DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket Number EE–2007–BT–STD–0016]

RIN 1904–AB50

Energy Conservation Program: Energy Conservation Standards for Fluorescent Lamp Ballasts

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

ACTION: Notice of proposed rulemaking (NOPR) and public meeting.

SUMMARY: The Energy Policy and Conservation Act (EPCA) prescribes energy conservation standards for various consumer products and commercial and industrial equipment, including fluorescent lamp ballasts (ballasts). EPCA also requires the U.S. Department of Energy (DOE) to determine if amended standards for ballasts are technologically feasible and economically justified, and would save a significant amount of energy, and to determine whether to adopt standards for additional ballasts not already covered by Federal standards. In this NOPR, DOE proposes amended energy conservation standards for those ballasts currently subject to standards, and new standards for certain ballasts not currently covered by standards. This NOPR also announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES: DOE will hold a public meeting on May 10, 2011, from 9 a.m. to 4 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section 0, "Public Participation," for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than June 10, 2011. *See* section 0, "Public Participation," of this NOPR for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room GE–086, 1000 Independence Avenue, SW., Washington, DC 20585. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Brenda Edwards at (202) 586–2945 to initiate the necessary procedures.

Any comments submitted must identify the NOPR for Energy Conservation Standards for Fluorescent Lamp Ballasts and provide docket number EE–2007–BT–STD–0016 and/or regulatory information number (RIN) number 1904–AB50. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments.
2. *E-mail: ballasts.rulemaking@ee.doe.gov.* Include the docket number and/or RIN in the subject line of the message.
3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD. It is not necessary to include printed copies.

Written comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this proposed rule may be submitted to Office of Energy Efficiency and Renewable Energy through the methods listed above and by e-mail to *Christine_J._Kymn@omb.eop.gov.*

For detailed instructions on submitting comments and additional information on the rulemaking process, *see* section 0 of this document (Public Participation).

Docket: The docket is available for review at *http://www.regulations.gov,* including **Federal Register** notices, framework documents, public meeting attendee lists and transcripts, comments, and other supporting documents/materials. All documents in the docket are listed in the *http://www.regulations.gov* index. Not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

A link to the docket web page can be found at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/fluorescent_lamp_ballasts.html.* This web page will contain a link to the docket for this notice on regulations.gov. The regulations.gov web page contains simple instructions on how to access all documents, including public comments, in the docket. *See* section 0 for further information on how to submit comments through *http://www.regulations.gov.*

For further information on how to submit or review public comments or participate in the public meeting, contact Ms. Brenda Edwards at (202) 586–2945 or e-mail: *Brenda.Edwards@ee.doe.gov.*

FOR FURTHER INFORMATION CONTACT:

Dr. Tina Kaarsberg, 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) 287–1393. E-mail: *Tina.Kaarsberg@ee.doe.gov.*

Ms. Elizabeth Kohl, U.S. Department of Energy, Office of the General Counsel, GC–71, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–7796. E-mail: *Elizabeth.Kohl@hq.doe.gov.*

SUPPLEMENTARY INFORMATION:

I. Summary of the Proposed Rule

The Energy Policy and Conservation Act (42 U.S.C. 6291 *et seq.;* EPCA or the Act), as amended, requires that any new or amended energy conservation standard DOE prescribes for certain products, such as fluorescent lamp ballasts (ballasts), 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)) Furthermore, the new or amended standard must result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)(B)) In accordance with these and other statutory provisions discussed in this notice, DOE proposes new and amended energy conservation standards for ballasts. The proposed standards are shown in Table I.1. These proposed standards, if adopted, would apply to all products listed in Table I.1 and manufactured in, or imported into, the United States on or after June 30, 2014.

TABLE I.1—PROPOSED STANDARDS

Product class *	Proposed standard **	Percent improvement over current standard or baseline +
IS and RS ballasts that operate:		
4-foot MBP lamps	1.32 * Ln (total lamp arc power) + 86.11	1.9 to 13.4.
8-foot slimline lamps		
PS ballasts that operate:		
4-foot MBP lamps	1.79 * ln (total lamp arc power) + 83.33	9.3 to 12.6.
4-foot MiniBP SO lamps		
4-foot MiniBP HO lamps		
IS and RS ballasts that operate 8-foot HO lamps.	1.49 * ln (total lamp arc power) + 84.32	34.7.
PS ballasts that operate 8-foot HO lamps.	1.46 * ln (total lamp arc power) + 82.63	32.0.
Ballasts that operate 8-foot HO lamps in cold temperature outdoor signs.	1.49 * ln (total lamp arc power) + 81.34	31.7.

* IS = instant start; RS = rapid start; MBP = medium bipin; PS = programmed start; SO = standard output; HO = high output.
** The proposed standards are based on an equation that is a function of the natural logarithm (ln) of the total lamp arc power operated by the ballast.
+ Range is applicable to the representative ballasts analyzed.

DOE's analyses indicate that the proposed standards would save a significant amount of energy—an estimated 3.7–6.3 quads of cumulative energy over 30 years (2014 through 2043). This amount is equivalent to the annual energy use of approximately 18.5 million to 31.5 million U.S. homes.

