will vary widely throughout the country. For these reasons, DOE does not believe that it should explicitly assume that new, more stringent codes will necessarily be adopted, implemented, and enforced. Furthermore, building codes are informed by product capabilities, IESNA recommended light levels, and lamp and ballast efficiencies, rather than vice versa. With that said, however, while not a driver of development of more efficient technology, DOE agrees that increasingly-stringent residential building codes are likely to contribute to a greater share of shipments being higher-efficacy lamps by the end of the analysis period as compared to the start of the period. Consistent with this trend, DOE's market share matrices show migration to higher-efficacy lamps in the base case, which allow for the effects of more-energy-efficient building codes, although DOE did not directly analyze those effects. *See* chapter 10 of the TSD for the full market-share matrices in 2012 and 2042.

7. GSFL Shipments Growth

NEMA also commented on several aspects of the GSFL shipment forecasts. NEMA commented that DOE should forecast shipments that account for a migration to GSFL with longer lifetimes. NEMA argued that this phenomenon, currently occurring through both the increased shipments of T8 lamps relative to T12 lamps and through a movement from short-life T8 lamps to long-life T8 lamps, will result in a decline of overall GSFL shipments. NEMA stated that such an effect would materially affect DOE's economic justification of GSFL standard levels. (NEMA, No. 81 at p. 14) In response to NEMA's concern, DOE agrees that it is important to account for the economic effects of consumers purchasing longer-life GSFL and has done so. In its NOPR analyses and in chapter 11 of the TSD, DOE has fully accounted for this migration toward longer-life lamps in its calculations of consumer equipment costs and industry revenues, which are inputs into its calculations of NPV and INPV. According to the NIA model, the average commercial sector 4-foot MPB T8 shipped in 2012 has a lifetime of approximately 6 years; in 2042, the average lifetime is approximately 7 years.

NEMA also commented that DOE overlooked the trend toward more lighting controls and occupancy sensors in the commercial sector and, therefore, did not account for this effect in slowing shipment growth and reducing potential energy savings. NEMA asserted that this highlights the flaw in the current rulemaking approach (*e.g.,* considering lamps instead of lighting systems). (NEMA, No. 81 at p. 14)

In response, DOE researched the issue of lighting controls and how their deployment may affect the potential energy savings from more-efficient lamps. DOE agrees that lighting controls are penetrating the commercial buildings sector and as these technologies advance, building managers seek to control costs, and more recent commercial building energy codes are adopted. DOE's research suggested this trend is almost entirely in the new construction and major renovation market segments. A 2003 study suggested such controls are already common to roughly 60 percent of newly-constructed commercial square footage.[36] DOE has determined that the impacts of lighting controls are captured by the operating-hours data derived from CBECS and employed in DOE's analysis. However, as NEMA pointed out, given the additional time for the continued market penetration of these controls throughout the analysis period and the fact that buildings larger than 5,000 square feet require automatic shutoff controls to be in compliance with the most recent versions of the most referenced energy codes,[37] higher penetration rates are possible in the future. Therefore, to evaluate the potential increased penetration of lighting controls, DOE conducted a sensitivity analysis in which it estimated that all new commercial building floor space after 2012 featured automated lighting controls, such as occupancy sensors and scheduling systems.

Next, DOE estimated the reduced operating hours due to these lighting controls based on industry references. A Lighting Research Center study on savings potential from occupancy sensors found a range of 17 percent to 60 percent, depending on the application and tenant behavior.[38] This finding was in line with other industry estimates. For its analysis, DOE assumed the midpoint of these findings (38.5 percent) as the energy savings achieved by new commercial buildings employing lighting controls. DOE then reduced commercial operating hours by the product of the energy savings, increase in commercial square footage with lighting controls, and the average proportion of the lighting market serving newly-constructed commercial buildings over the analysis period. Based on these inputs, DOE calculated approximately a 0.5 percent decline in national energy savings and an average reduction in shipments of 0.5 percent over the analysis period. Although this reflects a relatively small impact, DOE considered this information in weighing the economic justification of the final rule. See TSD chapter 11 for more details on the lighting controls sensitivity analysis.

8. Residential Installed GSFL Stock

In the April 2009 NOPR, DOE allotted a portion of the 4-foot MBP installed stock in 2012 to the residential sector. To model this, DOE chose the representative system as a 40W T12, 4-foot MBP lamp on a magnetic low-ballast-factor ballast. 74 FR 16920, 16942–16943 (April 13, 2009). DOE

[35] *See: http://www.energycodes.gov/implement/state_codes/index.stm.*

[36] DiLouie, Craig, ''Lighting Controls: Current Use, Major Trends and Future Direction,'' Lighting Controls Association (2003).

[37] *See,* for example, *http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/article/1566.* (Last accessed June 16, 2009).

[38] VonNeida, Bill; Maniccia, Dorene; Tweed, Alan, An Analysis of the Energy and Cost Savings Potential of Occupancy Sensors for Commercial Lighting Systems, Lighting Research Center and Environmental Protection Agency (August 2000).

received comments on its residential sector analysis for the GSFL NIA. These comments are discussed below.

NEMA stated that DOE's analysis overlooked the fact that a small portion of the residential installed base is already composed of T8 lamps, thereby resulting in an overstatement of energy savings. NEMA stated that fixture manufacturers have begun to sell more T8 fixtures for the residential sector and that one luminaire manufacturer reported sales in the sector are currently split evenly between T8 and T12 fixtures. (NEMA, No. 81 at p. 8)

DOE acknowledges that in there is some present migration to T8 lamps in the residential sector. However, DOE also believes that the vast majority of the installed GSFL stock in the residential sector is T12 lamps. This view was communicated in public meetings, comments, and manufacturer interviews, as noted in the April 2009 NOPR. 74 FR 16920, 16942 (April 13, 2009). For example, in earlier comments, NEMA stated that the residential sector is projected to use more than 75 percent of all 4-foot medium bipin T12 lamps sold by 2012 and this level would be expected to persist, given that the 2000 Ballast Rule allows continued use of the most common residential magnetic ballast. (NEMA, No. 21, at p. 20; OSI, Public Meeting Transcript, No. 20 at p. 276) DOE's estimates are roughly in line with this estimate. Furthermore, DOE's approach is consistent with a 2008 PG&E study that assumed, based on discussions with fixture manufacturers and distributors, all current residential fixtures were T12 systems.[39] Based on these comments, interviews, and its own research, DOE chose to analyze the 4-foot medium bipin T12 lamp as the representative system in the residential sector. Taken together, PG&E's study and the public comments DOE received do not compel a change in this approach. However, DOE does assume and account for rapid migration to T8 lamps in the residential sector in the base case, reflecting the trend noted by NEMA. For example, in the base case, DOE assumes the stock of 4-foot medium bipin T8 lamps in the residential sector will grow more than 10-fold in the first decade after the effective date, or roughly at a 28-percent compounded annual growth rate.

[39] ''Codes and Standards Enhancement (CASE) Initiative for PY2008: Title 20 Standards Development,'' *Analysis of Standards Options for Linear Fluorescent Fixtures* (Prepared for PG&E by ACEEE, Lighting Wizards, and Energy Solutions). (Last modified May 14, 2008)

Therefore, DOE has retained its methodology in this respect.

EEI commented that 34W T12 lamps are being sold now in hardware stores for the residential market, and, therefore, DOE should not assume that the entire residential market is composed of 40W T12 lamps. Southern California Edison commented that only about 25 percent of T12 lamps are 40W (DOE's baseline lamp) in California. On the other hand, GE commented that the overwhelming majority of GSFL in the residential market are 40W lamps. (EEI, Public Meeting Transcript, No. 38.4 at p. 222; Southern California Edison, Public Meeting Transcript, No. 38.4 at pp. 188–189; GE, Public Meeting Transcript, No. 38.4 at p. 189)

DOE acknowledges that some 34W T12 lamps may be sold to residential consumers. Therefore, DOE has revised its residential 4-foot T12 market-share matrix to reflect this effect. In addition, DOE revised its 4-foot T12 market-share matrices in both the commercial and residential markets to better reflect confidential manufacturer survey data, as it relates to triphosphor and halophosphor shipment categories. As a result of these two changes, DOE now assumes that in the 2012 base case, 8 percent of 4-foot T12 lamp shipments in the residential sector are 34W, and 92 percent are 40W (down from 100 percent in the April 2009 NOPR). Overall, for this final rule, DOE allocated 90 percent (up from 67 percent) of the commercial 4-foot T12 market to 34W lamps and 10 percent to 40W.

9. GSFL Lighting Expertise Scenarios

In the April 2009 NOPR, DOE considered two sets of standards-case scenarios for GSFL shipments: (1) Roll-up and Shift scenarios; (2) High and Market Segment-Based Lighting Expertise scenarios. 74 FR 16920, 16967–16968 (April 13, 2009). The Roll-up and Shift scenarios address the issue of whether consumers who currently purchase lamps with efficacies that exceed (not just meet) the minimum standard would be likely to shift to even higher efficacy lamps in the face of amended standards. These scenarios and the comments DOE received on them are described below. For further details on the scenarios DOE analyzed and developed, see TSD chapter 10.

For the April 2009 NOPR, DOE modeled the Lighting Expertise scenarios that analyzed the lamp and ballast purchase decisions consumers are likely to make when required to purchase higher-efficacy lamps. DOE analyzed these scenarios because how consumers respond to this situation could substantially affect the potential energy savings and NPV that will result from amended standards. For example, to maintain lumen output with a new higher-efficacy lamp, some consumers may select a reduced-wattage lamp to replace a less-efficacious predecessor. Others may simply replace the lamp with one of the same wattage, not make any other adjustments, and accept higher light output. For GSFL, which operate on ballasts, consumers may also choose to run the higher-efficacy lamps on lower-ballast-factor ballasts. To the extent that lower ballast factors (BF) can achieve the appropriate lumen output, DOE incorporated them into the technology choices facing consumers.

The Lighting Expertise scenarios estimate the extent to which consumers in the standards case may migrate to energy-saving, reduced-wattage lamps, or, when reduced-wattage lamps are not available or feasible, pair the new lamps with a lower-BF ballast (*i.e.*, ballast factor ''tuning''). With the results of this analysis, DOE developed two standards-case scenarios called the ''High'' and ''Market Segment-Based'' Lighting Expertise scenarios. This set of scenarios characterizes the likelihood consumers will maintain equivalent light output upon the purchase of a new higher-efficacy lamp or accept higher lighting levels. In the High Expertise scenario, consumers who can maintain lumen levels, do so. Conversely, in the Market Segment-Based scenario, DOE assumes only a percentage of consumers will have the expertise, based primarily on their market segment and purchase event, to make this energy savings decision.

In general, NEMA supported the modeling of the Market Segment-Based Lighting Expertise scenario as the more realistic outcome of amended energy conservation standards. NEMA stated that despite an increase in efficacy, triphosphor lamps (particularly those at TSL4 and TSL5) will not save consumers any energy, because the lamps will be the same wattage as those they replace (with consumers simply realizing higher lighting levels). (Philips, Public Meeting Transcript, No. 38.4 at pp. 253–254; GE, Public Meeting Transcript, No. 38.4 at pp. 256–7; NEMA, No. 81 at p. 19) NEMA also commented that original equipment manufacturer (OEM) sales data indicates that roughly 90 percent of OEM luminaires (used in the fixture replacement, renovation, and new construction markets), are shipped with ballasts with a normal ballast factor. Therefore, NEMA commented, DOE's estimate of consumers with high expertise for new construction and renovation in the commercial sector (69 percent and 78 percent, respectively) are likely overstated and should probably be closer to what it estimates for the fixture replacement (34 percent) market. (OSI, Public Meeting Transcript, No. 38.4 at pp. 233–235, NEMA, No. 81, pp. 15–16)

In response to the comments it received, DOE conducted further research and interviews on this issue. Specifically, DOE reevaluated its assumptions based on confidential sales channel data on instant-start electronic T8 ballast sales that DOE received. The data were categorized by ballast type (standard or high-efficiency), ballast factor, and sales channel. OEM sales, which represent ballasts generally sold to fixture manufacturers, best match the fixture replacement, renovation, and new construction purchase events in DOE's analysis.

While the OEM sales data suggest, as NEMA noted, that most ballasts shipped for new fixtures have normal ballast factors, DOE does not believe such a distribution will necessarily characterize the lamp/ballast market in the standards case for the following reasons. First, the current distribution of ballast factors cannot be assumed to be predictive of the standards-case distribution. As more efficient lamps are introduced, a key variable—lumen output—in the utility of fixtures will have changed, all other things being equal. If, in the standards case, fixture OEMs were agnostic to ballast factor and continued to purchase the same distribution of high, normal, and low ballast factors, they would be altering and perhaps jeopardizing this utility the consumer derives from their product. Because fixtures are often designed and marketed for a typical lumen output, DOE does not believe it is likely that OEMs would be disinterested in the light output of their product in the standards case. This is reinforced by the emphasis on the cost of ownership estimates provided by fixture manufacturers in their specifications sheets and marketing materials. Given higher-efficacy lamps, DOE believes fixture manufacturers will continue to market energy savings as before, which will require pairing reduced-wattage lamps (if sold with the fixture) or low BF ballasts with their fixtures.

Next, discussions with fixture manufacturers and DOE's product research indicate fixture manufacturers have the flexibility to meet the demand of their end-users. There are no inherent substitutability issues that would pose obstacles in migrating from normal ballast factor to a low ballast factor. In interviews, fixture manufacturers communicated their desire and that of their customers to ''match'' lumens—*i.e.*, not over-light or under-light relative to the system being replaced. For example, one fixture manufacturers noted that it was common for them to replace three-lamp fixtures with two-lamp fixtures.

Manufacturers stated during the public meeting that the commercial sector is mostly characterized by a high level of lighting sophistication. (Philips, Public Meeting Transcript, No. 38.4 at pp. 239–240) For all of these reasons, DOE believes that fixture OEMs would be likely to consider lower BF ballasts, if more-efficacious lamps were required due to standards. Therefore, DOE decided not to change its lighting expertise assumptions for this final rule and continues to use the results of its analysis to characterize the Market-Segment-Based Lighting Expertise scenario. However, whereas DOE believes it has modeled market behavior which is consistent with the available research, DOE acknowledges the uncertainty in these estimates, and, therefore, modeled a sensitivity scenario in which it assumed that 34 percent (as recommended by NEMA) of consumers in the new construction and renovation markets migrate to lower-ballast-factor ballasts or low-wattage lamps. Generally, this sensitivity scenario reduces energy savings and NPV by approximately 20 percent and 25 percent, respectively (depending on the TSL and scenario). NPV and NES remain highly positive. See TSD chapter 11 for results of this sensitivity analysis.

In the April 2009 NOPR, DOE characterized residential consumers as having low lighting expertise in the Market-Segment-Based Lighting Expertise scenario and assumed 0 percent of these consumers would migrate to lower-BF ballasts or lower-wattage lamps in this standards-case scenario. 74 FR 16920, 16968 (April 13, 2009). ASAP commented that the residential consumer's expertise, or lack thereof, is not as relevant as what is on the store shelf and what is on sale. Therefore, ASAP argued, 0 percent choosing a lower BF ballast or reduced wattage is likely not accurate for fixture replacement in the residential sector. (ASAP, Public Meeting Transcript, No. 38.4 at pp. 236–237)

DOE reiterates that how consumers behave in this respect is highly uncertain. What is on sale in the store clearly has an effect, but to assert that it is the only determinate would be to disregard the impact of consumer choice. Additionally, what is on sale depends largely on the expertise of the agent deciding what the store should stock, and how responsive this agent is to consumer demand. As discussed in the April 2009 NOPR, because of the uncertainty around this issue DOE decided to consider both the High and Market Segment-Based Lighting Expertise scenarios. 74 FR 16920, 16967–68 (April 13, 2009). With these scenarios, DOE attempts to capture this range of potential impacts, with the Market Segment-Based scenario characterizing the lower bound. DOE decided for this final rule to continue to assume, in the Market Segment-Based lighting expertise scenario, that 0 percent of residential fixture replacement purchases will pair lower ballast factors with higher-efficacy lamps, or purchase reduced-wattage lamps. In contrast, the High Lighting Expertise scenario is meant to represent the upper bound of impacts and assumes that 100 percent of residential decision-makers have high lighting expertise.

10. IRL Product Substitution Scenarios

In the April 2009 NOPR, DOE modeled two sets of standards-case scenarios for IRL: Shift/Roll-up and Product Substitution/No Product Substitution. 74 FR 16920, 16969–70 (April 13, 2009). Similar to GSFL, the Shift/Roll-up scenarios consider whether consumers purchasing lamps with efficacies that exceed (not just meet) the minimum standard would be likely to shift to even higher efficacy lamps in the face of amended standards. In the Product Substitution scenario, DOE assumed consumers purchasing covered IRL in the base case do not necessarily continue to purchase regulated IRL in the standards case. Accordingly, DOE modeled a shift to both exempted BR lamps (namely the 65W BR30 lamp) and to R–CFL in the standards case. In the ''No Production Substitution'' scenario, DOE assumed consumers who purchase covered IRL technology in the base case continue to purchase covered IRL technology in the standards case (i.e., the total number of installed covered IRL in the base case is the same as that in the standards case throughout the analysis period). In this scenario, DOE did not model any additional shift in the standards case to non-regulated reflector technologies. For more information about the IRL standards-case scenarios, see chapter 10 of the NOPR TSD.

DOE received several comments on the merits of modeling the Product Substitution and No Product Substitution scenarios. ASAP and the Alliance to Save Energy commented that DOE should model migration to R–CFL and migration to exempt BR lamps separately in order to better determine the effects of standards. ASAP suggested that DOE's decision to simultaneously model R–CFL and BR lamps obscured standards-case impacts because it combined two offsetting effects-migration to BR lamps, which would decrease energy savings, and migration to R–CFL, which would increase energy savings. (ASAP, Public Meeting Transcript, No. 38.4. at p. 241; *Alliance to Save Energy,* Public Meeting Transcript, No 38.4. at pp. 243–244). ACEEE and ADLT commented that because DOE intends to cover previously-exempted lamps in a separate rulemaking, it should eliminate or greatly reduce modeled migration to these lamps in the standards case. (ACEEE, No. 76 at p. 6, ADLT, No. 72 at p. 4) Philips also commented that DOE's assumption in the No Product Substitution scenario—that consumers who purchase covered IRL in the base case will continue to do so in the standards case—is incorrect because standards will increase the cost of covered IRL. This increase will tend to accelerate the penetration of competing technologies, which the No Product Substitution scenario fails to incorporate. (Philips, Public Meeting Transcript, No. 38.4 at p. 239)

First, DOE notes that currently exempted BR lamps, which are not included in the current rulemaking but are largely at issue in this discussion, *may* be analyzed for energy conservation standards in a separate rulemaking. At this time, DOE cannot predict what minimum efficacy requirements, if any, may be established for BR lamps. Therefore, it is impossible to determine how lamps exempted from this rulemaking (BR lamps) will compare in cost and efficacy to those IRL covered by today's final rule. As a result, there is a great deal of uncertainty in estimating the number of consumers likely to migrate to BR lamps. For this very reason, DOE maintains the following two scenarios. In the first scenario, no migration to the exempted 65W BR lamp is modeled (representative of a situation in which the exempted lamps are regulated at the same efficacy level as those IRL in this rulemaking) and only migration to R–CFL occurs. In the second scenario, DOE models the same migration to the 65W BR lamp as in the NOPR (representative of a situation in which the exempted lamps remain unregulated).

However, DOE agrees that modeling the two separate offsetting standards-case impacts (migration to R–CFL and migration to the 65W BR lamp together) conflates two variables that may be more illustrative when modeled separately. Therefore, for this final rule, DOE is modifying what was called the Product Substitution scenario in the April 2009 NOPR and by dividing it into two scenarios and renaming them the ''R–CFL Product Substitution'' and ''BR Product Substitution'' scenarios, respectively. In the R–CFL Product Substitution scenario, DOE models migration to only R–CFL in response to standards (for the reasons addressed in the comments and responses above). Similarly, in the BR Product Substitution scenario, DOE models migration only to BR lamps. DOE believes this approach best isolates the potential energy savings impacts of migration to the two different technologies. DOE has maintained its approach of modeling incrementally greater migration to R–CFL and BR lamps for higher TSLs in these scenarios; it also maintained the magnitude of these increases. In consideration of Philips's comment, DOE is no longer analyzing the ''No Product Substitution Scenario.'' DOE received several comments on the merits of modeling the ''No Product Substitution'' scenario for determining manufacturer impacts due to standards. These comments are discussed in section V.F.

Philips commented that it would be unlikely for the commercial sector to migrate to BR lamps in the standards case because the sector is driven by life-cycle costs (which are generally higher for BR lamps) and because most commercial entities have high lighting knowledge. As for the residential sector, Philips noted that BR lamps are not suitable for outdoor applications, limiting the pool of applications for which BR lamps are suitable to be potential replacements for covered IRL in the standards case. (Philips, Public Meeting Transcript, No. 38.4 at p. 239)

DOE agrees that PAR lamps may be more suitable for outdoor applications than the exempted BR lamps. However, as noted in the April 2009 NOPR and based on residential estimates that 40 percent of all residential IRL are PAR lamps,[40] DOE believes that a considerable portion of residential PAR lamps are used in non-outdoor applications that are suitable for both PAR and the exempted BR lamps. 74 FR 16920, 16970 (April 13, 2009). Thus, DOE maintains for this final rule that some residential consumers may move to exempted IRL in the standards case, although a great deal of uncertainty remains. For this reason DOE models a separate scenario which reflects no migration to the 65W BR lamps. Regarding NEMA's assertion that commercial consumers are more sensitive to life-cycle cost, DOE agrees that the penetration rates of less-cost-effective lamps will be lower in the commercial sector than the residential sector. In the April 2009 NOPR, DOE took this factor into account in its analysis by using separate payback period-penetration relationships for each sector. 74 FR 16920, 16963 (April 13, 2009). For the reasons discussed above, for this final rule, DOE maintains the same migration to the 65W BR lamp as modeled in the April 2009 NOPR in the Product Substitution scenario.

IALD commented that DOE did not consider all the possible substitution scenarios in the April 2009 NOPR. For example, consumers may switch to fixtures with exempted AR (aluminum reflector) and MR (multi-faceted reflector) lamps because of the lower upfront cost, or lamp manufacturers may choose to produce 39W lamps (outside the scope of coverage of DOE's regulations). (IALD, No. 71 at p. 2, 3) In response, DOE believes that a migration to AR and MR lamps is unlikely to have a material impact on energy savings due to the unique characteristics (*e.g.*, lamp size, voltage, or socket) of these lamps and because they generally cannot be interchanged with other reflectorized lamps.[41] In addition, DOE does not expect a significant migration to 39W lamps as a result of standards for the following reason. If these lamps were manufactured at lower efficacies without halogen technology (thereby circumventing the standard), they would likely have much lower lumen output than needed to meet the demand of consumers of the existing lamp, thereby making it an unacceptable replacement.

For more information about the R–CFL Product Substitution and BR Product Substitution standards-case scenarios, *see* chapter 10 of the TSD.

11. Discount Rates

In its analyses, DOE multiplies monetary values in future years by a discount factor in order to determine its present value. DOE estimated national impacts using both a 3-percent and a 7-percent real discount rate as the average real rate of return on private investment

[40] New York State Energy Research and Development Authority, Incandescent Reflector Lamps Study of Proposed Energy Efficiency Standards for New York State (2006) (Last accessed Oct. 7, 2006). Available at: *http://www.nyserda.org/publications/Report%2006-07-Complete%20report-web.pdf.*

[41] Lighting Resource Center, NLPIP Lighting Answers: Volume 6, Issue 2 (Sept. 2002) (Last accessed: June 21, 2009). Available at: *http://www.lrc.rpi.edu/programs/nlpip/lightingAnswers/mr16/reflectorizedLamps.asp.*

in the U.S. economy. NRDC argued that DOE should use a 2-percent or 3-percent discount rate and should not apply it to the value of carbon emissions. (NRDC, No. 82 at p. 5).

In response, DOE notes that it follows the guidelines on discount factors set forth by the Office of Management and Budget (OMB). Specifically, DOE uses these discount rates in accordance with guidance that OMB provides to Federal agencies on the development of regulatory analysis (OMB Circular A–4 [42] (Sept.17, 2003), particularly section E, ''Identifying and Measuring Benefits and Costs''). Accordingly, DOE is continuing to use 3-percent and 7-percent real discount rates for the relevant calculations for this final rule. Furthermore, DOE continues to report both undiscounted and discounted values of carbon emission reductions. DOE believes this allows for consideration of a range of policy perspectives, one of which is the view that a reduction in emissions today is more valuable than one in thirty years.

E. Consumer Sub-Group Analysis

In analyzing the potential impact of new or amended standards on commercial customers, DOE evaluates the impact on identifiable groups (*i.e.*, sub-groups) of customers, such as different types of businesses that may be disproportionately affected by a National standard level. In the April 2009 NOPR, DOE identified low-income consumers, institutions of religious worship, and institutions that serve low-income populations, and consumers of T12 electronic ballasts as lamp consumer sub-groups that could be disproportionately affected, and examined the impact of proposed standards on this group. 74 FR 16920, 16971–72 (April 13, 2009). DOE determined the impact on this consumer sub-group using the LCC spreadsheet model. DOE did not receive comments on sub-groups chosen to analyze nor on the assumptions applied to those sub-groups. DOE relied on the same methodology outlined in the April 2009 NOPR for the final rule analysis. The results of DOE's LCC sub-group analysis are briefly summarized in section VII.C.1.b and described in detail in chapter 12 of the TSD.

F. Manufacturer Impact Analysis

DOE performed a manufacturer impact analysis (MIA) to estimate the financial impact of energy conservation standards on manufacturers of GSFL and IRL, and to assess the impact of such standards on employment and manufacturing capacity. DOE's MIA methodology is discussed in detail in the April 2009 NOPR (74 FR 16920, 16972–77 (April 13, 2009)) and in chapter 13 of the TSD. DOE conducted the MIA for GSFL and IRL in three phases. Phase 1 (Industry Profile) consisted of preparing an industry characterization, including data on market share, sales volumes and trends, pricing, employment, and financial structure. Phase 2 (Industry Cash Flow Analysis) focused on the industries as a whole. In this phase, DOE used the Government Regulatory Impact Model (GRIM) to prepare an industry cash-flow analysis for each industry (GSFL and IRL). Using publicly-available information developed in Phase 1, DOE adapted the GRIM's generic structure to perform an industry cash flow analysis for manufacturers of GSFL and IRL both with and without energy conservation standards. In Phase 3 (Sub-Group Impact Analysis) DOE conducted interviews with manufacturers representing the majority of domestic GSFL and IRL sales. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics specific to each company and obtained each manufacturer's view of the industries. The interviews provided valuable information DOE used to evaluate the impacts of an energy conservation standard on manufacturer cash flows, manufacturing capacities, and employment levels. DOE then finalized its assumptions for the cash flow analysis and described the qualitative impacts on manufacturers due to amended energy conservation standards.

The GRIM inputs consist of data regarding the cost structures for GSFL and IRL industries, shipments, and revenues. These include information from many of the analyses described above, such as retail prices from the product price determination analysis and shipments forecasts from the NIA.

For the final rule, DOE incorporates a number of changes to GRIM inputs that were made in the other analyses for this rulemaking. The GRIM uses the medium prices in the product price determination analysis to calculate the manufacturer production costs (MPCs) for each equipment class at each TSL. By multiplying the production costs by different sets of markups, DOE derives the manufacturer selling prices used to calculate industry revenues. Following the NOPR, DOE updated its product price determination analysis using the CPI. DOE uses these updated prices in the GRIM for the final rule.

The GRIM estimates manufacturer revenues based on total-unit-shipment forecasts and the distribution of these shipments by efficacy. Changes in the efficacy mix at each standard level are a significant driver of manufacturer finances. For the final rule analysis, DOE updated the GSFL and IRL MIA results based on the total shipments and efficacy distribution estimated in the final rule NIA.

As described in section V.D.10, DOE updated the substitution scenarios in the IRL GRIM. For the April 2009 NOPR, DOE modeled a set of standards-case IRL scenarios called the ''Product Substitution'' and ''No Product Substitution'' scenarios. 74 FR 16920, 16969–70 (April 13, 2009). In the Product Substitution scenario, DOE assumed consumers purchasing covered IRL in the base case do not necessarily purchase covered IRL in the standards case. DOE modeled a shift to both exempted BR R–CFL in the standards case. In the ''No Production Substitution'' scenario, DOE assumed consumers who purchase covered IRL technology in the base case continue to purchase covered IRL technology in the standards case.

In response to comments by ASAP, for today's final rule, DOE modified the IRL shipments scenarios. The Product Substitution is modified by dividing it into two and renaming them the ''R–CFL Product Substitution'' and ''BR Product Substitution'' scenarios. In the R–CFL Product Substitution scenario, DOE models migration to only R–CFL in response to standards. Similarly, in the BR Product Substitution scenario, DOE models migration only to BR lamps. For further detail in DOE's modification of the Product Substitution scenarios and its response to ASAP's comments regarding this issue, see section V.D.10 of today's notice.

For the April 2009 NOPR, DOE determined the total capital conversion costs that would be required for the IRL industry to convert existing production to meet demand at each TSL. For the NOPR, DOE scaled the IRL capital conversion costs using the Existing Technologies base-case shipments to account for the decline in shipments before standards become effective. DOE used the same capital conversion costs for all scenarios. For today's final rule, DOE updated the capital and product conversion costs to 2008$ using the PPI for NAICS code 335110 (electric lamp bulb and part manufacturing) for both GSFL and IRL. Additionally, for the final rule, DOE is using two sets of capital conversion costs. For all IRL scenarios in the Existing Technologies base case, DOE scales its updated

[42] Available at: *http://www.whitehouse.gov/omb/assets/regulatory_matters_pdf/a-4.pdf*.

estimate of the capital conversion costs using the Existing Technologies base-case shipments. For all IRL scenarios in the Emerging Technology base case, DOE scales its updated estimate of the capital conversion costs using the Emerging Technologies base-case shipments. Scaling the IRL capital conversion costs for each base case results in lower capital conversion costs in the Emerging Technologies base case than in the Existing Technologies base case. DOE believes this approach to scaling capital conversion cost with shipments more accurately captures the capital costs that the IRL industry could incur in each scenario.

For today's final rule and in response to comments, DOE developed a shortened lifetime scenario for IRL to investigate the effects of shorter lamp lifetime at higher TSLs. In this sensitivity scenario, DOE changes the lifetime and prices of the higher-efficacy representative lamps at TSL 4 and TSL 5. These changes in characteristics also simulate certain lamps becoming a commodity product in response to energy conservation standards. These alterations cause higher shipments in the standards case and result in reduced negative impacts on the industry. See section VI.C.1 of today's final rule for an explanation of the lifetime sensitivity scenario. For the INPV results in the lifetime sensitivity scenario, see section VII.C.2.a of today's notice and chapter 13 of the TSD.

For the April 2009 NOPR, DOE used a set of markup scenarios to calculate manufacturer selling prices in order to estimate industry revenues in its cashflow analysis. 74 FR 16920, 16977 (April 13, 2009). In both the IRL and GSFL GRIM, DOE modeled a Flat Markup scenario. This scenario assumed that the cost of goods sold for each lamp is marked up by a flat percentage to cover standard selling, general, and administrative (SG&A) expenses, research and development (R&D) expenses, and profit. To derive this percentage, DOE evaluated publicly-available financial information for manufacturers of lighting equipment. For today's final rule, DOE continues to model a Flat Markup scenario in both the IRL and GSFL GRIM.

For GSFL only, DOE also modeled a Four-Tier markup scenario for the April 2009 NOPR. 74 FR 16920, 16977 (April 13, 2009). In this scenario, DOE assumed that the markup on lamps varies by efficacy in both the base case and the standards case. DOE used information provided by manufacturers, the medium prices in its product price determination, and industry average gross margins to estimate markups for GSFL under a four-tier pricing strategy in the base case. In this scenario premium products have a higher markup at each increasing tier of efficacy (i.e., a higher markup for each increasing phosphor series). In the standards case, DOE modeled the situation in which a reduction in product portfolios squeezes the margins of higher-efficacy products as they are ''demoted'' to lower-relative-efficacy-tier products.

For today's final rule, DOE incorporates additional assumptions in its Four-Tier markup scenario for both the base case and standards case. For the final rule, DOE continues to model a base-case pricing strategy in which each phosphor series earns a separate markup. However these mark-ups are changing over time during the analysis period to take into account commoditization of more-efficient lamps as they gain market share. Depending on the product class of GSFL, the market share of either 800 or 800 plus series lamps overtakes the market share of 700 series lamps. This capture of market share is fully realized at later dates (between 2035 and 2040, depending on the base-case scenario and product class). The original markups for 700, 800, and 800 plus series lamps converge to a single, lower markup over time. The Four-Tier markup standards case continues to ''squeeze'' the margins of commoditized lamps, but the impacts are reduced because the margins are already lowered in the base case. For an extensive explanation of the revised Four-Tier markup scenario, see chapter 13 of the TSD.

During the NOPR public meeting OSI commented that the INPV results for GSFL show that the manufacturer impacts were taken into consideration in DOE's arrival at the appropriate proposed energy conservation standard. However, the negative INPV results for IRL, especially at the proposed TSL 4, indicated that the impact on manufacturers was not considered in DOE's proposed energy conservation standard for IRL (OSRAM/Sylvania, Public Meeting Transcript, No. 38 at pp 284–286). Similarly, NEMA commented that DOE failed to give adequate consideration to the negative INPV at TSL4 (NEMA, No. 81 at p. 4). Philips added that the analysis for IRL showed a large increase in NPV at TSL 3, the first TSL to require exclusively infrared technology. The benefit to consumers moving past TSL 3 was incremental whereas the impacts on manufacturers were worse at TSL 4 than TSL 3 (Philips, Public Meeting Transcript, No. 38 at pp 292–293).

For the April 2009 NOPR, DOE presented the results of the MIA and its determination of proposed energy conservation standard levels for GSFL and IRL based on the EPCA criteria. Specifically, EPCA provides that any such standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified and that results in significant conservation of energy. (42 U.S.C. 6295(o)(2)(A) and (3)(B)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens, to the greatest extent practicable, considering the seven factors. (42 U.S.C. 6295(o)(2)(B)(i)) DOE believes that the industry commenters took a contrasting approach to the agency's analysis under the relevant statutory criteria by attempting to frame the issue as one of comparing incremental benefits to consumers relative to impacts on manufacturers at in moving from TSL3 to TSL 4. Instead, DOE interprets the proper application of statutory criteria, to require atop-down approach, which implies DOE must first analyze the TSL that would save the maximum amount of energy. If that TSL is not economically justified (i.e., the benefits do not exceed the burdens), DOE must then analyze the TSL with the next greatest energy savings until it reaches a TSL that it determines is economically justified and technologically feasible. Impacts on manufacturers and consumers are specific criteria that DOE must consider in its analysis. (42 U.S.C. 6295 (o)(2)(B)(i)(I)) In the April 2009 NOPR, DOE found that TSL 5 was not economically justified for IRL. DOE then analyzed TSL 4 and found that it was economically justified and technologically feasible. 74 FR 16920, 17018 (April 13, 2009).

For the April 2009 NOPR, DOE considered the negative impacts on INPV for IRL manufacturers at TSL 4. However, the Secretary reached the initial conclusion that the benefits of energy savings, emissions reductions, the positive net economic savings to the Nation, and positive life-cycle cost savings at TSL 4 would outweigh the potentially large reduction in INPV for manufacturers. 74 FR 16920, 17018 (April 13, 2009). For the final rule, DOE continues to base its determination of whether a standard level is economically justified using all seven EPCA factors. While the impacts on consumers and manufacturers are both considered in making this determination, none of these factors are reviewed in isolation. Although DOE gathers information on each of the seven statutory factors individually, the Secretary must ultimately consider the seven factors collectively in determining whether a standard is economically justified.

In its comments on DOE's April 2009 NOPR, ADLT stated that DOE's use of longer lifetimes at TSL 4 and TSL 5 is counter to manufacturer interviews. According to ADLT, because longer lamp lifetimes would have a significant impact on IRL shipments, the MIA overstates the impact on manufacturers. (ADLT, No. 72 at p. 3)

DOE acknowledges that lifetimes of analyzed lamps have a significant impact on IRL shipments. For the April 2009 NOPR, DOE presented its assumptions for lamp lifetimes and shipment projections. 74 FR 16920, 16956–57, 16959–65 (April 13, 2009). DOE also acknowledges that shipments are a significant driver of INPV results, especially in the IRL industry. To analyze the effects of lower lifetimes on IRL shipments at TSL 4 and TSL 5, DOE included a lifetime sensitivity analysis for today's final rule. The INPV results for the sensitivity scenario show that reduced lamp lifetimes at TSL 4 and TSL 5 significantly reduce the negative impacts on IRL manufacturers. DOE agrees with ADLT that the impacts on the IRL industry would be lower if manufacturers reduced lamp lifetimes in response to the energy conservation standards. See section VI.C.1 of today's final rule for an explanation of the lifetime sensitivity scenario. For the INPV results in the lifetime sensitivity scenario, see section VII.C.2.a of today's notice and chapter 13 of the TSD.

The CA Stakeholders are concerned that DOE's analysis of the burden on the GSFL industry may have focused primarily on the worst case scenario, rather than on the more likely combination of scenarios. The CA Stakeholders argue that if DOE were to average the impacts on GSFL manufacturers in the 16 possible scenarios, the industry losses would be less than half of the losses associated with the worst case scenario (CA Stakeholders, No. 63 at p. 11).

In arriving at the energy conservation standards in this final rule, DOE considered the full range of potential impacts on GSFL manufacturers. To determine the range of potential impacts on GSFL manufacturers, DOE performed an analysis which included 16 different industry cash flow scenarios. These scenarios considered numerous variables which influence the analysis (level of emerging technologies, markup strategies, product substitution, consumer lighting expertise, and product mix). To better explain the basis of its decision DOE describes how it balanced the likelihood of the scenarios and the range of uncertainty in arriving at today's standards. For a more detailed explanation of how DOE arrived at its decision for today's final rule, see section VII.D of today's notice.