The cumulative national net present value (NPV) of total consumer costs and savings of the proposed standards for products shipped in 2014–2043, in 2009$, ranges from $8.1 billion (at a 7-percent discount rate) to $24.7 billion (at a 3-percent discount rate).[1] The NPV

[1] DOE uses discount rates of 7 and 3 percent based on guidance from the Office of Management and Budget (OMB Circular A–4, section E,

Continued

is the estimated total value of future operating-cost savings during the analysis period, minus the estimated increased product costs, discounted to 2011. The industry net present value (INPV) is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (2014 to 2043). Using a real discount rate of 7.4 percent, DOE estimates that INPV for manufacturers of all fluorescent lamp ballasts in the base case ranges from $853 million to $1.24 billion in 2009$. If DOE adopts the proposed standards, it expects that manufacturer INPV may change from a loss of 7.7 percent to a loss of 34.7 percent, or approximately a loss of $95.3 million to a loss of $296.2 million. Using a 7-percent discount rate, the NPV of consumer costs and savings from today's proposed standards would amount to 27–119 times the total estimated industry losses. Using a 3-percent discount rate, the NPV would amount to 53–246 times the total estimated industry losses.

The projected economic impacts of the proposed standards on individual consumers are generally positive. For example, the estimated average life-cycle cost (LCC) savings are approximately $11–$25 for 2-lamp IS and RS ballasts that operate common 4-foot T8 lamps in the commercial sector.[2] When more than one baseline existed for a representative ballast type, DOE performed separate LCC analyses comparing replacement lamp-and-ballast systems to each baseline. Because T8 systems are generally more efficient than T12 systems, the incremental energy savings in a T8 baseline case are considerably lower than when comparing the same efficiency levels to a T12 baseline. It was only in these dual-baseline (*i.e.,* T12 and T8) cases that DOE observed negative economic impacts at the proposed standard levels, as the incremental energy and operating cost savings in the T8 baseline cases were not sufficient to offset the increased prices of more efficient replacements.

In addition, the proposed standards would have significant environmental benefits. The energy saved is in the form of electricity, and DOE expects the energy savings from the proposed standards to eliminate the need for approximately 4.37–7.22 gigawatts (GW) of generating capacity by 2043. The savings would result in cumulative (undiscounted) greenhouse gas emission reductions of approximately 40–121 million metric tons (MMt)[3] of carbon dioxide (CO_2) between 2014 and 2043. During this period, the proposed standards would result in undiscounted emissions reductions of approximately 32–44 thousand tons of nitrogen oxides (NO_X) and 0.59–1.67 tons of mercury (Hg).[4] DOE estimates the net present monetary value of the CO_2 emissions reduction is between $0.18 and $6.67 billion, expressed in 2009$ and discounted to 2011, based on a range of discount rates discussed in section 0. DOE also estimates the net present monetary value of the NO_X emissions reduction, expressed in 2009$ and discounted to 2011, is between $19 and $35 million at a 7-percent discount rate, and between $42 and $65 million at a 3-percent discount rate.[5]

The benefits and costs of today's proposed standards, for products sold in 2014–2043, can also be expressed in terms of annualized values. The annualized monetary values shown in Table I.2 are the sum of (1) the annualized national economic value, expressed in 2009$, of the benefits from consumer operation of products that meet the proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase and installation costs, which is another way of representing consumer NPV), and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[6]

The value of the CO_2 reductions, otherwise known as the Social Cost of Carbon (SCC), is calculated using a range of values per metric ton of CO_2 developed by a recent interagency process. The monetary costs and benefits of emissions reductions are reported in 2009$ to permit comparisons with the other costs and benefits in the same dollar units. The derivation of the SCC values is discussed in section 0.

Although combining the values of operating savings and CO_2 emission reductions provides a useful perspective, two issues should be considered. First, the national operating savings are domestic U.S. consumer monetary savings that occur as a result of market transactions while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and CO_2 savings are performed with different methods that use quite different time frames for analysis. The national operating cost savings is measured for the lifetime of ballasts shipped between 2014 and 2043. The SCC values, on the other hand, reflect the present value of all future climate-related impacts resulting from the emission of one ton of CO_2 in each year. These impacts go well beyond 2100.

Using a 7-percent discount rate and the SCC value of $21.40/ton in 2010 (in 2007$), which was derived using a 3-percent discount rate (see note below Table I.2), the cost of the standards proposed in today's rule is $276 million–437 million per year in increased equipment costs, while the annualized benefits are $931 million–1,359 million per year in reduced equipment operating costs, $44 million–111 million in CO_2 reductions, and $1.6 million–2.8 million in reduced NO_X emissions. In this case, the net benefit amounts to $701 million–1,036 million per year. Using a 3-percent discount rate and the SCC value of $21.40/ton in 2010 (in 2007$), the cost of the standards proposed in today's rule is $311 million–539 million per year in increased equipment costs, while the benefits are $1,153 million–1,800 million per year in reduced operating costs, $44 million–111 million in CO_2 reductions, and $2.1 million–3.3 million in reduced NO_X emissions. At a 3-

September 17, 2003). See section IV.G for further information.

[2] The LCC is the total consumer expense over the life of a product, consisting of purchase and installation costs plus operating costs (expenses for energy use, maintenance and repair). To compute the operating costs, DOE discounts future operating costs to the time of purchase and sums them over the lifetime of the product.

[3] A metric ton is equivalent to 1.1 short tons. Results for NO_X and Hg are presented in short tons.

[4] DOE calculates emissions reductions relative to the most recent version of the Annual Energy Outlook (AEO) Reference case forecast. As noted in chapter 16 of the TSD, this forecast accounts for regulatory emissions reductions through 2008, including the Clean Air Interstate Rule (CAIR, 70 FR 25162 (May 12, 2005)), but not the Clean Air Mercury Rule (CAMR, 70 FR 28606 (May 18, 2005)). Subsequent regulations, including the proposed CAIR replacement rule and the proposed Clean Air Transport Rule (75 FR 45210 (August 2, 2010)), do not appear in the forecast.

[5] DOE is aware of multiple agency efforts to determine the appropriate range of values used in evaluating the potential economic benefits of reduced Hg emissions. DOE has decided to await further guidance regarding consistent valuation and reporting of Hg emissions before it once again monetizes Hg in its rulemakings.

[6] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in the same year used for discounting the NPV of total consumer costs and savings. To calculate the present value, DOE used discount rates of three and seven percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates, as shown in Table I.2. From the present value, DOE then calculated the corresponding time-series of fixed annual payments over a 30-year period starting in the same year used for discounting the NPV of total consumer costs and savings. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined would be a steady stream of payments.

percent discount rate, the net benefit amounts to $887 million–1,376 million per year.

TABLE I.2—ANNUALIZED BENEFITS AND COSTS OF PROPOSED STANDARDS FOR BALLASTS FOR 2014–2043 ANALYSIS PERIOD

	Discount rate	Monetized *million 2009$/year*		
		Primary estimate	Low estimate (emerging technologies, roll-up scenario)	High estimate (existing technologies, shift scenario)
Benefits				
Operating Cost Savings	7%	1,145	931	1,359.
	3%	1,477	1,153	1,800.
CO_2 Reduction at $4.7/t *	5%	20	12	28.
CO_2 Reduction at $21.4/t *	3%	78	44	111.
CO_2 Reduction at $35.1/t *	2.5%	122	68	177.
CO_2 Reduction at $64.9/t *	3%	237	134	340.
NO_X Reduction at $2,519/t *	7%	2.2	1.6	2.8.
	3%	2.7	2.1	3.3.
Total (Operating Cost Savings, CO_2 Reduction and NO_x Reduction)†.	7% plus CO_2 range	1,167 to 1,384	945 to 1,067	1,389 to 1,702.
	7%	1,225	977	1,473.
	3%	1,557	1,199	1,915.
	3% plus CO_2 range	1,499 to 1,716	1,167 to 1,289	1,831 to 2,144.
Costs				
Incremental Product Costs	7%	357	276	437.
	3%	425	311	539.
Net Benefits/Costs				
Total (Operating Cost Savings, CO_2 Reduction and NO_x Reduction, Minus Incremental Product Costs)†.	7% plus CO_2 range	810 to 1,027	669 to 790	952 to 1,264.
	7%	868	701	1,036.
	3%	1,131	887	1,376.
	3% plus CO_2 range	1,074 to 1,291	856 to 977	1,292 to 1,604.

* The CO_2 values represent global monetized values (in 2007$) of the social cost of CO_2 emissions in 2010 under several scenarios. The values of $4.7, $21.4, and $35.1 per ton are the averages of SCC distributions calculated using 5-percent, 3-percent, and 2.5-percent discount rates, respectively. The value of $64.9 per ton represents the 95th percentile of the SCC distribution calculated using a 3-percent discount rate. The value for NO_x (in 2009$) is the average of the low and high values used in DOE's analysis.

† Total Benefits for both the 3-percent and 7-percent cases are derived using the SCC value calculated at a 3-percent discount rate, which is $21.4/ton in 2010 (in 2007$). In the rows labeled as "7% plus CO_2 range" and "3% plus CO_2 range," the operating cost and NO_x benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values with the $4.7/ton value at the low end, and the $64.9/ton value at the high end.

DOE has tentatively concluded that the proposed standards represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy. DOE further notes that products achieving these standard levels are already commercially available for all product classes covered by today's proposal. Ballasts are commercially available at the proposed standard level for all representative ballast types. Based on the analyses described above, DOE found the benefits of the proposed standards to the nation (energy savings, positive NPV of consumer benefits, consumer LCC savings, and emission reductions) outweigh the burdens (loss of INPV for manufacturers and LCC increases for some consumers).

Based on consideration of the public comments DOE receives in response to this notice and related information collected and analyzed during the course of this rulemaking effort, DOE may adopt energy use levels presented in this notice that are either higher or lower than the proposed standards, or some combination of level(s) that incorporate the proposed standards in part.