All manufacturers expressed the view that the supply of standards-compliant lamps would be constrained. OSI commented that the large, negative INPV impacts for IRL manufacturers show that after the effective date of the standard, only the current volumes of standards-compliant lamps will be produced by manufacturers. (OSI, Public Meeting Transcript, No. 38 at p. 286). Philips stated that there is not an opportunity to invest in IRL because of negative impacts on manufacturers at the proposed level and the limited time horizon of the investment due to emerging technology. According to Philips, these factors could cause the IRL industry to experience a capacity constraint of HIR lamps (Philips, Public Meeting Transcript, No. 38 at pp. 287–288). GE agreed that this rulemaking forces a decision upon manufacturers in terms of whether to invest in a technology whose market is expected to decline over time. This limited investment will lead to a constrained IRL HIR lamp market (GE, Public Meeting Transcript, No. 38 at pp. 292–293). Similarly, NEMA commented that TSL 4 or above is essentially unthinkable for the industry and would cause capacity issues. NEMA added that TSL 3 or above for IRL would require manufacturers to over-invest to increase capacity of HIR lamps that will no longer be needed in a few years. NEMA believes these investments, which may never be recovered, cannot be justified financially and economically because of the diminishing market of covered IRL as a result of emerging technology. (NEMA, No. 81 at pp. 5, 10)

In the April 2009 NOPR, DOE included the capital conversion costs that would be required to meet the entire industry demand at each TSL. 74 FR 16920, 17001–02 (April 13, 2009). DOE based these estimates on interviews with manufacturers that produce the vast majority of IRL for sale in the United States. DOE obtained financial information through these manufacturer interviews and aggregated the results to mask any proprietary or confidential information from any one manufacturer. These estimates were found to be consistent with financial ratios for plant, property, and equipment reported in manufacturer financial statements. For TSL 5, because some manufacturers did not provide capital costs since they had no access to the needed technology, DOE supplemented manufacturer information with information provided by a supplier of coating technology. Therefore, DOE believes that the large capital conversion costs identified are representative of the expenditures that would be required for the industry to increase the production of higher-efficacy lamps at each TSL. DOE also cited these large capital conversion costs as a primary driver of the large, negative impacts on INPV. 74 FR 16920, 17002–03 (April 13, 2009).

In the April 2009 NOPR, DOE acknowledged manufacturers' concern about the potential for emerging technologies to further erode the IRL market. 74 FR 16920, 17002–03 (April 13, 2009). DOE also noted that an IRL standard would be unique because it would force investments in a market that could shrink over the entire lifetime of the investment. These large capital conversion costs continue to be a significant driver of the large, negative INPV values.

DOE believes that the large, negative INPV results compared to the industry value using the Emerging Technologies base case accurately captures manufacturer concerns about the lack of a financial return from large capital conversion in a shrinking market.

Philips commented that the capacity constraint would be worse at TSL 4 than at TSL 3, even though both these TSLs involve HIR technology. According to Philips, the additional time needed for the manufacturing processes associated with IRL lamps that meet TSL 4 could lead to additional capacity constraints because fewer products can be produced after the effective date of the standards. (Philips, Public Meeting Transcript, No. 38 at pp. 292–293)

DOE agrees that the INPV impacts at TSL 4 are larger than at TSL 3. The production of improved infrared capsules is more time consuming than the production of standard HIR lamps. The improvements to standard HIR lamps lower the output of each coating machine because production run would require additional cycle time for the coating process and quality control. The additional capital conversion costs at TSL 4 include the additional production equipment required to meet industry demand with a lower production output rate. DOE believes that there is sufficient lead time for manufacturers to convert their existing facilities to meet market demand with standards-compliant lamps. Manufacturers could mitigate possible capacity constraints by installing additional coaters, purchasing infrared burners from a supplier, and using existing excess capacity.

The CA Stakeholders and ACEEE commented that DOE's capital conversion and product conversion costs for IRLs should have addressed the fact that massive investments in advanced IR technologies will likely be happening absent standards. According to the CA Stakeholders, due to great potential improvements and consumer preferences, IRL manufacturers will already be making investments in advanced burner technology to meet the EISA 2007 requirement for general service incandescent lamps. These investments include coating machines and coating technology that can be applied to both general service lamp burners and reflector lamp burners. (CA Stakeholders, No. 63 at p. 27) (ACEEE, No. 76 at p. 5)

DOE believes that the energy conservation standards set by today's final rule are more stringent than the EISA 2007 requirements for general service incandescent lamps in 2012, and, therefore, these GSIL investments are not pertinent to the IRL analysis. The EISA 2007 GSIL standards that are effective in 2020 are similar to the IRL energy conservation standards for today's final rule. If manufacturers use the same technology in 2020, improved capsule technology could be used to reach prescribed GSIL efficacy levels. However, it is uncertain that a similar pathway for GSIL will be used to reach the prescribed efficacy levels in 2020 since emerging technologies may offer a better solution. Because the GSIL regulation is effective eight years after the effective date for today's IRL energy conservation standard and because manufacturers will have already made investments for IRL, any GSIL investments to meet the 2020 requirements will not impact the magnitude of investments needed by the IRL industry to meet today's final rule.

OSI stated that an additional concern about the declining market share of IRL due to emerging technology is that IRL are manufactured mostly in the United States, whereas the alternative technologies are not. The commenter argued that a standard that hastens the shift to alternative technologies would have negative impacts on domestic employment in the IRL industry. (OSI, Public Meeting Transcript, No. 38 at p. 286)

In response, DOE notes that in the April 2009 NOPR, DOE includes two base-case scenarios which examine the employment impacts of energy conservation standards. The Emerging Technologies base case models the situation in which emerging technologies such as LED and CMH lamps take an increasing share of covered IRL. Shipments of IRL are eroded in both the Existing Technologies and Emerging Technologies scenarios by R–CFL (a fully mature technology). In the Emerging Technology base case, IRL shipments are replaced by CMH, LEDs, and other emerging technologies that have the potential to replace a greater percentage of recessed can fixtures. DOE treats the erosion of the IRL market as a base-case issue, since the market decline is occurring without standards. In the April 2009 NOPR and in today's final rule, DOE acknowledges that the differential between employment levels in the Existing Technologies and Emerging Technologies base cases is large. However, the impact caused by standards is much less than the difference in employment between the two base cases. In any scenario, energy conservation standards have a small impact on the average employment levels in the IRL industry.

At the NOPR public meeting, GE expressed concern that the GSFL energy conservation standards could shift production overseas. (GE, Public Meeting Transcript, No. 38 at pp. 278–279)

DOE agrees that energy conservation standards will require significant capital conversion costs that could cause manufacturers to consider sourcing decisions, but DOE believes that many other factors could mitigate the decision to relocate production facilities abroad in response to amended standards. For example, the majority of GSFL are produced domestically on high-speed lines. The large capital conversion costs required at higher TSLs involve converting these existing high-speed lines to ones capable of producing smaller-diameter lamps. While these capital conversion costs are large, moving production outside the United States would require additional costs to transport existing production lines and to build a green field facility, none of which would eliminate the cost to convert the lines for smaller-diameter lamps. Furthermore, the highly-capitalized production process causes the labor content of GSFL to be a relatively small portion of the overall cost of each lamp. Because the vast majority of GSFL production costs are material costs, the labor cost savings from moving abroad would be relatively low. Most of the GSFL labor cost results from skilled workers that monitor and control the production process. There are relatively few unskilled workers in the production process, which further reduces the labor cost savings from relocation. Instead, the labor content of GSFL represents intellectual capital for GSFL production, so this would present another hurdle that would need to be addressed with relocation. A final mitigating factor that could prevent relocation of domestic production is increased shipping costs. Higher shipping costs, especially if production required oceanic freight, would likely outweigh any labor cost savings. For further information of conversion costs and possible employment impacts due to today's energy conservation standards, see chapter 13 of the TSD.

While DOE describes the factors that could mitigate a decision by U.S. manufacturers to relocate production facilities abroad due to amended energy conservation standards, DOE also recognizes that access to rare earth phosphors could also impact sourcing decisions. As described in section VI.G, most of the current supply of rare earth phosphors is controlled by China. A drastic change to export quotas or tariffs could influence the sourcing decision of U.S. manufacturers more significantly than amended energy conservation standards. If export quotas continue to decrease, companies could decide to relocate to China in order to gain access to the available rare earth phosphors supply, regardless of the energy conservation standard. However, DOE's direct employment conclusions do not account for the possible relocation of domestic manufacturing to other countries as a result of changes in export quotas or tariffs on materials used (*e.g.,* rare earth phosphors) because the potential for relocation is uncertain.

During the public meeting, Energy Solutions inquired if the IRL analysis considered that emerging technology and other IRL replacements are often made by the same manufacturers (Energy Solutions, Public Meeting Transcript, No. 38, at pp. 288–289). The CA Stakeholders, ACEEE, and NRDC commented that DOE's INPV analyses should consider the positive impacts to lamp manufacturers associated with the increased sales of the non-covered products resulting from standards. (CA Stakeholders, No. 63 at p. 4) (ACEEE, No. 76 at p. 6) (NRDC, No. 82 at pp. 4–5) The CA Stakeholders, ACEEE, and NRDC claimed the MIA impacts are overstated because the IRL and GSFL products that might see a reduction in shipment volume are generally made by the same manufacturers who sell the emerging technologies that may see a resulting increase in shipment volume. (CA Stakeholders, No. 63 at p. 7) (ACEEE, No. 76 at p. 6) (NRDC, No. 82 at pp. 4–5) Accordingly, the CA

Stakeholders agreed with the petitioners'[43] argument in appealing that the Secretary must fully consider, ''the economic impact of the standard on the manufacturers * * * of the products subject to such standard.'' (42 U.S.C. 6295(o)(2)(B)(i)I). The CA Stakeholders stated that because one of the impacts ''of the standard on the manufacturers'' of IRL and GSFL products will be increased sales (at higher markups) of exempt or non-covered lamps made by the same manufacturers, the statutory language requires that these positive impacts also be taken into account. Similarly, EEI commented that manufacturer impacts should account for the lost sales of baseline products as well as increased sales of high-efficiency products. (EEI, No. 39 at p. 4)

In response, the Emerging Technologies scenario describes how emerging technologies may erode the market for covered products in the base case, absent standards. The penetration of emerging technology reduces the number of covered lamps sold in future years in the same manner as a reduction in commercial floor space over time might reduce demand for covered IRL and GSFL lamps. The level of base-case reduction in lamp sales is independent of the energy conservation standard. The Emerging Technologies base case has lower energy savings in the NIA and lower base-case INPV in the GRIM, as compared to the Existing Technologies scenario.

The situation described for the furnaces and boilers rulemaking only exists for IRL in this rulemaking. In the furnaces and boilers rulemaking, the MIA analysis captured the product switching from gas furnaces to electric heat pumps induced by amended energy conservation standards. 72 FR 65136, 65158–61 (Nov. 19, 2007). The analogous situation for IRL occurs when the higher prices of covered lamps induce sales of non-covered BR lamps and R–CFLs. This migration from covered IRL to non-covered products was modeled in the April 2009 NOPR in the Product Substitution scenario. 74 FR 16920, 16969–70 (April 13, 2009). For the final rule, this situation was modeled in both the BR Product Substitution scenario and the R–CFL Product Substitution scenario. Thus, DOE modeled the impacts on the IRL industry from reduced sales of covered IRL due to price effects. The difference in INPV of including or excluding the sales of non-covered products was found to be small. Including these sales in the GRIM is not a major driver of the INPV results.

Instead, the larger declines in INPV in the Emerging Technologies scenario (compared to the Existing Technologies scenario) are not due to the exclusion of emerging technology sales from the analysis or to the declining sales of covered products, since the covered products are also declining in the base case. Instead, the larger impacts are caused by the overinvestment in the standards-compliant technology. In the Emerging Technologies scenario, manufacturers must invest in production levels anticipated for 2012, but the sales of covered products immediately begin to fall. In the base case, sales of covered products also decline, but manufacturers do not need to make extraordinary capital expenses. These extraordinary capital expenses cause the industry's cash flow to decrease significantly in comparison to the base case, causing an overall decrease of estimated INPV.

The CA Stakeholders claimed that by focusing on decreased sales of the specific technology being regulated, DOE is interpreting the statute to favor the *status quo* over more-efficient alternative technologies that are not being specifically regulated. According to the CA Stakeholders, there is nothing in the statue that limits DOE's review to only consider the impacts on regulated IRL and GSFL. (CA Stakeholders, No. 63 at p. 8) The CA Stakeholders recommended that DOE should focus its analysis on the economic impact on lighting manufacturers as a whole, rather than on the impacts of the specific technology being regulated. (CA Stakeholders, No. 63 at p. 8) Similarly, Earthjustice commented that the INPV results shown in the MIA should be bounded around the corporation, not the profit center that makes the covered products (Earthjustice, Public Meeting Transcript, No. 38, at p. 295). Agreeing with Earthjustice, the Appliance Standards Awareness Project stated that INPV impacts shown in the MIA should be bounded around the corporation and added that the difficulty in analyzing the impacts at the corporation level does not remove DOE's obligation to do so (ASAP, Public Meeting Transcript, No. 38, at pp. 290–291 and pp. 295–297). EEI also commented that DOE should not try to analyze the impacts of the lighting standard on all operations of manufacturers, especially those with multiple product lines and multiple global production facilities. EEI stated that such an analysis would take too much time and could possibly delay the issuance of a standard. (EEI, No. 39 at p. 4)

In response, DOE recognizes that the energy conservation standards may induce sales of non-covered products which are in whole or in part manufactured by the same manufacturers as the products covered by this rulemaking. These sales will increase the revenues and possibly increase the profits of the manufacturers that make covered IRL and GSFL. To include these revenues and profits in the GRIM analysis requires the same level of information about the product costs, required investments to increase sales, and the profitability as covered products. This information greatly increases both the complexity and uncertainty of the analysis of the products covered by this rulemaking. Much of this analysis is also outside the scope of this rulemaking. However, understanding that this can be a major driver of the GRIM results for some rulemakings, DOE attempted to bound the potential impact of the product substitutions on the industry value. For this reason, in the April 2009 NOPR, DOE ran the No Product Substitution scenario in the GRIM analysis. For today's final rule, DOE ran both the BR Substitution and the R–CFL Substitution scenarios. The difference in impacts between the Product Substitution and No Product Substitution scenarios represented the lost sales and profits to manufacturers. The difference in industry value from including the revenue from induced sales of BR lamps in the BR Product Substitution scenario and excluding the revenue represents the potential benefits of these sales to manufacturers of covered IRL. The difference in industry value from including the revenue from induced sales of R–CFL lamps in the R–CFL Product Substitution scenario and excluding the revenue represents the potential benefits of these sales to manufacturers of covered IRL. DOE reports these differences and qualitatively describes those factors which might mitigate the impact on those firms which produce both types of produces. The analysis shows that the inclusion of the additional revenues has minimum impacts on the estimated INPVs. For further qualitative and quantitative information on the scenarios and results for the MIA, see chapter 13 of the TSD.

Although IRL manufacturers may receive revenue from additional sales of R–CFL and exempted BR lamps, it is not certain that this would be a net benefit to manufacturers. In both the R–CFL

[43] (States of New York, Connecticut, New Jersey, and California, Commonwealth of Massachusetts, City of New York, and California Energy Commission) in the United States Court of Appeals in a petition regarding DOE's Furnace Rulemaking (*State of New York* v. *U.S. Dep't of Energy,* No. 08–0311 (2d Cir. filed January 17, 2008))

Substitution and BR Substitution scenarios, covered IRL sales are not completely replaced by the additional sales of R–CFL and exempted BR lamps.. To provide an upper bound of the potential benefit to IRL manufacturers, DOE includes the revenue from R–CFL and exempted BR lamps but does not consider any capital conversion costs to increase sales of these products. In any scenario, the potential benefits of these sales to IRL manufacturers have far less impact on INPV than the capital and product conversion costs needed to reach higher TSLs for covered IRL. In any of the April 2009 NOPR and today's final rule substitution scenarios, the large capital conversion costs are the biggest driver of the large, negative impacts on INPV. Thus, any additional benefit from sales of non-covered IRL products are not enough to mitigate the impacts on INPV due to the necessary estimated capital and product conversion costs.

The CA Stakeholders, ACEEE, and NRDC commented that the American Recovery and Reinvestment Act of 2009 (ARRA) has tax provisions that could possibly mitigate the impacts on manufacturers due to energy conservation standards. Specifically, the commenters cited provisions in ARRA offer low-interest ''industrial development bonds'' for expanding manufacturing capabilities, as well as an advanced energy project tax credit for manufacturers of covered products. According to the commenters, these provisions would help manufacturers cover possible conversion costs associated with energy conservation standards. (CA Stakeholders, No. 63 at p. 7) (ACEEE, No. 76 at pp. 5–6) (NRDC, No. 82 at p. 3)

DOE acknowledges that manufacturers of GSFL and IRL may qualify for the industrial development bonds and advanced energy project tax credit programs. If GSFL and IRL manufacturers do apply and receive the bonds and/or tax credit, these benefits could help mitigate some of the impacts of energy conservation standards. However, structures for the industrial development bonds and advanced energy project tax credit programs have not been finalized, and there is insufficient information available to do a thorough analysis of their potential impacts. Accordingly, DOE cannot determine with certainty that manufacturers of covered IRL and GSFL are eligible for either program. Any quantitative analysis of the industrial development bonds program or the advanced energy project tax credit program and their possible impacts on the GSFL and IRL industry would be highly speculative. Therefore, DOE did not include the bonds or tax credit in its analysis of potential impacts on the GSFL and IRL industries.

According to the CA Stakeholders and ACEEE, the MIA does not consider pending legislation that could help mitigate the impacts due to energy conservation standards. Specifically, the CA Stakeholders cite three examples of pending legislation that could help to mitigate the impacts on GSFL and IRL manufacturers due to amended energy conservation standards: (1) Restoring America's Manufacturing Leadership through Energy Efficiency Act of 2009; (2) 21st Century Energy Technology Deployment Act of 2009; and (3) American Clean Energy and Security Act of 2009. (CA Stakeholders, No. 63 at p. 7) (ACEEE, No. 76 at p. 6)

If adopted in present form, DOE acknowledges that the proposed legislation cited by the CA Stakeholders could potentially mitigate the impacts of energy conservation standards on GSFL and IRL manufacturers if they were to qualify for the benefits in the proposed legislation. However, because the legislation is pending and has not become public law, passage of such proposed legislation or the final form of those provisions are the matters of speculation. Therefore, DOE does not include the proposed legislation's potential to mitigate the impacts on GSFL and IRL manufactures in its analysis nor has it considered the pending legislation in its decision for today's rule.

The CA Stakeholders commented that energy conservation standards have consistently spurred innovation, resulting in even higher-efficiency products. However, in its analysis, DOE assumes that high-lumen T8 lamps represent the only opportunity for manufacturers to maintain profit margins through 2042. (CA Stakeholders, No. 63 at p 13) Additionally, the CA Stakeholders and ACEEE argued that DOE did not consider that GSFL manufacturers at TSL 4 and TSL 5 will be able to maintain high margins on a variety of other covered and non-covered products in their portfolio. These other covered products include T5s and extremely-high-lumen T8s, while non-covered products include solid state lighting such as LEDs. According to the CA Stakeholders, ACEEE, and NRDC, GSFL have other characteristics that could command higher margins besides efficacy, including long life, low wattage, resistance to high and low temperature, and low mercury content. If any of these upsell opportunities commanded higher markups, the positive impacts on INPV would be significant and should be reflected in DOE's analysis. (CA Stakeholders, No. 63 at pp. 13–14) (ACEEE, No. 76 at p. 4) (NRDC, No. 82 at p. 3).

In response, DOE recognizes that manufacturers will attempt to devise product differentiation strategies to compensate for a compression of the efficacy range of their product lines as a result of energy conservation standards. These strategies may include redefining efficacy tiers to more narrow bands, introducing more efficacious lamps than are currently offered, or stressing product attributes other than efficacy. The great number of assumptions required to model all possible markup strategies in the GRIM would not add to DOE's qualitative description of how these upsells would impact INPV. As described previously, the Flat Markup scenario captures the INPV effects, assuming that manufacturers fully compensate for a reduced range of efficacy values in their product portfolio. Thus, DOE's consideration of the factors evoked by the CA Stakeholders and ACEEE is encompassed in the inclusion of a Flat Markup scenario and in its discussion of the relative weight it places on the markup scenarios for each of the TSLs.

In comments on DOE's April 2009 NOPR, the CA Stakeholders stated that based on a sensitivity analysis of the GSFL GRIM, DOE's concern that standards could eliminate higher margins currently earned by more-efficacious products was a significant driver in determining the total impacts on the GSFL industry. The CA Stakeholders pointed out that the Four-Tier markup scenario had the greatest effect in determining the INPV impacts on the GSFL industry. (CA Stakeholders, No. 63 at p. 12)

For the April 2009 NOPR, DOE modeled two different markup scenarios to capture potential pricing schemes manufacturers apply to their products. 74 FR 16920, 16977 (April 13, 2009). The Flat Markup scenario applies a single markup to all products regardless of their efficacy. This scenario also assumes that manufacturers maintain their gross margin as a constant percentage throughout the analysis period, regardless of standards. The Four-Tier markup scenario applied a different markup to four different tiers of products (that correspond to the four phosphor series). As higher efficacies are required by energy conservation standards, manufacturers' product portfolios are reduced, squeezing the gross margins of higher-efficacy products as they are ''demoted'' to lower-relative-efficacy-tier products.

DOE agrees with the CA Stakeholders that the markup strategy is the primary driver of INPV for GSFL manufacturers. Therefore, to capture the full range of potential impacts of energy conservation standards on the GSFL INPV, DOE used the two markup scenarios for the April 2009 NOPR. For today's final rule, DOE continues to use both the Flat Markup and the Four-Tier markup scenarios to bound the potential impacts of energy conservation standards on the GSFL INPV.

The CA Stakeholders and ACEEE commented that the base cases overestimated the margins that manufacturers will be able to maintain for high-lumen T8 lamps as the market naturally shifts to more-efficient products. (CA Stakeholders, No. 63 at p. 4) (ACEEE, No. 76 at p. 4) Additionally, the CA Stakeholders commented that as products become more efficient, absent standards and in a competitive market, higher-efficacy products will not maintain their current margins. (CA Stakeholders, No. 63 at p. 12) The CA Stakeholders also argued that DOE's Four-Tier markup analysis for the four-foot medium bi-pin lamps appears to show manufacturers will maintain the estimated markup for 800 series high-lumen T8 lamps meeting TSL 5 indefinitely. According to the CA Stakeholders, high-lumen T8s have been available for several years and are already being commoditized. However, DOE's own analysis has shown that the market is shifting to higher-efficacy products without energy conservation standards. (CA Stakeholders, No. 63 at p. 12)

For the April 2009 NOPR, DOE modeled two different markup scenarios. 74 FR 16920, 16977 (April 13, 2009). The first scenario applies a single markup to all products regardless of their efficacy. The second markup scenario applies a different markup to four tiers of product efficacies that correspond to the four phosphor series. As the CA Stakeholders correctly stated, DOE assumed these two markup structures would be maintained throughout the analysis period. The CA Stakeholders also correctly stated that markups are the primary driver of INPV for GSFL. The CA Stakeholders believe that higher-efficacy lamps are already being commoditized and that non-covered, emerging technology will command high margins for manufacturers. While this assumption is not certain, DOE agrees that the premium GSFL covered in this rulemaking will likely follow a typical product life cycle, in which the average margins decrease over time in the base case, thereby resulting in a lower INPV than quantified by the Four-Tier markup scenario presented in the April 2009 NOPR. DOE also agrees that it is likely that as more-efficacious lighting products enter or replace GSFL in the market, premium products which currently command higher markups will become commoditized over time, and margins will erode. As non-covered emerging technologies reduce the size of the GSFL market, the overall margins of the GSFL market will also be reduced. Based on these additional assumptions, DOE has revised the Four-Tier markup scenario for today's final rule as previously described. DOE estimates that this commoditization reduces the base-case industry value and, to a lesser degree, the INPV impacts in the standards case. For further explanation of the Four-Tier markup scenario and the revised INPV results, see chapter 13 of the TSD.

NRDC commented that commoditization of features and margin reduction will occur regardless of the standard set for the GSFL industry, but technological innovation will result in the introduction of new premium products as well. NRDC added that DOE has forecasted two scenarios and compared them to determine the manufacturer impact. According to NRDC's comments, the reality will certainly be somewhere in between a no-standards situation and the product commoditization scenario. NRDC concluded that the MIA results are likely to be significantly overstated because the true impacts will be in between these two situations (NRDC, No. 82 at p. 3).

In the April 2009 NOPR, DOE requested comment on the ability of GSFL manufacturers to maintain margins through differentiation by other means and how the ability to differentiate products might vary over time. 74 FR 16920, 17001 (April 13, 2009). At TSL 5, DOE believes that the ability for manufacturers to differentiate products by means other than efficacy by the year 2012 is limited. Currently, only the most efficient lamps available meet this efficacy level. This ability could improve in later years as other features and higher efficacy products are introduced. However, given the discounting of future cash flows, the effect of this gradual improvement will be small. For this reason, DOE believes that the INPV results would be greater than the midpoint of the range of impacts. At TSL 4, manufacturers maintain some ability to create tiers of efficacy, which will mitigate some of the effects of commoditization of premium GSFL. However, DOE disagrees with the statement that the impacts on manufacturers are likely to be significantly overstated. DOE believes the revisions to the Four-Tier markup scenario have addressed the Advocates' concerns regarding an unrealistic change in profitability in the standards cases.

The CA Stakeholders commented that DOE should conduct its own research and/or seek alternate sources of information to calculate the manufacturer margins and conversion costs for T12 and T8 lamps. The CA Stakeholders argued that because manufacturer margins and conversion costs are two of the most significant GRIM inputs, to preserve the transparency of its analysis, DOE should not rely primarily on confidential data provided by one set of stakeholders (CA Stakeholders, No. 63 at p. 14).

In response, DOE understands the need for transparent and accurate data on which to base its analysis. Profit margin data at the product-line level are possibly the most sensitive data for any company, and therefore, are not readily available to the public. DOE attempts to validate any sensitive data provided by manufacturers, including information about profit margins, by first requesting any documentary evidence. DOE also compares the data submittals for each manufacturer for consistency. To the extent possible DOE has developed and will continue to develop its own estimates of key parameters for the MIA, such as manufacturing costs and pricing, by researching published sources, contacting tooling suppliers, and retaining the services of industry consultants. To maintain confidentiality and transparency at the same time, DOE makes its estimates of manufacturer margins and conversion costs available for public comment in an industry-aggregated form. This process allows DOE to further refine its assumptions and estimates based on the responses provided by interested parties.

The CA Stakeholders commented that the MIA's assumptions should not be revised to consider the current economic recession. The CA Stakeholders argued that such revisions would not add any practical value, given that it is impossible to accurately predict the direction of short-term economic cycles. (CA Stakeholders, No. 63 at p. 8)

As previously stated, for today's final rule, DOE has updated the GSFL and IRL GRIMs with revised NIA shipments and scenarios and used the updated product price determination inputs. DOE also revised the conversion costs using the appropriate PPI. These changes are typical revisions for energy conservation rulemakings and are not specifically attributable to current economic conditions. DOE agrees with CA Stakeholders and has not made revisions to the MIA specifically in response to the current near-term economic downturn. For additional information on the updates to the NIA and product price determination, see section V.D of today's notice, respectively. For further explanation of inputs and updates to the GSFL and IRL GRIMs, see chapter 13 of the TSD.

The CA Stakeholders commented that the effective date of today's final rule for GSFL and IRL energy conservation standards has a significant impact on the reported INPVs, and that any prorogation of the effective date would help mitigate impacts on the industry due to energy conservation standards. The CA Stakeholders recommended that DOE should establish an effective date for GSFL for their proposed Tier 1 standards (TSL4) in 2012 and for Tier 2 (TSL5) in 2016. (CA Stakeholders, No. 63 at p. 2, 14). Similarly, ACEEE argued that a phase-in standard would allow additional lead time for manufacturers and capture maximum energy savings. However, ACEEE requested expedited phase-in dates for GSFL standards at Tier 1 (July 2012) and Tier 2 (July 2015) (ACEEE, No. 76 at p. 2). ACEEE presented the alternative of a later effective date for choosing TSL 5 for all covered GSFL (2013 or 2014), because it provides manufacturers additional time to spread conversion cost, thereby minimizing the impacts on INPV (ACEEE, No. 76 at pp. 2–3). Similar to ACEEE's alternative effective date, OSI requested a one-year extension of the effective date for IRL products only. OSI commented that the extension would allow sufficient time to replace its capital base for covered IRL and allow for manufacturing of the higher-efficacy products to stabilize (OSI, No. 84 at p. 1).

DOE agrees that the effective date of energy conservation standards (*i.e.*, compliance date) has a significant impact on INPV. In the GRIM cashflow analyses, the conversion costs are implemented in the years between the announcement of the final rule and the effective date of the standards. By delaying the effective date and the required capital and product conversion costs, it would in theory be possible to reduce the negative impacts on INPV calculated for the proposed standards case, due to discounting the negative cash flows for conversion costs in later years. However, for the reasons discussed in section VI.I, for today's final rule, DOE is not using a tiered approach to set energy conservation standards. Similarly, for the reasons discussed in section VI.I, DOE is not considering a later effective date for either the GSFL or the IRL energy conservation standard. The implications of a later effective date on the GSFL and IRL INPV are not being considered.

For a detailed discussion of the MIA, see chapter 13 of the TSD accompanying this notice.

G. Employment Impact Analysis

DOE considers employment impacts in the domestic economy as one factor in setting energy conservation standards. Employment impacts include direct and indirect impacts. Direct employment impacts are changes in the number of employees for manufacturers of the appliance products that are subject to standards, their suppliers, and related service firms. The MIA addresses these impacts. Indirect employment impacts from standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, due to: (1) Reduced spending by end users on energy; (2) reduced spending on new energy supply by the utility industry; (3) increased consumer spending on the purchase of new products; and (4) the effects of those three factors throughout the economy. DOE expects the net monetary savings from standards to be redirected to other forms of economic activity. DOE also expects these shifts in spending and economic activity to affect the demand for labor in the short term.

In developing the April 2009 NOPR and today's final rule, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies (ImSET [44]). ImSET is a spreadsheet model of the U.S. economy that focuses on 188 sectors most relevant to industrial, commercial, and residential building energy use. ImSET is a special-purpose version of the ''U.S. Benchmark National Input-Output'' (I–O) model designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model with structural coefficients to characterize economic flows among the 188 sectors. ImSET's national economic I–O structure is based on a 1997 U.S. benchmark table, especially aggregated to those sectors. For further details, *see* chapter 15 of the TSD accompanying this notice.

As described in section V.G, DOE uses ImSet to consider indirect employment impacts when evaluating alternative standard levels. Direct employment impacts on the manufacturers that produce IRL and GSFL are analyzed in the manufacturer impact analysis, as discussed in section V.F.

H. Utility Impact Analysis

The utility impact analysis determines the changes to energy supply and demand (and forecasted power generation capacity) that result from the end-use energy savings due to new or amended energy conservation standards. DOE used a version of EIA's National Energy Modeling System (NEMS) for this utility impact analysis. NEMS, which is available in the public domain, is a large, multisectoral, partial-equilibrium model of the U.S. energy sector. EIA uses NEMS to produce its *AEO,* a widely-recognized baseline energy forecast for the United States. The version of NEMS used for appliance standards analysis is called NEMS–BT [45] and is primarily based on the April Update of the *AEO 2009* [46] with minor modifications. The analysis output includes a forecast of the total electricity generation capacity at each TSL.

DOE obtained the energy savings inputs associated with electricity consumption savings from the NIA. These inputs reflect the effects on electricity of efficiency improvements due to the deployment of GSFL and IRL that would meet the energy conservation standards set forth in this rulemaking. Chapter 14 of the TSD accompanying this notice presents details on the utility impact analysis.

DOE received comments to the ANOPR requesting that DOE report gas and electricity price impacts, and the economic benefits of reduced need for new electric power plants and infrastructure. The expectation is that lower electricity demand will lead to

[44] Roop, J. M., M. J. Scott, and R. W. Schultz, *ImSET: Impact of Sector Energy Technologies* (PNNL–15273 Pacific Northwest National Laboratory) (2005). Available at *http://www.pnl.gov/main/publications/external/technical_reports/PNNL-15273.pdf.*

[45] EIA approves the use of the name NEMS to describe only an official *AEO* version of the model without any modification to code or data. Because the present analysis entails some minor code modifications and runs the model under various policy scenarios that deviate from AEO assumptions, the name NEMS–BT refers to the model as used here. (''BT'' stands for DOE's Building Technologies Program.) For more information on NEMS, refer to ''The National Energy Modeling System: An Overview,'' DOE/EIA–0581 (98) (Feb. 1998). Available at *http://tonto.eia.doe.gov/ftproot/forecasting/058198.pdf.*

[46] An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook, April 2009.

lower prices for both electricity and natural gas that would benefit consumers.

DOE considered reporting gas and electricity price impacts but found that the uncertainty of price projections, together with the fairly small impact of the standards relative to total electricity demand, makes these price changes highly uncertain. As a result, DOE believes that they should not be weighed heavily in the decision concerning the standard level. Given the current complexity of utility regulation in the United States (with significant variances among States), it does not seem appropriate to attempt to measure impacts on infrastructure costs and prices where there is likely to be significant overlap.

I. Environmental Assessment

Pursuant to the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 *et seq.*) 42 U.S.C. 6295(o)(2)(B)(i)(VI), DOE prepared an environmental assessment (EA) of the potential impacts of the proposed standards it considered for today's final rule which it has included as chapter 16 of the TSD for the final rule. DOE found the environmental effects associated with the standards for GSFL and IRL to be insignificant. Therefore, DOE is issuing a Finding of No Significant Impact (FONSI), pursuant to NEPA, the regulations of the Council on Environmental Quality (40 CFR parts 1500–1508), and DOE's regulations for compliance with NEPA (10 CFR part 1021). The FONSI is available in the docket for this rulemaking.

In the EA, DOE estimated the reduction in total emissions of CO_2 and NO_X using the NEMS–BT computer model. DOE also calculated a range of estimates for reduction in mercury (Hg) emissions using power sector emission rates. The EA does not include the estimated reduction in power sector impacts of sulfur dioxide (SO_2), because DOE has determined that any such reduction resulting from an energy conservation standard would not affect the overall level of SO_2 emissions in the United States due to the presence of national caps on SO_2 emissions. These topics are addressed further below; see chapter 16 of the TSD for additional detail.

EEI commented that DOE should consider the environmental impacts of the production processes especially if higher efficiency standards would result in more manufacturing overseas. (EEI, No. 45 at p. 4) As discussed in the manufacturer impact analysis (see section V.F), DOE does not expect a migration of production of IRL overseas as a result of this rule. In addition, as the migration of GSFL production overseas is highly speculative, DOE does not feel it appropriate to incorporate the environmental impacts of production processes if moved overseas.

Earthjustice stated that DOE must calculate the amount of reductions in emissions of particulate matter (PM) that will result from standards for GSFLs and IRLs (and monetize the value). Earthjustice stated that even if DOE believes that the impacts on secondary PM emissions were physically impossible to estimate due to their complexity, it would not justify DOE ignoring the impact of standards on primary emissions of PM from power plants. (Earthjustice, No. 60 at pg 8) PM emissions reductions are much more difficult to estimate than other emissions due to the wide range of power plant controls and individual plant operations that impact PM emissions. DOE is not currently able to run a model that can make these estimates reliably at the national level.

NEMS–BT is run similarly to the *AEO2009* NEMS, except that lighting energy use is reduced by the amount of energy saved (by fuel type) due to the trial standard levels. The inputs of national energy savings come from the NIA analysis. For the EA, the output is the forecasted physical emissions. The net benefit of a standard is the difference between emissions estimated by NEMS–BT and the Updated *AEO2009* Reference Case. The NEMS–BT tracks CO_2 emissions using a detailed module that provides results with broad coverage of all sectors and inclusion of interactive effects.

The Clean Air Act sets an emissions cap on SO_2 for all affected Electric Generating Units. The attainment of the emissions cap is flexible among generators and is enforced through the use of emissions allowances and tradable permits. In other words, with or without a standard, total cumulative SO_2 emissions will always be at or near the ceiling, and there may be some timing differences among yearly forecasts. Thus, it is unlikely that there will be reduced overall SO_2 emissions from standards as long as the emissions ceilings are enforced. Although there may be no actual reduction in SO_2 emissions, there still may be an economic benefit from reduced demand for SO_2 emission allowances. Electricity savings decrease the generation of SO_2 emissions from power production, which can lessen the need to purchase SO_2 emissions allowance credits, and thereby decrease the costs of complying with regulatory caps on emissions.

NO_X emissions from 28 eastern States and the District of Columbia (DC) are limited under the Clean Air Interstate Rule (CAIR), published in the **Federal Register** on May 12, 2005.[47] Although CAIR has been remanded to EPA by the DC Circuit, it will remain in effect until it is replaced by a rule consistent with the Court's July 11, 2008 opinion in *North Carolina* v. *EPA*.[48] Because all States covered by CAIR opted to reduce NO_X emissions through participation in cap-and-trade programs for electric generating units, emissions from these sources are capped across the CAIR region.

For the 28 eastern States and D.C. where CAIR is in effect, no NO_X emissions reductions will occur due to the permanent cap. Under caps, physical emissions reductions in those States would not result from the energy conservation standards under consideration by DOE, but standards might have produced an environmentally-related economic impact in the form of lower prices for emissions allowance credits, if they were large enough. However, DOE determined that in the present case, such standards would not produce an environmentally-related economic impact in the form of lower prices for emissions allowance credits, because the estimated reduction in NO_X emissions or the corresponding allowance credits in States covered by the CAIR cap would be too small to affect allowance prices for NO_X under the CAIR. In contrast, new or amended energy conservation standards would reduce NO_X emissions in those 22 States that are not affected by CAIR. As a result, the NEMS–BT does forecast emissions reductions from the proposed amended standards considered in today's final rule.

In the April 2009 NOPR, however, DOE provided a different estimate of NO_X reductions, because DOE assumed that the CAIR had been vacated. 74 FR 16920, 17009–14 (April 13, 2009). This is because the CAIR rule was vacated by the U.S. Court of Appeals for the District of Columbia Circuit (DC Circuit) in its July 11, 2008 decision in *North Carolina* v. *Environmental Protection Agency*.[49] Although the DC Circuit, in a December 23, 2008 opinion,[50] decided to allow the CAIR rule to remain in effect until it is replaced by a rule consistent with the

[47] 70 FR 25162 (May 12, 2005).