II. Introduction

The following section briefly discusses the statutory authority underlying today's proposal as well as some of the relevant historical background related to the establishment of standards for fluorescent lamp ballasts.

A. Authority

Title III of EPCA sets forth a variety of provisions designed to improve energy efficiency. Part B of Title III (42 U.S.C. 6291–6309) provides for the Energy Conservation Program for Consumer Products Other than Automobiles.[7] EPCA covers consumer products and certain commercial equipment (referred to collectively hereafter as "covered products"), including the types of fluorescent lamp ballasts that are the subject of this rulemaking.[8] (42 U.S.C. 6292(a)(13)) EPCA prescribes energy conservation standards for these products (42 U.S.C.

[7] This part was titled Part B in EPCA, but was subsequently codified as Part A in the U.S. Code for editorial reasons.

[8] Ballasts are used primarily in the commercial and industrial sectors. While Part B includes a range of consumer products that are used primarily in the residential sector, such as refrigerators, dishwashers, and clothes washers, Part B also includes several products used primarily in the commercial sector, including fluorescent lamp ballasts. (Part C of Title III—Certain Industrial Equipment, codified in the U.S. Code as Part A–1, concerns products used primarily in the commercial and industrial sectors, such as electric motors and pumps, commercial refrigeration equipment, and packaged terminal air conditioners and heat pumps.)

6295(g)(5), (6), and (8)), and also requires that DOE conduct two rulemakings to determine (1) whether EPCA's original standards for ballasts in 42 U.S.C. 6295(g)(5) should be amended, including whether such standards should apply to the ballasts in 42 U.S.C. 6295(g)(6) and other fluorescent ballasts; and (2) whether the standards then in effect for ballasts should be amended, including whether such standards should apply to additional ballasts. (42 U.S.C. 6295(g)(7)(A)–(B)) As explained in further detail in section II.C, "Background," this rulemaking is the second of the two required rulemakings. In this rulemaking, DOE considers whether to amend the existing standards for ballasts, including those in 42 U.S.C. 6295(g)(8), and also considers standards for additional ballasts. See section 0 for a discussion of additional fluorescent lamp ballasts DOE considered for coverage. In addition, under 42 U.S.C. 6295(m), DOE must periodically review established energy conservation standards for covered products.

Under EPCA, DOE's energy conservation program for covered products consists essentially of four parts: (1) Testing, (2) labeling, (3) the establishment of Federal energy conservation standards, and (4) certification and enforcement procedures. The Federal Trade Commission (FTC) is primarily responsible for labeling, and DOE implements the remainder of the program. EPCA authorizes DOE, subject to certain criteria and conditions, to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. (42 U.S.C. 6293) Manufacturers of covered products must use the prescribed DOE test procedure as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of those products. (42 U.S.C. 6293(c) and 6295(s)) Similarly, DOE must use these test procedures to determine whether the products comply with standards adopted under EPCA. *Id.* The test procedures for ballasts currently appear at title 10, Code of Federal Regulations (CFR), part 430, subpart B, appendix Q.

EPCA provides criteria for prescribing amended standards for covered products. As indicated above, any amended standard for a covered product 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)) Furthermore, EPCA precludes DOE from adopting any standard that would not result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)) Moreover, DOE may not prescribe a standard: (1) For certain products, including ballasts, if no test procedure has been established for the product, or (2) if DOE determines by rule that the proposed standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B)) EPCA also provides that, in determining whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i)) DOE must do so after receiving comments on the proposed standard, and 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 the covered 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, or as applicable, water, 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 and water conservation; and
7. Other factors the Secretary of Energy (Secretary) considers relevant. (42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

EPCA also contains what is known as an "anti-backsliding" provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered product. (42 U.S.C. 6295(o)(1)) Also, 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 covered product type (or class) of 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))

Further, EPCA establishes a rebuttable presumption that a standard 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 savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. *See* 42 U.S.C. 6295(o)(2)(B)(iii).

EPCA requires DOE to specify a different standard level than that which applies generally to a type or class of products for any group of covered products that have the same function or intended use if DOE determines that 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. (42 U.S.C. 6294(q)(1)) In determining whether a performance-related feature justifies a different standard for a group of products, DOE must consider such factors as the utility to the consumer of the feature and other factors DOE deems appropriate. *Id.* Any rule prescribing such a standard must include an explanation of the basis on which such higher or lower level was established. (42 U.S.C. 6295(q)(2))

Federal energy conservation requirements 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 the Act. (42 U.S.C. 6297(d))

Finally, EPCA requires that energy conservation standards address standby mode and off mode energy use. (42 U.S.C. 6295(gg)) Specifically, when DOE adopts a standard for a covered product after July 1, 2010, DOE must, if justified by the criteria for adoption of standards in 42 U.S.C. 6295(o), incorporate standby mode and off mode energy use into the standard, if feasible. If incorporation is not feasible, DOE must adopt a separate standard for such energy use for that product, if justified under 42 U.S.C. 6295(o). (42 U.S.C. 6295(gg)(3)(A)–(B)) DOE has determined that ballasts do not operate in an "off mode" as defined by EPCA (42 U.S.C. 6291(gg)(1)(A)(ii)), and that the only ballasts that consume power in a "standby mode" as defined by EPCA (42 U.S.C. 6291(gg)(1)(A)(iii)) are those that incorporate an electronic circuit enabling the ballast to communicate with and be part of a lighting control system. DOE's current test procedures for ballasts address such standby mode energy use. 74 FR 54455 (October 22, 2009); 10 CFR part 430, subpart B, appendix Q, section 3.5. In this rulemaking, as discussed in section 0, DOE has not proposed amended standards for dimming ballasts currently covered by standards (42 U.S.C. 6295(g)(8)) because DOE has not found any of these covered products in the marketplace. As the scope of coverage does not include any additional dimming ballasts, this NOPR does not include energy conservation standards for standby mode energy use.

B. Background

1. Current Standards

The current Federal energy conservation standards for ballasts are set forth in Table II.1 and Table II.2 below. The standards in Table II.1 were adopted in a final rule published on September 19, 2000, 65 FR 56739, which completed the first of the two rulemakings required under 42 U.S.C. 6295(g)(7) to consider amending the standards for ballasts (hereafter referred to as the 2000 Ballast Rule). The standards in Table II.2 were established by amendments to EPCA in the Energy Policy Act of 2005 (EPACT 2005), Public Law 109–58.

TABLE II.1—ENERGY CONSERVATION STANDARDS FROM THE 2000 BALLAST RULE

Application for operation of	Ballast input voltage	Total nominal lamp watts	Ballast efficacy factor
One F40T12 lamp	120	40	2.29
	277	40	2.29
Two F40T12 lamps	120	80	1.17
	277	80	1.17
Two F96T12 lamps	120	150	0.63
	277	150	0.63
Two F96T12HO lamps	120	220	0.39
	277	220	0.39

10 CFR 430.32(m)(3).

TABLE II.2—ENERGY CONSERVATION STANDARDS FROM EPACT 2005

Application for operation of	Ballast input voltage	Total nominal lamp watts	Ballast efficacy factor
One F34T12 lamp	120/277	34	2.61
Two F34T12 lamps	120/277	68	1.35
Two F96T12/ES lamps	120/277	120	0.77
Two F96T12/HO/ES lamps	120/277	190	0.42

(42 U.S.C. 6295(g)(8)(A); 10 CFR 430.32(m)(5))

In summary, as reflected in the foregoing two tables, the ballasts currently regulated under EPCA consist of ballasts that are designed to operate:

• One and two nominally 40-watt (W) and 34W 4-foot T12 medium bipin (MBP) lamps (F40T12 and F34T12);

• Two nominally 75W and 60W 8-foot T12 single-pin (SP) slimline lamps (F96T12 and F96T12/ES); and

• Two nominally 110W and 95W 8-foot T12 recessed double contact high output lamps (F96T12 and F96T12/ES) at nominal input voltages of 120 or 277 volts (V) with an input current frequency of 60 hertz (Hz).

2. History of Standards Rulemaking for Fluorescent Lamp Ballasts

EPCA establishes energy conservation standards for certain ballasts and requires that DOE conduct two cycles of rulemakings to determine whether to amend the standards for ballasts, including whether to adopt standards for additional ballasts. (42 U.S.C. 6295(g)(5)–(8)) As indicated above, DOE completed the first of these rulemaking cycles in the 2000 Ballast Rule. 65 FR 56740 (Sept. 19, 2000). In this rulemaking, the second rulemaking cycle required by 42 U.S.C. 6295(g)(7), DOE considers whether to amend the existing standards for ballasts and whether to adopt standards for additional ballasts.

DOE initiated this rulemaking on January 14, 2008 by publishing in the **Federal Register** a notice announcing the availability of the "Energy Conservation Standards Rulemaking Framework Document for Fluorescent Lamp Ballasts." (A PDF of the framework document is available at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/ballast_framework_011408.pdf*. In this notice, DOE also announced a public meeting on the framework document and requested public comment on the matters raised in the document. 73 FR 3653 (Jan. 22, 2008). The framework document described the procedural and analytical approaches that DOE anticipated using to evaluate energy conservation standards for the ballasts, and identified various issues to be resolved in conducting this rulemaking.

DOE held the public meeting on February 6, 2008, where it: presented the contents of the framework document; described the analyses it planned to conduct during the rulemaking; sought comments from interested parties on these subjects; and in general, sought to inform interested parties about, and facilitate their involvement in, the rulemaking. Interested parties at the public meeting discussed the active mode test procedure and several major analyses related to this rulemaking. At the meeting and during the period for commenting on the framework document, DOE received many comments that helped identify and resolve issues involved in this rulemaking.