[48] 531 F.3d 896 (D.C. Cir. 2008); see also *North Carolina* v. *EPA*, 550 F.3d 1176 (D.C. Cir. 2008).

[49] 531 F.3d 896 (D.C. Cir. 2008).

[50] *See* 550 F.3d 1176 (D.C. Cir. 2008).

Court's earlier opinion, DOE retained its analysis of NO_X emissions reductions based on an assumption that the CAIR rule was not in effect, because: (1) The NOPR was so advanced at the time that the December 23, 2008 opinion was issued that revisiting the analysis would have caused undue delay; and (2) neither the July 11, 2008, nor the December 23, 2008 decisions of the D.C. Circuit changed the standard-setting proposals offered in the NOPR.

Thus, for the April 2009 NOPR, DOE established a range of NO_X reductions based on low and high emissions rates (in metric kilotons of NO_X emitted per terawatt-hour (TWh) of electricity generated) derived from the *AEO2008.* DOE anticipated that, in the absence of the CAIR's trading program, the new or amended energy conservation standards would reduce NO_X emissions nationwide, not just in 22 States.

Similar to SO_2 and NO_X, future emissions of Hg would have been subject to emissions caps under the Clean Air Mercury Rule [51] (CAMR), which would have permanently capped emissions of mercury for new and existing coal-fired plants in all States by 2010, but the CAMR was vacated by the DC Circuit in its decision in *New Jersey* v. *Environmental Protection Agency* [52] prior to publication of the April 2009 NOPR. However, the NEMS–BT model DOE initially used to estimate the changes in emissions for the proposed rule assumed that Hg emissions would be subject to CAMR emission caps.

After CAMR was vacated, DOE was unable to use the NEMS–BT model to estimate any changes in the quantity of mercury emissions (anywhere in the country) that would result from standard levels it considered for the proposed rule. Instead, DOE used an Hg emissions rate (in metric tons of Hg per energy produced) based on the AEO2008 for the April 2009 NOPR. Because virtually all mercury emitted from electricity generation is from coal-fired power plants, DOE based the emissions rate on the metric tons of mercury emitted per TWh of coal-generated electricity. To estimate the reduction in mercury emissions, DOE multiplied the emissions rate by the reduction in coal-generated electricity associated with the standards considered. Because the CAMR remains vacated, DOE continued to use the approach it used for the April 2009 NOPR to estimate the Hg emission reductions due to standards for today's final rule.

[51] 70 FR 28606 (May 18, 2005).

[52] 517 F 3d 574 (D.C. Cir. 2008).

EEI commented that, ''if the standard leads to more use of compact fluorescent technology as replacements for incandescent reflector lamps, there will be an increase in mercury use and disposal issues compared to the baseline technologies.'' (EEI, No. 45 at p. 4). DOE estimates that any increase in use of CFLs, as compared to having no new or amended GSFL and IRL standards, would be minimal and any related mercury releases would be environmentally insignificant and speculative, particularly since only a fraction of CFLs are improperly disposed of and only a small fraction of the mercury in those CFLs leaches into the environment.

Earthjustice and NRDC argue that DOE should incorporate the value of CO_2 emissions reductions into the LCC and NPV analyses because the value of CO_2 emissions reductions affects the economic justification of standards, DOE must incorporate these effects into the LCC and NPV analyses. (Earthjustice, No. 60, at pgs 7–8 and (NRDC and Earthjustice, Issue Paper, No. 82 at p. 1)) New York, *et al.* also recommended that DOE prioritize energy savings and reduced CO_2 emissions and allocate at least as much weight to the monetary value of reduced carbon emissions as it does to other monetary impacts. (NY *et al.*, No. 88 at p. 1)[53] On the other hand, NEMA expressed support of the approach used by DOE in the NOPR to reflect a range for monetized values and report environmental benefits separately from the net benefits of energy savings. (NEMA, No. 81 at p. 21)

DOE notes that neither EPCA nor NEPA requires that the economic value of emissions reduction be incorporated in the LCC or NPV analysis of energy savings. DOE has chosen to report these benefits separately from the net benefits of energy savings. A summary of the monetary results is shown in section VII.C.6 of this notice. DOE considered both values when weighing the benefits and burdens of standards.

J. Monetizing Carbon Dioxide and Other Emissions Impacts

DOE also calculated the possible monetary benefit of CO_2, NO_X, and Hg reductions. Cumulative monetary benefits were determined using discount rates of 3 and 7 percent. DOE monetized reductions in CO_2 emissions due to the standards in this final rule based on a range of monetary values drawn from studies that attempt to estimate the present value of the marginal economic benefits (based on the avoided marginal social costs of carbon) likely to result from reducing greenhouse gas emissions. The marginal social cost of carbon is an estimate of the monetary value to society of the environmental damages of CO_2 emissions.

[53] A joint comment by the States of New York, California, Connecticut, Delaware, Illinois, Massachusetts, New Hampshire, New Jersey, Ohio, Vermont, and Washington.

Several parties provided comments regarding the economic valuation of CO_2 for the April 2009 NOPR. NRDC commented that New England now has a CO_2 trading price that could be used by DOE (NRDC, Public Meeting Transcript, No. 38.4 at p. 311–312) NRDC and Earthjustice argue that DOE should incorporate an assumption of a mandatory cap on CO_2 emissions or at the very least revise the range of CO_2 valuation. (NRDC and Earthjustice, Issue Paper, No. 82, p. 1–14) NY *et al.* also criticized the range of CO_2 values used in the NOPR and recommended the use of a long-run marginal abatement cost of CO_2 for monetizing CO_2 emission reductions, rather than the damage costs given the highly uncertain nature of the latter (NY *et al.*, No. 88, p. 9–10). As discussed in section VII.C.6, DOE has updated the approach described in the April 2009 NOPR (74 FR 16920, 17009 (Apr. 13, 2009)) for its monetization of environmental emissions reductions for today's rule.

Although this rulemaking does not affect SO_2 emissions or NO_X emissions in the 28 eastern States and D.C. where CAIR is in effect, there are markets for SO_2 and NO_X emissions allowances. The market clearing price of SO_2 and NO_X emissions allowances is roughly the marginal cost of meeting the regulatory cap, not the marginal value of the cap itself. Further, because national SO_2 and NO_X emissions are regulated by a cap-and-trade system, the cost of meeting these caps is included in the price of energy. Thus, the value of energy savings already includes the value of SO_2 and NO_X control for those consumers experiencing energy savings. The economic cost savings associated with SO_2 and NO_X emissions caps is approximately equal to the change in the price of traded allowances resulting from energy savings multiplied by the number of allowances that would be issued each year. That calculation is uncertain because the energy savings from new or amended standards for IRL and GSFL would be so small relative to the entire electricity generation market that the resulting emissions savings would have almost no impact on price formation in the allowances market. These savings would most likely be outweighed by uncertainties in the marginal costs of compliance with SO_2 and NO_X emissions caps.

EEI commented that the cost of remediating emissions such as CO_2, NO_X, SO_2, and mercury were already included in electricity rates paid by consumers and therefore emission reductions should not be ''monetized'' because it would lead to double counting. (EEI, No. 78 at p. 4–5). As described above, DOE has only monetized the value of emissions not covered by existing caps, such as NO_X in regions not covered by CAIR. The monetization of these emissions is based on estimates of their damage costs (*i.e.*, health effects) that are not included in economic prices.

EEI also commented that DOE should consider the most recent trends in electricity generation, including reductions in emissions, the rise of renewable portfolio standards, and the possibility of an upcoming CO_2 cap-and-trade program which would reduce the amount of CO_2 produced per kWh generated. (EEI, No. 45 at p. 5) Earthjustice stated that Federal caps will likely be in place by the time new standards become effective, so DOE should increase its electricity prices to reflect the cost of complying with emission caps. Earthjustice also noted that there are regional cap-and-trade programs in effect in the Northeast (Regional Greenhouse Gas Initiative (RGGI)) and the West (Western Climate Initiative (WCI)) that will affect the price of electricity but are not reflected in the *AEO* energy price forecasts. (Earthjustice, No. 60 at p. 6–7) NY *et al.* also recommended including some level of CO_2 pricing in its modeling. (NY *et al.*, No. 88, at p. 25)

In response, DOE incorporated current trends in its analysis, but expressly did not include possible future legislation in this rulemaking. The current NEMS–BT model used in projecting the environmental impacts includes the CAIR rule, as described above, which is projected to reduce SO_2 and NO_X emissions. NEMS–BT also takes into account the current set of State level renewable portfolio standards, the effect of the RGGI, and utility investor reactions to the possibility of future CO_2 cap and trade programs, all of which impact electricity prices and reduce the projected carbon intensity of generation.[54]

[54] For more information, see the Update to the *AEO2009* and the *AEO2009* Assumptions documentation [add proper cites].

VI. Discussion of Other Key Issues and Comments

A. Sign Industry Impacts

The CA Stakeholders supported the adoption of TSL3 for the 8-foot SP Slimline and 8-foot RDC HO product classes partially due to concern for the outdoor sign industry. Based on communication with the Director of Technical & Regulatory Affairs for the International Sign Association, the CA Stakeholders believed that the outdoor sign industry would experience significant negative impacts if covered 8-foot T12 lamps were eliminated by DOE proposing TSL4. (CA Stakeholders, No. 63 at p. 10) However, DOE does not believe that such an impact exists. The definition of ''general service fluorescent lamp'' exempts any fluorescent lamp designed and marketed for cold temperature applications. 10 CFR 430.2. Because outdoor signs typically require lamps and ballasts designed for cold temperature operation, they should be minimally impacted by an energy conservation standard. If owners of outdoor signs are in fact using covered 8-foot T12 lamps, they have the option to replace those lamps with either a covered 8-foot T8 lamp or an exempted 8-foot T12 lamp designed for use in cold temperature applications. Thus, the outdoor sign industry will not be negatively impacted by DOE adopting TSL4.

B. Max-Tech IRL

As required under 42 U.S.C. 6295(p)(1) and described in the April 2009 NOPR, DOE identified the efficacy levels that would achieve the maximum improvements in energy efficiency that are technologically feasible (max-tech levels) for GSFL and IRL. 74 FR 16920, 16933–35 (April 13, 2009). For IRL, DOE tentatively determined that the maximum technologically feasible efficacy level would incorporate the highest-efficiency technologically feasible reflector, halogen infrared coating, and filament design. *Id.* Combining all three of these high-efficiency technologies simultaneously results in the maximum technologically feasible level. However, because the only technology pathway to this level is dependent on a proprietary technology, DOE did not consider this level further in its analyses. In the April 2009 NOPR, DOE analyzed TSL5, which is the most efficient commercially-available IRL and employs a silver reflector, an improved (but not most-efficient) IR coating, and a filament design that results in a lifetime of 4,200 hours. Although this commercially-available lamp uses the patented silver technology, DOE believes that there are alternate pathways to achieve this level. A combination of redesigning the filament to achieve higher temperature operation (and thus reducing lifetime to 3,000 hours), employing other non-proprietary high-efficiency reflectors, and applying a higher-efficiency IR coating has the potential to result in an IRL that meets an equivalent efficacy level (for more information regarding these technologies, see chapter 3 of the TSD). Therefore, in the April 2009 NOPR, DOE concluded that TSL5 is the maximum technologically feasible level for IRL that is not dependent on the use of a proprietary technology. *Id.*

1. Treatment of Proprietary Technologies

Several stakeholders commented that DOE did not analyze the max-tech level for IRL as required by EPCA because IRL can achieve efficacies even higher than TSL5. (ASAP, Public Meeting Transcript, No. 38.4 at p. 96; ADLT, Public Meeting Transcript, No. 38.4 at p. 113; Earthjustice, No. 60 at pp. 2–3; CA Stakeholders, No. 63 at p. 14; ACEEE, No. 76 at p. 5; NRDC, No. 82 at p. 2) Commenters disagreed with DOE's conclusion that it could not establish a TSL that required the use of a proprietary technology. (Earthjustice, No. 60 at pp. 3–4; CA Stakeholders, No. 63 at p. 14; ACEEE, No. 76 at p. 5) These stakeholders claimed that DOE must either analyze the economic impacts of the true max-tech level, which would incorporate the proprietary technology, or show that standards based on the proprietary silverized reflector are not technologically feasible. (Earthjustice, No. 60 at p. 4; CA Stakeholders, No. 63 at pp. 14–15)

DOE agrees with the stakeholders that max-tech level for IRL is different than TSL5. While TSL5 is the highest efficiency level on which DOE performed the full range of economic analyses (including LCC, national impacts, and manufacturer impacts), DOE maintains that it did in fact consider and analyze the max-tech level consistent with EPCA. According to EPCA, DOE is required to establish energy conservation standards that ''shall be designed to achieve the maximum improvement in energy efficiency * * * which the Secretary determines is technologically feasible and economically justified.'' (42 U.S.C. 6295(o)(2)(A)) To determine economic justification, DOE considers (among other factors) ''the economic impact of the standard on the manufacturers'' and ''the impact of any lessening of competition * * * that is likely to result from the imposition of a standard.'' (42 U.S.C. 6295(o)(2)(B)(i)(I) and (V))

The observation that DOE did not label the max tech level as TSL6 does not mean that DOE did not consider this efficiency level. As noted in the April 2009 NOPR and further explained below, DOE rejected this level because it required the use of a proprietary technology. However, DOE is not broadly screening out proprietary technologies or otherwise eliminating them from its analysis. In contrast to the present case, most patents do not convey market power to their owners because close substitutes for these inventions exist. Licensors will pay no more for these technologies than the cost advantage they provide over the next best alternative pathway to compliance with the efficiency standard. Ultimately the availability of cost-effective alternate technology pathways is what limits the ability of the owner of a proprietary technology to extract high fees for its use.

However, it is DOE's opinion that a standard level which can only be met with a single proprietary technology which comes without assurances of open and free technology access should be rejected because it carries great risk of resulting in an anti-competitive market, a principle consistently applied in past DOE rulemakings. In such a situation, the standards-setting process itself would convey great market power because there would be no alternative means to satisfy the standard. DOE believes that this is sufficient cause to conclude that the max-tech level in question is not economically justified. Having made this determination, there was no need or benefit to performing additional analyses relevant to the other statutory criteria. In fact, in *Natural Resources Defense Council* v. *Herrington*, the DC Circuit recognized that a complete analysis of all factors in not always required: '' If no standard could have been based on prototypes without requiring manufacturers to accomplish the impossible, we agree that DOE could reasonably deem all such standards economically unjustified without trudging through the remaining statutory factors.'' 768 F.2d 1355, 1396–97 (D.C. Cir. 1985).

At the NOPR public meeting, ASAP suggested that DOE should consider cross-licensing as a vehicle for manufacturers to access proprietary technologies if such technologies might comprise the only pathway to compliance with a certain standard level. (ASAP, Public Meeting Transcript, No. 38.4 at p. 97) While DOE acknowledges that manufacturers of proprietary technologies can create cross-licensing agreements with other organizations, DOE continues to reject the notion that a standard requiring a specific proprietary technology can be established under the EPCA criteria, for several reasons. First, the availability and the price of the proprietary technology could change after the efficiency standards are established, if the patent owner attempts to extract the value added by the standard-setting process in royalty fees for the technology required to meet the max-tech level. Second, DOE believes that the terms of cross-licensing agreements are generally not made public, so it is difficult to assess historical trends as to the impact of such agreements on the market. Thus, DOE cannot assess the cost implications of current or future cross-licensing agreements made in the industry; by extension, DOE cannot assess the manufacturer, consumer, or nationwide impact of a standard that requires the usage of a proprietary technology.

In consideration of all of these factors, DOE maintains that it considers a standard level which can be met by only one proprietary design to be economically unjustified. Thus, DOE has rejected the max-tech level for IRL, and conducted the full range of economic analyses on what it believes to be the next highest efficiency level (not dependent on a proprietary design), TSL5.

2. Other Technologies

In response to the April 2009 NOPR, DOE received a number of comments suggesting that even without the use of a proprietary technology, several existing technologies could be utilized to produce IRL with efficacies that meet or exceed TSL5. (ADLT, Public Meeting Transcript, No. 38.4 at pp. 107–110, 113; CA Stakeholders, No. 63 at pp. 16–17; ADLT, No. 72 at p. 2; ACEEE, No. 76 at p. 5; NRDC, No. 82 at p. 4) Manufacturers also commented on the burdens and barriers associated with implementing some of these technologies. Comments received regarding alternate technologies that could be used to meet or exceed TSL5 are summarized below.

a. High-Efficiency IR Coatings

DOE analyzed advanced IR coatings in the April 2009 NOPR as a possible technology pathway to achieving TSL5 without the use of the proprietary silverized reflector. 74 FR 16920, 16944–45 (April 13, 2009). As part of its analysis (documented in the Appendix 5D of the TSD), DOE obtained several halogen burners on which advanced IR coatings were deposited.[55] Using a combination of testing and engineering calculations, DOE determined the maximum lamp efficacy that could result from implementing an advanced IR coating and non-proprietary aluminum reflector, while maintaining a lamp lifetime similar to the baseline lamp lifetime.

In response to the April 2009 NOPR, several stakeholders noted that DOE's maximum lamp efficacy as presented in Appendix 5D of the TSD, far exceeds that of TSL5 and, thus, should have been considered as a higher TSL6. (PG&E, Public Meeting Transcript, No. 38.4 at p. 99; CA Stakeholders, No. 63 at p. 15) The CA Stakeholders further agreed with DOE's statement in appendix 5D that advanced IR coatings are not a developmental product. (CA Stakeholders, No. 63 at p. 17) ADLT confirmed that the uncoated burner tested by DOE for appendix 5D has been used in products for several years in the United States and that the coating applied to this burner has been in production in Europe on 12V burners for several years. (ADLT, No. 72 at p. 3)

In contrast, NEMA commented that because DOE's lamp efficacies calculated in Appendix 5D are based on prototype burners, and not on product that is currently in production, these values overestimate the final performance that would be achieved after making all design and process tradeoffs necessary to implement a complete high-speed, high-volume assembly process. (NEMA, No. 81 at pp. 28–29) In addition, both Philips and ADLT agreed that there is a difference between the efficacy that can be attained in a laboratory production process and that which can be attained in an industrial environment. ADLT acknowledged that this difference is more pronounced when employing higher-efficiency IR coatings. (Philips, Public Meeting Transcript, No. 38.4 at p. 111; ADLT, Public Meeting Transcript, No. 38.4 at pp. 112–113)

While DOE considers advanced IR coatings to be a valid design option for increasing IRL efficacy and has not screened it out of the analysis, DOE also

[55] Halogen infrared (HIR) lamps that are commercially available today typically use infrared (IR) coatings with alternating layers of two materials (*i.e.*, SIO_2 and a second material of either Ta_2O_5 or Nb_2O_5) and have layer counts ranging from 45 to 75. In contrast, the most-efficient HIR lamps have a coating made of three materials: SiO_2, Ta_2O_5, and TiO_2, the latter in the high-index rutile phase. This three-material coating, described as a Hybrid™ by Advanced Lighting Technologies, Inc. (hereafter referred to as ''advanced IR coating ''), has an effective IR reflectance significantly higher than that of the two-material coatings used in the commercially-available examples, thereby resulting in enhanced lumen-per-watt (lm/W) values.

recognizes that it lacks the data to accurately estimate the performance of lamps utilizing this design option when manufactured at the production volumes needed to service the IRL market. Although all individual components of the prototype have been produced in high volume for separate products, that alone does not prove that a lamp with that combination of parts would have the same efficacy when manufactured on a large scale. In addition, as the analysis performed in appendix 5D of the TSD was based on an IR coating deposited in a laboratory environment, it is reasonable to assume that the efficacy of similar burners when manufactured in an industrial environment will be lower. While DOE recognizes that advanced IR coatings will likely produce higher-efficacy IRL, because DOE does not have adequate data to accurately estimate this efficacy, DOE is no longer considering the tested burners in establishing the max-tech level or alternate technology pathways to achieving other TSLs.

b. Silverized Reflectors

Commenters stated that in addition to the patent for GE's silverized reflector, two other patents exist for manufacturing coatings of reflective silver. Another company possesses a provisional patent for a silverized lamp reflector (''Reflector A''), a technology (currently in development) that has been demonstrated in prototypes that have tested performances at least equal to that of the patented technology. A third entity has a patent for a ''durable silver reflective coating'' (''Reflector B'') that could be used for lamp applications. (CA Stakeholders, No. 63 at p. 19–20; ADLT, No. 72 at p. 2)

While recognizing the promise of these reflective silver technologies, DOE notes that significant uncertainty remains as to the successful implementation of both of these designs in commercial products at the scale needed to service the IRL market. In addition, DOE has no data on the performance of Reflector A. Although stakeholder have provided tested efficacies of lamps utilizing Reflector B, similar to the discussion regarding advance IR coatings, DOE is unable accurately estimate the performance of these lamps when produced at high volumes in industrial environments. For this reason, although DOE considers silverized reflectors as an IRL design option, DOE has concluded that it cannot base its establishing of max-tech or adoption of any other TSL on the potential performance of these reflectors.

c. Integrally-Ballasted Low-Voltage IRL

In the April 2009 NOPR, DOE screened out integrally-ballasted low-voltage IRL as a technology option, because it was unaware of any IRL with integrated transformers that stepped down voltage from 120V line voltage. 74 FR 16920, 16940 (April 13, 2009). Therefore, DOE could not conclusively determine if this technology option was technologically feasible. (See the Chapter 4 of the NOPR TSD). To demonstrate technological feasibility, the California Stakeholders contracted a consulting company to combine existing lamp components to make several prototypes of 120V IRL utilizing low-voltage capsules. The tested efficacies of these prototype indicated that low-voltage capsules could be used as a technology pathway to meeting TSL4 and TSL5. (California Stakeholders, No. 63 at pp. 20–21) Regarding the technological feasibility of low-voltage IRL, Philips commented that higher mains voltages found in Europe (such as 220V and 240V) allow greater improvements in efficiency to be obtained by IRL with integrated transformers, but such improvements could not be obtained as easily in the U.S., where a mains voltage of 120V is used. (Philips, Public Meeting Transcript, No. 38.4 at pp. 318–319)

In response, because the California Stakeholders have demonstrated that an integrally-ballasted low-voltage IRL operating on 120V mains is technologically feasible, DOE is no longer screening out this technology option in its screening analysis. However, because one of the tested prototypes (in particular, the only one claimed to meet TSL5) combined the low-voltage capsule with a developmental silverized reflector (see section V.B.5.d), DOE believes that there is significant uncertainty regarding the actual efficacies when such a product is manufactured on large scales. In addition, as stakeholders did not provide the lifetime of their tested prototypes, DOE cannot confirm that the resulting efficacies represent products with lifetimes similar to the baseline lamps DOE analyzed. Therefore, although DOE recognizes the potential of integrally-ballasted low-voltage IRL to reach high efficacies, due to the lack of definitive data DOE cannot base the establishing of max tech or the adoption of any other TSL on the test data provided.

3. Lamp Lifetime

Because lamp lifetime affects lamp efficacy, certain commenters suggested that the max-tech level should reflect a typical baseline lamp with a lifetime of between 1,000 and 2,000 hours. (CA Stakeholders, No. 63 at p. 15) ADLT acknowledged that a relationship exists between lamp lumens and lifetime in which, all other things remaining equal, one cannot be changed without affecting the other. ADLT suggested that DOE should analyze lamps with lifetimes between 2,000 and 3,000 hours, which represents lifetimes commonly found in the commercial and residential markets. (ADLT, No. 72 at p. 3)

DOE agrees that the max-tech level should be based on a lamp with a lifetime typical to the baseline lamp, and it conducted its rulemaking analyses accordingly. As discussed in Chapter 5 of the TSD and consistent with ADLR's recommendation, DOE believes typical lifetimes of IRL regulated by this rulemaking are currently 2,500 to 3,000 hours. As discussed in section I.A.2, DOE has already considered that the maximum technologically feasible level would incorporate the highest-efficiency filament design, and such a filament would increase operating temperature (and efficacy) to a point that would result in a lifetime equivalent to the baseline lamp lifetime. However, because this level requires the use of the proprietary silverized reflector, DOE rejected this level as not economically-justified.

In addition, DOE has reevaluated whether TSL5 represents the maximum technologically feasible level not dependent on a single proprietary technology. In the April 2009 NOPR, DOE based TSL5 on a commercially-available IRL which employs a proprietary silver reflector, an improved (but not most-efficient) IR coating, and a filament design that results in a lifetime of 4,200 hours. However, DOE also stated that it believed that other technology pathways (not dependent on the proprietary technology) may exist. This belief was largely based on advanced IR coated capsules DOE tested (as documented in Appendix 5D). However, as discussed in section VI.B.2.a, DOE does not have the required certainty regarding these tested efficacies, and, therefore, is not considering them in establishing standard levels for this final rule. To verify that an alternate technology pathway exists to achieving TSL5, DOE evaluated commercially-available lamps at TSL4 (that generally have lifetimes of 4,000 hours) and modeled their efficacies at a reduced life-time similar to the baseline (2,500 hours). Using the 9th edition of the IESNA Lighting Handbook and by developing a relationship between lifetime, lumens, and wattage, DOE determined that a reduced lifetime TSL4 lamp (not using the proprietary silver reflector) would in fact just meet the efficacy requirements of TSL5. Therefore, DOE believes that TSL5 represents the maximum technologically feasible level not dependent on a single proprietary technology, taking into account all lifetime considerations.

C. IRL Lifetime

1. Baseline Lifetime Scenario

As discussed earlier, DOE's NOPR analyses were primarily based on commercially-available lamps, modeling 4,000-hour-lifetime and 4,200-hour-lifetime lamps at TSL4 and TSL5. DOE received a number of comments on the anticipated availability of IRL of various lifetimes under amended standards. Specifically, NEMA stated that it is possible to achieve higher efficacy levels (*e.g.*, TSL4 and TSL5), but that only shorter-lifetime lamps are likely to be offered at those levels. NEMA also argued that PAR halogen lamps must have lifetimes of at least 2,000 hours (and more typically 3,000 hours) in order to be economically viable to consumers. (NEMA, No. 81 at pp. 5, 31) In addition, ADLT commented that the market determines the appropriate combination of efficacy and lifetime, it predicted that, in the future, higher-efficacy lamps would have shorter lifetimes than those proposed by DOE at TSL4 and TSL5 in the April 2009 NOPR. (ADLT, No. 72 at p. 3–4) The CA Stakeholders also disagreed with DOE's selection of longer-lifetime lamps at TSL4 and TSL5. They stated that on a technology basis, lamp lifetime does not necessarily increase with the use of improved halogen technology. The CA Stakeholders believed that because manufacturers will be able to produce lamps with different combinations of lamp life and efficacy at TSL4 and TSL5, DOE's shipment analysis should not assume any change in average lamp life at those levels. (CA Stakeholders, No. 63 at p. 28)

Although DOE acknowledges that there is a technology trade-off between IRL lifetime and efficacy, based on the current stock of commercially-available product, DOE has concluded that lamp lifetimes of 4,000 hours and 4,200 hours are technologically feasible at TSL4 and TSL5, respectively. However, DOE also recognizes that given the issues regarding proprietary technologies, some manufacturers may choose to meet these higher efficacy levels by reducing lifetime to 2,500 hours and 3,000 hours. In addition, DOE also agrees with the CA Stakeholders, that beyond issues regarding proprietary technologies, given their ability to provide similar offerings of lamp lifetime, manufacturers will likely choose to offer lamps at lifetime similar to the baseline lamps (2,500 to 3,000 hours). Finally, DOE agrees with stakeholders that such an assumption will likely change the impacts of amended standards on consumers and manufacturers from those presented in the April 2009 NOPR.

For this reason, DOE developed a Baseline Lifetime scenario (in which it analyzed LCC savings, NPV, and manufacturer impacts) to investigate the effects of shorter lamp lifetime at TSL4 and TSL5. DOE determined it was not necessary to apply this scenario to TSL1 through TSL3, because at those levels, DOE already analyzes lamps with lifetimes similar to those of the baseline lamp lifetimes. However, for this scenario at TSL4, for each of the three baseline lumen packages, DOE analyzed an additional IRL with a lifetime equivalent to the baseline lamp's lifetime (2500 hours for the 90W lumen package, 2500 hours for the 75W lumen package, 3000 hours for the 50W lumen package). The efficacy and wattages of the additional IRL were the same as those analyzed at TSL4 in the April 2009 NOPR. In addition, as DOE had no indication that a less-costly technology could be utilized to meet TSL4 at these lower lifetimes, DOE modeled that the price of these additional lamps would be the same as the long-lifetime TSL4 lamps.

For the Baseline Lifetime scenario at TSL5, as discussed in section VI.B.3, DOE's calculations indicate that the operating temperature of the 4,000 hour TSL4 lamp could be increased so as to result in a 2,500 hour lifetime lamp with an efficacy that would just meet TSL5. Therefore, at TSL5, DOE models three additional lamps (one for each baseline lumen package) which have lifetimes of 2,500 hours, the same prices of the TSL4 lamps (since these lamps would use the same technologies), and the same wattages and efficacies of the previously analyzed TSL5 lamps. The results of this Baseline Lifetime scenario are presented with the Commercial Product Lifetime scenario in sections VII.B, VII.C.1, VII.C.2 and VII.C.3.

2. Minimum Lamp Lifetime Requirement

Some stakeholders expressed concern regarding the possibility of extremely low lifetime lamps entering the market if DOE were to adopt TSL4 or TSL5. As mentioned above, NEMA stated that a PAR halogen lamp must have a lifetime of at least 2,000 hours, and more typically 3,000 hours, to be economically viable. (NEMA, No. 81 at p. 31) NEMA stated that shorter-lifetime lamps are unacceptable for long-life applications and negatively impacted the environment, because more lamps must be manufactured, transported, and disposed of. (NEMA, No. 81 at pp. 5, 31) Thus, NEMA commented that DOE should have considered a minimum lamp life when setting efficacy standards. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 104, 111–112) Edison Electric Institute recommended that DOE should consider setting a minimum lifetime standard for IRL, as was done for CFL via the Energy Policy Act of 2005 (EPACT 2005). (EEI, Public Meeting Transcript, No. 38.4 at p. 117)

While DOE acknowledges that EPACT 2005 set a minimum lifetime standard for CFL based on the August 9, 2001 version of the Energy Star Program Requirements for Compact Fluorescent Lamps (42 U.S.C. 6295(bb)), DOE does not have the authority to set minimum lifetime standards for incandescent reflector lamps, because lamps lifetime is not an energy efficiency metric. Under 42 U.S.C. 6291(6), ''energy conservation standard'' is defined as: (1) A performance standard which prescribes a minimum level of energy efficiency or a maximum quantity of energy use; or (2) a design requirement (only for specifically enumerated products, which do not include incandescent reflector lamps). Because a standard for lamp lifetime would not fall under the definition of ''energy conservation standard'' as defined by 42 U.S.C. 6291(6), DOE cannot adopt a minimum lifetime requirement for IRL in this final rule.

3. 6,000-Hour-Lifetime Lamps

In response to these comments, DOE notes that it selected IRL designs for its Commercial Product Lifetime scenario that would preserve the lifetime of the baseline IRL analyzed in this rulemaking, even though DOE understands that manufacturers can increase IRL efficacy by reducing IRL lifetime. 73 FR 13620, 13650 (March 13, 2008). DOE notes that improved HIR lamps, as well as lamps introduced to meet TSL5 in the April 2009 NOPR have lifetimes greater than 4,000 hours, demonstrating that longer-life lamps can meet higher standard levels. DOE also believes that the life-cycle cost analysis results presented in this rulemaking accurately indicate the economic benefits to consumers, as the life-cycle cost analysis inherently considers lamp lifetime as well as the time value of money. Furthermore, in the April 2009

NOPR, DOE expressed its belief that lamp lifetime is an economic issue rather than a utility issue because lifetime does not change the light output of the lamp. 74 FR 16920, 16939 (April 13, 2009). Nevertheless, DOE analyzed whether long-life lamps would be available at higher TSLs. At TSL5, DOE has determined that manufacturers can provide lamps with a lifetime of at least 4,200 hours, but is unable to confirm that they could offer lamps with a lifetime of 6,000 hours. However, at TSL4, DOE believes that manufacturers can achieve lifetimes of 6,000 hours by decreasing the efficacy of a lamp compliant with TSL5. Thus, 6,000-hour-lifetime lamps would not be eliminated at this standard level.

In summary, DOE understands that lifetime and IRL efficacy are related, but believes that the selection of an IRL lifetime by a lamp designer does not automatically determine the efficacy of the lamp. There are a variety of methods that lamp designers can utilize to meet DOE's standard levels, and these methods are analyzed in this rulemaking. DOE considers how lamp lifetime affects consumers in its LCC analysis.

D. Impact on Competition

1. Manufacturers

DOE received several comments related to the impact of IRL standards on industry competition. Philips believed that because most technologies employed to manufacture advanced IR coatings were proprietary, the adoption of IRL standards that required such a technology would adversely affect competition among lamp manufacturers. (Philips, Public Meeting Transcript, No. 38.4 at pp. 111–112)

ADLT disagreed that advanced IR coatings required proprietary technology. (ADLT, Public Meeting Transcript, No. 38.4 at p. 112) The CA Stakeholders also disagreed and instead supported DOE's assertion in appendix 5D that advanced IR coatings were not a developmental product, and were presently not patented and were available to all lamp manufacturers. (CA Stakeholders, No. 63 at p. 17) ADLT confirmed that the uncoated burner tested by DOE for appendix 5D has been in production for several years in the United States. Furthermore, the coating applied to this burner has been in production in Europe on 12V burners for several years. (ADLT, No. 72 at p. 3)

The California Stakeholders asserted that adoption of a high standard level for IRL would not cause a significant lessening of competition. They commented that because manufacturers invest in new technologies at different times in competition with rivals, manufacturers currently offer products of different efficacies. The California Stakeholders added further that manufacturers have already invested significant capital to develop efficient burners and reflectors, which is reflected by the fact that they offer products currently meeting TSL 4 and TSL 5. (California Stakeholders, No. 63 at pp. 24–25)

In response, DOE does not believe that the adoption of a high standard level will adversely affect competition between lamp manufacturers. Consumers purchase lamps for a variety of utility features (size, color, dimming capability, directional light, lifetime, etc.) other than efficacy. Because consumer choice among these many features will remain unrestricted by this final rule, manufacturers have many grounds on which to compete. Furthermore, continued innovation in incandescent technology—driven, in part, by the desire to maintain a schedule of margins based on efficiency (as opposed to simply the utility features noted above)—is likely to maintain or even promote competition. DOE also acknowledges the proprietary silverized reflector technology at issue. As discussed in section VI.A, DOE believes there are alternative technologies to meeting higher efficacy levels and therefore believes that this final rule does not provide for any technological advantage that doesn't already exist in the marketplace. A more detailed discussion of the impact of the adopted IRL standard on industry competition is contained in section VII.C.5.

DOE also received comment regarding the impact of the effective date for IRL standards on industry competition. To DOE's knowledge, two of the three major manufacturers of IRL currently sell a full product line (across common wattages) that meet TSL4. However, it is DOE's understanding that OSI employs a technology platform that, due to the positioning of the filament in the HIR capsule, is inherently less efficient. Therefore, it is likely that in order to meet TSL4, OSI would have to make considerably higher investments than the other manufacturers, placing it at a competitive disadvantage. OSI commented that they required one additional year to obtain the requisite approval, design, build, and install equipment, and stabilize high volume production if DOE were to adopt TSL4. (OSI, No. 84 at p. 1)

While DOE recognizes the challenges inherent in gaining access to technology and building capacity needed to begin production, as detailed in section VI.I of this notice DOE does not have the statutory authority to extend the implementation period. OSI did not provide the detailed information which DOE would need to appreciate why what is achievable in 4 years cannot be accomplished in the 3 years lead time specified by EPCA. For example DOE believes that proprietary technologies are not required to meet TSL 4 and that suppliers could provide HIR capsules if these could not be manufactured in-house. Furthermore it is unclear how it might be possible to stabilize high volume production without producing high volumes of lamps. For this reason DOE believes that a 3 year lead time will be sufficient to ensure that the IRL market is supplied.

2. Suppliers

DOE also received several comments related to the potential impact of the adopted IRL standard on the competition between technology suppliers. The Applied Coatings Group (ACG) expressed concern regarding the adoption of an IRL standard that could only be met using an advanced IR coating manufactured by ADLT (this coating is described in appendix 5D of the TSD). ACG believed that such an action may create a monopoly for DSI, a subsidiary of ADLT, which would be detrimental for the lighting industry and consumers. (ACG, No. 52 at p. 2)

Conversely, the CA Stakeholders believed that there is already competition to manufacture advanced coatings for lamps. They provided a list of companies that had either already invested in the technology or were considering such an investment. (CA Stakeholders, No. 63 at p. 18) DSI, a U.S. company which is owned by ADLT, applies coatings using a sputtering process in a vacuum chamber. Auer Lighting, a German company also owned by ADLT, manufactures a similar coating of comparable efficiency and price using plasma impulse chemical vapor deposition (PICVD). Furthermore, a patent is pending on a third process to apply an IR coating to improve lamp efficacy (CA Stakeholders, No. 63 at pp. 17–18) The CA Stakeholders believe that the IRL standards adopted by this rulemaking and the GSIL standards imposed by EISA 2007 will only increase the level of competition in the advanced coatings industry. (CA Stakeholders, No. 63 at pp. 18–19)

DOE agrees with the CA Stakeholders that the adopted standard for IRL will not create a monopoly for DSI because sufficient competition exists in the advanced coatings industry. As discussed above, other companies are currently investing in advanced IR coating technology or are considering such an investment prior to DOE adopting revised IRL standards in this final rule. Furthermore, technology pathways exist other than advanced IR coatings that can meet or exceed the highest efficacy level. Thus, it is extremely unlikely for one company to become a monopoly as a result of DOE's adopted standards because there is more than one technology pathway to meet the most efficient level. For these reasons, DOE believes that the IRL standards adopted in today's final rule will not adversely impact competition among technology suppliers.

E. Xenon

In response to the March 2008 ANOPR, DOE received comments regarding the price and availability of xenon. Manufacturers believed that because of xenon's high price and limited supply, it should not be considered for use as a higher efficiency inert fill gas. (NEMA, No. 21 at p. 9) Although price is not considered in the screening analysis, DOE did conduct an in-depth market assessment of the supply of xenon, and the potential impact of xenon supply limitations on IRL standard levels. DOE determined that although xenon is a rare gas, its supply is sufficiently large to incorporate into all IRL and that the xenon supply would not affect IRL product availability (see appendix 3B of the TSD for more details). As such, in the April 2009 NOPR, DOE believed that the use of xenon as a higher efficiency inert fill gas satisfied the screening criteria and considered it as a design option when developing efficacy levels.

The CA Stakeholders agreed with DOE's analysis and conclusions in appendix 3B of the TSD that xenon is not likely to impact manufacturers' ability to produce IRL at higher standard levels. (CA Stakeholders, No. 63 at p. 22) NEMA agreed with DOE's observations regarding the fluctuating demand for xenon and its price being affected by demand in other industries. However, NEMA reiterated that DOE must consider the increased cost of xenon in its LCC analysis because NEMA estimates these costs to be substantial ($0.50 to $0.75 per lamp). (NEMA, No. 81 at p. 20)

In response, DOE did consider the impact of the price of xenon on LCC savings in the April 2009 NOPR and has updated its analysis with NEMA's inputs. DOE performed an analysis, described in appendix 3B, in which it calculated how much the price of xenon would have to increase before LCC savings became negative. DOE concluded that, in general, the price of xenon could approximately triple before it significantly negatively impacted LCC savings. However, DOE notes that when examining LCC savings for lamps modeled in the Baseline Lifetime scenario (see section VI.C.1), the economic benefits of moving to higher efficacy lamps is much reduced. Therefore, increases in the price of xenon could in fact turn LCC savings to LCC increases for some consumers. DOE also maintains its conclusion that the availability of xenon will not be impacted by this final rule because historical evidence shows that supply slowly increases until it meets demand. For more details, *see* appendix 3B of the TSD.

F. IRL Hot Shock

In interviews, manufacturers of IRL expressed concern that halogen and HIR IRL are susceptible to a premature failure mode known as ''hot shock'' when installed in energized sockets, which could reduce LCC savings for consumers. The hot shock condition occurs when the lamp filament contacts another part of itself due to vibration or torque, causing an electrical short within the lamp. In written comments, both NEMA and GE expressed that hot shock is a significant concern for efficacious IRL, especially in the residential sector, where IRL in recessed ceiling cans of multi-floor houses may experience hot shock due to vibrations caused by the movement of people on the upper floors shared by the ceilings where IRL are installed. (NEMA, No. 81 at p. 6, p. 10, pp. 27–28; GE, No. 80 at p. 7–8) In contrast, the California Stakeholders provided three reasons why they believed that the hot shock failure mode is not prevalent enough to prevent DOE from selecting a standard level that may require higher efficiency technologies. (California Stakeholders, No. 63 at pp. 21–22) Firstly, the California Stakeholders stated that in product documentation, manufacturers describe simple ways to avoid hot shock, primarily by avoiding installing or directing lamps while circuits are on. Secondly, the California Stakeholders stated that a patented technology (specifically a voltage reduction circuit) exists that claims to eliminate the risk of hot shock. Lastly, the California Stakeholders argued that as manufacturers have been selling halogen and HIR lamps for many years, if hot shock was a significant concern, there would be a noticeable adverse market response and mentioning of consumer dissatisfaction (of which their research found neither).

DOE acknowledges that halogen and HIR IRL are susceptible to hot shock during installation in energized sockets or due to vibration that occurs during operation. DOE cannot set standards that necessitate the usage of a proprietary technology due to the adverse impacts on manufacturers and industry competition that may result. Thus, DOE is not considering the patent described by the California Stakeholders as a feasible way of preserving LCC savings. See section VI.B.1 for further details. DOE does agree, however, that halogen and HIR products are readily available on the market despite the risk of hot shock. DOE was unable to determine the prevalence of hot shock in the commercial or residential sectors due to a lack of available data, so DOE determined at what lifetime a standards-compliant lamp purchased by a commercial or residential consumer would experience negative LCC savings. The results are shown in Table VI.1 for commercial consumers and Table VI.2 for residential consumers. Entries of ''N/A'' represent lamps that already give negative LCC savings to consumers. DOE also notes, as discussed in the April 2008 NOPR, during interviews manufacturers stated hot shock could decrease lifetime by 25 to 30 percent.

TABLE VI.1—IRL LIFETIME FOR NEGATIVE LCC SAVINGS IN THE COMMERCIAL SECTOR

Efficacy level	IRL lifetime (hours)		
	90W baseline	75W baseline	50W baseline
EL1	N/A	N/A	N/A
EL2—6,000 hr	2587	2587	3277
EL2—3,000 hr	2242	2242	N/A
EL3	1897	1897	2932
EL4	1897	2242	3277

TABLE VI.1—IRL LIFETIME FOR NEGATIVE LCC SAVINGS IN THE COMMERCIAL SECTOR—Continued

Efficacy level	IRL lifetime (hours)		
	90W baseline	75W baseline	50W baseline
EL5	1897	1897	3277

TABLE VI.2—IRL LIFETIME FOR NEGATIVE LCC SAVINGS IN THE RESIDENTIAL SECTOR

Efficacy level	IRL lifetime (hours)		
	90W baseline	75W baseline	50W baseline
EL1	2443	N/A	N/A
EL2—6,000 hr	2355	2532	3233
EL2—3,000 hr	1999	2177	2977
EL3	1644	1821	2621
EL4	1733	1910	2977
EL5	1644	1910	3243

G. Rare Earth Phosphors

During manufacturer interviews, manufacturers asserted that higher TSLs for GSFL would require substantially larger amounts of triphosphor to attain those efficiency levels. As compared to halophosphor, triphosphor is composed of more expensive rare earth elements that increase many performance features of GSFL, including efficacy, lumen maintenance, and color rendition. Manufacturers commented that a standards-induced increase in triphosphor demand would drive up prices for the rare earth elements used to make triphosphor, and might potentially exceed what the market could supply. In response, for the April 2009 NOPR, DOE conducted a market assessment of the rare earth phosphor industry (see April 2009 NOPR TSD Appendix 3C). DOE focused on the key rare earth elements used in high-efficacy GSFL—yttrium, terbium, and europium—because they are major cost drivers of triphosphor and were the subject of manufacturer concerns over availability. After completing the assessment, DOE did not believe it had sufficient information to project phosphor prices by modeling future supply and demand curves. Instead, DOE compared the LCC savings of consumers purchasing high-efficacy lamps to potential increases in the incremental first cost of rare-earth-based 800-series lamps that would result from higher rare earth phosphor prices. In general, DOE found that in most commercial and residential purchase events, consumer LCC savings was sufficiently high to remain positive even in the face of potentially dramatic increases in phosphor prices. DOE also stated that higher prices were likely to attract mining firms into the market and make less-concentrated rare earth deposits economically viable. 74 FR 16920, 16974 (April 13, 2009)

NEMA disagreed with DOE's analysis in the April 2009 NOPR and conclusion on four major points: First, DOE underestimated the increase in standards-induced triphosphor demand; second, DOE did not appropriately consider the problems with supply in the industry; third, higher efficacy levels will have a negative environmental impact due to the required increase in mining operations; fourth, the cumulative effect of the above factors would lead to dramatic increases in costs to manufactures and consumers.

Specifically, on the magnitude of standards-induced triphosphor demand, NEMA argued that TSL 1 or TSL 2 would prohibit halophosphor lamps, which would double manufacturer triphosphor demand. NEMA commented that shifting all lamps to TSL 4 or TSL 5 would increase the industry's triphosphor needs by an additional factor of three. In sum, NEMA estimated TSL 1, TSL 2, TSL 3, TSL 4, and TSL 5 would require 175 percent, 200 percent, 230 percent, 250 percent, and 350 percent of current triphosphor usage, respectively. (Philips, Public Meeting Transcript, No 38.4 at pp. 247–248, 251–252; NEMA, No. 81 at pp. 3, 18–19) Conversely, NRDC argued that the conversion of T12 lamps to T8 and T5 lamps would mitigate the increase in phosphor demand. (NRDC, No. 82 at p. 3)

In response to all comments, DOE conducted additional research on the rare earth industry, including several interviews with agents along the triphosphor value chain and other industry experts. Based on these interviews, manufacturer comments, further research and analysis of additional data obtained, DOE reevaluated its rare earth phosphor market analysis and assumptions.

To determine how much trisphosphor demand would increase at each TSL, DOE determined the amount of triphosphor required in each lamp type at each TSL, using assumptions from manufacturer interviews and industry interviews. For example, DOE used Philips' estimate that high performance 800-series lamps require three to four times as much triphosphor as standard 700-series lamps to establish the difference in triphosphor weight between the two phosphor series. DOE then multiplied these amounts by its shipments projections (*see* section V.D.2) for each phosphor series. (*See* TSD appendix 3C for a more detailed discussion of DOE's methodology.)

Based on this analysis, DOE agrees with the industry commenters that amended standards will lead to significant increases in manufacturers' need for triphosphor, and by extension, europium (Eu), terbium (Tb), and yttrium (Y). DOE estimates that at TSL 3, TSL 4, and TSL 5, manufacturer demand for triphosphor in covered products in 2012 would be 171 percent, 183 percent, and approximately 230 percent of base-case usage, respectively. These ranges reflect DOE's upper-bound and lower-bound energy savings scenarios, which DOE used to capture the effect of consumers selecting different phosphor series lamps in response to standards. In the lower-bound scenario, triphosphor usage actually declines from TSL 3 to TSL 4, as the increase in triphosphor usage due to higher-efficacy lamps is offset by the decline in usage from the elimination of high-efficacy T12 lamps. At TSL 5, there is a large incremental jump in usage under any scenario.

DOE believes its own estimate of the standards-induced triphosphor demand differs from NEMA's estimate for several reasons. First, DOE's estimate is relative to the 2012 market as opposed to current usage. DOE's analysis attempts to isolate the impact on triphosphor usage from the energy conservation standards under consideration in this rulemaking, net of the expected increase between now and the effective date. As such, DOE accounts for a currently-ongoing trend toward triphosphor lamps in the base case due to the increased penetration of triphosphor T8 lamps relative to halophosphor T12 lamps. Supporting this base-case increase in triphosphor usage, one industry supplier told DOE it expected triphosphor demand for linear GSFL to double in five to six years in the base case. Another said it expects continued double-digit growth in terbium demand. Second, DOE's estimate does not assume that all T8 lamps are 700-series in the 2012 base case. For example, 22 percent of 4-foot medium bipin lamps T8 are 800-series or high-performance 800-series lamps.

Regarding NEMA's second point regarding the total available supply of rare earth phosphors, Philips commented that Rhodia, a major phosphor supplier, told them in 2006 that there was only a 14-year terbium supply left in the ground, meaning that if demand doubled due to standards, the lamp industry would struggle to obtain sufficient amounts of terbium in six to seven years. NEMA commented that Rhodia predicted that even without changes to DOE's energy conservation standards, terbium, and europium would be in short supply within five years. (Philips, Public Meeting Transcript, No 38.4 at pp. 254–255, 258–259, 263)

NEMA also highlighted China's monopolistic position in the rare earth market as a threat to supply. NEMA stated that China, in an attempt to move manufacturing of products such as GSFL to their country, is setting production caps, reducing export quotas and licenses, and placing taxes on exports of rare earth commodities. According to NEMA, Chinese mine operators will not flood the market with the more abundant elements because that would depress their value. (NEMA, No. 81 at pp. 16–18)

NEMA also rejected the notion that mines outside China, induced by higher phosphor prices, could augment supply by the amount China is restricting it. NEMA asserted that DOE should focus not on rare earths in general but rather those that are important to GSFL, particularly terbium and europium, because they represent only a tiny fraction of the rare earth mined. NEMA stated that DOE's list of potential mines in the April 2009 NOPR TSD (appendix 3b) does not indicate the presence of significant phosphor elements needed for GSFL manufacturing. For example, one mine DOE had listed as a potential source is in Mountain Pass, California. However, NEMA stated that its ore contained only 0.2 percent europium and no measure of terbium, according to the U.S. Geological Survey. (NEMA, No. 81 at p. 16–19) Even if other mines eventually go into production, Philips argued, they will not come online quickly enough to meet standards-induced demand. (Philips, Public Meeting Transcript, No 38.4 at pp. 253, 259) NEMA commented that DOE's conclusion that higher rare earth prices will attract additional mining operations is not supported by the record or anyone with knowledge of the subject. (NEMA, No. 81 at p. 19)

As it relates to the physical availability of Y, Tb, and Eu, DOE reevaluated its analysis on the supply and demand of the key rare earths to the lighting industry given manufacturer comments. DOE agrees that the availability of rare earth phosphors (particularly with regard to terbium and europium) is a serious issue. As stated above, DOE agrees that manufacturers will most likely require large increases in rare earth phosphors to meet the standard established by this final rule. DOE interviewed industry experts and suppliers along the triphosphor value chain about the quantity of the key elements likely to be available over the near, intermediate, and long term. DOE received conflicting reports from those within the field regarding future supplies of these key materials. Many factors obscure the amount of recoverable rare earth that will be available to manufacturers, including future Chinese policy and strategic priorities, policies of countries outside China, demand from other applications, reclamation efforts, and lack of transparency in the industry. Industry experts have suggested there are sufficient amounts available to meet expected demand for anywhere from 15 years to indefinitely. That is not to say that a supply shortage of these key elements and other rare earths is unlikely. Indeed, many of those experts that DOE interviewed expect shortages of most rare earths—not because of this rulemaking, but because of Chinese policy. Based on its interviews and research, DOE has concluded that the pivotal issue governing the risk to the physical availability of rare earths is Chinese policy. China currently supplies some 95 percent of the rare earth market and has taken steps to restrict the exportation of rare earths resources. Many in the field, as noted by manufacturers, consider this to be more a reflection of China's strategic decision to compel rare earth-dependent industries (which tend to be burgeoning high-technology fields) to host operations in China,[56] rather than an indication of limitation in terms of the physical availability of the resource.[57] DOE does not dispute such a strategy could restrict rare earth phosphor supplies. However, DOE again notes this is substantially not a function of this final rule, but of external factors that may or may not affect industry in the base case as well as the standards case.

In terms of other mining operations outside China, DOE found differing opinions on whether such operations have the potential to appreciably increase the supply of the key rare earths. DOE understands the key difference between those elements critical to the lighting industry and rare earths in general (discussed below) and agrees with NEMA that simply increasing production of rare earths is not sufficient to meet the specific needs of lamp manufacturers. While DOE also agrees that new projects outside of China could take years to come online, industry experts related that part of the reason for this is the threat of China increasing supply, thereby reducing prices, just as other facilities embark on the large capital costs required to develop mines. While this does imply a limited role for non-Chinese suppliers, it necessarily also implies an increase in rare earth phosphor supply.

DOE continues to believe that any sharp increase in demand over the long term will send strong price signals to rare earth suppliers and potential suppliers around the globe, thereby increasing investment in the exploration and recovery of rare earths, as discussed in appendix 3B of the TSD. Another view common to the industry is that nations outside China will be forced to view rare earths as a strategic resource and take steps to secure access. The United States Geological Survey estimates that 58 percent of rare earth reserves base are in China,[58] meaning

[56] Latimer, Cole; Kim, Jieun, Kim; Tahara-Stubbs, Mia; Wang, Yumin, ''China's Rare Earth Monopoly Threatens Global Suppliers, Rival Producers Claim,'' Financial Times (May 29, 2009).

[57] Richardson, Ed, Thomas & Skinner, ''High Performance Magnets,'' Strategic Minerals Conference (April 2009).

[58] Hedrick, James B., *Mineral Commodity Summaries*, United States Geological Survey (Jan. 2009).

there could be other sources of rare earths, although reserves of those specific rare earth elements key to lighting use may be more highly concentrated in China than all rare earths. (Please see appendix 3C of the TSD for a list of potential rare earth development projects.) Two potential domestic rare earth sources are the Mountain Pass, California site and the Pea Ridge iron ore mine in Missouri. NEMA and Philips noted that while 20,000 tons of rare earths could potentially be mined at Mountain Pass, only 0.2% was europium. Regardless of the likelihood of the mine in Mountain Pass reopening, DOE notes that that amount equates to 40 tons of europium annually, a figured DOE confirmed by interviews with the mine's operators. Production could in fact be higher, and such an amount is not insignificant amount given that estimated total worldwide demand for europium was 300 tons in 2007 and was projected to be 420 tons in 2012.[59] While estimates vary, a Rhodia presentation estimates terbium demand to be 420 tons in 2012, not the 600 tons NEMA noted. The company also told DOE that it expects supply and demand to be in balance in the near term for terbium and europium. Reports of the Pea Ridge resource indicate it is relatively rich in the rare earths key to the lighting industry, including terbium.[60] Molycorp, the company that owns the Mountain Pass site, also told DOE that it is currently exploring four other sites outside China that have significant concentrations of the heavy rare earths (the group to which the critical rare earths such as terbium belong).

NEMA also commented on phosphor reclamation as another source of rare earth supply. Philips stated that Rhodia has said there physically will not be enough phosphor beyond 2015 without reclamation. NEMA argued that while reclamation could augment supply, it would require significant infrastructure investment and still bring issues such as mercury contamination into play with regard to international transport (as many phosphor manufacturers are overseas). Such infrastructure and systems of collection and handling currently do not exist. Therefore, NEMA argued, while it expects recycling to emerge in response to the impending shortage, it is ''entirely speculative'' to assume reclamation can impact the rare earth phosphor shortage in this decade. Philips stated that only one of the two types of the green phosphor can currently be recycled; the type commonly used in CFLs cannot. In addition, GE stated that at TSL 4 and TSL 5, reclamation will not enlarge supply because reclaimed phosphor does not perform well enough to meet those levels. (Philips, Public Meeting Transcript, No 38.4 at pp. 261, 262; NEMA, No. 81 at p. 18)

Based on interviews, DOE believes that reclamation efforts can play a significant role in augmenting supply, but only in the longer term. Rhodia estimates that by 2015 there will be more than 250 tons of rare earth oxide in recycled lamps.[61] Rhodia already has reclamation ability and is ramping up its capacity, but technical and economic challenges of commercial-scale operations remain. First, the infrastructure to collect recycled GSFL must be in place. With this infrastructure, a commercial-scale, technically-viable process for distilling the rare earths from the other lamp materials—glass, alumina, halophosphate, etc.—must be established. This will have to include chemical treatments, mercury removal, and waste disposal.

While DOE agrees that reclaimed phosphor is too degraded to be used at TSL 4 or TSL 5, DOE notes that Rhodia stated that it can still meet the needs of high-performance lamps because the company refines the triphosphor back down into its original elements (*e.g.*, terbium, europium) and then remanufactures the triphosphor. Because this process clearly adds cost to the reclaimed triphosphor, it is likely only higher price points will trigger additional supply via reclamation.

The attractiveness of reclamation will depend not only on the cost of the process versus the price of normal rare earth acquisition, but also the amount of rare earth available for recovery in the retiring lamp stock. Currently, the universe of retiring lamps was installed several years ago; they are mostly halophosphor lamps. Therefore, the yield of rare earth oxides from recycling these lamps would be unlikely to make commercial-scale reclamation economically attractive in the very near future. As such, in light of the other details, DOE agrees that large-scale reclamation is unlikely to occur before 2015. However, in several years, Rhodia expects the amount of recoverable useful rare earth to grow significantly as high-performance GSFL become commonplace.[62] Just as energy conservation standards will increase the demand for rare earth phosphor in 2012, they will provide larger volumes available for reclamation when they retire. At such time, it is entirely possible that reclamation eventually could augment supply.

On its third point regarding the impact of rare earth mining, NEMA argued that those who think TSL 5 is environmentally sound are not considering the environmental impact that will arise from such an increase in demand. Philips argued that the goal of the U.S. should not be to quadruple strip mining operations around the world. According to Philips, TSL 5 would increase mining by 300 percent relative to TSL 3, depleting natural resources more rapidly and increasing the cost to the consumer. (Philips, Public Meeting Transcript, No 38.4 at pp. 253, 259; NEMA, No. 81 at p. 19)

DOE agrees with NEMA and Philips that increased demand could require additional mining operations. However, mining for rare earths reflects a small portion of all global mining operations. DOE does not believe that the increase in global demand resulting from this final rule will come close to requiring the mining increase suggested by Philips as industry experts also noted that rare earths in many instances could be mined as byproducts and, therefore, not create the same footprint as an entirely new project.

On its fourth point, NEMA and Philips argued that a massive price spike in rare earth phosphors will occur in 2012 when manufacturers supplying the U.S. market have to double their requirements as China continues to reduce quotas. GE commented that this would lead to very expensive lamps for consumers. (GE, Public Meeting Transcript, No 38.4 at pp. 256; Philips, Public Meeting Transcript, No 38.4 at pp. 248–249; NEMA, No. 81 at p. 18) Conversely, the California Stakeholders commented that they agreed with DOE's April 2009 NOPR analysis related to rare earth phosphors, stating that rare earth phosphor prices and availability would not affect product availability or consumers' life cycle cost savings. (California Stakeholders, No. 63 at p. 11) ACEEE commented that it does not expect the availability of rare earth phosphors to result in excessive price volatility. (ACEEE, No. 76 at p. 2)

In response, as discussed in the April 2009 NOPR, DOE believes that the standards case, all other things being

[59] Cuif. Jean-Pierre, Rhodia Silcea—Electronics BU, ''Is there enough rare earth for the ''green switch'' and flat Tvs?'', Phosphor Global Summit 2008 (March 2008).

[60] Available at: *http://www.wingsironore.com/data/wings_enterprises_reo_quick_summary.pdf*

[61] Rhodia, ''Phosphor Recycling: Dream or New Source of Rare Earths?'' Presentation at Phosphor Global Summit 2009 (March 2009).

[62] Rhodia, ''Phosphor Recycling: Dream or New Source of Rare Earths?'', Presentation at Phosphor Global Summit 2009 (March 2009).

equal, will result in higher prices for yttrium, europium, and terbium. (74 FR 16920, 16974 (April 13, 2009) As in the April 2009 NOPR, DOE does not believe is it possible to generate reasonable price forecasts, particularly given the historical volatility in rare earth prices, trade restrictions, trade policies, lack of publically-available data from China, and potential supply sources coming online. As an example of the price volatility, terbium prices on May 20, 2009 were roughly half what they averaged in 2008,[63] this after increasing dramatically in previous years.

However, given that DOE believes standards-induced demand increase has the potential to affect the worldwide demand of europium, terbium, and yttrium, DOE has concluded that it is possible prices will rise for these elements, all other things being equal. To broadly gauge the potential impact of standards on prices, DOE assessed the standards-induced increase of their demand in the context of the international market for these materials, as these key rare earths have many applications and are transacted in a global market. DOE estimates that this final rule will increase worldwide demand for terbium and europium relative to the 2012 base case by roughly 10 percent. DOE used Rhodia estimates for the 2012 base case.[64]

DOE's interviews and research showed that there are many value-added processes in the supply chain of triphosphor. Some of the cost attendant to these processes is not directly driven by the demand (and scarcity) of these rare earth elements themselves, but by the mining, chemical processing and concentrating, and blending costs that are inherent to triphosphor production. According to interview participants, these processes are highly driven by energy costs, which will be mostly equivalent in the base case and standards cases. This is supported by the fact that despite the prospect of increasing demand, the prices of the key rare earths declined significantly from summer 2008 to spring 2009, more in line with oil and other commodity prices. Other important cost drivers to manufacturers include a 25-percent tariff on the export of key rare earths from China, which will also be the same in the base case and standards cases.

As it did in the April 2009 NOPR, DOE conducted a sensitivity analysis for this final rule to address the potential increases in end-user lamp prices attributable to higher rare earth input costs. And despite the fact that price increases in the key rare earth elements are unlikely to be equal to triphosphor costs (because of the many other cost inputs), to be conservative, DOE assumed that such a relationship existed. That is, if Eu, Y, and Tb prices—weighted for their proportional use in triphosphor—doubled, DOE assumed the price of triphosphor also doubled. DOE used the analysis to determine how robust consumer LCC savings are at TSL 3, TSL 4, and TSL 5. DOE compares the LCC savings due to purchasing higher-efficacy GSFL (as calculated in chapter 8) to LCC savings under scenario with higher phosphor prices. As discussed in appendix 3C of the TSD, DOE determined the quantity of each rare earth phosphor required to manufacture each phosphor series of GSFL. DOE then estimated how a range of prices for the key rare earth phosphors would affect manufacturing lamp costs. Next, by applying manufacturer and retail markups, DOE analyzed how increases in rare earth phosphor prices may affect LCC savings for a consumer of each lamp type.

DOE found that for most commercial and residential purchase events, consumer LCC savings were sufficiently high to remain positive even if there were dramatic increases in triphosphor prices and manufacturers were forced to pass those cost increases on to the consumer with current markup levels. In fact, all events that yield positive LCC savings at TSL 4 at current triphosphor prices would maintain positive LCC savings despite dramatic increases in trisphosphor prices (as a result of rare earth price increases). By the same token, DOE calculated that the dramatic decline in rare earths prices since the summer of 2008 likely did not significantly affect consumer LCC savings.

In conclusion, regardless of the differences between DOE and NEMA's phosphor usage estimates, it is worth noting that moving from TSL 3 to TSL 4 results in a much smaller increase in triphosphor usage than any other incremental step up in efficacy levels, according to each estimate. As noted above, NEMA estimates a relatively small increase in usage at TSL 4 relative to TSL 3 (250 percent vs. 230 percent) and both show a much larger increase in moving to TSL 5 (350 percent). Given that NEMA commented that TSL 3 could be implemented in terms of triphosphor, despite more than doubling domestic usage, DOE believes the relatively small incremental demand increase of moving to TSL 4 works to justify the latter, higher efficacy level. (NEMA, No. 81 at p. 2; GE, Public Meeting Transcript, No 38.4 at pp. 254–255) Similarly, while it is impossible to guarantee the amount of recoverable rare earth in the ground, or predict the supply impacts of Chinese policy, DOE does not believe the slight incremental impact of TSL 4 relative to TSL 3 significantly exacerbates these concerns. However, given the large increases in rare earth phosphor required at TSL 5 relative to TSL 4, DOE is concerned about the impact of TSL 5 on product availability as well as the potential environmental impact of producing the necessary rare earth resources.

For all of these reasons—a relative small increase in triphosphor needs at TSL4 relative to TSL 3, which industry acknowledged was acceptable; continued LCC savings for the consumer even with higher triphosphor prices and tariffs; greater potential for additional supply resources and reclamation with higher rare earth prices; and, significantly, the fact that the major factors in rare earth availability and prices are largely independent of this rulemaking—DOE concludes that TSL 1 through TSL 4 are appropriate with respect to rare earth phosphor availability, prices, and environmental impact.

H. Product and Performance Feature Availability

1. Dimming Functionality

NEMA expressed concern about the loss of dimming capability as IRL consumers migrate to other technologies. NEMA acknowledged that although no data exists to characterize the dimming market, industry believes there is ''considerable overlap'' between dimmer and IRL installations. Thus, for both the commercial and residential sector, NEMA believes that a significant number of installed halogen lamps are used in combination with dimmers. NEMA commented that at TSL4 and TSL5 specifically, the high price of covered IRL will likely force consumers to buy lower cost, but non-dimmable technologies. NEMA argued this would disappoint end-users, especially those in the residential sector, as they are more likely to purchase a lamp based on its first cost. Furthermore, NEMA argued that because a significant percentage of installed halogen lamps are used in dimming applications (and therefore consume less energy when dimmed), the energy saving benefit of an alternative non-dimmable replacement is reduced. (NEMA, No. 81 at p. 29–30) Lutron also urged DOE to account for this functional loss in its

[63] *See http://lynascorp.com/page.asp?category_id=1&page_id=25.*

[64] Cuif. Jean-Pierre, Rhodia Silcea—Electronics BU, ''Is there enough rare earth for the ''green switch'' and flat Tvs?'', Phosphor Global Summit 2008 (March 2008).

analysis. (Lutron, No. 38.4 at p. 316) Similarly, IALD commented that IRL provide utility, such as high CRI and dimming capability, that is unlikely to be met with emerging technologies and used in special applications, such as auditorium and art gallery lighting. (IALD, No. 71 at p. 2)

In response, DOE believes that it has already accounted for dimming functionality in its analysis. First, DOE's efficacy levels do not eliminate any dimming capability from the market. Thus, DOE is not assuming this functionality must be met with emerging technologies. Covered IRL are available at every TSL for use in dimming applications. Second, DOE's emerging and existing scenarios already incorporate the effect of consumers who make purchasing decisions based only on a lamp's first cost. Third, DOE disagrees that the percentage of covered lamps used in dimming applications would affect DOE's projected energy savings. While DOE agrees with NEMA that when lamps are dimmed they consume less energy, DOE expects the usage of dimmers to remain the same in both the base and standards case. It is unlikely that a consumer would dim a lamp more or less only because he/she is using a standards-compliant lamp. Lastly, DOE believes consumers who would be ''greatly disappointed'' without dimming functionality would not be deterred from an incrementally higher first cost associated with retaining that functionality. For these reasons, DOE has already accounted for dimming functionality in its analysis.

2. GSFL Product Availability

NEMA wrote that TSL4 and TSL5 cannot be economically justified, partly because these efficacy levels would preserve T8 lamps that are mostly incompatible with today's installed base of T8 ballasts; NEMA also stated that higher standards for U-shaped lamps would negatively impact competition and eliminate energy-efficient U-shaped lamps with 6-inch spacing. (NEMA, Public Meeting Transcript, No. 38.4 at pp. 24, 38, NEMA, No. 81 at pp. 2–3)

DOE disagrees with NEMA that TSL 3 would remove nearly all T12 lamps from the market by the effective date. Certain T12 lamps still meet TSL 3, as presented in NOPR, a point that NEMA does not dispute. Moreover, given the magnitude of the current T12 shipments, particularly in the residential sector, where, as NEMA has noted, the most common residential magnetic ballast is exempted, DOE believes that T12 lamps will remain on the market at TSL 3.

Next, DOE has accounted for compatibility with existing ballasts, as well as the need for a new ballast purchases (when applicable), in all its analyses, as discussed in the April 2009 NOPR. While DOE agrees TSL 4 or higher may eliminate T12 lamps from the market, as presented in DOE's market share matrices, at least five T8 lamps meet TSL 4, and two providing residential consumers with product options. Therefore, DOE does not believe this final rule presents a possibility of product shortages.

I. Alternative Standard Scenarios

In the April 2009 NOPR, DOE noted that although it was proposing TSL3, serious consideration would be given to a more stringent standard level for GSFL in the final rule. Accordingly, DOE requested comment on alternative scenarios for GSFL standards that could achieve greater energy savings than the proposed TSL3. In addition to consideration of a standard that would eliminate T12 lamps as presented in TSL4 and TSL5, DOE also provided two examples of alternative standard scenarios that may be considered: (1) A standard with a delayed implementation date (*i.e.*, extended lead time); and (2) a standard with differentiated residential and commercial levels. 74 FR 16920, 17017, 17025 (April 13, 2009). In response, DOE received several comments on these example scenarios.

1. Tiered Standard

ACEEE, the California stakeholders, NEMA, and NEEP all recommended various forms of tiered standards. (ACEEE, No. 55 at pp. 1–3; NEEP, No. 61 at p. 4; NEMA, No. 81 at p. 23, 24; California Stakeholders, No. 2 at p. 2) ACEEE and the California Stakeholders also argued that DOE set a precedent for such a tiered, phased-in standard in 2001 with residential clothes washers, when DOE issued a final rule making one efficiency level effective in 2004 and second level effective in 2007. (California Stakeholders, No. 61 at p. 9; ACEEE, No. 55 at p. 2)

DOE analyzed the impacts of a tiered, phased-in standard, as suggested by many stakeholders. Under such approach, DOE's analysis showed a mitigation of manufacturer INPV, similar to a delayed effective date alternative scenario but to a lesser extent. Again, the lower capital costs (due to more time for the base-case migration away from T12s), time value of money effects, and longer retention of higher-margin sales, all mitigate the negative INPV impacts. DOE, however, again carefully reviewed the governing statute and has determined that it does not have the authority to implement tiered, phased-in standards under EPCA.

DOE carefully evaluated the legality of tiered standards based on the language in EPCA. 42 U.S.C. 6295(i)(3) requires amended standards for GSFL and IRL to apply to products manufactured ''on or after'' the 36-month period beginning on the date such final rule is published. DOE interprets this provision to mean that the standard will be in place for covered lamps that are manufactured precisely three years after publication of the final rule and prospectively thereafter. DOE reasoned that it would be illogical to give separate meaning to the terms ''on'' and ''after'', an interpretation that could conceivably allow for a second-tier standard effective at some point subsequent to the date 36 months after the publication date of the rule, because this interpretation would also allow for a rule that requires compliance with the established standards on only the exact date 36 months from the publication date. Therefore, DOE concluded that section 6295(i)(3) of EPCA does not allow tiered standards for the final GSFL and IRL rule. This is in contrast to EPCA's general service lamps provisions at 42 U.S.C. 6295(i)(6)(A)(iv), where Congress explicitly directed DOE to consider phased-in effective dates. DOE notes that 42 U.S.C. 6295(i)(5), relating to ''additional'' GSFL lamps, contains a different formulation providing that the standards shall apply to products manufactured ''after'' a date that is 36 months after the date the rule is published. However, it is DOE's understanding that the ''additional'' GSFL covered by subsection (i)(5) are not those products which significantly alter INPV or consumer LCC savings in this rulemaking. In light of the above, DOE chose not to adopt tiered standards for these lamps.

2. Delayed Effective Date

ACEEE and the California Stakeholders, as well as NEMA and Osram Sylvania, stated that DOE should consider various delayed effective dates, although the California Stakeholders suggested that this should be a last resort. (California Stakeholders, No. 61 at p. 4; ACEEE, No. 55 at p. 2; NEMA, No. 81 at pp. 2, 24–26; Osram Sylvania, No. 84 at p. 2)

DOE carefully evaluated the legality of delayed implementation dates based on the language in EPCA. DOE concluded that a delayed effective date which sets no standards for compliance on or about June 30, 2012, which is the anticipated date ''on or after the 36-month period beginning on the date such final rule is published,'' would not be permissible under EPCA (42 U.S.C. 6295(i)(3)). As in the discussion above for tiered standards, DOE interprets the language of 42 U.S.C. 6295(i)(3) to mean that a standard will be in place for covered lamps that are manufactured precisely three years after publication of the final rule and prospectively thereafter. This is again in contrast to EPCA's general service lamps provisions at 42 U.S.C. 6295(i)(6)(A)(iv), where Congress explicitly directed DOE to consider phased-in effective dates. DOE also carefully considered 42 U.S.C. 6295(i)(5), which provides that the final rule for ''additional'' GSFL shall apply to products ''manufactured after a date which is 36 months after the date such rule is published'' and could potentially support a later effective date for ''additional'' GSFL. However, it is DOE's understanding that ''additional'' GSFL are not those products which significantly alter INPV or consumer LCC savings in this rulemaking. In light of the above, DOE chose not to use delayed effective dates for those lamps as recommended by commenters.

3. Residential Exemption

NEEP, GE and NEMA recommended various forms of residential exemptions and/or labeling for T12 lamps as alternate standard scenarios. (NEEP, No. 61 at p. 4; NEMA, No. 81 at pp. 2, 24–26; (GE, No. 80 at pp. 1–3) ACEEE and the California Stakeholders opposed separate treatment for the residential sector through a bifurcated standard. (California Stakeholders, No. 61 at p. 9; ACEEE, No. 55 at p. 3; NEMA, No. 81 at pp. 2, 24–26)

DOE considered the option of having differentiated standards for residential consumers and commercial consumers. Absent a specific statutory directive (*e.g.*, one conveying product labeling or packaging authority), it has long been DOE's position that it regulates equipment, rather than product use. In general, DOE has sought to avoid interfering with manufacturing decisions related to product use, marketing, or packaging. This approach is also reflective of the inherent difficulties in enforcing product usage requirements and the potential loopholes that may be created.

In the present case, DOE notes that in contrast to situations where it sets product classes whose efficiency-related differences (*e.g.*, in terms of utility, capacity, type of energy use) warrant different standard levels, the lamps under consideration here have no significant technical differences as would support different standard levels. Given the identical nature of T12 lamps used in residential and commercial settings, it would be potentially easy for commercial customers to purchase and install T12 lamps marketed for residential use. DOE is concerned that this option could significantly undermine the energy savings potential to the Nation of the lamps standard. Therefore, DOE has decided not to consider such an approach further.

4. Conclusions Regarding Alternative Standard Scenarios

In considering whether to adopt a more stringent standard for GSFL than the proposed TSL3, DOE sought to explore various approaches (*e.g.*, tiered standards, delayed effective dates) to mitigate the impacts on manufacturers and certain consumers. However, after careful examination of the relevant provisions of EPCA, for the reasons explained above, DOE has determined that none of these options is available. Accordingly, the effective date of this final rule for all covered product classes will be three years from the date of publication.

J. Benefits and Burdens

Since DOE opened the docket for this rulemaking, it has received more than 80 written comments, with hundreds of signatories, from a diverse set of parties, including manufacturers and their representatives, state attorney generals, members of Congress, energy conservation advocates, consumer advocacy groups, private citizens, and electric and gas utilities. DOE also received more than 20,000 email form letter submissions recommending DOE strengthen the proposed energy conservation standards. All substantive comments on the analytic methodologies DOE used are discussed heretofore in sections of this final rule notice. DOE also received many comments related to the relative merits of various TSLs. Generally, these comments either stated a certain TSL was economic justified, technologically feasible, and maximized energy, or they argued how DOE should weight the various factors that go into making that determination. See section VII for a discussion of DOE's analytic results and how it weighed those factors in establishing today's final rule.