DOE then gathered additional information and performed preliminary analyses to help develop potential energy conservation standards for ballasts. DOE published in the **Federal Register** an announcement of the availability of the preliminary technical support document (the preliminary TSD) and of another public meeting to discuss and receive comments on the following matters: the product classes DOE planned to analyze; the analytical framework, models, and tools that DOE was using to evaluate standards; the results of the preliminary analyses performed by DOE; and potential standard levels that DOE could consider. 75 FR 14319 (March 24, 2010) (the March 2010 notice). DOE also invited written comments on these subjects. *Id.* The preliminary TSD is available at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/fluorescent_lamp_ballasts_ecs_prelim_tsd.html.* In the notice, DOE requested comment on other relevant issues that would affect energy conservation standards for ballasts or that DOE should address in this notice of proposed rulemaking (NOPR). *Id.* at 14322.

The preliminary TSD provided an overview of the activities DOE undertook in developing standards for ballasts, and discussed the comments DOE received in response to the framework document. It also described the analytical framework that DOE uses in this rulemaking, including a description of the methodology, the analytical tools, and the relationships among the various analyses that are part of the rulemaking. The preliminary TSD presented and described in detail each analysis DOE performed up to that point, including descriptions of inputs, sources, methodologies, and results. These analyses were as follows:

- A *market and technology assessment* addressed the scope of this rulemaking, identified the potential product classes for ballasts, characterized the markets for these products, and reviewed techniques and approaches for improving their efficiency;
- A *screening analysis* reviewed technology options to improve the efficiency of ballasts, and weighed these options against DOE's four prescribed screening criteria;
- An *engineering analysis* estimated the manufacturer selling prices (MSPs) associated with more energy-efficient ballasts;
- An *energy use analysis* estimated the annual energy use of ballasts;
- A *markups analysis* converted estimated MSPs derived from the engineering analysis to consumer prices;
- A *life-cycle cost analysis* calculated, for individual consumers, the discounted savings in operating costs throughout the estimated average life of the product, compared to any increase in installed costs likely to result directly from the imposition of a given standard;
- A *payback period (PBP) analysis* estimated the amount of time it takes individual consumers to recover the higher purchase expense of more energy efficient products through lower operating costs;
- A *shipments analysis* estimated shipments of ballasts over the time period examined in the analysis, which was used in performing the national impact analysis (NIA);
- A *national impact analysis* assessed the national energy savings, and the national net present value of total consumer costs and savings, expected to result from specific, potential energy conservation standards for ballasts; and
- A *preliminary manufacturer impact analysis* took the initial steps in evaluating the effects on manufacturers of new efficiency standards.

The public meeting announced in the March 2010 notice took place on April 26, 2010. At this meeting, DOE presented the methodologies and results of the analyses set forth in the preliminary TSD. Interested parties discussed the following major issues at the public meeting: the pros and cons of various efficiency metrics; how test procedure variation might affect efficiency measurements; special requirements for electromagnetic interference (EMI)-sensitive environments; product class divisions; MSPs and overall pricing methodology; markups; the maximum technologically feasible ballast efficiency; cumulative regulatory burden; and shipments. The comments received since publication of the March 2010 notice, including those received at the April 2010 public meeting, have contributed to DOE's proposed resolution of the issues in this rulemaking. This NOPR responds to the issues raised in the comments received.

Since the April 2010 public meeting, additional changes have been proposed to the active mode test procedure that have directly impacted this rulemaking. After reviewing comments submitted in response to the active mode test procedure NOPR (75 FR 14287, March 24, 2010) and conducting additional research, DOE issued a supplemental NOPR (SNOPR) proposing a lamp-based ballast efficiency metric instead of the resistor-based metric proposed in the NOPR. 75 FR 71570 (November 24, 2010). DOE believes the lamp-based metric more accurately assesses the real-life performance of a ballast. In the SNOPR, DOE sought additional comment on this approach. This NOPR evaluates standards for fluorescent lamp ballasts in terms of the new metric proposed in the active mode test procedure SNOPR. Please refer to section 0 for more details.

3. Compliance Date

EPCA contains specific guidelines regarding the compliance date for any standards amended by this rulemaking. EPCA requires DOE to determine whether to amend the standards in effect for fluorescent lamp ballasts and whether any amended standards should apply to additional ballasts. (42 U.S.C. 6295(g)(7)(B)). As stated above, the existing standards for ballasts are the standards established in the 2000 Ballast Rule and the standards established through the EPCA amendments to EPACT 2005. EPCA specifies that any amended standards established in this rulemaking shall apply to products manufactured after a date that is five years after—(i) The effective date of the previous amendment; or (ii) if the previous final rule did not amend the standards, the earliest date by which a previous amendment could have been effective; except that in no case may any amended standard apply to products manufactured within three years after publication of the final rule establishing such amended standard. (42 U.S.C. 6295(g)(7)(C)). DOE is required by consent decree to publish any amended standards for ballasts by June 30, 2011.[9] As a result, and in compliance with 42 U.S.C. 6295(g)(7)(C), DOE expects the compliance date to be 3 years after the publication of any final amended standards, by June 30, 2014.