PSI stated that DOE should adopt GSFL and IRL standards that align with or surpass the European Union's ''Eco-Design Standards for Energy-Using Product (EuP) Directive.'' On the other hand, a private citizen wrote to DOE expressing that DOE's proposed standards for GSFL and IRL will not save significant energy, will negatively impact the work of lighting designers, and may have a negative impact on the quality of work and living spaces; the citizen expressed that conservation in other areas could yield greater reduction in energy usage. (Private Citizen, No. 48 at pp. 1–3)

VII. Analytical Results and Conclusions

A. Trial Standard Levels

DOE analyzed the costs and benefits of five TSLs each for the GSFL and IRL covered in today's final rule. Table VII.1 and Table VII.2 present the TSLs and the corresponding product class efficacy requirements for GSFL and IRL. See the engineering analysis in section V.B.4 of this final rule for a more detailed discussion of the efficacy levels. In this trial standard levels section, DOE presents the analytical results for the TSLs of all product classes that DOE analyzed, including scaled product classes. See chapter 5 of the final rule TSD for further information on representative and scaled product class efficacy levels.

1. General Service Fluorescent Lamps

As discussed in section V.B.2, the following lamps with a CCT less than 4,500K compose the five representative GSFL product classes: (1) 4-foot medium bipin; (2) 8-foot single pin slimline; (3) 8-foot recessed double contact HO lamps; (4) 4-foot miniature bipin T5 SO; and (5) 4-foot miniature bipin T5 HO lamps. U-shaped lamps with a CCT less than 4,500K are a scaled product class. The six lamp types (including U-shaped lamps) with CCTs greater than or equal to 4500K compose six additional product classes, which are also scaled product classes. DOE developed TSLs that generally follow a trend of increasing efficacy by using higher-quality phosphors. The TSLs also represent a general move from higher-wattage technologies to lower-wattage, lower-diameter lamps with higher efficacies. Table VII.1 shows the TSLs for GSFL. DOE composed each TSL utilizing the same methodology employed in the April 2009 NOPR. TSL5 represents all maximum technologically feasible GSFL efficacy levels, as in the April 2009 NOPR. 74 FR 16920, 16980 (April 13, 2009).

For this final rule, DOE revised the efficacy levels for 4-foot T5 MiniBP standard-output and high-output lamps to reflect testing at 25° C as well as manufacturing variability. The April 2009 NOPR EL1 requirements for T5 standard-output lamps have thus been revised from 103 lm/W to 86 lm/W, and the April 2009 NOPR EL2 requirements have been revised from 108 lm/W to 90 lm/W. The April 2009 NOPR EL1 requirements for T5 high-output lamps have been revised from 89 lm/W to 76 lm/W. 74 FR 16920, 16980 (April 13, 2009). The EPCA standard for GSFL in the representative product classes of this final rule are shown in Table I.3. Trial standard levels for all GSFL product classes in this final rule are shown in Table VII.1.

TABLE VII.1—TRIAL STANDARD LEVELS FOR GSFL—EFFICACY LEVELS FOR ALL GSFL PRODUCT CLASSES

CCT	Lamp type	Trial standard level				
		1	2	3	4	5
≤4,500K	4-foot medium bipin (representative)	78	81	85	89	93
	2-foot U-shaped	70	72	76	84	87
	8-foot single pin slimline (representative)	86	92	95	97	98
	8-foot recessed double contact HO (representative).	83	86	88	92	95
	4-foot T5 miniature bipin SO (representative).	86	86	86	86	90
	4-foot T5 miniature bipin HO (representative).	76	76	76	76	76
>4,500K and ≤7,000K	4-foot medium bipin	77	79	82	88	92
	2-foot U-shaped	65	67	71	81	85
	8-foot single pin slimline	83	87	91	93	94
	8-foot recessed double contact HO	80	83	84	88	91
	4-foot T5 miniature bipin SO	81	81	81	81	85
	4-foot T5 miniature bipin HO	72	72	72	72	72

2. Incandescent Reflector Lamps

As discussed in section V.B.4, DOE has established five efficacy levels based on an equation relating efficacy to lamp wattage. As also discussed in section V.B.2, DOE only directly analyzed the standard-spectrum IRL with a diameter greater than 2.5 inches and voltage less than 125 volts; DOE then scaled minimum efficacy requirements to other product classes. This is consistent with what DOE did for the April 2009 NOPR. 74 FR 16920, 16981 (April 13, 2009).

The EPCA standard for IRL is shown in Table I.4. The efficacy levels for all IRL product classes are shown as coefficients for the efficacy level requirement equation *A*P∧0.27* in Table VII.2 for the TSLs to which they correspond, where *A* is the coefficient shown in the table for a specific product class and TSL, and *P* represents the rated wattage of the lamp. TSL5 represents the maximum technologically feasible level, as in the April 2009 NOPR. 74 FR 16920, 16981–2 (April 13, 2009). For this final rule, DOE revised the April 2009 NOPR efficacy levels for the representative IRL product class in order to account for IRL manufacturing variability, as described in chapter 5 of the TSD.

TABLE VII.2—TRIAL STANDARD LEVELS FOR IRL-COEFFICIENTS OF EFFICACY LEVELS FOR ALL IRL PRODUCT CLASSES

Lamp wattage	Lamp type	Diameter (in inches)	Voltage	Trial standard level				
				1	2	3	4	5
40W–205W	Standard-spectrum	> 2.5	≥125V	5.3	5.5	6.2	6.8	7.4
			<125V[1]	4.6	4.8	5.4	5.9	6.4
		≤2.5	≥125V	4.7	4.9	5.5	5.7	6.2
			<125V	4.0	4.2	4.8	5.0	5.4
40W–205W	Modified-spectrum	>2.5	≥125V	4.5	4.7	5.3	5.8	6.3
			<125V	3.9	4.1	4.6	5.0	5.4
		≤2.5	≥125V	4.0	4.1	4.6	4.9	5.3
			<125V	3.4	3.6	4.0	4.2	4.6

[1](Representative.)

At the public meeting, Energy Solutions suggested that DOE present efficacy levels for IRL in terms of lumen output rather than wattage because lumen output is a more appropriate measure of the functional performance of a lamp. (Energy Solutions, Public Meeting Transcript, No. 38.4 at pp. 94–95) DOE understands that the primary function of a lamp is to provide light for the consumers' applications. Market research indicated that the most common IRL baselines on the market today provide three distinct levels of initial lumen output: 1,310 lumens from a 90W baseline, 1,050 lumens from a 75W baseline, and 630 lumens from a 50W baseline, respectively. Based on this understanding, DOE utilized a ''lumen package'' perspective in the April 2009 NOPR to select and analyze more-efficacious replacements for these three IRL baselines such that their lumen output is no greater than 10% below the baseline lumen output. 74 FR 16920, 16944 (April 13, 2009). DOE believes that the usage of lumen classes allows DOE to take into account consumers' interests in light output when developing efficacy levels based on IRL wattage. Thus, DOE has not changed its presentation of efficacy levels for the final rule.

B. Significance of Energy Savings

To estimate the energy savings through 2042 due to potential standards, DOE compared the energy consumption of GSFL and IRL under the base case (no standards) to energy consumption of these products under each standards case (each TSL that DOE has considered). Table VII.3 and Table VII.4 show the forecasted national energy savings (including rebound effect and HVAC interactions where applicable) in quads (quadrillion BTU) at each TSL for GSFL and IRL. As discussed in section V.D.1, DOE models two base-case shipment scenarios and several standards-case shipment scenarios. For each lamp type, these scenarios combined produce eight possible sets of NES results. The tables below present the results of the two scenarios that represent the maximum and minimum energy savings resulting from all the scenarios analyzed.

For GSFL, DOE presents ''Existing Technologies, High Lighting Expertise, Shift'' and ''Emerging Technologies, Market Segment-Based Lighting Expertise, Roll-Up'' in Table VII.3 as the scenarios that produce the maximum and minimum energy savings, respectively. Due to a larger reduction in the installed stock of lamps affected by standards, the Emerging Technologies base-case forecast results in lower energy savings than the Existing Technologies base-case forecast. In addition, because a portion of consumers purchasing non-energy-saving, higher-lumen-output systems in the Market Segment-Based Lighting Expertise scenario, it results in lower energy savings than the High Lighting Expertise scenario. Finally, because in the Shift scenario more consumers move to higher-efficacy lamps than in the Roll-Up scenario, the Shift scenario results in higher energy savings than the Roll-Up scenario.

Table VII.3 presents total national energy savings for each TSL (labeled as ''Total'' savings). The table also reports national energy savings due to individually regulating each type of GSFL (presented next to the lamp type names), assuming no amended standard on all other lamp types. However, it is important to note that individual lamp type energy savings (due to separate regulation) do not sum to equal total energy savings achieved at the trial standard levels due to standards-induced substitution effects between lamp types. Instead, these savings are provided merely to illustrate the approximate relative energy savings of each lamp type under a TSL. Please see the NOPR for a discussion of the affect of various TSLs on NES. 74 FR 16920, 17005–06 (April 13, 2009).

TABLE VII.3—SUMMARY OF CUMULATIVE NATIONAL ENERGY SAVINGS FOR GSFL

TSL/EL	Lamp type	National energy savings (quad btu)	
		Existing technologies, high lighting expertise, shift	Emerging technologies, market segment-based lighting expertise, roll-up
1	4-foot MBP	0.89	0.61
	8-foot SP Slimline	0.25	0.25
	8-foot RDC HO	0.17	0.02
	4-foot MiniBP SO	0.69	0.11
	4-foot MiniBP HO	0.96	0.53
	2-foot U-Shaped	0.04	0.03
	Total	3.01	1.54
2	4-foot MBP	0.99	0.75
	8-foot SP Slimline	0.28	0.27
	8-foot RDC HO	0.22	0.19
	4-foot MiniBP SO	0.69	0.11
	4-foot MiniBP HO	0.96	0.53
	2-foot U-Shaped	0.05	0.03
	Total	3.19	1.88
3	4-foot MBP	4.17	1.81
	8-foot SP Slimline	0.32	0.32
	8-foot RDC HO	0.23	0.19
	4-foot MiniBP SO	0.69	0.11
	4-foot MiniBP HO	0.96	0.53
	2-foot U-Shaped	0.19	0.08
	Total	6.59	3.06
4	4-foot MBP	6.96	2.30
	8-foot SP Slimline	0.37	0.23
	8-foot RDC HO	0.56	0.56
	4-foot MiniBP SO	0.69	0.11
	4-foot MiniBP HO	0.96	0.53
	2-foot U-Shaped	0.32	0.10
	Total	9.94	3.83
5	4-foot MBP	8.79	3.32
	8-foot SP Slimline	0.37	0.24
	8-foot RDC HO	0.62	0.57
	4-foot MiniBP SO	0.82	0.26
	4-foot MiniBP HO	0.96	0.53

TABLE VII.3—SUMMARY OF CUMULATIVE NATIONAL ENERGY SAVINGS FOR GSFL—Continued

TSL/EL	Lamp type	National energy savings (quad btu)	
		Existing technologies, high lighting expertise, shift	Emerging technologies, market segment-based lighting expertise, roll-up
	2-foot U-Shaped	0.40	0.15
	Total	12.00	5.08

For IRL, DOE presents ''Existing Technologies, R–CFL Production Substitution, Shift'' and ''Emerging Technologies, BR Product Substitution, Roll-Up'' in Table VII.4 as the scenarios that produce the maximum and minimum energy savings, respectively. Similar to GSFL, the Existing Technologies base-case forecast results in higher energy savings than the Emerging Technologies base-case forecast due to the greater installed stock of IRL affected by standards. The BR Product Substitution scenario, which includes migration to exempted BR lamps but not to R–CFL, results in lower energy savings than the R–CFL Product Substitution scenario, which accounts for the reverse effect. In addition, while the effect is greater for GSFL than for IRL, the Shift scenario (only affecting commercial consumers because DOE assumes residential consumers always purchase the lowest first-cost lamp) also represents higher energy savings than the Roll-Up scenario for IRL. As seen in the table below, TSL 5 achieves maximum energy savings for both scenarios. As discussed in section VI.C.1, DOE also analyzed a ''Baseline Lifetime Scenario.'' Although this scenario considers shortened lifetimes as TSL 4 and TSL 5, national energy savings do not change because shipments remain the same as the normal lifetime scenario.

TABLE VII.4—SUMMARY OF CUMULATIVE NATIONAL ENERGY SAVINGS FOR INCANDESCENT REFLECTOR LAMPS

TSL	National energy savings (quads)	
	Existing technologies, R–CFL product substitution, shift	Emerging technologies, BR product substitution, roll-up
1	0.45	0.16
2	1.09	0.40
3	1.91	0.81
4	2.39	0.94
5	2.72	1.12

C. Economic Justification

1. Economic Impact on Consumers

a. Life-Cycle Costs and Payback Period

Consumers affected by new or amended standards usually experience higher purchase prices and lower operating costs. Generally, these impacts are best captured by changes in life-cycle costs. DOE designed the LCC analysis around lamp purchasing events and calculated the LCC savings relative to the baseline for each lamp replacement event separately in each lamp product class, as done for the April 2009 NOPR. 74 FR 16920, 16982 (April 13, 2009). The separate computation of the impacts on each event and each product class allowed DOE to view the results of many subgroup populations in the LCC analyses. The following discussion presents salient results from the LCC analysis. When a standard results in ''positive LCC savings,'' the life cycle cost of the standards-compliant lamp or lamp-and-ballast system is less than the life cycle cost of the baseline lamp or lamp-and-ballast system, and the consumer benefits economically. When a standard results in ''negative LCC savings,'' the life cycle cost of the standards-compliant lamp or lamp-and-ballast system is higher than the life cycle cost of the baseline lamp or lamp-and-ballast system, and the consumer is adversely affected economically. The results at some efficacy levels are presented as ranges, which reflect the results of multiple systems (*i.e.*, multiple lamp-ballast pairings) that consumers could purchase to meet those specific efficacy levels.

The LCC results shown in this notice reflect a subset of all of the lamp purchasing events analyzed by DOE, although they represent the most prevalent purchasing events. As done in the April 2009 NOPR, DOE is also presenting the installed prices of the lamp-and-ballast systems in order to allow comparisons of the up-front costs that consumers must bear when purchasing baseline or standards-case systems. 74 FR 16920, 16982 (April 13, 2009). All of the LCC results shown in this notice were generated using the April 2009 *AEO2009* reference case electricity price trend (which includes the impact of ARRA) as well as medium-range lamp and ballast prices. In many cases, DOE omitted Events IB (Lamp Failure: Lamp & Ballast Replacement) and IV (Ballast Retrofit) in this notice, because DOE believes these lamp purchase events to be relatively less frequent. In addition, DOE has chosen not to present detailed PBP results by efficacy level in this final rule notice because DOE believes that LCC results are a better measure of cost-effectiveness. However, a full set of both LCC and PBP results for the systems DOE analyzed is available in chapter 8 and appendix 8B of the TSD. Chapter 8 presents LCC results for all lamp purchasing events analyzed by DOE. Furthermore, chapter 8 includes the LCC results presented in this notice along with additional presented details, such as system design option details, start-year operating cost savings, and payback periods. Appendix 8B presents Monte Carlo simulation results performed by DOE as part of the LCC analysis and also presents sensitivity results, such as LCC savings under the *AEO2009* high-economic-growth and low-economic-growth cases.

i. General Service Fluorescent Lamps

Table VII.5 through Table VII.12 present the results for the baseline lamps in each of the five GSFL product classes DOE analyzed (*i.e.*, 4-foot medium bipin, 4-foot miniature bipin SO, 4-foot miniature bipin HO, 8-foot single pin slimline, and 8-foot recessed double contact HO). Not all baselines have suitable replacement options for every lamp purchasing event at every efficacy level. For instance, because DOE assumed that consumers wish to purchase systems or lamp replacements with a lumen output within 10 percent of their baseline system output, in some cases, the only available replacement options produce less light than this. Thus, the replacement options are considered unsuitable substitutions. These cases are marked with ''LL'' (less light) in the LCC results tables below. In some cases, when consumers who currently own a T12 system need to replace their lamps, no T12 energy saving lamp replacements are available. In these cases, in order to save energy, the consumers must switch to other options, such as a T8 lamp and appropriate ballast. These cases are marked with ''NER'' (no energy-saving replacement) in tables.

Because some baseline lamps already meet higher efficacy levels (*e.g.*, the baseline 32W 4-foot T8 MBP lamp achieves EL2), LCC savings at the levels below the baseline are zero. In these cases, ''BAE'' (baseline above efficacy level) is listed in the tables to indicate that the consumer makes the same purchase decision in the standards-case as they do in the base-case. Also, not all lamp purchase events apply for all baseline lamps or efficacy levels. For example, DOE assumed that the standards-induced retrofit event does not apply to the 32W T8 system, because it is already the most efficacious 4-foot medium bipin GSFL system. For these events, an ''EN/A'' (event not applicable) exists in the table. Finally, because LCC savings are not relevant when no energy conservation standard is established, ''N/A'' (not applicable) exists in the LCC savings column for the baseline system.

Overall, based on the NIA model, DOE estimates that at TSL4 and TSL5 in 2012, approximately 2 percent of 4-foot MBP shipments result in negative LCC savings, and 9 percent of shipments are associated with the high installed price increases due to forced retrofits. At TSL5, all 4-ft T5 miniature bipin standard output shipments result in positive LCC savings; For 8-foot SP slimline at TSL4 and TSL5, approximately 24 percent of 2012 shipments would result in negative LCC savings, and 65 percent of shipments would be associated with the high installed price increases due to forced retrofits. DOE estimates that at TSL5 in 2012, approximately 33 percent of 8-foot RDC HO shipments would result in negative LCC savings, and 86 percent of shipments would be associated with the high installed price increases due to forced retrofits.

For 4-foot MiniBP T5 standard-output lamps, TSL4 would require these lamps to meet EL1, resulting in positive LCC savings of $1.10 for lamp replacement and $43.30 for new construction or renovation (seen in Table VII.9). At TSL5 (EL2 for standard output T5 lamps), all consumers have available lamp designs which result in positive LCC savings of $1.10 (for lamp replacement) and $45.67 to $47.49 (for new construction or renovation).

For 4-foot MiniBP T5 high-output lamps, TSL4 and TSL5 have identical life-cycle cost impacts: Consumers of high-output lamps who need only a lamp replacement would experience negative LCC savings of −$3.03 (approximately 44 percent of shipments, according the NIA model). However, purchasing a T5 high-output system for new construction or renovation would result in positive LCC savings of $65.69 to $67.06.

Table VII.5 presents the findings of an LCC analysis on various 3-lamp 4-foot medium bipin GSFL systems operating in the commercial sector. The analysis period (based on the longest-lived baseline lamp's lifetime) for this product class in the commercial sector is 5.5 years. As seen in the table, DOE analyzes three baseline lamps: (1) 40W T12; (2) 34W T12; and (3) 32W T8. For a complete discussion of the 4-foot MBP LCC results, see chapter 8 of the TSD and the April 2009 NOPR. 74 FR 16920, 16984 (April 13, 2009).

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Table VII.5 LCC Results for a 3-Lamp Four-Foot Medium Bipin GSFL System Operating in the Commercial Sector

Baseline	Efficacy Level	LCC Savings 2008$			Installed Price 2008$		
		Event IA: Lamp Replacement*	Event II: Standards-Induced Retrofit (Lamp and Ballast Replacement)*	Event III: Ballast Failure*†	Event IA: Lamp Replacement	Event II: Standards-Induced Retrofit (Lamp and Ballast Replacement)	Event III: Ballast Failure†
40 Watt T12	Baseline	N/A	N/A	N/A	14.50	14.50	68.44
	EL1	LL	EN/A	-7.66 to -5.88	LL	EN/A	75.31 to 80.14
	EL2	LL	EN/A	-7.94	LL	EN/A	80.45
	EL3	22.09	EN/A	13.07 to 14.79	26.10	EN/A	70.85 to 80.04
	EL4	NR	12.95 to 25.60	22.11 to 34.76	NR	65.71 to 78.48	63.31 to 76.08
	EL5	NR	18.73 to 24.16	27.89 to 33.32	NR	67.33 to 73.94	64.93 to 71.55
34 Watt T12	Baseline	N/A	N/A	N/A	11.65	11.65	65.59
	EL1	NER	-18.98	-1.85	15.49	71.82	69.42
	EL2	NER	-24.30 to -4.84	-9.15 to 10.30	12.43 to 22.79	62.04 to 79.12	59.64 to 76.72
	EL3	NER	-24.58 to 4.85	-9.43 to 20.00	15.65 to 26.10	65.26 to 82.44	62.87 to 80.04
	EL4	NR	10.20 to 21.14	25.35 to 36.29	NR	65.71 to 70.50	63.31 to 68.10
	EL5	NR	13.93 to 16.20	29.08 to 31.35	NR	65.96 to 67.33	63.57 to 64.93
32 Watt T8	Baseline	N/A	N/A	N/A	12.43	12.43	59.64
	EL1	BAE	EN/A	BAE	BAE	EN/A	BAE
	EL2	BAE	EN/A	BAE	BAE	EN/A	BAE
	EL3	NER	EN/A	9.69	NER	EN/A	62.87
	EL4	4.76 to 25.98	EN/A	15.05 to 25.98	16.98 to 20.89	EN/A	63.31 to 68.10
	EL5	9.70	EN/A	9.70 to 13.60	16.35	EN/A	63.57 to 64.93

†For 32 Watt T8 baseline, includes Event V (New Construction and Renovation).

*Analysis period is 5.5 years.

N/A: Not Applicable; NER: No Energy-Saving Replacement; LL: Available Options Produce Less Light; EN/A: Event Not Applicable; BAE: Baseline Above Efficacy Level; NR: No Replacement

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Table VII.7 presents the LCC results for a 4-foot medium bipin system operating in the residential sector under average operating hours. Under average operating hours, only the ballast failure event (Event III) applies because the ballast and fixture reach the end of their 15 year life before the baseline lamp (which would otherwise have a lifetime of 19 years when operated for 791 hours per year) fails. DOE uses a 15-year analysis period, based on the effective service life of the lamp (limited by the fixture or ballast life). 74 FR 16920, 16985 (April 13, 2009).

TABLE VII.6—LCC RESULTS FOR A 2-LAMP FOUR-FOOT MEDIUM BIPIN GSFL SYSTEM OPERATING IN THE RESIDENTIAL SECTOR WITH AVERAGE OPERATING HOURS

Baseline	Efficacy level	LCC savings	Installed price
		2008$	2008$
		Event III: Ballast failure*	Event III: Ballast failure
40 Watt T12	Baseline	N/A	51.38.
	EL1	7.03 to 10.25	49.04 to 56.19.
	EL2	6.82 to 19.17	50.51 to 56.39.
	EL3	1.06 to 18.86	52.66 to 60.19.
	EL4	18.57 to 24.36	52.96 to 56.15.
	EL5	20.21 to 22.32	53.13 to 54.04.

*Analysis period is 15.0 years.
N/A: Not Applicable.

In addition to conducting the LCC analysis under average operating hours, DOE also computed residential LCC results under high operating hours (1,210 hours per year) in order to analyze the economic impacts of the lamp failure event (Event I). Table VII.7 presents these LCC and installed-price results for a 2-lamp four-foot medium bipin GSFL system under the lamp failure event and high operating hours. As seen in Table VII.7, DOE divides the residential GSFL lamp failure event into Events IA (Lamp Failure: Lamp Replacement) and IB (Lamp Failure: Lamp and Ballast Replacement). Event IA, presented also in the commercial sector analysis, solely models a lamp purchase (in response to lamp failure) in both the base case and standards case. With high operating hours, DOE calculates that the baseline lamp initially purchased with a ballast fails after 12.4 years. Thus, a replacement lamp will operate for only 2.6 additional years before the fixture is removed. To compute the results shown in Table VII.7, DOE assumes that residential-sector GSFL consumers will discard their replacement lamp when the fixture is removed and therefore uses a 2.6 year analysis period.

TABLE VII.7—LCC RESULTS FOR A 2-LAMP FOUR-FOOT MEDIUM BIPIN GSFL SYSTEM OPERATING IN THE RESIDENTIAL SECTOR WITH HIGH OPERATING HOURS

Baseline	Efficacy level			Installed price	
	LCC savings	2008$		2008$	
		Event IA: Lamp replacement*	Event IB: Lamp and ballast replacement*	Event IA: Lamp replacement	Event IB: Lamp and ballast replacement
40 Watt T12	Baseline	N/A	N/A	4.13	4.13.
	EL1	LL	EN/A	LL	EN/A.
	EL2	LL	EN/A	LL	EN/A.
	EL3	−5.53	EN/A	12.94	EN/A.
	EL4	NR	−4.13 to −2.04	NR	52.96 to 56.15.
	EL5	NR	−3.52 to −2.87	NR	53.13 to 54.04.

*Analysis period is 2.6 years.
N/A: Not Applicable; LL: Available Options Produce Less Light; EN/A: Event Not Applicable; NR: No Replacement.

As discussed in section V.C.8, DOE analyzed additional residential-sector GSFL lamp failure LCC scenarios for this final rule based on the understanding that some residential-sector GSFL consumers may preserve their lamps during fixture end-of-life and then install those lamps on a new fixture instead of discarding them. Consumers exhibiting this behavior can operate lamps for their full lifetimes and thus will eventually experience a lamp failure even when operating with average operating hours. When operated for average operating hours, the baseline lamp has a lifetime of 19 years; therefore, DOE uses 19 years as the analysis period. This analysis shows that some residential consumers with T12 systems do in fact obtain LCC savings when forced to retrofit their T12 ballast with a T8 system at EL4 and EL5. However, DOE also notes that the results of this analysis are highly dependent on the remaining years of lifetime left on the T12 ballast when the lamp is replaced. Therefore, as seen in Table VII.8 DOE computes LCC savings for several scenarios of remaining ballast life at the time of lamp replacement. At EL3, under the scenario where consumers retain their lamp upon ballast replacement, consumers obtain LCC savings. At EL4, consumers can achieve positive LCC savings if their ballast have less than 8 years of life remaining at the point of lamp failure. In other words, consumers who would need to purchase a ballast within 8 years after replacing their lamp would benefit from a standard at EL4. At EL5, standards-case consumers can achieve positive LCC savings if their fixtures have less than 7 years of life remaining.

Table VII.8 LCC Savings at Various Values of Remaining Fixture Life for Residential-Sector GSFL Consumers with Lamp Preservation, Average Operating Hours

Event	Efficacy Level	LCC Savings (2008$)					
		Remaining Ballast Life (years)					
		1	3	6	9	12	15
IA: Lamp Repl.	EL 1	LL	LL	LL	LL	LL	LL
	EL 2	LL	LL	LL	LL	LL	LL
	EL 3	4.78	4.78	4.78	4.78	4.78	4.78
IB: Lamp & Ballast Repl.	EL 4	18.69 to 27.06	10.06 to 18.43	-0.14 to 8.23	-8.69 to -0.33	-16.62 to -8.26	-24.02 to -15.65
	EL 5	20.98 to 22.62	12.35 to 13.99	2.15 to 3.79	-6.40 to -4.77	-14.33 to -12.70	-21.72 to -20.09

LL: Available Options Produce Less Light

Table VII.9 presents the results for an electronically-ballasted 4-foot T5 miniature bipin standard-output, baseline system operating in the commercial sector. Table VII.10 presents the results for an electronically-ballasted 4-foot T5 miniature bipin high-output baseline system operating in the industrial sector. For further discussion on the 4-foot MiniBP LCC results see the April 2009 NOPR and Chapter 8 of the TSD. 74 FR 16920, 16987 (April 13, 2009).

TABLE VII.9—LCC RESULTS FOR A 2-LAMP FOUR-FOOT MINIATURE BIPIN STANDARD OUTPUT GSFL SYSTEM OPERATING IN THE COMMERCIAL SECTOR

Baseline	Efficacy level	LCC savings		Installed price	
		2008$		2008$	
		Event IA: Lamp replacement*	Event V: New construction/renovation*	Event IA: Lamp replacement	Event V: New construction/renovation
28 Watt T5	Baseline	N/A	N/A	9.75	71.87.
	EL1	NER	43.30	13.66	75.78.
	EL2	1.10	45.67 to 47.49	15.44	77.56 to 78.06.

*Analysis period is 5.5 years.
N/A: Not Applicable; NER: No Energy-Saving Replacement.

TABLE VII.10—LCC RESULTS FOR A 2-LAMP FOUR-FOOT MINIATURE BIPIN HIGH OUTPUT GSFL SYSTEM OPERATING IN THE INDUSTRIAL SECTOR

Baseline	Efficacy level	LCC savings		Installed price	
		2008$		2008$	
		Event IA: Lamp replacement*	Event V: New construction/renovation*	Event IA: Lamp replacement	Event V: New construction/renovation
54 Watt T5	Baseline	N/A	N/A	10.84	74.09.
	EL1	−3.03	65.69 to 67.06	20.61	79.31 to 83.87.

* Analysis period is 3.9 years.
N/A: Not Applicable; NER: No Energy-Saving Replacement.

Table VII.11 presents the results for an 8-foot single-pin slimline GSFL system operating in the commercial sector. The analysis period is 4 years. For this product class, DOE analyzes three baseline lamps: (1) 75W T12; (2) 60W T12; and (3) 59W T8. For further discussion on the 8-foot SP slimline LCC results, see the April 2009 NOPR and chapter 8 of the TSD. 74 FR 16920, 16988 (April 13, 2009).

Table VII.11 LCC Results for a 2-Lamp Eight-Foot Single-Pin Slimline GSFL System Operating in the Commercial Sector

Baseline	Efficacy Level	LCC Savings 2008$			Installed Price 2008$		
		Event IA: Lamp Replacement*	Event II: Standards-Induced Retrofit (Lamp and Ballast Replacement)*	Event III: Ballast Failure*†	Event IA: Lamp Replacement	Event II: Standards-Induced Retrofit (Lamp and Ballast Replacement)	Event III: Ballast Failure†
75 Watt T12	Baseline	N/A	N/A	N/A	16.79	16.79	92.37
	EL1	LL	EN/A	-4.91	LL	EN/A	98.99
	EL2	LL	EN/A	-0.78	LL	EN/A	100.97
	EL3	36.57	EN/A	LL	20.19	EN/A	LL
	EL4	NR	LL	LL	NR	LL	LL
	EL5	NR	9.68	28.43	NR	98.80	96.40
60 Watt T12	Baseline	N/A	N/A	N/A	11.77	11.77	87.35
	EL1	BAE	BAE	BAE	BAE	BAE	BAE
	EL2	NER	-26.73	-2.73	16.63	94.61	92.22
	EL3	NER	-25.89 to -25.83	-1.83	13.23 to 20.19	92.46 to 98.17	95.77
	EL4	NR	-16.72	7.28	NR	97.01	94.62
	EL5	NR	-15.81 to -13.89	8.18 to 10.11	NR	97.41 to 98.80	95.02 to 96.40
59 Watt T8	Baseline	N/A	EN/A	N/A	13.23	EN/A	90.07
	EL1	BAE	EN/A	BAE	BAE	EN/A	BAE
	EL2	BAE	EN/A	BAE	BAE	EN/A	BAE
	EL3	BAE	EN/A	BAE	BAE	EN/A	BAE
	EL4	NER	EN/A	-0.44	NER	EN/A	94.62
	EL5	6.45 to 10.28	EN/A	8.12 to 10.28	17.33 to 18.18	EN/A	94.17 to 96.40

†For 59-Watt T8 baseline, includes Event V (New Construction and Renovation).
*Analysis period is 4.0 years.
N/A: Not Applicable; NER: No Energy-Saving Replacement; LL: Available Options Produce Less Light; EN/A: Event Not Applicable; BAE: Baseline Above Efficacy Level; NR: No Replacement

Table VII.12 shows LCC results for an 8-foot recessed double-contact GSFL system operating in the industrial sector. The analysis period for this product class is 2.3 years. DOE analyzes 110W T12 and 95W T12 baseline lamps on magnetic ballasts. For further discussion on the 8-foot RDC HO LCC results see the April 2009 NOPR and chapter 8 of the TSD. 74 FR 16920, 16990 (April 13, 2009).

Table VII.12 LCC Results for a 2-Lamp Eight-Foot Recessed Double-Contact High Output GSFL System Operating in the Industrial Sector

Baseline	Efficacy Level	LCC Savings 2008$			Installed Price 2008$		
		Event I: Lamp Replacement*	Event II: Standards-Induced Retrofit (Lamp and Ballast Replacement)*	Event III: Ballast Failure*	Event I: Lamp Replacement	Event II: Standards-Induced Retrofit (Lamp and Ballast Replacement)	Event III: Ballast Failure
110 Watt T12	Baseline	N/A	N/A	N/A	20.51	20.51	101.36
	EL1	LL	EN/A	9.43	LL	EN/A	117.60
	EL2	LL	EN/A	LL	LL	EN/A	LL
	EL3	10.75 to 11.40	EN/A	10.75 to 21.86	33.64 to 34.29	EN/A	114.49 to 119.40
	EL4	NR	LL	LL	NR	LL	LL
	EL5	NR	13.07	51.60	NR	131.38	128.99
95 Watt T12	Baseline	N/A	N/A	N/A	14.46	14.46	95.31
	EL1	BAE	LL	LL	BAE	LL	LL
	EL2	NER	-27.63	7.87	20.83	108.34	105.95
	EL3	NER	-37.95 to -37.30	-2.46 to -1.81	33.64 to 34.29	121.15 to 121.80	118.75 to 119.40
	EL4	NR	-12.35 to -9.07	23.14 to 26.42	NR	128.03 to 128.38	125.64 to 125.98
	EL5	NR	-7.97	27.52	NR	131.38	128.99

*Analysis period is 2.3 years.

N/A: Not Applicable; NER: No Energy-Saving Replacement; LL: Available Options Produce Less Light; EN/A: Event Not Applicable; BAE: Baseline Above Efficacy Level; NR: No Replacement

ii. Incandescent Reflector Lamps

Table VII.13 shows the commercial and residential sector LCC results for IRL. The results are based on the reference case April 2009 *AEO2009* electricity price forecast (which includes the impact of the ARRA) and medium-range lamp prices. The analysis period is 3.4 years for the residential sector and 0.9 years for the commercial sector. In general, the results of the LCC analysis are consistent with those presented in the April 2009 NOPR. 74 FR 16920, 16991 (April 13, 2009). As discussed in section VI.C.1, DOE analyzed an additional scenario, called the Baseline Lifetime scenario, for the LCC analysis, NIA and MIA that modeled lamps at EL4 and EL5 with similar lifetimes to that of the baseline lamp lifetimes. The LCC results for both the Baseline Lifetime scenario and the Commercial Lifetime scenario (in which lamps at EL4 and EL5 have lifetimes of 4,000 hours and 4,200 hours, respectively) are shown as ranges at EL4 and EL5. As seen in Table VII.13, the lower range of LCC savings, representing the Baseline Lifetime scenario lamps, are negative for the 50W baseline in both sectors at EL5 and only in the commercial sector at EL4.

TABLE VII.13—LCC RESULTS FOR INCANDESCENT REFLECTOR LAMPS

Baseline	Efficacy level	LCC savings (2008$)		Installed price (2008$)	
		Event I: Lamp replacement/event V: New construction and renovation			
		Commercial *	Residential **	Commercial	Residential
90 Watt PAR38	Baseline	N/A	N/A	6.43	5.33.
	EL1	−0.12	0.14	7.41	6.31.
	EL2	3.72 to 6.12	3.19 to 4.94	7.88 to 8.06	6.78 to 6.96.
	EL3	6.01	5.81	8.06	6.96.
	EL4	2.61 to 7.95	3.78 to 7.45	9.43	8.33.
	EL5	4.26 to 9.14	5.65 to 9.10	9.43 to 10.02	8.33 to 8.92.
75 Watt PAR38	Baseline	N/A	N/A	6.43	5.33.
	EL1	−0.40	−0.17	7.41	6.31.
	EL2	3.17 to 5.76	2.57 to 4.54	7.88 to 8.06	6.78 to 6.96.
	EL3	4.64	4.25	8.06	6.96.
	EL4	1.51 to 6.85	2.54 to 6.20	9.43	8.33.
	EL5	2.42 to 7.30	3.56 to 7.01	9.43 to 10.02	8.33 to 8.92.
50 Watt PAR30	Baseline	N/A	N/A	5.80	4.70.
	EL1	−0.37	−0.29	6.78	5.68.
	EL2	−0.07 to 2.74	0.11 to 2.36	7.25 to 7.43	6.15 to 6.33.
	EL3	0.63	0.92	7.43	6.33.
	EL4	−0.25 to 1.81	0.11 to 1.75	8.80	7.70.
	EL5	−3.17 to 1.36	−1.64 to 1.51	8.80 to 9.39	7.70 to 8.29.

* Analysis period is 0.9 years.
** Analysis period is 3.4 years.

b. Consumer Subgroup Analysis

Certain consumer subgroups may be disproportionately affected by standards. As done for the April 2009 NOPR, DOE performed LCC subgroup analyses as part of its proposal for low-income consumers, institutions of religious worship, and institutions that serve low-income populations. 74 FR 16920, 16991 (April 13, 2009). See section V.C for a review of the inputs to the LCC analysis. DOE found the impacts on these consumer subgroups to be generally consistent with those presented in the April 2009 NOPR with one exception: for institutions that serve low-income populations, with updates to electricity prices in this final rule, consumers who in the base case purchase a 75W T12 replacement lamp, no longer obtain LCC savings. 74 FR 16920, 16996 (April 13, 2009). For further detail on the consumer subgroup analysis, see chapter 12 of the TSD.

2. Economic Impact on Manufacturers

DOE estimated the impact of amended energy conservation standards for covered products on the INPV of the industries that manufacture the products. The impact of amended standards on INPV consists of the difference between the INPV in the base case and the INPV in the standards case. INPV is the primary metric used in the MIA and represents one measure of the fair value of the GSFL and IRL industries in 2008$. For each industry affected by today's rule, DOE calculated INPV by summing all of the net cash flows, discounted at the industry's cost of capital or discount rate.

Table VII.14 through Table VII.17 show the changes in INPV that bound the range of impacts that DOE estimates would result from the TSLs considered for this final rule.

TABLE VII.14—MANUFACTURER IMPACT ANALYSIS FOR GSFL WITH THE FLAT MARKUP SCENARIO UNDER THE EXISTING TECHNOLOGY BASE CASE—HIGH LIGHTING EXPERTISE—SHIFT IN EFFICIENCY DISTRIBUTIONS

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2008$ millions)	639	697	695	721	635	671
Change in INPV	(2008$ millions)		58	56	82	−4	33
	(%)		9.11%	8.83%	12.82%	−0.64%	5.09%
Amended Energy Conservation Standards Product Conversion Costs.	(2008$ millions)		3.3	8.8	8.8	11.6	29.6
Amended Energy Conservation Standards Capital Conversion Costs.	(2008$ millions)		38.5	60.5	104.5	181.5	181.5
Total Investment Required	(2008$ millions)		41.8	69.3	113.3	193.1	211.1

TABLE VII.15—MANUFACTURER IMPACT ANALYSIS FOR GSFL WITH THE FOUR-TIER MARKUP SCENARIO UNDER THE EMERGING TECHNOLOGY BASE CASE—MARKET SEGMENT LIGHTING EXPERTISE—ROLLUP IN EFFICIENCY DISTRIBUTIONS

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2008$ millions)	527	662	629	432	365	316

TABLE VII.15—MANUFACTURER IMPACT ANALYSIS FOR GSFL WITH THE FOUR-TIER MARKUP SCENARIO UNDER THE EMERGING TECHNOLOGY BASE CASE—MARKET SEGMENT LIGHTING EXPERTISE—ROLLUP IN EFFICIENCY DISTRIBUTIONS—Continued

	Units	Base case	Trial standard level				
			1	2	3	4	5
Change in INPV	(2008$ millions)		134	102	−95	−162	−211
	(%)		25.47%	19.29%	−18.08%	−30.74%	−40.04%
Amended Energy Conservation Standards Product Conversion Costs.	(2008$ millions)		3.3	8.8	8.8	11.6	29.6
Amended Energy Conservation Standards Capital Conversion Costs.	(2008$ millions)		38.5	60.5	104.5	181.5	181.5
Total Investment Required	(2008$ millions)		41.8	69.3	113.3	193.1	211.1

TABLE VII.16—MANUFACTURER IMPACT ANALYSIS FOR IRL UNDER THE EXISTING TECHNOLOGIES BASE CASE—NO PRODUCT SUBSTITUTION SCENARIO—SHIFT IN EFFICIENCY DISTRIBUTION

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2008$ millions)	301	293	233	221	199	190
Change in INPV	(2008$ millions)		(8)	(68)	(81)	(102)	(111)
	(%)		−2.80%	−22.71%	−26.78%	−34.02%	−36.90%
Amended Energy Conservation Standards Product Conversion Costs.	(2008$ millions)		$3	$3	$2	$3	$7
Amended Energy Conservation Standards Capital Conversion Costs.	(2008$ millions)		$32	$83	$134	$167	$185
Total Investment Required	(2008$ millions)		$35	$87	$137	$170	$192

TABLE VII.17—MANUFACTURER IMPACT ANALYSIS FOR IRL UNDER THE EMERGING TECHNOLOGY BASE CASE—PRODUCT SUBSTITUTION—ROLL-UP IN EFFICIENCY DISTRIBUTIONS

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2008$ millions)	221	205	158	139	123	117
Change in INPV	(2008$ millions)		(15)	(63)	(81)	(98)	(104)
	(%)		−6.87%	−28.58%	−36.80%	−44.36%	−47.18%
Amended Energy Conservation Standards Product Conversion Costs.	(2008$ millions)		$3	$3	$2	$3	$7
Amended Energy Conservation Standards Capital Conversion Costs.	(2008$ millions)		$29	$77	$125	$155	$172
Total Investment Required	(2008$ millions)		$33	$81	$127	$158	$179

The April 2009 NOPR provides a detailed discussion of the estimated impact of amended standards for GSFL and IRL on INPVs. 74 FR 16920, 16999–17003 (April 13, 2009). This qualitative discussion on the estimated impacts of amended GSFL and IRL standards in INPVs for the final rule can be found in chapter 13 of the TSD.

a. Industry Cash Flow Analysis Results for the IRL Lifetime Sensitivity

For the final rule, DOE analyzed the effects of the Baseline Lifetime scenario as a sensitivity. The impacts of this scenario on INPV are presented below. For a full description of the scenario, *see* section VI.C.1 of today's final rule.

TABLE VII.18—MANUFACTURER IMPACT ANALYSIS FOR IRL UNDER THE EXISTING TECHNOLOGIES BASE CASE—BR SUBSTITUTION SCENARIO—ROLL-UP IN EFFICIENCY DISTRIBUTION—BASELINE LIFETIME SCENARIO*

	Units	Base case	Trial standard level	
			4	5
INPV	(2008$ millions)	301	281	258
Change in INPV	(2008$ millions)		(21)	(43)
	(%)		−6.81%	−14.24%
Amended Energy Conservation Standards Product Conversion Costs.	(2008$ millions)		$3	$7

TABLE VII.18—MANUFACTURER IMPACT ANALYSIS FOR IRL UNDER THE EXISTING TECHNOLOGIES BASE CASE—BR SUBSTITUTION SCENARIO—ROLL-UP IN EFFICIENCY DISTRIBUTION—BASELINE LIFETIME SCENARIO*—Continued

	Units	Base case	Trial standard level	
			4	5
Amended Energy Conservation Standards Capital Conversion Costs.	(2008$ millions)		$167	$167
Total Investment Required	(2008$ millions)		$170	$174

* The scenarios that bound the INPV results in the sensitivity scenario are different than the scenarios that bound the INPV results in the normal standards cases.

TABLE VII.19—MANUFACTURER IMPACT ANALYSIS FOR IRL UNDER THE EMERGING TECHNOLOGY BASE CASE—R–CFL PRODUCT SUBSTITUTION—SHIFT IN EFFICIENCY DISTRIBUTIONS—BASELINE LIFETIME SCENARIO*

	Units	Base case	Trial standard level	
			4	5
INPV	(2008$ millions)	221	160	171
Change in INPV	(2008$ millions)		(61)	(49)
	(%)		−27.52%	−22.35%
Amended Energy Conservation Standards Product Conversion Costs.	(2008$ millions)		$3	$7
Amended Energy Conservation Standards Capital Conversion Costs.	(2008$ millions)		$155	$155
Total Investment Required	(2008$ millions)		$158	$162

* The scenarios that bound the INPV results in the sensitivity scenario are different than the scenarios that bound the INPV results in the normal standards cases.

The sensitivity results show that decreasing the lifetime of the standards-compliant lamps at TSL 4 and TSL 5 lowers the estimated range of INPV impacts relative to the no sensitivity results. In the base case, the lamps that meet TSL 4 and TSL 5 are premium products with longer life than standard HIR lamps. If manufacturers decreased the lifetime of the lamps in response to the energy conservation standards, the industry revenues in the standards case are greater due to higher total shipments at TSL 4 and TSL 5. The higher revenues help to mitigate the impacts of the significant capital conversion costs required to comply with the energy conservation standards.

b. Cumulative Regulatory Burden

The April 2009 NOPR notes that one aspect of DOE's assessment of manufacturer burden is the cumulative impact of multiple regulatory actions that affect manufacturers. 74 FR 16920, 17003 (April 13, 2009). In addition to DOE's energy conservation regulations for GSFL and IRL, DOE identified other requirements that manufacturers face for these and other products and equipment they manufacture in the three years before and after the anticipated effective date of the amended DOE regulations. *Id.* DOE believes that the EISA 2007 requirements for GSIL are significant and could have the greatest cumulative burden on manufacturers, but that they will not pose insurmountable challenges. *Id.*

Chapter 13 of the TSD addresses in greater detail the issue of cumulative regulatory burden.

c. Impacts on Employment

As discussed in the April 2009 NOPR, and for today's final rule, DOE believes that amended energy conservation standards will not alter domestic employment levels of the GSFL industry. 74 FR 16920, 17003 (April 13, 2009). During interviews with manufacturers, DOE learned that GSFL are produced on high-speed, fully-automated lines. Production workers are not involved in the physical assembly of the final product (*e.g.*, in inserting components, transferring partly assembled lamps, soldering lamp bases). The employment levels required for these tasks are a function of the total volume of the facility, not the labor content of the product mix produced by the plant. Since higher TSLs involve using more-efficient phosphors, employment will not be impacted because standards will not change the overall scale of the facility.

As discussed in the April 2009 NOPR, and for today's final rule, DOE believes that amended energy conservation standards will not significantly impact IRL direct employment. 74 FR 16920, 17004 (April 13, 2009). The impact that new standards will have on employment is far less significant than the potential impact from emerging technologies. Both scenarios show that the absolute magnitudes of employment impacts due to standards are small. Whether standards have a positive or negative impact on employment is largely determined by the extent to which consumers elect to substitute IRL with other lamp technologies (such as R–CFL or exempted IRL) in the standards case.

Further support for these conclusions is set forth in chapter 13 of the TSD.

d. Impacts on Manufacturing Capacity

DOE stated its view in the April 2009 NOPR, 74 FR 16920, 17004 (April 13, 2009), that amended standards would not significantly affect GSFL production capacity. Over the long-term, any redesign of GSFL needed to meet standards would largely be a materials issue that would not affect manufacturing capacity. In the short term, although higher are expediting the shift from T12 shipments to T8 shipments and require shutting down and retooling production lines, manufacturers are able to temporarily ramp up production before shutdowns occur to maintain shipments during retooling. For today's final rule, DOE maintains its belief that amended energy conservation standards for GSFL will not significantly impact manufacturing capacity.

In the NOPR, DOE stated it did not believe there would be a capacity constraint at the proposed standard level. DOE stated that manufacturers could install additional coaters, purchase infrared burners from a supplier, and use existing excess capacity. These options would allow IRL manufacturers to maintain production capacity levels and continue to meet market demand. 74 FR 16920, 17004 (April 13, 2009). In response to the April 2009 NOPR, manufacturers did raise concerns that the energy conservation standards in today's final rule could result in a constrained market. However, none of the comments DOE received indicated that that the energy conservation standards would result in the unavailability of standards-compliant products. At worst, the energy conservation standards could result in a short-term disruption in which the one manufacturer that requested additional time in between the announcement and effective date does not supply covered IRL. DOE did not receive comment that would indicate the other manufacturers would not have the necessary volume of standards-compliant lamps by the effective date of the final rule. For today's final rule, DOE maintains its belief that manufacturers will be able to maintain production capacity of covered IRLs and will be able to meet market demand.

e. Impacts on Manufacturers That Are Small Businesses

As discussed in the April 2009 NOPR, 74 FR 16920, 17004 (April 13, 2009), DOE identified no small manufacturers of IRL but did identify one small manufacturer that produces covered GSFL and is unlikely to be significantly affected by today's final rule.[65] In response to the April 2009 NOPR, one small business requested it be included in DOE's small business manufacturer impact analysis. For today's final rule, DOE re-analyzed its list of potential small business manufacturers, including those that submitted comments. DOE still has not identified any small manufacturer of covered IRL. However, DOE continues to identify the one small manufacturer that produces covered GSFL. For a discussion of the impacts on small business manufacturers, see chapter 13 of the TSD and section VIII.B of today's notice.

3. National Net Present Value and Net National Employment

The NPV analysis is a measure of the cumulative benefit or cost of standards to the Nation, discounted to $2008 dollars. In accordance with the OMB's guidelines on regulatory analysis,[66] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. The 7-percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy, and reflects the returns to real estate and small business capital, as well as corporate capital. DOE used this discount rate to approximate the opportunity cost of capital in the private sector because recent OMB analysis has found the average rate of return to capital to be near this rate. DOE also used the 3-percent rate to capture the potential effects of standards on private consumption (*e.g.*, through higher prices for equipment and the purchase of reduced amounts of energy). This rate represents the rate at which society discounts future consumption flows to their present value. This rate can be approximated by the real rate of return on long-term government debt (*i.e.*, yield on Treasury notes minus annual rate of change in the Consumer Price Index), which has averaged about 3 percent on a pre-tax basis for the last 30 years.

The tables below show the forecasted net present value at each trial standard level for GSFL and IRL. As shown above for NES results, Table VII.20 presents the ''Existing Technologies, High Lighting Expertise, Shift'' scenario and the ''Emerging Technologies, Market Segment-Based Lighting Expertise, Roll Up'' scenario as the maximum and minimum NPVs for GSFL, respectively. In general, the NPV results at each trial standard level are a reflection of the life-cycle cost savings at the corresponding efficacy levels. As seen in section VII.C.1.a, for most lamp purchasing events and most baseline lamps, increasing efficacy levels generally result in increased LCC savings. *See* the April 2009 NOPR and chapter 11 of the TSD for a description of the effect of various TSLs on NPV. 74 FR 16920, 17006–07 (April 13, 2009).

TABLE VII.20—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR GSFL

TSL/EL	Product class	NPV (billion 2008$)			
		Existing technologies, high lighting expertise, shift		Emerging technologies, market segment-based lighting expertise, roll-up	
		7% Discount	3% Discount	7% Discount	3% Discount
1	4-foot MBP	3.30	6.86	1.11	2.88
	8-foot SP Slimline	0.55	1.40	0.51	1.34
	8-foot RDC HO	0.54	0.88	−0.19	−0.24
	4-foot MiniBP SO	1.47	3.37	0.08	0.26
	4-foot MiniBP HO	2.22	4.81	1.19	2.63
	2-foot U-Shaped	0.15	0.31	0.05	0.13
	Total	8.24	17.63	2.75	7.00
2	4-foot MBP	2.63	5.99	0.75	2.60
	8-foot SP Slimline	0.60	1.53	0.58	1.50
	8-foot RDC HO	0.68	1.09	0.77	1.20
	4-foot MiniBP SO	1.47	3.37	0.08	0.26
	4-foot MiniBP HO	2.22	4.81	1.19	2.63

[65] As discussed in the April 2009 NOPR, 74 FR 17004–05, DOE identified only manufacturer of covered GSFL or IRL that met the criteria to be classified as a small business. For further detail on DOE's inquiry regarding small manufacturers, *please see* section VIII.B on the review under the Regulatory Flexibility Act.

[66] OMB Circular A–4, section E (Sept. 17, 2003).

TABLE VII.20—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR GSFL—Continued

TSL/EL	Product class	NPV (billion 2008$)			
		Existing technologies, high lighting expertise, shift		Emerging technologies, market segment-based lighting expertise, roll-up	
		7% Discount	3% Discount	7% Discount	3% Discount
	2-foot U-Shaped	0.12	0.27	0.03	0.12
	Total	7.73	17.07	3.41	8.31
3	4-foot MBP	9.40	20.06	2.68	7.05
	8-foot SP Slimline	0.82	1.82	0.82	1.82
	8-foot RDC HO	0.32	0.59	0.22	0.39
	4-foot MiniBP SO	1.47	3.37	0.08	0.26
	4-foot MiniBP HO	2.22	4.81	1.19	2.63
	2-foot U-Shaped	0.43	0.91	0.12	0.32
	Total	14.81	31.80	5.18	12.60
4	4-foot MBP	18.66	37.88	6.34	14.22
	8-foot SP Slimline	0.84	1.97	0.24	0.91
	8-foot RDC HO	1.87	3.17	1.87	3.17
	4-foot MiniBP SO	1.47	3.37	0.08	0.26
	4-foot MiniBP HO	2.22	4.81	1.19	2.63
	2-foot U-Shaped	0.85	1.72	0.29	0.65
	Total	26.31	53.53	10.02	21.84
5	4-foot MBP	22.79	45.79	6.12	14.24
	8-foot SP Slimline	0.84	1.97	0.33	1.07
	8-foot RDC HO	1.98	3.36	1.81	3.10
	4-foot MiniBP SO	1.91	4.29	0.32	0.91
	4-foot MiniBP HO	2.22	4.81	1.19	2.63
	2-foot U-Shaped	1.04	2.08	0.28	0.65
	Total	30.93	62.55	10.05	22.57

For IRL, DOE presents the ''Existing Technologies, R–CFL Product Substitution, Shift'' and ''Emerging Technologies, BR Product Substitution, Roll-Up'' scenarios as the maximum and minimum NPVs, respectively. As seen in Table VII.21, NPV increases with TSL, consistent with LCC savings generally increasing with efficacy level. In particular, for the BR Product Substitution scenario, the negative NPV at TSL1 results because the life-cycle cost savings at EL1 (the associated EL) are primarily negative. However, as seen in the R–CFL Product Substitution scenario, TSL1 achieves positive NPV due to primarily the increased movement to highly cost-effective R–CFLs. For further discussion of the NPV results see the April 2009 NOPR and chapter 11 of the TSD. 74 FR 16920, 17006–07 (April 13, 2009).

TABLE VII.21—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR INCANDESCENT REFLECTOR LAMPS

TSL	NPV (billion 2008$)			
	Existing technologies, R–CFL product substitution, shift		Emerging technologies, BR product substitution, roll-up	
	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate
1	0.45	1.11	−0.09	−0.04
2	4.59	8.94	2.08	3.93
3	6.34	12.50	3.04	5.84
4	9.06	17.81	4.20	8.02
5	10.16	20.01	4.90	9.38

As discussed in section VI.C, DOE developed a Baseline Lifetime scenario (which it analyzed the LCC savings, NPV, and manufacturer impacts) to investigate the effects of shorter lamp lifetime at TSL4 and TSL5. DOE did not feel it necessary to apply this scenario to TSL1 through TSL3 because DOE already analyzes lamps with lifetimes similar to that of the baseline lamp lifetimes. Relative to the normal lifetime scenario, NPV decreases due to the significant increase in incremental equipment costs, since more lamps need to be shipped as they have shorter lifetimes.

TABLE VII.22—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR INCANDESCENT REFLECTOR LAMPS—"BASELINE LIFETIME SCENARIO"

TSL	NPV (billion 2008$)			
	Existing technologies, R–CFL product substitution, shift		Emerging technologies, BR product substitution, roll-up	
	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate
4	5.22	10.81	1.83	3.78
5	4.86	10.13	2.53	5.12

DOE also estimated the national employment impacts that would result from each TSL. In addition to considering the direct employment impacts for the manufacturers of products covered in this rulemaking (discussed above), DOE also developed estimates of the indirect employment impacts of energy conservation standards on the economy in general. As Table VII.23 and Table VII.24 show, DOE estimates that any net monetary savings from GSFL and IRL standards would be redirected to other forms of economic activity. DOE also expects these shifts in spending and economic activity would affect the demand for labor. DOE estimated that net indirect employment impacts from energy conservation standards for GSFL and IRL would be positive (*see* Tables below), but very small relative to total national employment. This increase would likely be sufficient to fully offset any adverse impacts on employment that might occur in the lamp products industries. Earthjustice commented that the value of this additional employment should be monetized using a wage rate and included in the justification of the TSL selected. (Earthjustice, No. 60 at pg 6) However, this would double count the consumer savings that are the source of the job creation. DOE believes it more appropriate to consider job benefits separately from the direct benefits of energy savings similar to DOE's approach for considering environmental emissions benefits. For details on the employment impact analysis methodology and results, see chapter 15 of the TSD accompanying this notice.

TABLE VII.23—NET NATIONAL CHANGE IN INDIRECT EMPLOYMENT FOR GSFL, JOBS IN 2042

Trial standard level	Net national change in jobs (thousands)	
	Existing technologies, shift, high expertise	Emerging technologies, roll-up, market segment based expertise
1	12.0	6.5
2	12.2	5.5
3	15.1	10.7
4	18.4	13.3
5	19.6	15.5

TABLE VII.24—NET NATIONAL CHANGE IN INDIRECT EMPLOYMENT FOR IRL, JOBS IN 2042

Trial standard level	Net national change in jobs (thousands)	
	Existing technologies, shift, R–CFL substitution	Emerging technologies, roll-up, BR lamp substitution
1	1.7	0.7
2	4.3	2.5
3	6.9	4.8
4	9.5	6.0
5	10.4	6.8

4. Impact on Utility or Performance of Products

As indicated in sections IV.D.d and VI.B.4 of the April 2009 NOPR, DOE has concluded that TSLs it considered for GSFL and IRL would not lessen the utility or performance of any GSFL or IRL covered by this rulemaking. 74 FR 16920, 17009 (April 13, 2009)

5. Impact of Any Lessening of Competition

As discussed in the April 2009 NOPR, 74 FR 16920, 16936, 17009 (April 13, 2009), and in section IV.D.e of this preamble, DOE considers any lessening of competition likely to result from standards; the Attorney General determines the impact, if any, of any such lessening of competition.

The DOJ concluded that the GSFL standards contained in the proposed rule would not likely lead to a lessening of competition. DOJ has not determined the impact on competition of more stringent standards than those proposed in the April 2009 NOPR (DOJ, No. 77 at p. 1). Although DOJ did not evaluate the impacts on competition of TSL 4 for GSFL, DOE believes that TSL 4 does not raise competitive issues. For all product classes analyzed DOE found that all manufacturers offered product at TSL 4. Further, the product modifications needed to reach TSL 4 involve the use of more efficient phosphor blends which do not entail proprietary barriers.

For IRL, DOJ concluded that the proposed TSL 4 could adversely affect competition. IRL standards proposed in the April 2009 NOPR would increase the minimum efficiency levels to the second highest level under consideration in this rulemaking. DOJ commented that the IRL market is highly concentrated, with three domestic manufacturers. Based on its review, DOJ stated that it appears that only two of the large manufacturers identified may currently manufacture IRLs that would meet the new standard and that these firms produce only limited quantities of such products for high-end applications. The current producers may not have the capacity to meet demand. In addition, one of these manufacturers uses proprietary technology currently unavailable to other manufacturers. Given the capital investments new entrants or providers would be required to make, and the potential that manufacturers may have to obtain proprietary technology, there is a risk that one or more IRL manufacturers will not produce products that meet the proposed standard. Note also that the National Impact Analysis does not consider the possibility of lessened competition effects, and so, depending on their magnitude, such effects may negatively impact the Net Present Value of the standards. DOJ requested that DOE consider the possibility of new technology in this area as it settles on standards in this field. (DOJ, No. 77 at pp. 1–2)

DOE agrees with DOJ that the IRL market is highly concentrated, with three major manufacturers supplying the vast majority of the U.S. market. However, for the April 2009 NOPR, DOE stated that all manufacturers produced at least one lamp that met TSL 4, even though one manufacturer did not produce a full line of product at this efficacy. 74 FR 16920, 17003 (April 13, 2009).

In the NOPR, DOE indicated that it believed manufacturers could maintain production capacity levels and continue to meet market demand at the proposed IRL standard (TSL 4). DOE noted that the current volume of these improved HIR lamps is many times lower than the volume of standard halogen lamps for all three major manufacturers. DOE used market research and analysis of HIR capsule production, and interviews with manufacturers of lamps and suppliers of HIR capsules and coating decks to analyze if manufacturers of IRL would be able to supply the market if lamp manufacturers outsourced all or part of their capsule production. In the NOPR, DOE stated it did not believe there would be a capacity constraint at the proposed standard level. DOE stated that manufacturers could install additional coaters, purchase infrared burners from a supplier, and use existing excess capacity. All these stated options would allow IRL manufacturers to maintain production capacity levels and continue to meet market demand for all IRL standard levels. 74 FR 16920, 17004 (April 13, 2009).

For today's final rule, DOE did not receive comments that indicated that the energy conservation standards would result in the unavailability of standards-compliant products. DOE did receive comments about the potential for a short-term market disruption. One major manufacturer requested additional time in between the announcement and effective date to allow more time to stabilize improved HIR manufacturing before the regulation mandates the improved technology. (OSI, No. 84 at p. 1) Another major manufacturer responded to April 2009 NOPR by commenting that TSL 4 allows the continued manufacture and sale of energy efficient products to the market and that these products have also been proven manufacturable by at least two major lighting companies. (Philips, No. 75 at p. 1) In its individual comment, the third major manufacturer did not comment on its intention to make the required capital investments. DOE believes that this manufacturer will not have difficulty supplying at least part of the market at the proposed standards because this manufacturer currently has a full line of products at both TSL 4 and TSL 5. Although DOE received comments that there could be a constrained market, other comments suggest that this constraint will at worst be a short-term problem. However, since all three large manufacturers currently manufacture product at the efficacies required by today's final rule, a short-term constraint would not be a competitive issue.

DOE does not believe manufacturers will have to obtain proprietary technology to meet the energy conservation standards set forth by today's rule. As stated in section VI.B.2, all major manufacturers have access to alternative technology pathways to meet TSL 4 without the use of proprietary technology. In the April 2009 NOPR, DOE stated that all major manufacturers produce two or more lamps that exceed TSL 4, some of which are not dependent on proprietary technology. DOE listed alternative technologies to meet TSL 4 including other non-patented types of improved reflectors and higher-efficiency IR coatings. 74 FR 16920, 16945 (April 13, 2009). DOE did not receive additional information or comments that would indicate that the identified alternative technologies necessary to meet energy conservation standards set forth by today's final rule will lead to any lessening of competition. Section VI.B of today's final rule further discusses alternative technology pathways and proprietary technology.

The Attorney General's response is reprinted at the end of today's rulemaking.

6. Need of the Nation To Conserve Energy

Improving the energy efficiency of GSFL and IRL, where economically justified, would likely improve the security of the Nation's energy system by reducing overall demand for energy, thus reducing the Nation's reliance on foreign sources of energy. Reduced demand might also improve the reliability of the electricity system, particularly during peak-load periods. As a measure of this reduced demand, DOE expects the energy savings from the adopted standards to eliminate the need for approximately 1.8 to 6.2 gigawatts (GW) of generating capacity for GFSL and up to 200 to 1,100 megawatts (MW) for IRL by 2042.

Enhanced energy efficiency also produces environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production. Table VII.25 and Table VII.26 provide DOE's estimate of cumulative CO_2, NO_X, and Hg emissions reductions that would result from the TSLs considered in this rulemaking. The expected energy savings from these GSFL and IRL standards may also reduce the cost of maintaining nationwide emissions standards and constraints. In the environmental assessment (EA; chapter

16 of the TSD accompanying this notice), DOE reports estimated annual changes in CO_2, NO_X, and Hg emissions attributable to each TSL.

TABLE VII.25—SUMMARY OF EMISSIONS REDUCTIONS FOR GSFL

[Cumulative reductions for products sold from 2012 to 2042]

		TSL1	TSL2	TSL3	TSL4	TSL5
(i) Existing Technologies, Shift, High Lighting Expertise						
CO_2 (MMT)		130.3	133.9	296.6	487.6	552.0
NO_X (kt)		11.7	10.0	17.0	36.8	58.1
Hg (t)	low	0.0	0.0	0.0	0.0	0.0
Hg (t)	high	2.0	2.4	4.8	7.3	8.8
Emerging Technologies, Roll Up, Market Segment Based Lighting Expertise						
CO_2 (MMT)		66.4	86.0	148.3	174.6	262.0
NO_X (kt)		1.9	5.1	7.3	11.0	12.9
Hg (t)	low	0.0	0.0	0.0	0.0	0.0
Hg (t)	high	1.2	1.4	2.3	2.8	4.0

TABLE VII.26—SUMMARY OF EMISSIONS REDUCTIONS FOR IRL

[(Cumulative reductions for products sold from 2012 to 2042)]

		TSL1	TSL2	TSL3	TSL4	TSL5
Existing Technologies, Shift, R–CFL Substitution						
CO_2 (MMT)		19.8	48.9	85.1	105.7	118.1
NO_X (kt)		1.9	5.5	7.6	8.4	9.3
Hg (t)	low	0.0	0.0	0.0	0.0	0.0
Hg (t)	high	0.3	0.7	1.3	1.7	1.8
Emerging Technologies, Roll Up, BR Lamp Substitution						
CO_2 (MMT)		7.5	19.1	37.8	44.0	53.3
NO_X (kt)		1.3	3.2	5.4	6.4	8.1
Hg (t)	low	0.0	0.0	0.0	0.0	0.0
Hg (t)	high	0.1	0.3	0.6	0.7	0.8

MMt = million metric tons.
kt = thousand metric tons.
t = metric tons.
NOTE: The derivation for the emission ranges are described below.

As discussed in section IV.I of this final rule, DOE does not report SO_2 emissions reductions from power plants because reductions from an energy conservation standard would not affect the overall level of SO_2 emissions in the United States due to the emissions caps for SO_2.

NO_X emissions from 28 eastern States and the District of Columbia (DC) are limited under the Clean Air Interstate Rule (CAIR), published in the **Federal Register** on May 12, 2005.[67] Although CAIR has been remanded to EPA by the D.C. Circuit, it will remain in effect until it is replaced by a rule consistent with the Court's December 23, 2008, opinion in *North Carolina* v. *EPA*.[68] Because all States covered by CAIR opted to reduce NO_X emissions through participation in cap-and-trade programs for electric generating units, emissions from these sources are capped across the CAIR region.

For the 28 eastern States and D.C. where CAIR is in effect, no NO_X emissions reductions will occur due to the permanent cap. Under caps, physical emissions reductions in those States would not result from the energy conservation standards under consideration by DOE, but standards might have produced an environmentally related economic impact in the form of lower prices for emissions allowance credits, if they were large enough. However, DOE determined that in the present case, such standards would not produce an environmentally related economic impact in the form of lower prices for emissions allowance credits, because the estimated reduction in NO_X emissions or the corresponding allowance credits in States covered by the CAIR cap would be too small to affect allowance prices for NO_X under the CAIR. In contrast, new or amended energy conservation standards would reduce NO_X emissions in those 22 States that are not affected by CAIR. As a result, the NEMS–BT does forecast emission reductions from the proposed amended standards considered in today's final rule.

In the April 2009 NOPR, however, DOE provided a different estimate of NO_X reductions because DOE assumed that the CAIR rule had been vacated. This is because the CAIR rule was vacated by the U.S. Court of Appeals for the District of Columbia Circuit (DC Circuit) in its July 11, 2008 decision in *North Carolina* v. *Environmental Protection Agency*.[69] Although the D.C. Circuit, in a December 23, 2008, opinion,[70] decided to allow the CAIR rule to remain in effect until it is replaced by a rule consistent with the

[67] 70 FR 25162 (May 12, 2005).

[68] *North Carolina* v. *EPA*, 550 F.3d 1176 (DC Cir. 2008).

[69] 531 F.3d 896 (D.C. Cir. 2008).

[70] *See North Carolina* v. *EPA*, 550 F.3d 1176 (DC Cir. 2008).

court's earlier opinion, DOE retained its analysis of NO_X emissions reductions based on an assumption that the CAIR rule was not in effect because: (1) The NOPR rulemaking was sufficiently advanced at the time that the December 23, 2008, opinion was issued that revisiting the analysis would have caused undue delays; and (2) neither the July 11, 2008, nor the December 23, 2008, decisions of the D.C. Circuit changed the standard-setting proposals offered in the NOPR.

Thus, for the April 2009 NOPR, DOE established a range of NO_X reductions based on low and high emission rates (in metric kilotons of NO_X emitted per terawatt-hour (TWh) of electricity generated) derived from the *AEO2008*. DOE anticipated that, in the absence of the CAIR Rule's trading program, the new or amended conservation standards would reduce NO_X emissions nationwide not just in 22 statues.

As noted in section IV.I, DOE was able to estimate the changes in Hg emissions associated with an energy conservation standard as follows. DOE notes that the NEMS–BT model used for the NOPR, used as an integral part of today's rulemaking, does not estimate Hg emission reductions due to new energy conservation standards, as it assumed that Hg emissions would be subject to EPA's CAMR.[71] CAMR would have permanently capped emissions of mercury for new and existing coal-fired plants in all States by 2010. As with SO_2 and NO_X, DOE assumed that under such a system, energy conservation standards would have resulted in no physical effect on these emissions, but might have resulted in an environmentally related economic benefit in the form of a lower price for emissions allowance credits if those credits were large enough. DOE estimated that the change in the Hg emissions from energy conservation standards would not be large enough to influence allowance prices under CAMR.

On February 8, 2008, the DC Circuit issued its decision in *New Jersey* v. *Environmental Protection Agency*[72] to vacate CAMR. In light of this development and because the NEMS–BT model could not be used to directly calculate Hg emission reductions, DOE used the Hg emission rates discussed below to calculate emissions reductions in the NOPR. This same methodology is used for the Final Rule as well due to the continued fluid environment ''* * * with many States planning to enact new laws or make existing laws more stringent.''[73] The NEMS–BT has only rough estimates of mercury emissions, and it was felt that the range of emissions used in the NOPR remain appropriate given these circumstances.

Therefore, rather than using the NEMS–BT model, DOE established a range of Hg rates to estimate the Hg emissions that could be reduced through standards. DOE's low estimate assumed that future standards would displace electrical generation only from natural gas-fired power plants, thereby resulting in an effective emission rate of zero. (Under this scenario, coal-fired power plant generation would remain unaffected.) The low-end emission rate is zero because natural gas-fired power plants have virtually zero Hg emissions associated with their operation. Earthjustice stated that basing the low end of the range on the displacement of only gas-fired power plants was inconsistent with DOE's utility impact analysis (Earthjustice, No. 60 at pg. 8–9). DOE believes that the estimate should provide the full range of possible outcomes and has selected the low and high values to bracket the uncertainties associated with estimating mercury emission reductions.

DOE's high estimate, which assumed that standards would displace only coal-fired power plants, was based on an estimate of the 2006 nationwide mercury emission rate from *AEO2008*. (Under this scenario, DOE assumed that gas-fired power plant generation would remain unaffected and that no future reductions in the rate of mercury emissions from such sources would occur.) Because power plant emission rates are a function of local regulation, scrubbers, and the mercury content of coal, it is extremely difficult to identify a precise high-end emission rate. Therefore, the most reasonable high estimate is based on the assumption that all displaced coal generation would have been emitting at the 2006 average emission rate for coal generation as specified by the April Update to *AEO2009*. This is viewed as a high estimate because it is likely that future emission controls will be installed at coal-fired power plants which will reduce their average emission rate. As noted previously, because virtually all mercury emitted from electricity generation is from coal-fired power plants, DOE based the emission rate on the tons of mercury emitted per TWh of coal-generated electricity. Based on the emission rate for 2006, DOE derived a high-end emission rate of 0.0255 tons per TWh. To estimate the reduction in mercury emissions, DOE multiplied the emission rate by the reduction in coal-generated electricity due to the standards considered in the utility impact analysis. These changes in Hg emissions are small, ranging from 0.2 to 1.0 percent of the national base-case emissions forecast by NEMS–BT for GFSL, depending on the TSL and scenario, and less than 0.2 percent for all IRL levels.

In the April 2009 NOPR, DOE considered accounting for a monetary benefit of CO_2 emission reductions associated with standards. To put the potential monetary benefits from reduced CO_2 emissions into a form that would likely be most useful to decision makers and interested parties, DOE used the same methods it used to calculate the net present value of consumer cost savings. DOE converted the estimated yearly reductions in CO_2 emissions into monetary values that represented the present value, in that year, of future benefits resulting from that reduction in emissions, which were then discounted from that year to the present using both 3-percent and 7-percent discount rates.

In the April 2009 NOPR, DOE proposed to use the range $0 to $20 per ton for the year 2007 in 2007$. 74 FR 16920, 17012 (April 13, 2009). These estimates were originally derived to represent the lower and upper bounds of the costs and benefits likely to be experienced in the United States. The lower bound was based on an assumption of no benefit and the upper bound was based on an estimate of the mean value of worldwide impacts due to climate change that was reported by the Intergovernmental Panel on Climate Change (IPCC).[74] DOE expected that such domestic values would be 10% or less of comparable global values; however, there were no consensus estimates for the U.S. benefits likely to

[71] 70 FR 28606 (May 18, 2005).

[72] 517 F.3d 574 (DC Cir. 2008).

[73] Energy Information Administration, Annual Energy Outlook 2009 (March 2009), page 18.

[74] During the preparation of its review of the state of climate science, the IPCC identified various estimates of the present value of reducing CO_2 emissions by 1 ton over the life that these emissions would remain in the atmosphere. The estimates reviewed by the IPCC spanned a range of values. Absent a consensus on any single estimate of the monetary value of CO_2 emissions, DOE used the estimates identified by the study cited in ''Summary for Policymakers,'' prepared by Working Group II of the IPCC's ''Fourth Assessment Report,'' to estimate the potential monetary value of CO_2 reductions likely to result from standards considered in this rulemaking. According to IPCC, the mean social cost of carbon (SCC) reported in studies published in peer-reviewed journals was $43 per ton of carbon. This translates into about $12 per ton of CO_2. The literature review (Tol 2005) from which this mean was derived did not report the year in which these dollars were denominated. However, DOE understands this estimate was for the year 1995 denominated in 1995$. Updating that estimate to 2007$ yields a SCC for the year 1995 of $15 per ton of CO_2.

result from CO_2 emission reductions. Because U.S.-specific estimates were unavailable, DOE used the global mean value as an upper bound U.S. value.

Given the uncertainty surrounding estimates of the social cost of carbon, DOE previously concluded that relying on any single estimate may be inadvisable because that estimate will depend on many assumptions. Working Group II's contribution to the ''Fourth Assessment Report'' of the IPCC notes the following:

The large ranges of SCC are due in the large part to differences in assumptions regarding climate sensitivity, response lags, the treatment of risk and equity, economic and non-economic impacts, the inclusion of potentially catastrophic losses, and discount rates.[75]

Because of this uncertainty, DOE used the SCC value from Tol (2005), which was presented in the IPCC's ''Fourth Assessment Report'' and provided a comprehensive meta-analysis of estimates for the value of SCC. 74 FR 16920, 17012 (April 13, 2009).

NRDC and Earthjustice and NY et al. commented that DOE should use global, rather than U.S. based estimates for CO_2 values (NRDC, Issue Paper, No. 82 at p. 13 and NY et al., Attachment, No. 88 at p. 3). NY *et al.* recommended DOE use $80 per short ton CO_2 ($88 metric) in 2009$ based on recent meta-analysis of GHG abatement cost analyses published by international agencies and multinational consultancies. NY *et al.*, also criticized the range of CO_2 values used in the NOPR and recommended the use of a long-run marginal abatement cost of CO_2 for monetizing CO_2 emission reductions, rather than the damage costs given the highly uncertain nature of the latter (NY *et al.*, No. 88, p. 9–10).

DOE continues to use SCC values in today's final rule. DOE has not adopted using an abatement cost because the actual costs of reducing CO_2 emissions are highly variable. They range from negative costs, such as energy efficiency improvement measures that produce net economic benefits, to hundreds of dollars per ton of CO_2, such as emission reductions that might require the early abandonment of large capital investments in power plants, industrial facilities or buildings. In order to identify a specific marginal cost per ton of CO_2 reduced usually requires the establishment of key parameters, such as the scope of the emissions covered, the quantity of emission reductions to be achieved and the timeframe for the achievement of these reductions. These parameters must be determined through legislative or regulatory processes. Moreover, the use of SCC is consistent with the IPCC Fourth Assessment Report. However, if a nationwide regulatory mandate is established to limit or reduce U.S. greenhouse gas emissions, the marginal costs of reducing emissions that are imposed by such a mandate might be the basis for valuing such emission reductions in the future.