[9] Under the consolidated Consent Decree in *New York* v. *Bodman,* No. 05 Civ. 7807 (S.D.N.Y. filed Sept. 7, 2005) and *Natural Resources Defense Council* v. *Bodman,* No. 05 Civ. 7808 (S.D.N.Y. filed Sept. 7, 2005) the U.S. Department of Energy is required to publish a final rule amending energy conservation standards for fluorescent lamp ballasts no later than June 30, 2011.

III. Issues Affecting the Scope of This Rulemaking

A. Additional Fluorescent Lamp Ballasts for Which DOE Is Proposing Standards

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

As discussed above, amendments to EPCA established energy conservation standards for certain fluorescent lamp ballasts, (42 U.S.C. 6295(g)(5), (6), and (8)) and directed DOE to conduct two rulemakings to consider amending the standards. The first amendment was completed with the publication of the 2000 Ballast Rule. This rulemaking fulfills the statutory requirement to determine whether to amend standards a second time. EPCA specifically directs DOE, in this second amendment, to determine whether to amend the standards in effect for fluorescent lamp ballasts and whether such standards should be amended so that they would be applicable to additional fluorescent lamp ballasts. (42 U.S.C. 6295(g)(7)(B))

The preliminary TSD notes that a wide variety of fluorescent lamp ballasts are not currently covered by energy conservation standards, and they are potential candidates for coverage under 42 U.S.C. 6295(g)(7). DOE encountered similar circumstances in a recent rulemaking that amended standards for general service fluorescent and incandescent reflector lamps (hereafter referred to as the 2009 Lamps Rule).[10] 74 FR 34080, 34087–8 (July 14, 2009). In that rule, DOE was also directed by EPCA to consider expanding its scope of coverage to include additional products: General service fluorescent lamps (GSFL). EPCA defines general service fluorescent lamps as fluorescent lamps that can satisfy the majority of fluorescent lamp applications and that are not designed and marketed for certain specified, non-general lighting applications. (42 U.S.C. 6291(30)(B)) As such, the term "general service fluorescent lamp" is defined by reference to the term "fluorescent lamp," which EPCA defines 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 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)) To construe "general service fluorescent lamp" in 42 U.S.C. 6295(i)(5) as limited by those types of fluorescent lamps 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.

Therefore, DOE concluded that the term "additional general service fluorescent lamps" in 42 U.S.C. 6295(i)(5) allows DOE to set standards for GSFL other than the four enumerated lamp types specified in the EPCA definition of "fluorescent lamp." As a result, the 2009 Lamps Rule defined "fluorescent lamp" to include:

(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.

10 CFR 430.2

In this rulemaking, DOE is directed to consider whether any amended standard should be applicable to additional fluorescent lamp ballasts. (42 U.S.C. 6295(g)(7)(B)) EPCA defines a "fluorescent lamp ballast" as "a device which is used to start and operate fluorescent lamps by providing a starting voltage and current and limiting the current during normal operation." (42 U.S.C. 6291(29)(A)) For this rule, DOE proposes to reference the definition of fluorescent lamp adopted by the 2009 Lamps Rule. This definition allows DOE to consider expanding coverage to include additional fluorescent lamp ballasts while not eliminating coverage of any ballasts for which standards already exist.

2. Identification of the Additional Ballasts for Which DOE Proposes Standards

In considering whether to amend the standards in effect for fluorescent lamp ballasts so that they apply to "additional" fluorescent lamp ballasts as specified in section 325(g)(7)(B) of EPCA, DOE will consider all fluorescent lamp ballasts (for which standards are not already prescribed) that operate fluorescent lamps, as defined in 10 CFR 430.2. For each additional fluorescent lamp ballast, DOE considers potential energy savings, technological feasibility and economic justification when determining whether to include them in the scope of coverage. In its analyses, DOE assessed the potential energy savings from market share estimates, potential ballast designs that improve efficiency, and other relevant factors. For market share estimates, DOE used both quantitative shipment data and information obtained during manufacturer interviews. DOE also assessed the potential to achieve energy savings in certain ballasts by considering whether those ballasts could serve as potential substitutes for other regulated ballasts.

In the preliminary TSD, DOE considered extending the scope of coverage to several additional ballast types including those that operate: Additional numbers and diameters of 4-foot MBP lamps, additional numbers and diameters of 8-foot high output (HO) lamps, additional numbers and diameters of 8-foot slimline lamps, 4-foot miniature bipin (miniBP) standard output (SO) lamps, 4-foot miniBP high output lamps, and 8-foot high output cold temperature lamps commonly used in outdoor signs. DOE also considered whether to extend coverage to dimming ballasts, but determined that those ballasts represent a very small portion of the overall market and are unlikely to be substituted for covered products due to their high first cost. The California investor-owned utilities (the California Utilities), and the Northwest Energy Efficiency Alliance (NEEA) and Northwest Power and Conservation Council (NPCC) agreed with the expanded scope of coverage presented in the preliminary TSD. In particular, the California Utilities commented that there is a wide range of efficiencies among the products included in the proposed coverage and that cost-effective standards will lead to significant energy savings. The National Electrical Manufacturers Association (NEMA) generally agreed with the expanded scope of coverage, but requested a specific exemption for