For today's final rule, DOE is relying on an updated range of values consistent with that presented in the Model Year 2011 fuel economy standard final rule issued by the National Highway Traffic Safety Administration (NHTSA): $2, $33 and $80 per ton. In the MY 2011 fuel economy standard final rule, NHTSA relied on a range of estimates representing the uncertainty surrounding global values of the SCC, while also encompassing, at the low end, possible domestic values. These three values encompass much of the variability in the estimates of the global value of the SCC. The lower end of this range, $2, also approximates possible mean value for domestic benefits. The middle of the range, $33, is equal to the mean value in Tol (2008) and the high end of the range, $80, represents one standard deviation above the mean global value. 74 FR 14196, 14346 (March 30, 2009).

The global value of $33 is based on Tol's (2008) expanded and updated survey of 211 estimates of the global SCC.[76] Tol's 2008 survey encompasses a larger number of estimates for the global value of reducing carbon emissions than its previously-published counterpart, Tol (2005), and continues to represent the only recent, publicly-available compendium of peer-reviewed estimates of the SCC that has itself been peer-reviewed and published.

The domestic value ($2) was developed by NHTSA by using the mean estimate of the global value of reduced economic damages from climate change resulting from reducing CO_2 emissions as a starting point; estimating the fraction of the reduction in global damages that is likely to be experienced within the U.S.; and applying this fraction to the mean estimate of global benefits from reducing emissions to obtain an estimate of the U.S. domestic benefits from lower GHG emissions. NHTSA constructed the estimate of the U.S. domestic benefits from reducing CO_2 emissions using estimates of U.S. domestic and global benefits from reducing greenhouse gas emissions developed by EPA and reported in EPA's Technical Support Document accompanying its advance notice of proposed rulemaking on motor vehicle CO_2 emissions.[77]

A complete discussion of NHTSA's analysis is available in Chapter VIII of the Final Regulatory Analysis of the Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks (NHTSA, March 2009).

After considering comments and the currently available information and analysis, which was reflected in the approach employed by NHTSA, DOE concluded that it was appropriate to consider the global benefits of reducing CO_2 emissions, as well as the domestic benefits. Consequently, DOE considered in its decision-process for this final rule the potential benefits resulting from reduced CO_2 emissions valued at $2, $33 and $80. The resulting range is based on current peer-reviewed estimates of the value of SCC and, DOE believes, fairly represents the uncertainty surrounding the global benefits resulting from reduced CO_2 emissions and, at the $2 level, also encompasses the likely domestic benefits, DOE also concluded, based on the most recent Tol analysis, that it was appropriate to escalate these values at 3% [78] per year to represent the expected increases, over time, of the benefits associated with reducing CO_2 and other greenhouse gas emissions.

The tables below present the resulting estimates of the potential range of net present value benefits associated with reducing CO_2 emissions.

[75] ''Climate Change 2007—Impacts, Adaptation and Vulnerability.'' Contribution of Working Group II to the ''Fourth Assessment Report'' of the IPCC, 17. Available at *www.ipcc.ch/ipccreports/ar4-wg2.htm* (last accessed Aug. 7, 2008).

[76] Richard S.J. Tol (2008), The social cost of carbon: Trends, outliers, and catastrophes, Economics—the Open-Access, Open-Assessment E-Journal, 2 (25), 1–24.

[77] U.S. EPA, Technical Support Document on Benefits of Reducing GHG Emissions, June 12, 2008.

[78] Estimates of SCC are assumed to increase over time since future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed as the magnitude of climate change increases. Although most studies that estimate economic damages caused by increased GHG emissions in future years produce an implied growth rate in the SCC, neither the rate itself nor the information necessary to derive its implied value is commonly reported. Given the limited amount of debate thus far about the appropriate growth rate of the SCC, applying a rate of 3%/yr seems appropriate at this stage. This value is consistent with the range recommended by IPCC (2007).

TABLE VII.27—ESTIMATES OF VALUE OF CO_2 EMISSIONS REDUCTIONS FOR GSFL UNDER TRIAL STANDARD LEVELS AT SEVEN-PERCENT AND THREE-PERCENT DISCOUNT RATES

GSFL TSL	Estimated cumulative CO_2 (MMt) emission reductions	Value of estimated CO_2 emission reductions (billion 2008$) at 7% discount rate			Value of estimated CO_2 emission reductions (billion 2008$) at 3% discount rate		
		CO_2 value of $2/ton CO_2	CO_2 value of $33/ton CO_2	CO_2 value of $80/ton CO_2	CO_2 value of $2/ton CO_2	CO_2 value of $33/ton CO_2	CO_2 value of $80/ton CO_2
1	66 to 130	0.1 to 0.1	1.1 to 2.1	2.6 to 5.1	0.1 to 0.3	2.3 to 4.5	5.6 to 10.9.
2	86 to 134	0.1 to 0.1	1.5 to 2.2	3.6 to 5.3	0.2 to 0.3	3.0 to 4.6	7.2 to 11.2.
3	148 to 297	0.2 to 0.3	2.5 to 4.9	6.1 to 11.9	0.3 to 0.6	5.1 to 10.3	12.5 to 24.9.
4	175 to 488	0.2 to 0.5	3.1 to 8.4	7.5 to 20.4	0.4 to 1.0	6.0 to 16.9	14.7 to 40.9.
5	262 to 552	0.3 to 0.6	4.6 to 9.6	11.1 to 23.4	0.6 to 1.2	9.1 to 19.1	22.0 to 46.4.

TABLE VII.28—ESTIMATES OF VALUE OF CO_2 EMISSIONS REDUCTIONS FOR IRL UNDER TRIAL STANDARD LEVELS AT SEVEN-PERCENT AND THREE-PERCENT DISCOUNT RATES

IRL TSL	Estimated cumulative CO_2 (MMt) emission reductions	Value of estimated CO_2 emission reductions (billion 2008$) at 7% discount rate			Value of estimated CO_2 emission reductions (billion 2008$) at 3% discount rate		
		CO_2 value of $2/ton CO_2	CO_2 value of $33/ton CO_2	CO_2 value of $80/ton CO_2	CO_2 value of $2/ton CO_2	CO_2 value of $33/ton CO_2	CO_2 value of $80/ton CO_2
1	7 to 20	0.0 to 0.0	0.1 to 0.3	0.3 to 0.8	0.0 to 0.0	0.3 to 0.7	0.6 to 1.7.
2	19 to 49	0.0 to 0.1	0.4 to 0.8	0.8 to 2.1	0.0 to 0.1	0.7 to 1.7	1.6 to 4.1.
3	38 to 85	0.0 to 0.1	0.7 to 1.5	1.7 to 3.6	0.1 to 0.2	1.3 to 2.9	3.2 to 7.1.
4	44 to 106	0.0 to 0.1	0.8 to 1.8	1.9 to 4.4	0.1 to 0.2	1.5 to 3.7	3.7 to 8.9.
5	53 to 118	0.1 to 0.1	1.0 to 2.0	2.3 to 4.9	0.1 to 0.2	1.8 to 4.1	4.5 to 9.9.

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other green house gas emissions (GHG) to changes in the future global climate and the potential resulting damages to the world economy continues to evolve rapidly. Thus, any value placed in this rulemaking on reducing CO_2 emissions is subject to likely change.

The Department of Energy, together with other Federal agencies, is reviewing various methodologies for estimating the monetary value of reductions in CO_2 and other greenhouse gas emissions. This review will consider the comments on this subject that are part of the public record for this and other rulemakings, as well as other methodological assumptions and issues, such as whether the appropriate values should represent domestic U.S. benefits, as well as global benefits (and costs). Given the complexity of the many issues involved, this review is ongoing. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this final rule the most recent values and analyses employed in a rulemaking by another Federal agency.

DOE also investigated the potential monetary benefit of reduced SO_2, NO_X, and Hg emissions from the TSLs it considered. As previously stated, DOE's initial analysis assumed the presence of nationwide emission caps on SO_2 and Hg, and caps on NO_X emissions in the 28 States covered by CAIR. In the presence of these caps, DOE concluded that no physical reductions in power sector emissions would occur, but that the standards could put downward pressure on the prices of emissions allowances in cap-and-trade markets. Estimating this effect is very difficult because of factors such as credit banking, which can change the trajectory of prices. DOE has concluded that the effect from energy conservation standards on SO_2 allowance prices is likely to be negligible based on runs of the NEMS–BT model. See chapter 16 of the TSD accompanying this notice for further details.

Because the courts have decided to allow the CAIR rule to remain in effect, projected annual NO_X allowances from NEMS–BT are relevant.[79] As noted above, standards would not produce an economic impact in the form of lower prices for emissions allowance credits in the 28 eastern States and D.C. covered by the CAIR cap. New or amended energy conservation standards would reduce NO_X emissions in those 22 States that are not affected by CAIR. For the area of the United States not covered by CAIR, DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for today's final rule based on environmental damage estimates from the literature. Available estimates suggest a very wide range of monetary values for NO_X emissions, ranging from $370 per ton to $3,800 per ton of NO_X from stationary sources, measured in 2001$ (equivalent to a range of $432 per ton to $4,441 per ton in 2007$).[80]

For Hg emissions reductions, DOE estimated the national monetized values resulting from the TSLs considered for today's rule based on environmental damage estimates from the literature. DOE conducted research for today's final rule and determined that the impact of mercury emissions from power plants on humans is considered highly uncertain. However, DOE identified two estimates of the environmental damage of mercury based on two estimates of the adverse impact of childhood exposure to methyl mercury on IQ for American children, and subsequent loss of lifetime economic productivity resulting from these IQ losses. The high-end estimate is based on an estimate of the current aggregate cost of the loss of IQ in American children that results from exposure to mercury of U.S. power plant origin ($1.3 billion per year in year 2000$), which works out to $32.6 million per ton emitted per year

[79] The Update to the AEO2009 based version of NEMS–BT includes the representation of CAIR.

[80] Office of Management and Budget Office of Information and Regulatory Affairs, ''2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities,'' Washington, DC (2006).

(2007$).[81] The low-end estimate is $0.66 million per ton emitted (in 2004$) or $0.729 million per ton (in 2007)$. DOE derived this estimate from a published evaluation of mercury control using different methods and assumptions from the first study, but also based on the present value of the lifetime earnings of children exposed.[82] Table VI.28 and Table VI.29 present the resulting estimates of the potential range of present value benefits associated with reduced national NO_X and Hg emissions from the TSLs DOE considered.

TABLE VII.29—ESTIMATES OF SAVINGS FROM NO_X EMISSIONS REDUCTIONS FOR GSFL

TSL	Estimated cumulative NO_X (kt) emission reductions	Value of estimated NO_X emission reductions (million 2008$) at 7% discount rate	Value of estimated NO_X emission reductions (million 2008$) at 3% discount rate
1	1.9 to 11.7	$0.7 to $23.8	$0.8 to $34.5.
2	5.1 to 10.0	$1.5 to $21.9	$1.9 to $30.4.
3	7.3 to 17.0	$2.2 to $41.1	$2.7 to $54.7.
4	11.0 to 36.8	$4.2 to $107.2	$4.6 to $132.4.
5	12.9 to 58.1	$5.0 to $125.6	$5.5 to $173.9.

TABLE VII.30—ESTIMATES OF SAVINGS FROM NO_X EMISSIONS REDUCTIONS FOR IRL

TSL	Estimated cumulative NO_X (kt) emission reductions	Value of estimated NO_X emission reductions (million 2007$) at 7% discount rate	Value of estimated NO_X emission reductions (million 2007$) at 3% discount rate
1	1.3 to 1.9	$0.3 to $4.6	$0.4 to $6.0.
2	3.2 to 5.5	$0.8 to $13.8	$1.1 to $17.9.
3	5.4 to 7.6	$1.5 to $19.7	$1.9 to $25.2.
4	6.4 to 8.4	$1.8 to $24.4	$2.2 to $30.0.
5	8.1 to 9.3	$2.2 to $27.0	$2.7 to $33.1.

TABLE VII.31—ESTIMATES OF SAVINGS FROM HG EMISSIONS REDUCTIONS FOR GSFL

TSL	Estimated cumulative Hg (tons) emission reductions	Value of estimated Hg emission reductions (million 2007$) at 7% discount rate	Value of estimated Hg emission reductions (million 2007$) at 3% discount rate
1	0.0 to 2.0	$0 to $16.5	$0 to $32.7.
2	0.0 to 2.4	$0 to $20.3	$0 to $39.6.
3	0.0 to 4.8	$0 to $41.4	$0 to $80.2.
4	0.0 to 7.3	$0 to $67.7	$0 to $125.6.
5	0.0 to 8.8	$0 to $84.5	$0 to $154.4.

TABLE VII.32—ESTIMATES OF SAVINGS FROM HG EMISSIONS REDUCTIONS FOR IRL

TSL	Estimated cumulative Hg (tons) emission reductions	Value of estimated Hg emission reductions (million 2007$) at 7% discount rate	Value of estimated Hg emission reductions (million 2007$) at 3% discount rate
1	0.0 to 0.3	$0 to $2.7	$0 to $5.2.
2	0.0 to 0.7	$0 to $6.7	$0 to $12.5.
3	0.0 to 1.3	$0 to $11.7	$0 to $22.1.
4	0.0 to 1.7	$0 to $15.0	$0 to $28.1.
5	0.0 to 1.8	$0 to $16.0	$0 to $30.2.

7. Other Factors

EPCA allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII) and 6316(e)(1)) In adopting today's standards, the Secretary considered the potential for GSFL and IRL standards to adversely affect low-income consumers, institutions of religious worship, historical facilities, institutions that serve low-income populations, and consumers of T12 electronic ballasts.

D. Conclusion

EPCA contains criteria for prescribing new or amended energy conservation standards. It provides that any such standard for GSFL and IRL must be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) As stated above, in determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standards exceed its burdens considering the seven factors discussed

[81] Trasande, L., *et al.*, ''Applying Cost Analyses to Drive Policy that Protects Children,'' 1076 Ann. N.Y. Acad. Sci. 911 (2006).

[82] Ted Gayer and Robert Hahn, ''Designing Environmental Policy: Lessons from the Regulation of Mercury Emissions,'' Regulatory Analysis 05–01, AEI-Brookings Joint Center for Regulatory Studies, Washington, DC (2004). A version of this paper was published in the *Journal of Regulatory Economics* in 2006. The estimate was derived by back-calculating the annual benefits per ton from the net present value of benefits reported in the study.

in section IV.D. (42 U.S.C. 6295(o)(2)(B)(i)) A determination of whether a standard level is economically justified is not made based on any one of these factors in isolation. The Secretary must weigh each of these seven factors in total in determining whether a standard is economically justified. Further, the Secretary may not establish an amended standard if such standard would not result in ''significant conservation of energy,'' or ''is not technologically feasible or economically justified.'' (42 U.S.C. 6295(o)(3)(B))

As discussed in section V.A.1, DOE established a separate set of TSLs for GSFL and for IRL. Therefore, DOE analyzed each lamp type (GSFL or IRL) separately when considering various TSLs and eventually proposing standards. The following discussion briefly explains the development of the TSLs, consideration of the TSLs (starting with the most stringent) under the statutory factors, and the conclusion as to the GSFL standards and IRL standards that most improve energy efficiency that DOE has determined would most improve energy-efficiency and would be technologically feasible and economically justified.

For GSFL, DOE considered five TSLs in the April 2009 NOPR, with TSL5 being the most stringent level for which DOE performed full analyses. 74 FR 16920, 16979–82 (April 13, 2009). It is noted that DOE also considered the potential for a standard level beyond TSL5 that would require GSFL to use a higher-efficiency gas fill composition, which would have been the maximum technologically feasible level. Although more-efficient fill gases (often including higher molecular weight gases) are appropriate for and are currently used in some lamp applications, DOE is also aware employing this technology can cause lamp instability resulting in striations or flickering in some circumstances. DOE's research indicated that a potential standard level that would require the use of higher-efficiency fill gases would significantly reduce (or in some cases eliminate) the utility and performance of the covered GSFL. DOE concluded on this basis that a level with such an adverse impact on product utility would not be economically justified.[83] (42 U.S.C. 6295(o)(2)(B)(i)(IV) and (3)(B)) Having made this determination, there was no need to perform additional analyses relevant to the other statutory criteria. (See section I.A.2 for additional detail.) Consequently, TSL5 represents the most-efficient level analyzed for GSFL.

For IRL, DOE's engineering analysis considered the maximum technologically feasible level, which would require the use of a silver reflector. However, this level utilized a proprietary technology that represents a unique pathway to achieving that efficiency level. Accordingly, DOE determined that such level was likely to have significant anti-competitive effects on the markets for such lamps and ultimately concluded that it is not economically justified. (42 U.S.C. 6295(o)(3)(B)) Therefore, TSL5, which does not require installation of the proprietary silver reflector, represents the most efficient level analyzed for IRL. (See sections VI.B and VII.A.2 of this notice for more information on maximum technologically feasible levels and other efficacy levels DOE analyzed.)

DOE then considered the impacts of standards at each trial standard level that was identified and analyzed, beginning with the most efficient level, to determine whether the given level was economically justified. DOE then considered less efficient levels until it reached the highest level that meets the key statutory criteria in terms of being technologically feasible, economically justified, and saving a significant amount of energy.

DOE discusses the benefits and/or burdens of each trial standard level in the following sections. DOE bases its discussion on quantitative analytical results for each trial standard level (presented in section VII) such as national energy savings, net present value (discounted at 7 percent and 3 percent), emissions reductions, industry net present value, life-cycle cost, and consumers installed price increases. In addition to providing a summary of results, DOE discusses below the life-cycle cost and consumer installed price increase results for each product class and baseline, where appropriate. Beyond the quantitative results, DOE also considers other burdens and benefits that affect economic justification, including how the impacts of standards on competition, supply constraints, and lamp input prices may affect the economic benefits and burdens presented.

1. General Service Fluorescent Lamps Conclusion

In addition to the results presented above, DOE also calculates the annualized benefits and costs of each TSL. The table below presents these values for GSFL.

TABLE VII.33—ANNUALIZED BENEFITS AND COSTS FOR GSFL

TSL	Category	Unit	Primary estimate		Low estimate		High estimate	
			7%	3%	7%	3%	7%	3%
1	Benefits							
	Annualized Monetized ($millions/year)	2008$	650	741	445	504	855	978
	Annualized Quantified	CO_2 (Mt) .... NO_X (kT) ...... Hg (T)	2.73 0.37 0.02	2.98 0.28 0.03	1.83 0.17 0.00	2.01 0.10 0.00	3.64 0.57 0.05	3.96 0.46 0.06
	Costs							
	Annualized Monetized ($millions/year)	2008$	123	80	181	128	64	31
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	527	661	264	375	791	946

[83] DOE notes that it did not eliminate higher-efficiency fill gases from further consideration as a technology under the screening analysis, because that technology may be appropriate for low-wattage lamp applications.

TABLE VII.33—ANNUALIZED BENEFITS AND COSTS FOR GSFL—Continued

TSL	Category	Unit	Primary estimate		Low estimate		High estimate	
			7%	3%	7%	3%	7%	3%
2	Benefits							
	Annualized Monetized ($millions/year)	2008$	761	842	586	633	936	1051
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	3.22 0.45 0.03	3.41 0.33 0.04	2.68 0.38 0.00	2.73 0.25 0.00	3.76 0.52 0.07	4.08 0.40 0.07
	Costs							
	Annualized Monetized ($millions/year)	2008$	224	160	255	186	192	134
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	537	683	330	448	744	918
3	Benefits							
	Annualized Monetized ($millions/year)	2008$	1528	1663	1017	1089	2038	2237
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	6.50 0.76 0.07	6.89 0.55 0.07	4.51 0.55 0.00	4.67 0.37 0.00	8.49 0.98 0.14	9.11 0.73 0.15
	Costs							
	Annualized Monetized ($millions/year)	2008$	577	484	522	417	633	550
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	950	1179	495	671	1405	1688
4	Benefits							
	Annualized Monetized ($millions/year)	2008$	2302	2420	1329	1387	3275	3452
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	10.48 1.78 0.11	10.60 1.19 0.11	5.76 1.03 0.00	5.69 0.63 0.00	15.20 2.54 0.22	15.52 1.76 0.23
	Costs							
	Annualized Monetized ($millions/year)	2008$	582	425	378	230	786	621
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	1720	1994	951	1158	2489	2831
	Incremental Net Benefits/Costs Relative to TSL3							
	Annualized Monetized ($millions/year)	2008$	770	815	456	487	1084	1143
5	Benefits							
	Annualized Monetized ($millions/year)	2008$	2850	2988	1738	1811	3961	4165
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	12.95 2.10 0.14	13.07 1.53 0.14	8.33 1.21 0.00	8.41 0.75 0.00	17.57 2.98 0.27	17.73 2.31 0.28
	Costs							
	Annualized Monetized ($millions/year)	2009$	911	737	783	613	1039	861
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2009$	1939	2251	955	1197	2922	3304
	Incremental Net Benefits/Costs Relative to TSL4							
	Annualized Monetized ($millions/year)	2008$	219	257	4	39	433	473

Note: Annualized values are for the period from 2012 to 2042.

a. Trial Standard Level 5

For GSFL, DOE first considered the most efficient level, TSL5, which would save an estimated total of 5.1 to 12.0 quads of energy through 2042—a significant amount of energy. For the Nation as a whole, TSL5 would have a net savings of $10.0 billion to $30.9 billion at a 7-percent discount rate and $22.6 billion to $62.6 billion at a 3-percent discount rate. The emissions reductions at TSL5 are estimated at 262 to 552 MMt of CO_2, 13 to 58 kt of NO_X, up to 9 metric tons of Hg. Total generating capacity in 2042 is estimated to decrease compared to the reference case by 2.7 to 7.3 GW under TSL5. The monetized values of emissions reductions are estimated at $5.0 to $125.6 million for NO_X and up to $84.5 million for Hg at a 7-percent discount rate and $5.5 to $173.9 million for NO_X and up to $154.4 million for Hg at a 3-percent discount rate. The estimated benefits of reducing CO_2 emissions using the mid-range of the CO_2 value (using $33 per ton) is $4.6 to $9.6 billion and $9.1 to $19.1 billion at 7-percent and 3-percent discount rates respectively. The full range of likely benefits of CO_2 emission reductions is $0.3 billion to $23.4 billion at a 7-percent discount rate and $0.6 billion to $46.4 billion at a 3-percent discount rate.

The impacts on manufacturers at TSL5 result from the commoditization of high-efficacy lamps and the need to convert all T12 lines to T8 lines, requiring a capital investment of $211 million. The projected change in industry value ranges from a decrease of $211 million to an increase of $33 million. The extent of the industry impacts is driven primarily by how successful manufacturers will be in maintaining their current gross margins at near their current levels as efficient products become commoditized. Currently, manufacturers obtain higher margins for more-efficient products; therefore, to avoid the higher end of the anticipated impacts, manufacturers are likely to have to find new ways to differentiate GSFL to maintain full product lines. At TSL5, DOE recognizes the risk of very large negative impacts if the high end of the range of impacts is reached, resulting in a net loss of 40 percent in INPV.

At TSL5, DOE projects that most GSFL consumers would experience life-cycle cost savings. The following discussion summarizes the specific life-cycle cost impacts of TSL5 on the separate product classes and baseline lamps.

Table VII.5 presents the findings of an LCC analysis on various three-lamp, 4-foot medium bipin GSFL systems operating in the commercial sector. Regardless of the baseline lamp currently employed, consumers have lamp designs available which result in positive LCC savings at TSL5. At this standard level, users of 40W or 34W 4-foot MBP T12 baseline lamps installed on a magnetic ballast who need to replace their lamp would incur the cost of a lamp and ballast replacement ($65.96 to $73.94) because no T12 lamp currently meets the efficacy requirements of TSL5. Comparing this cost of lamp-and-ballast replacements to the cost of only baseline lamp replacements ($11.65 to $14.50) results in installed price increases of $52.83 to $59.44. These ranges in prices depend on the specific baseline lamps previously owned by consumers and the specific combinations of lamps and ballasts they select in the standards case. However, over the life of the lamp, these consumers would save $13.93 to $24.16.

Table VII.6 presents LCC results for a two-lamp 4-foot MBP system operating in the residential sector under average operating hours. The results are presented for a system operating 40W T12 lamps with a magnetic ballast, as this configuration is typical of the installed base of residential GSFL systems. As discussed in the NOPR, DOE believes that the vast majority of lamps sold in the residential market are sold with new ballasts or luminaires. 74 FR 16920, 16951 (April 13, 2009) At TSL5, residential consumers are expected to purchase T8 lamps with electronic ballasts in lieu of the T12 lamps with magnetic ballasts that they would purchase absent standards. These consumers would see LCC savings of $20.21 to $22.32. DOE recognizes that not all residential GSFL lamps would be sold in conjunction with a new ballast or luminaire in the base case. In particular, consumers with higher operating hours or consumers who choose to not discard their lamps upon fixture or ballast replacement may need to replace their lamp on an existing system. However, at TSL5, there are no standards-compliant T12 replacement lamps available. As seen in Table VII.8, the consumer economics of retrofitting a T12 system with a T8 system for a residential 4-foot MBP system depend on the remaining life of the T12 ballast. For those consumers who replace a T12 system with less than 7 years of life remaining in 2012, the LCC savings are positive. Those consumers who have greater than 7 years of life remaining in their T12 systems in 2012 will experience negative LCC savings. Considering an average system life of 15 years, and estimating that 10 percent of T12 lamps sold to residential sector are replacement lamps, DOE calculates that fewer than 6 percent of current purchasers of T12 lamps in the residential sector will experience increases in LCC. The first-costs increase for residential consumers forced to retrofit to T8 systems would be $49.00 to $49.91 ($53.13 to $54.04 for an installed T8 system compared to $4.13 for two new T12 lamp).

With regard to 4-foot MBP consumer subgroups, all consumer subgroups analyzed achieve similar LCC savings to the average consumer with the exception of commercial consumers who own 40W or 34W 4-foot MBP T12 lamps installed on electronic ballasts. These consumers, upon lamp failure, are forced to retrofit their existing ballasts, resulting in negative LCC savings of −$12.43 to −$7.00. Overall, based on the NIA, DOE estimates that at TSL5 in 2012, less than 2 percent of 4-foot MBP shipments result in negative LCC savings, and 9 percent of shipments are associated with the high installed price increases due to forced retrofits.

Table VII.11 presents the findings of an LCC analysis on various two-lamp, 8-foot SP slimline GSFL systems operating in the commercial sector. Except for consumers who purchase reduced-wattage 60W T12 lamps absent standards (and experience a lamp failure), all other consumers have available lamp designs that result in positive LCC savings at TSL5. At this standard level, users of 75W or 60W 8-foot SP slimline T12 baseline lamps installed on a magnetic ballast who need to replace their lamp would incur the cost of a lamp and ballast replacement ($97.41 to $98.80) because no T12 lamp currently meets the efficacy requirements of TSL5. Comparing the cost of a lamp-and-ballast replacement to the cost of only a baseline lamp replacement ($11.77 to $16.79) results in an installed price increase of $82.01 to $87.03. In addition, users of 60W T12 lamps who need to replace their lamp experience negative LCC savings of −$15.81 to −$13.89. On the other hand, over the life of the lamp, users of 75W T12 lamps who require a lamp replacement would save $9.68.

With regard to 8-foot SP slimline consumer subgroups, all consumer subgroups analyzed achieve similar LCC savings to the average consumer with the exception of consumers of T12 lamps operating in religious institutions, consumers of T12 lamps operating in institutions that serve low-income populations, and users of T12 lamps installed on electronic ballasts. These consumers, upon lamp failure, are forced to retrofit their existing ballasts, resulting in negative LCC savings. In particular, consumers in institutions of religious worship (which have low operating hours in comparison with the average commercial-sector consumer) and consumers in institutions serving low income populations (experience negative LCC savings of −$30.56 to −$0.44. Consumers with T12 lamps installed on electronic ballasts experience negative LCC savings of −$33.55 to −$15.82. Overall, based on the NIA model, DOE estimates that at TSL5 in 2012, approximately 24 percent of 8-foot SP slimline shipments would result in negative LCC savings, and 65 percent of shipments would be associated with the high installed price increases due to forced retrofits.

Table VII.12 presents the findings of an LCC analysis on various two-lamp, 8-foot RDC HO GSFL systems operating in the industrial sector. With the exception of consumers who purchase reduced-wattage 95W T12 lamps absent standards (and purchase a lamp in response to a lamp failure), all other consumers have available lamp designs that result in positive LCC savings at TSL5. At this standard level, users of 110W or 95W 8-foot RDC HO T12 baseline lamps installed on a magnetic ballast who need to replace their lamp would incur the cost of a lamp and ballast replacement ($131.38) because no T12 lamp currently meets the efficacy requirements of TSL5. Comparing the cost of a lamp-and-ballast replacement to the cost of only a baseline lamp replacement ($14.46 to $20.51) results in an installed price increase of $110.87 to $116.92. Users of 95W T12 lamps who need to replace their lamp experience negative LCC savings of −$7.97. On the other hand, over the life of the lamp, users of 110W T12 lamps who require a lamp replacement would save $13.07.

With regard to 8-foot RDC HO consumer subgroups, all consumer subgroups analyzed achieve similar LCC savings to the average consumer except consumers who own T12 lamps installed on electronic ballasts. These consumers, upon lamp failure, are forced to retrofit their existing ballasts, resulting in negative LCC savings of −$20.50 to −$5.31. Overall, based on the NIA model, DOE estimates that at TSL5 in 2012, approximately 33 percent of 8-foot RDC HO shipments would result in negative LCC savings, and 86 percent of shipments would be associated with the high installed price increases due to forced retrofits.

Table VII.9 and Table VII.10 present the LCC analyses on two-lamp 4-foot MiniBP T5 standard-output and high-output systems, respectively. The standard-output system is modeled as operating in the commercial sector, and the high-output system is modeled as operating in the industrial sector. The baseline lamps for these systems are the model 28W and 54W halophosphor lamps, respectively, as discussed in section V.B.3. At TSL5 (EL2 for standard output T5 lamps), all consumers of standard output lamps have available lamp designs which result in positive LCC savings of $1.10 (for lamp replacement) and $45.67 to $47.49 (for new construction or renovation). At TSL5 (EL1 for high output T5 lamps), consumers of high-output lamps who need only a lamp replacement would experience negative LCC savings of −$3.03. However, purchasing a T5 high-output system for new construction or renovation would result in positive LCC savings of $65.69 to $67.06.

At TSL 5, the demand for rare-earth phosphors is significantly increased compared to current levels. DOE understands that it is difficult to predict the effects of new energy conservation standards on rare earth phosphor demand. However, DOE is sensitive to the trade vulnerability inherent in the concentrated geographical location of these resources and the possible incentives for manufacturers to relocate production (and associated employment) outside the U.S. It is particularly challenging to draw a line below which the risks are manageable and above which the risks become unacceptable. DOE notes that in its comments, NEMA views TSL 3 as a level that allows manufacturers to retain the flexibility needed to manage the impact of increased worldwide rare earth phosphor usage. In their comments, NEMA provided their estimate of the relative increase in rare earth phosphor demand for each TSL. This analysis showed the impacts at TSL 3 and TSL 4 to be very similar, increases of 230 percent and 250 percent, respectively. In contrast, the impacts at estimated by NEMA at TSL 5 are shown to be significantly larger at 350 percent. DOE concludes from this that NEMA perceives considerably larger risks at TSL 5 than at TSL 4 or TSL 3.

At TSL 5, product availability is also a concern, particularly the elimination of reduced-wattage 25W lamps, due to increased standard levels. DOE agrees with comments received that 25W lamps are valuable energy-saving products, because they provide a simple pathway to energy savings that does not require ballast replacements or design assistance. (California Stakeholders, No. 63 at p. 9) As demonstrated in DOE's national impact analysis, the level of expertise required to implement certain design choices is a key factor in determining energy savings, as well as consumer and national NPV benefits.

In summary, after carefully considering the analysis discussed above and weighing the benefits and burdens of TSL5, the Secretary has determined the following: At TSL 5, the benefits of energy savings, emissions reductions (both in terms of physical reductions and the monetized value of those reductions, including the likely U.S. and global benefits of reduced emissions of CO_2), and the positive net economic savings to the Nation (over 31 years) is outweighed by the economic burden on some consumers (as indicated by the large increase in total installed cost), the potentially large reduction in INPV for manufacturers resulting from large conversion costs and reduced gross margins, the elimination of certain low-wattage lamps, and the risks associated with significantly increased demand for rare-earth phosphors. Consequently, the Secretary has concluded that TSL 5 is not economically justified.

b. Trial Standard Level 4

Next, DOE considered TSL 4, which would save an estimated total of 3.8 to 9.9 quads of energy through 2042—a significant amount of energy. For the Nation as a whole, TSL4 would have a net savings of $10.0 billion to $26.3 billion at a 7-percent discount rate and $21.8 billion to $53.5 billion at a 3-percent discount rate. The emissions reductions at TSL4 are estimated at 175 to 488 MMt of CO_2, 11 to 37 kt of NO_X, and up to 7.3 metric tons of Hg. Total generating capacity in 2042 is estimated to decrease compared to the reference case by 1.8 to 6.2 GW under TSL4. The monetized values of emissions reductions are estimated at $4.2 to $107.2 million for NO_X and up to $67.7 million for Hg at a 7-percent discount rate and $4.6 to $132.4 million for NO_X and up to $125.6 million for Hg at a 3-percent discount rate. The estimated benefits of reducing CO_2 emissions using the mid-range of the CO_2 value (using $33 per ton) is $3.1 to $8.4 billion and $6.0 to $16.9 billion at 7-percent and 3-percent discount rates respectively. The full range of likely benefits of CO_2 emission reductions is $0.2 billion to $20.4 billion at a 7-percent discount rate and $0.4 billion to

$40.9 billion at a 3-percent discount rate.

Similar to TSL5, the level of impacts on manufacturers would depend primarily on their ability to differentiate their product offerings to offset the reduced range of efficacy levels. TSL 4 would also require a complete conversion of all T12 4-foot MBP, 8-foot SP slimline, and 8-foot RDC HO lines to T8 lines, a capital investment of $193 million. The projected change in industry value ranges from a decrease of $162 million to a decrease of $4 million. Because manufacturers have a broader range of efficiency available at TSL 4 than at TSL 5 (thereby permitting greater product differentiation and increased gross margins), DOE believes the impacts at TSL 4 will be significantly less than at TSL 5 and that the high range of impacts is less likely to occur.

As seen in Table VII.5 through Table VII.12, at TSL4, DOE projects that 4-foot MBP, 8-foot SP slimline, and 8-foot RDC HO consumers would experience similar life-cycle cost savings and increases as they would experience at TSL5. Like TSL5, most consumers who own T12 ballasts prior to 2012 at TSL4 would likely experience negative economic impacts, either through life-cycle cost increases or by large increases in total installed cost. For 4-foot MiniBP T5 standard-output lamps, TSL4 would require these lamps to meet EL1, resulting in positive LCC savings of $1.10 for lamp replacement and $43.30 for new construction or renovation (seen in Table VII.9). For 4-foot MiniBP T5 high-output lamps, TSL4 would require the same efficacy level (EL1) as TSL5, resulting in identical life-cycle cost impacts.

At TSL 4, the demand for rare-earth phosphors, although significantly increased compared to current levels, is similar to the demand at TSL 3, a level that manufacturers have suggested would allow them to retain the flexibility needed to manage the impacts of increased worldwide rare earth phosphor usage. In consideration of the small increased demand of rare-earth phosphors over a level that industry has indicated to be acceptable, DOE believes that risks of trade vulnerability and potential relocation of lamp production overseas in response to a standard adopted at TSL4 are low.

In contrast to TSL5, at TSL 4, consumers have several energy-saving lamp options including the reduced-wattage 25W and 30W 4-foot MBP lamps. The presence of these lamps on the market provides consumers with more simple pathways to achieving energy savings. As demonstrated in DOE's national impact analysis, the level of expertise required to implement certain design choices is a key factor in determining energy savings, as well as consumer and national NPV benefits.

In summary, after carefully considering the analysis discussed above and weighing the benefits and burdens of TSL4, the Secretary has determined the following: At TSL4, the benefits of energy savings, emissions reductions (both in terms of physical reductions and the monetized value of those reductions, including the likely U.S. and global benefits of reduced emissions of CO_2), and the positive net economic savings to the Nation (over 31 years) outweighs the economic burden on some consumers (as indicated by the large increase in total installed cost), the potential reduction in INPV for manufacturers, and the risks associated with increased demand for rare earth phosphors. Consequently, the Secretary has concluded that TSL4 offers the maximum improvement in efficacy that is technologically feasible and economically justified, and will result in significant conservation of energy. Therefore, DOE is adopting the energy conservation standards for GSFL at trial standard level 4.

2. Incandescent Reflector Lamps Conclusion

In addition to the results presented above, DOE also calculates the annualized benefits and costs of each TSL. The table below presents these values for GSFL.

TABLE VII.34—ANNUALIZED BENEFITS AND COSTS FOR IRL

TSL	Category	Unit	Primary estimate		Low estimate		High estimate	
			7%	3%	7%	3%	7%	3%
1	Benefits							
	Annualized Monetized ($millions/year)	2008$	120	130	68	72	173	188
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	0.43 0.09 0.00	0.43 0.07 0.00	0.24 0.07 0.00	0.24 0.05 0.00	0.62 0.11 0.01	0.63 0.08 0.01
	Costs							
	Annualized Monetized ($millions/year)	2008$	103	100	77	74	129	127
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	18	29	−9	−2	44	61
2	Benefits							
	Annualized Monetized ($millions/year)	2008$	293	313	176	182	410	443
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	1.1 0.26 0.01	1.1 0.19 0.01	0.66 0.21 0.00	0.63 0.14 0.00	1.53 0.32 0.02	1.56 0.23 0.02
	Costs							
	Annualized Monetized ($millions/year)	2008$	−33	−39	−28	−32	−39	−46

TABLE VII.34—ANNUALIZED BENEFITS AND COSTS FOR IRL—Continued

TSL	Category	Unit	Primary estimate		Low estimate		High estimate	
			7%	3%	7%	3%	7%	3%
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	326	352	203	215	449	489
3	Benefits							
	Annualized Monetized ($millions/year)	2008$	531	603	349	389	712	817
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	1.97 0.42 0.02	1.98 0.3 0.02	1.29 0.37 0.00	1.25 0.26 0.00	2.66 0.47 0.04	2.7 0.33 0.04
	Costs							
	Annualized Monetized ($millions/year)	2008$	72	71	52	50	92	92
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	459	532	297	339	620	725
4	Benefits							
	Annualized Monetized ($millions/year)	2008$	650	696	406	424	894	968
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	2.39 0.51 0.02	2.4 0.35 0.02	1.51 0.45 0.00	1.45 0.31 0.00	3.28 0.58 0.05	3.35 0.4 0.05
	Costs							
	Annualized Monetized ($millions/year)	2008$	118	106	227	218	9	−6
....	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	532	590	179	207	885	973
	Incremental Net Benefits/Costs Relative to TSL3							
	Annualized Monetized ($millions/year)	2008$	73	58	−118	−132	265	248
5	Benefits							
	Annualized Monetized ($millions/year)	2008$	750	802	480	502	1020	1103
	Annualized Quantified	CO_2 (Mt) NO_X (kT) Hg (T)	2.76 0.59 0.02	2.76 0.4 0.03	1.83 0.54 0.00	1.76 0.37 0.00	3.69 0.65 0.05	3.75 0.44 0.05
	Incremental Costs							
	Annualized Monetized ($millions/year)	2008$	126	116	232	222	26	9
	Net Benefits/Costs							
	Annualized Monetized ($millions/year)	2008$	621	687	247	280	994	1093
....	Incremental Net Benefits/Costs Relative to TSL4							
	Annualized Monetized ($millions/year)	2008$	89	97	68	73	109	120

Note: Annualized values are for the period from 2012 to 2042.

a. Trial Standard Level 5

For IRL, DOE first considered the most efficient level, TSL5, which would save an estimated total of 1.12 to 2.72 quads of energy through 2042—a significant amount of energy. For the Nation as a whole, TSL5 would have a net savings of $4.9 billion to $10.2 billion at a 7-percent discount rate and $9.4 billion to $20.0 billion at a 3-percent discount rate. The emissions reductions at TSL5 are estimated at 53 to 118 MMt of CO_2, 8 to 9 kt of NO_X, and up to 2 metric tons of Hg. Total generating capacity in 2042 is estimated to decrease compared to the reference case by 300 to 1400 MW under TSL5. The monetized values of emissions reductions are estimated at $2.2 to $27.0 million for NO_X and up to $16.0 million for Hg at a 7-percent discount rate and $2.7 to $33.1 million for NO_X and up to $30.2 million for Hg at a 3-percent discount rate. The estimated benefits of reducing CO_2 emissions using the mid-range of the CO_2 value (using $33 per ton) is $1.0 to 2.0 billion and $1.8 to $4.1 billion at 7-percent and 3-percent discount rates respectively. The full range of likely benefits of CO_2 emission reductions is $0.1 billion to $4.9 billion at a 7-percent discount rate and $0.1 billion to $9.9 billion at a 3-percent discount rate.

As seen in Table VII.13, regardless of the baseline lamp purchased absent standards, commercial-sector consumers have available lamp designs at TSL5 which would result in positive LCC savings ranging from $1.36 to $9.14, while residential-sector consumers have available lamp designs which would result in positive LCC savings ranging from $1.51 to $9.10.

The projected change in industry value at TSL5 would range from a decrease of $104 million to $111 million, or a net loss of 37 to 47 percent in INPV. The range in impacts is attributed in part to uncertainty concerning the future share of emerging technologies in the IRL market, as well as the expected migration to R–CFL and exempted IRL technologies under standards.

DOE based TSL5 on commercially-available IRL which employ a silver reflector, an improved IR coating, and a filament design that results in a lifetime of 4,200 hours. To DOE's knowledge, only one manufacturer currently sells products that meet TSL5. In addition, it is DOE's understanding that the silver reflector is a proprietary technology that all manufacturers may not be able to employ. However, DOE considered TSL5 in its analysis because it believes that there is an alternate, non-proprietary pathway to achieve this level. This pathway consists in redesigning the filament to achieve higher-temperature operation and, thus, reducing lifetime to 2,500 hours.

DOE conducted a complete set of analyses to capture the economic impacts of a TSL5 lamp designed to operate with a lifetime of 2500 hours instead of 4200 hours. Whereas the energy savings and emission reductions do not change for the Nation as a whole, a reduced-life lamp would result in much reduced net savings (NPV) of $2.53 billion to $4.86 billion at a 7-percent discount rate and $10.1 billion to $5.1 billion at a 3-percent discount rate. As seen in Table VII.13, as compared to one of the baseline lamps purchased absent standards, consumers would experience negative LCC savings, ranging from –$3.17 (in the commercial sector) to –$1.64 (in the residential sector), at TSL5. Because reduced lamp life results in greater IRL shipments, the projected change in industry value would be greatly reduced to a decrease of $43 million to $49 million, or a net loss of 14 to 22 percent in INPV.

The reduced LCC savings at TSL 5 for the reduced-life lamps brings added concern to the issue of hot shock, which is when vibrations that occur while the lamp is energized cause premature lamp failure. It is DOE's understanding that hot shock can reduce lamp life by 25 percent to 30 percent for some consumers. For a lamp rated at 2500 hours, this means that service life could be reduced to 1750 hours. As demonstrated in Tables Table VI.1 and Table VI.2, DOE expects that a lamp with price and efficacy associated with TSL5 and a lifetime of 1750 hours would result in negative LCC savings for the vast majority of consumers.

Furthermore, DOE is also concerned about the possible lessening of competition at TSL5. Only one manufacturer currently sells product that meets TSL5. This commercially-available product employs a proprietary technology, and while DOE has some evidence that alternative non-proprietary technologies may be used to meet this level, these alternative technologies have not been manufactured in large quantities and questions remain as to their cost and performance, as discussed above. Because DOE has not been able to verify manufacturer costs associated with these alternative technologies, it is possible that these approaches may not be cost-competitive with the currently-available product employing the proprietary technology. While DOE recognizes that a 2500-hour lamp at TSL 5 is technologically feasible and would not require the use of proprietary technologies, the LCC results show that these shortened-life lamps are likely to be less attractive to consumers and, therefore, at a competitive disadvantage.

In summary, after carefully considering the analysis discussed above and weighing the benefits and burdens of TSL5, the Secretary has determined the following: At TSL5, the benefits of energy savings, emissions reductions (both in terms of physical reductions and the monetized value of those reductions, including the likely U.S. and global benefits of reducing CO_2 emissions), the positive net economic savings to the Nation (over 31 years) is outweighed by the large capital conversion costs that could result in a reduction in INPV for manufacturers, possible negative LCC savings for some consumers of 2500-hour lamps, and the possible lessening of competition. Consequently, the Secretary has concluded that TSL5 is not economically justified.

b. Trial Standard Level 4

Next, DOE considered TSL4, which would save an estimated total of 0.94 to 2.39 quads of energy through 2042—a significant amount of energy. For the Nation as a whole, TSL4 would have a net savings of $4.20 billion to $9.06 billion at a 7-percent discount rate and $17.8 billion to $8.0 billion at a 3-percent discount rate. The emissions reductions at TSL4 are estimated at 44 to 106 MMt of CO_2, 6.4 to 8.4 kt of NO_X, and up to 2 metric tons of Hg. Total generating capacity in 2042 is estimated to decrease compared to the reference case by 200 to 1,100 MW under TSL4. The monetized values of emissions reductions are estimated at $1.8 to $24.4 million for NO_X and up to $15.0 million for Hg at a 7-percent discount rate and $2.2 to $30.0 million for NO_X and up to $28.1 million for Hg at a 3-percent discount rate. The estimated benefits of reducing CO_2 emissions using the mid-range of the CO_2 value (using $33 per ton) is $0.8 to $1.8 billion and $1.5 to $3.7 billion at 7-percent and 3-percent discount rates respectively. The full range of likely benefits of CO_2 emission reductions is $50 million to $4.4 billion at a 7-percent discount rate and $0.1 billion to $8.9 billion at a 3-percent discount rate.

The projected change in industry value at TSL4 would range from a decrease of $98 million to $102 million, or a net loss of 34 to 44 percent in INPV. The range in impacts is attributed in part to uncertainty concerning the future share of emerging technologies in the IRL market, as well as the expected migration to R–CFL and exempted IRL technologies under standards.

As seen in Table VII.13, regardless of the baseline lamp currently employed, commercial-sector consumers have available lamp designs at TSL4 which would result in positive LCC savings ranging from $1.81 to $7.95, while residential-sector consumers have available lamp designs which would result in positive LCC savings ranging from $1.75 to $7.45.

DOE does not believe TSL4 requires the use of a single proprietary technology. To DOE's knowledge, two manufacturers currently sell a full-range of lamp wattages that meet TSL4. Unlike TSL5, where it is possible that some manufacturers would not be able to achieve the level without lowering lamp lifetime, DOE believes that the existence of multiple technology pathways to TSL4 would not necessarily result in the reduction in lamp lifetime at TSL4. However, DOE also recognizes that manufacturers may choose to sell products with reduced lifetimes. Therefore, DOE conducted a complete set of analyses to capture the economic impacts of a TSL4 lamp designed to operate with a lifetime of 2500 hours and 3000 hours instead of 4000 hours. Whereas the energy savings and emission reductions do not change for the Nation as a whole, a reduced-life lamp would result in much reduced net savings (NPV) of $1.83 billion to $5.22 billion at a 7-percent discount rate and $10.8 billion to $3.8 billion at a 3-percent discount rate. As seen in Table VII.13, as compared to one of the baseline lamps purchased absent standards, commercial consumers would experience small negative LCC savings of −$0.25 at TSL4. Because reduced lamp life results in greater IRL shipments, the projected change in industry value would be greatly reduced to a decrease of $21 million to $61 million, or a net loss of 7 to 28 percent in INPV.

Hot shock is less of a concern at TSL4 than at TSL5. DOE understands that manufacturers may choose to reduce their negative impacts by providing lamps with lifetimes less than 4000 hours at TSL4. However, because 4000-hour TSL4 lamps can be produced without the use of proprietary technologies, manufacturers may be able to implement technological changes in their lamps to prevent hot shock, while retaining lifetimes above 3000 hours.

In addition, competitive impacts are less severe at TSL4 than at TSL5. To DOE's knowledge, two of the three major manufacturers of IRL currently sell a full product line (across common wattages) that meet this potential standard level. It is DOE's understanding that the third manufacturer employs a technology platform that, due to the positioning of the filament in the HIR capsule, is inherently less efficient. Therefore, it is likely that in order to meet TSL4, this manufacturer would have to make higher investments than the other manufacturers, placing it at a competitive disadvantage. This manufacturer has commented that it could manufacture products at TSL4 if the standards implementation lead time were extended by an additional one year. While DOE recognizes the challenges inherent in gaining access to technology and building capacity needed to begin production, as detailed in section VI.D.1 of this notice, DOE does not have the statutory authority to extend the implementation period.

In summary, after considering the analysis discussed above and comments on the April 2009 NOPR, and weighing the benefits and burdens of TSL4, the Secretary has determined the following: At TSL4, the benefits of energy savings, emissions reductions (both in terms of physical reductions and the monetized value of those reductions, including the likely U.S. and global benefits of reduced CO_2 emissions), the positive net economic savings to the Nation (over 31 years), and positive life-cycle cost savings outweighs the reduction in INPV for manufacturers. Consequently, the Secretary has concluded that TSL4 offers the maximum improvement in efficacy that is technologically feasible and economically justified, and will result in significant conservation of energy. Therefore, DOE is adopting the energy conservation standards for IRL at trial standard level 4.

VIII. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

Section 1(b)(1) of Executive Order 12866, ''Regulatory Planning and Review,'' 58 FR 51735 (Oct. 4, 1993), requires each agency to identify the problem it intends to address that warrants agency action such as today's final rule (including, where applicable, the failures of private markets or public institutions), and to assess the significance of that problem in evaluating whether any new regulation is warranted. DOE included a description of market failures in its April 2009 NOPR. 74 FR 16920, 17018–19 (April 13, 2009). DOE believes, in this final rule, that these market failures continue to persist.

In addition, because today's regulatory action is a significant regulatory action under section 3(f)(1) of Executive Order 12866, section 6(a)(3) of that Executive Order requires DOE to prepare and submit for review to the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB) an assessment of the costs and benefits of today's rule. Accordingly, DOE presented to OIRA for review the draft final rule and other documents prepared for this rulemaking, including a regulatory impact analysis (RIA). These documents are included in the rulemaking record and are available for public review in the Resource Room of DOE's Building Technologies Program, 950 L'Enfant Plaza, SW., 6th Floor, Washington, DC 20024, (202) 586–9127, between 9:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays.

Carlins Consulting stated that regulations were not necessary for consumers to adopt energy efficient lighting because the marketplace has provided the consumer with adequate options to choose a proper light source for any application given many variables. Specifically, the commenter cited the shift in office lighting from incandescent to fluorescent, then from T12 fluorescent lamps to T8 fluorescent lamps, the extinction of mercury vapor lamps after the introduction of metal halide lamps, and most recently—the popularity of lighting controls as evidence of the marketplace and economic incentives leading to the creation of energy efficient products. (Carlins Consulting, No. 57 at p. 1)

In response, the April 2009 NOPR contained a summary of the RIA, which evaluated the extent to which major alternatives to standards for GSFL and IRL could achieve significant energy savings at reasonable cost, as compared to the effectiveness of the proposed rule. 74 FR 16920, 17019–22 (April 13, 2009). The complete RIA *(Regulatory Impact Analysis for Proposed Energy Conservation Standards for General Service Fluorescent Lamps and Incandescent Reflector Lamps)* is contained in the TSD prepared for today's rule. The RIA consists of: (1) A statement of the problem addressed by this regulation, and the mandate for government action; (2) a description and analysis of the feasible policy alternatives to this regulation; (3) a quantitative comparison of the impacts of the alternatives; and (4) the national economic impacts of today's standards.

DOE sought additional information to further develop its analysis (*i.e.*, information to verify estimates of the percentages of consumers purchasing efficient lighting and the extent to which consumers will continue to purchase more-efficient lighting in future years), and to conduct additional analyses in support of its conclusions (*i.e.*, data on the correlation between the efficacy of existing lamps, usage patterns, and associated electricity price), but received no additional information or data in response to the April 2009 NOPR.

The major alternatives to the standards that DOE analyzed are: (1) No new regulatory action; (2) consumer rebates; (3) consumer tax credits; (4) manufacturer tax credits; (5) voluntary energy-efficiency targets; (6) bulk government purchases; and (7) early replacement. Each of these alternatives was analyzed in the RIA, with the exception of early replacement, because DOE found that the lifetimes of the lamps analyzed are too short for early replacement to result in significant savings. As explained in the April 2009 NOPR, DOE determined that none of these alternatives would save as much energy or have an NPV as high as the proposed standards, TSL3 for GSFL and TSL4 for IRL. That same conclusion applies to the standards in today's rule. DOE has determined that none of the alternatives save as much energy or have an NPV as high as the adopted standards, TSL4 for GSFL and TSL4 for IRL. (DOE further notes that for GSFL, the final rule standard set at TSL4 would save more energy and have a higher NPV than the proposed standard at TSL3.) Also, several of the alternatives would require new enabling legislation, since authority to carry out those alternatives does not presently exist. Additional detail on the regulatory alternatives is found in the RIA report in the TSD.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis for any rule that by law must be proposed for public comment, and a final regulatory flexibility analysis for any such rule that an agency adopts as a final rule, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. A regulatory flexibility analysis examines the impact of the rule on small entities and considers alternative ways of reducing negative impacts. Also, as required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site: *http://www.gc.doe.gov.*

The Small Business Administration (SBA) classifies manufacturers of GSFL and IRL as small businesses if they have 1,000 or fewer employees.[84] DOE used this small business size standard, published at 65 FR 30386 (May 15, 2000) and codified at 13 CFR part 121, to determine whether any small entities would be required to comply with today's rule. The size standard is listed by North American Industry Classification System (NAICS) code and industry description. GSFL and IRL manufacturing are classified under NAICS 335110, ''Electric Lamp Bulb and Part Manufacturing.''

As explained in the April 2009 NOPR, DOE reviewed the proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003 (68 FR 7990). On the basis of that review, DOE certified that the proposed rule, if promulgated, ''would not have a significant economic impact on a substantial number of small entities.'' *74 FR 16920, 17022–23 (April 13, 2009).* Therefore, DOE did not prepare an initial regulatory flexibility analysis for the proposed rule. DOE set forth its certification to the Chief Counsel for Advocacy of the SBA and the statement of factual basis for that certification.

DOE received comments from Tailored Lighting Inc. in response to the Regulatory Flexibility Act discussion in the April 2009 NOPR. Tailored Lighting Inc. stated that DOE incorrectly characterizes the small business manufactures in the market by not including Tailored Lighting Inc. and possibly other businesses like it. (Tailored Lighting Inc., No. 73 at p. 2)

For the April 2009 NOPR, DOE conducted an extensive characterization of the GSFL and IRL industries and presented its findings for review and comment. In its characterization, DOE found that the majority of covered GSFL and IRL are manufactured by three large companies. A very small percentage of the market is manufactured by either large or small companies that primarily specialize in lamps not covered by this rulemaking. 74 FR 16920, 17022–23 (April 13, 2009).

During its market survey for the April 2009 NOPR, DOE created a list of every company that manufactures covered and non-covered GSFL and IRL for sale in the United States. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers. DOE then reviewed publicly-available data and contacted companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer in the GSFL or IRL industries. In total, DOE contacted 57 companies that could potentially be small businesses. During initial review of the 57 companies in its list, DOE either contacted or researched each company to determine if it sold covered GSFL and IRL. Research included reviewing each company's product catalogs and reviewing company's independent research reports.[85] Based on its research, DOE screened out companies that did not offer lamps covered by this rulemaking or if research reports indicated they were large manufacturers. Initially, DOE estimated that only 12 out of 57 companies listed were potentially small business manufacturers of covered products. 74 FR 16920, 17023 (April 13, 2009). Out of those 12 companies, DOE interviewed the four companies that consented to be interviewed. From these interviews, DOE determined that one manufacturer was not a small business. Two of the companies sold covered products, but were not manufacturers. The remaining company was the small business manufacturer DOE identified in the NOPR.

For today's final rule, DOE contacted the remaining eight companies again and conducted additional research. Out of the eight other companies, DOE determined that seven did not manufacture covered products or were not the manufacturer of the covered products that they offered. DOE was unable to determine if the remaining company was a small business manufacturer.

DOE also reviewed the product offerings of Tailored Lighting to determine whether that company is a small business manufacturer impacted by this rule. DOE determined that Tailored Lighting Inc is not a ''small business'' manufacturer within the context of the present rulemaking because it does not currently manufacture covered products.

For the final rule, DOE continued to indentify the small GSFL manufacturer discussed in the April 2009 NOPR as the only small business manufacturer of products covered by this rulemaking. In the April 2009 NOPR, DOE found that the small manufacturer of covered GSFL shared some of the same concerns about energy conservation standards as large manufacturers. DOE summarized the key issues in the April 2009 NOPR. 74 FR 16920, 16974–75 (April 13, 2009). However, the small manufacturer was less concerned about the potential of standards to severely harm its business. Because the small manufacturer is more focused on specialty products not covered by this rulemaking, covered GSFL represents a smaller portion of its revenue and product portfolio. In addition, this manufacturer stated that it is possible to pass along cost increases to consumers, thereby limiting margin impacts due to energy conservation standards.

DOE could not use the GSFL GRIM to model the impacts of energy conservation standards on the small business manufacturer of covered GSFL.

[84] *See http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.*

[85] Dun and Bradstreet provides independent research regarding company cash flows, revenues, employees, and credit-worthiness.

The GSFL GRIM models the impacts on GSFL manufacturers if concerns about margin pressure and significant capital investments necessitated by standards are realized. The small manufacturer did not share these concerns, and, therefore, the GRIM model would not be representative of the identified small business manufacturer. Like large manufacturers, the small business manufacturer stated that more-efficient products earn a premium; however, unlike larger manufacturers, the small manufacturer stated that it could pass costs along to its customers (a statement expected to apply to both the proposed TSL3 and the final rule's TSL4). Since the GSFL GRIM models the financial impact of the standards commoditizing premium products, it is not representative of the small business manufacturer because the small business manufacturer did not share these concerns. Because of its focus on specialized products, the small manufacturer was more concerned about being able to offer the products to their customers than the impact on its bottom line. For further information about the scenarios modeled in the GRIM, see section V.F of today's notice and chapter 13 of the TSD.

DOE reviewed the standard levels considered in today's final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. On the basis of the foregoing, DOE reaffirms the certification. Therefore, DOE has not prepared a final regulatory flexibility analysis for this rule.

C. Review Under the Paperwork Reduction Act

DOE stated in the April 2009 NOPR that this rulemaking would impose no new information and recordkeeping requirements, and that OMB clearance is not required under the Paperwork Reduction Act (44 U.S.C. 3501 *et seq.*). 74 FR 16920, 17023 (April 13, 2009). DOE received no comments on this in response to the April 2009 NOPR, and, as with the proposed rule, today's rule imposes no information and recordkeeping requirements. Therefore, DOE has taken no further action in this rulemaking with respect to the Paperwork Reduction Act.

D. Review Under the National Environmental Policy Act

DOE prepared an environmental assessment of the impacts of today's standards, which it published as chapter 16 within the TSD for the final rule. DOE found the environmental effects associated with today's standards for GSFL and IRL to be not significant, and, therefore, it is issuing a Finding of No Significant Impact (FONSI) pursuant to the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 *et seq.*), the regulations of the Council on Environmental Quality (40 CFR parts 1500–1508), and DOE's regulations for compliance with the NEPA (10 CFR part 1021). The FONSI is available in the docket for this rulemaking.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 4, 1999), imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. In accordance with DOE's statement of policy describing the intergovernmental consultation process it will follow in the development of regulations that have Federalism implications, 65 FR 13735 (March 14, 2000), DOE examined the proposed rule and determined that the rule would not have a substantial direct effect on the States, on the relationship between the National Government and the States, or on the distribution of power and responsibilities among the various levels of government. 74 FR 16920, 17023 (April 13, 2009). DOE received no comments on this issue in response to the April 2009 NOPR, and its conclusions on this issue are the same for the final rule as they were for the proposed rule. This statement remains true even though DOE has adopted energy conservation standards for GSFL in this final rule (TSL4) that are at a higher level than those proposed (TSL3). Therefore, DOE is taking no further action in today's final rule with respect to Executive Order 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, the final regulations meet the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

As indicated in the April 2009 NOPR, DOE reviewed the proposed rule under Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) (UMRA), which imposes requirements on Federal agencies when their regulatory actions will have certain types of impacts on State, local, and Tribal governments and the private sector. 74 FR 16920, 17024 (April 13, 2009). DOE concluded that, although this rule would not contain an intergovernmental mandate, it may result in expenditure of $100 million or more in one year by the private sector. *Id.* Therefore, in the April 2009 NOPR, DOE addressed the UMRA requirements that it prepare a statement as to the basis, costs, benefits, and economic impacts of the proposed rule, and that it identify and consider regulatory alternatives to the proposed rule. *Id.* DOE received no comments concerning the UMRA in response to the April 2009 NOPR, and its conclusions on this issue are the same for the final rule as they were for the proposed rule. This statement remains true even though DOE has adopted energy conservation standards for GSFL in this final rule (TSL4) that are at a higher level than those proposed (TSL3). Therefore, DOE is taking no further action in today's final rule with respect to the UMRA.

H. Review Under the Treasury and General Government Appropriations Act of 1999

DOE determined that, for this rulemaking, it need not prepare a Family Policymaking Assessment under Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277). *Id.* DOE received no comments concerning Section 654 in response to the April 2009 NOPR, and, therefore, takes no further action in today's final rule with respect to this provision.

I. Review Under Executive Order 12630

DOE determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859 (March 18, 1988), that the proposed rule would not result in any takings which might require compensation under the Fifth Amendment to the U.S. Constitution. 74 FR 16920, 17024 (April 13, 2009). DOE received no comments concerning Executive Order 12630 in response to the April 2009 NOPR, and, today's final rule also would not result in any takings which might require compensation under the Fifth Amendment. Therefore, DOE takes no further action in today's final rule with respect to this Executive Order.

J. Review Under the Treasury and General Government Appropriations Act of 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. The OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed today's final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001) requires Federal agencies to prepare and submit to the OIRA a Statement of Energy Effects for any significant energy action. DOE determined that the proposed rule was not a ''significant energy action'' within the meaning of Executive Order 13211 because the rule, which sets energy efficiency standards for covered GSFL and IRL, would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. 74 FR 16920, 17024 (April 13, 2009). Accordingly, DOE did not prepare a Statement of Energy Effects on the proposed rule. DOE received no comments on this issue in response to the April 2009 NOPR. As with the proposed rule, DOE has concluded that today's final rule is not a significant energy action within the meaning of Executive Order 13211. This statement remains true even though DOE has adopted energy conservation standards for GSFL in this final rule (TSL4) that are at a higher level than those proposed (TSL3). Accordingly, DOE has not prepared a Statement of Energy Effects on the rule.

L. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, the OMB, in consultation with the Office of Science and Technology, issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (Jan. 14, 2005). The purpose of the Bulletin is to enhance the quality and credibility of the Government's scientific information. The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government. As indicated in the April 2009 NOPR, this includes influential scientific information related to agency regulatory actions, such as the analyses in this rulemaking. 74 FR 16920, 17024–25 (April 13, 2009).

As more fully set forth in the April NOPR, DOE conducted formal peer reviews of the energy conservation standards development process and analyses, and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. The ''Energy Conservation Standards Rulemaking Peer Review Report,'' dated February 2007, has been disseminated and is available at: *http://www.eere.energy.gov/buildings/appliance_standards/peer_review.html.*

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will submit to Congress a report regarding the issuance of today's final rule. DOE also will submit the supporting analyses to the Comptroller General in the U.S. Government Accountability Office (GAO) and make them available to each House of Congress.

IX. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's final rule.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovermental relations, Small businesses.

Issued in Washington, DC, on June 26, 2009.

Cathy Zoi,

Assistant Secretary, Energy Efficiency and Renewable Energy.

■ For the reasons set forth in the preamble, chapter II, subchapter D, of Title 10, Code of Federal Regulations, Parts 430 is amended as set forth below:

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

■ 1. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309; 28 U.S.C. 2461 note.

■ 2. Section 430.2 is amended by revising the definition of ''colored fluorescent lamp,'' ''fluorescent lamp,'' and ''rated wattage'' to read as follows:

§ 430.2 Definitions.

* * * * *

Colored fluorescent lamp means a fluorescent lamp designated and marketed as a colored lamp and not designed or marketed for general illumination applications with either of the following characteristics:

(1) A CRI less than 40, as determined according to the method set forth in CIE Publication 13.3 (incorporated by reference; *see* § 430.3); or

(2) A correlated color temperature less than 2,500K or greater than 7,000K as determined according to the method set forth in IESNA LM–9 (incorporated by reference; *see* § 430.3).

* * * * *

Fluorescent lamp means a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light, including only the following:

(1) Any straight-shaped lamp (commonly referred to as 4-foot medium bipin lamps) with medium bipin bases of nominal overall length of 48 inches and rated wattage of 25 or more;

(2) Any U-shaped lamp (commonly referred to as 2-foot U-shaped lamps) with medium bipin bases of nominal overall length between 22 and 25 inches and rated wattage of 25 or more;

(3) Any rapid start lamp (commonly referred to as 8-foot high output lamps) with recessed double contact bases of nominal overall length of 96 inches;

(4) Any instant start lamp (commonly referred to as 8-foot slimline lamps) with single pin bases of nominal overall length of 96 inches and rated wattage of 52 or more;

(5) Any straight-shaped lamp (commonly referred to as 4-foot

miniature bipin standard output lamps) with miniature bipin bases of nominal overall length between 45 and 48 inches and rated wattage of 26 or more; and

(6) Any straight-shaped lamp (commonly referred to 4-foot miniature bipin high output lamps) with miniature bipin bases of nominal overall length between 45 and 48 inches and rated wattage of 49 or more.

* * * * *

Rated wattage means:

(1) With respect to fluorescent lamps and general service fluorescent lamps:

(i) If the lamp is listed in ANSI C78.81 (incorporated by reference; *see* § 430.3) or ANSI C78.901 (incorporated by reference; *see* § 430.3), the rated wattage of a lamp determined by the lamp designation of Clause 11.1 of ANSI C78.81 or ANSI C78.901;

(ii) If the lamp is a residential straight-shaped lamp, and not listed in ANSI C78.81 (incorporated by reference; *see* § 430.3), the wattage of a lamp when operated on a reference ballast for which the lamp is designed; or

(iii) If the lamp is neither listed in one of the ANSI standards referenced in (1)(i) of this definition, nor a residential straight-shaped lamp, the electrical power of a lamp when measured according to the test procedures outlined in Appendix R to subpart B of this part.

(2) With respect to general service incandescent lamps and incandescent reflector lamps, the electrical power measured according to the test procedures outlined in Appendix R to subpart B of this part.

* * * * *

■ 3. Section 430.3 is amended by:
■ A. Removing paragraph (c)(1);
■ B. Redesignating paragraphs (c)(2) through (13) as (c)(1) through (12);
■ C. Revising newly redesignated paragraph (c)(1); and
■ D. In newly redesignated paragraph (c)(5), add ''430.32,'' after ''430.2,''.

The revision reads as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(c) * * *

(1) ANSI C78.3–1991 (''ANSI C78.3''), American National Standard for Fluorescent Lamps-Instant-start and Cold-Cathode Types-Dimensional and Electrical Characteristics, approved July 15, 1991; IBR approved for § 430.32.

* * * * *

■ 4. Appendix R to Subpart B of Part 430 is amended by adding paragraphs 4.1.2.3, 4.1.2.4, and 4.1.2.5 to read as follows:

Appendix R to Subpart B of Part 430—Uniform Test Method for Measuring Average Lamp Efficacy (LE) and Color Rendering Index (CRI) of Electric Lamps

* * * * *

4.1.2.3 8-foot slimline lamps shall be operated using the following reference ballast settings:

(a) *T12 lamps:* 625 volts, 0.425 amps, and 1280 ohms.

(b) *T8 lamps:* 625 volts, 0.260 amps, and 1960 ohms.

4.1.2.4 8-foot high output lamps shall be operated using the following reference ballast settings:

(a) *T12 lamps:* 400 volts, 0.800 amps, and 415 ohms.

(b) *T8 lamps:* 450 volts, 0.395 amps, and 595 ohms.

4.1.2.5 4-foot miniature bipin standard output or high output lamps shall be operated using the following reference ballast settings:

(a) *Standard Output:* 329 volts, 0.170 amps, and 950 ohms.

(b) *High Output:* 235 volts, 0.460 amps, and 255 ohms.

* * * * *

■ 5. Section 430.32 is amended by revising paragraph (n) to read as follows:

§ 430.32 Energy and water conservation standards and effective dates.

* * * * *

(n) *General service fluorescent lamps and incandescent reflector lamps.* (1) Except as provided in paragraphs (n)(2) and (n)(3) of this section, each of the following general service fluorescent lamps manufactured after the effective dates specified in the table shall meet or exceed the following lamp efficacy and CRI standards:

Lamp type	Nominal lamp wattage	Minimum CRI	Minimum average lamp efficacy (lm/W)	Effective date
4-foot medium bipin	>35W	69	75.0	Nov. 1, 1995.
	≤35W	45	75.0	Nov. 1, 1995.
2-foot U-shaped	>35W	69	68.0	Nov. 1, 1995.
8-foot slimline	≤35W	45	64.0	Nov. 1, 1995.
	>65W	69	80.0	May 1, 1994.
	>65W	45	80.0	May 1, 1994.
8-foot high output	>100W	69	80.0	May 1, 1994.
	≤100W	45	80.0	May 1, 1994.

(2) The standards described in paragraph (n)(1) of this section do not apply to:

(i) Any 4-foot medium bipin lamp or 2-foot U-shaped lamp with a rated wattage less than 28 watts;

(ii) Any 8-foot high output lamp not defined in ANSI C78.81 (incorporated by reference; see § 430.3) or related supplements, or not 0.800 nominal amperes; or

(iii) Any 8-foot slimline lamp not defined in ANSI C78.3 (incorporated by reference; see § 430.3).

(3) Each of the following general service fluorescent lamps manufactured after July 14, 2012, shall meet or exceed the following lamp efficacy standards shown in the table:

Lamp type	Correlated color temperature	Minimum average lamp efficacy (lm/W)
4-foot medium bipin	≤4,500K	89
	>4,500K and ≤7,000K	88
2-foot U-shaped	≤4,500K	84

Lamp type	Correlated color temperature	Minimum average lamp efficacy (lm/W)
	>4,500K and ≤7,000K	81
8-foot slimline	≤4,500K	97
	>4,500K and ≤7,000K	93
8-foot high output	≤4,500K	92
	>4,500K and ≤7,000K	88
4-foot miniature bipin standard output	≤4,500K	86
	>4,500K and ≤7,000K	81
4-foot miniature bipin high output	≤4,500K	76
	>4,500K and ≤7,000K	72

(4) Except as provided in paragraph (n)(5) of this section, each of the following incandescent reflector lamps manufactured after November 1, 1995, shall meet or exceed the lamp efficacy standards shown in the table:

Nominal lamp wattage	Minimum average lamp efficacy (lm/W)
40–50	10.5
51–66	11.0
67–85	12.5
86–115	14.0
116–155	14.5
156–205	15.0

(5) Each of the following incandescent reflector lamps manufactured after July 14, 2012, shall meet or exceed the lamp efficacy standards shown in the table:

Rated lamp wattage	Lamp spectrum	Lamp diameter (inches)	Rated voltage	Minimum average lamp efficacy (lm/W)
40–205	Standard Spectrum	>2.5	≥125V	$6.8*P^{0.27}$
			<125V	$5.9*P^{0.27}$
		≤2.5	≥125V	$5.7*P^{0.27}$
			<125V	$5.0*P^{0.27}$
40–205	Modified Spectrum	>2.5	≤125V	$5.8*P^{0.27}$
			<125V	$5.0*P^{0.27}$
		≤2.5	≥125V	$4.9*P^{0.27}$
			<125V	$4.2*P^{0.27}$

Note 1: P is equal to the rated lamp wattage, in watts.
Note 2: Standard Spectrum means any incandescent reflector lamp that does not meet the definition of modified spectrum in 430.2.

(6) (i)(A) Subject to the exclusions in paragraph (n)(6)(ii) of this section, the standards specified in this section shall apply to ER incandescent reflector lamps, BR incandescent reflector lamps, BPAR incandescent reflector lamps, and similar bulb shapes on and after January 1, 2008.

(B) Subject to the exclusions in paragraph (n)(6)(ii) of this section, the standards specified in this section shall apply to incandescent reflector lamps with a diameter of more than 2.25 inches, but not more than 2.75 inches, on and after June 15, 2008.

(ii) The standards specified in this section shall not apply to the following types of incandescent reflector lamps:

(A) Lamps rated at 50 watts or less that are ER30, BR30, BR40, or ER40 lamps;

(B) Lamps rated at 65 watts that are BR30, BR40, or ER40 lamps; or

(C) R20 incandescent reflector lamps rated 45 watts or less.

Appendix

[The following letter from the Department of Justice will not appear in the Code of Federal Regulations.]

Department of Justice, Antitrust Division, Main Justice Building, 950 Pennsylvania Avenue, NW., Washington, DC 20530–0001, (202) 514–2401/(202) 616–2645(f), *antitrust.atr@usdoj.gov, http://www.usdoj.gov/atr.*

June 15, 2009.

Warren Belmar, Esq.,
Deputy General Counsel for Energy Policy, Department of Energy, Washington, DC 20585.

Dear Deputy General Counsel Belmar: I am responding to your letter seeking the views of the Attorney General about the potential impact on competition of proposed amended energy conservation standards for general service fluorescent lamps (''GSFL'') and incandescent reflector lamps (''IRL''). Your request was submitted pursuant to Section 325(o)(2)(B)(i)(V) of the Energy Policy and Conservation Act, as amended, (''ECPA''), 42 U.S.C. 6295(o)(B)(i)(V), which requires the Attorney General to make a determination of the impact of any lessening of competition that is likely to result from the imposition of proposed energy conservation standards. The Attorney General's responsibility for responding to requests from other departments about the effect of a program on competition has been delegated to the Assistant Attorney General for the Antitrust Division in 28 CFR 0.40(g).

In conducting its analysis the Antitrust Division examines whether a proposed standard may lessen competition, for example, by substantially limiting consumer choice, leaving consumers with fewer competitive alternatives, placing certain manufacturers of a product at an unjustified competitive disadvantage compared to other manufacturers, or by inducing avoidable inefficiencies in production or distribution of particular products.

We have reviewed the proposed standards contained in the Notice of Proposed Rulemaking (''NOPR'') (74 FR 16920, April 13, 2009) and the supplementary information submitted to the Attorney General, and attended the February 3, 2009 public hearing on the proposed standards.

Based on this review, the Department of Justice does not believe that the proposed standard for GSFLs would likely lead to a lessening of competition. Our review has focused upon the standards DOE has proposed adopting; we have not determined the impact on competition of more stringent standards than those proposed in the NOPR.

With respect to IRLs, the Department is concerned that the proposed Trial Standard Level 4 could adversely affect competition. The NOPR would increase the minimum efficiency levels for IRLs to the second highest level under consideration in this rulemaking. The IRL market is highly concentrated, with three domestic manufacturers. Based on our review, it appears that only two of these firms may currently manufacture IRLs that would meet the new standard. It is our understanding that these firms produce only limited quantities of such products for high-end applications. The current producers may not have the capacity to meet demand. In addition, one of these manufacturers uses proprietary technology currently unavailable to other manufacturers.

Given the capital investments new entrants or providers would be required to make, and the potential that manufacturers may have to obtain proprietary technology, there is a risk that one or more IRL manufacturers will not produce products that meet the proposed standard. We request that the Department of Energy consider the possibility of new technology in this area as it settles on standards in this field.

Sincerely,

Christine A. Varney,

Assistant Attorney General.

[FR Doc. E9–15710 Filed 7–13–09; 8:45 am]

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