[10] Documents for the 2009 Lamps Rule are available at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/incandescent_lamps.html.*

magnetic ballasts that operate in EMI-sensitive applications. (NEMA, No. 29 at p. 2; California Utilities, No. 30 at p. 1; NEEA and NPCC, No. 32 at p. 2) [11] The sections below discuss the comments received in more detail.

a. Dimming Ballasts

Historically, energy conservation standards have exempted ballasts designed for dimming to 50 percent or less of their maximum output. (10 CFR 430.32(m)(4, 6–7)) However, in 2010, exemptions included in EPACT 2005 expired for dimming ballasts that operate certain reduced-wattage lamps. (10 CFR 430.32(m)(6–7)) DOE research has revealed no dimming ballasts currently on the market that operate these lamps because the gas composition of reduced-wattage lamps makes them undesirable for use in dimming applications. Additionally, dimming ballasts employ cathode heating to facilitate dimming and therefore operate lamps with two pins. Because 8-foot slimline lamps have only a single pin, these lamps are not suitable for use with dimming ballasts. Based on data from the 2005 U.S. Census and interviews with manufacturers, DOE determined in the preliminary TSD that dimming ballasts of all types had less than 1 percent market share. DOE also concluded that these ballasts are already used in energy-saving systems. After examining the potential for substitution from other ballast types, DOE believed there was little risk of dimming ballasts becoming a substitute for other covered ballast types. Dimming ballasts are more expensive than comparable fixed-light-output ballasts. Moreover, dimming ballasts require specialized control systems, resulting in additional up-front cost. For all of these reasons, DOE did not consider expanding coverage of dimming ballasts in the preliminary TSD.

NEMA, the California Utilities, and the NEEA and NPCC agreed with the exclusion of additional dimming ballasts. (NEMA, No. 29 at p. 2; California Utilities, No. 30 at p. 1; NEEA and NPCC, No. 32 at p. 3) Philips and Osram Sylvania emphasized that dimming ballasts are part of high-efficiency systems that realize greater energy savings than fixed-light-output systems. (Philips, Public Meeting Transcript, No. 34 at pp. 122–123; OSI, No. 34, Public Meeting Transcript, No. 34 at pp. 124–125) The California Utilities and the NEEA and NPCC also cited the lack of an industry-standard test procedure as a potential barrier to including dimming ballasts in this rulemaking. NEMA concurred, stating that industry has not agreed on the appropriate dimmed level for evaluation and that measuring at many levels is burdensome. (California Utilities, No. 30 at p. 1; NEEA and NPCC, No. 32 at p. 3; NEMA, No. 29 at p. 2)

DOE agrees that dimming ballasts have a very small market share and are already used in energy-saving systems. They are unlikely to become a substitute for fixed-light output ballasts due to their high up-front cost. The lack of an industry-standardized test procedure for newer dimming products makes it difficult for DOE to determine whether energy conservation standards for additional dimming ballasts are technologically feasible. For these reasons, DOE is not proposing to expand the coverage of dimming ballasts in this NOPR. However, the dimming ballasts that operate the four reduced-wattage lamp combinations described in 10 CFR 430.32(m)(5) (EPACT 2005 standards) will continue to be covered by existing energy conservation standards.

b. Sign Ballasts

Current energy conservation standards exclude ballasts designed to operate two F96T12HO lamps at ambient temperatures of 20 degrees Fahrenheit (°F) or less and for use in an outdoor sign. (10 CFR 430.32(m)) In the preliminary TSD, DOE considered whether to include these ballasts in the scope of coverage for this rulemaking. DOE found that the market share of cold temperature sign ballasts was about 1 percent in 2005. Despite their relatively small market share, the energy savings potential per ballast is substantial due to their operation of large numbers of high output lamps. Replacing a magnetic with an electronic [12] sign ballast could reduce energy consumption by as much as 25 percent to 35 percent. Given that sign ballasts exist at more than one level of efficiency, DOE has determined it is technologically feasible to improve the energy efficiency of sign ballasts. Preliminary results from the LCC and NIA analyses indicated that setting standards would be economically justified. For these reasons, DOE included them in the scope of coverage in the preliminary TSD.

The Appliance Standards Awareness Project (ASAP) and the NEEA and NPCC agreed with DOE's decision to expand coverage to include cold temperature outdoor sign ballasts. Although these products comprise a relatively small percentage of overall fluorescent ballast shipments, the NEEA and NPCC note that these ballasts have much higher energy use compared to other covered ballast types due to their high system input power and low efficiency of present systems. (ASAP, Public Meeting Transcript, No. 34 at pp. 121–122; NEEA and NPCC, No. 32 at p. 3) DOE received no comments suggesting that DOE should not include these ballasts in the scope of coverage for this rulemaking. Therefore, for the reasons set forth above, DOE proposes to include them in the scope of coverage for this NOPR. Cold temperature ballasts for outdoor signs are typically designed to operate a range of lamp lengths and numbers of lamps. Based on product catalogs and conversations with manufacturers, DOE found that a single sign ballast can be designed to operate a range of loads including HO lamps between 1.5 feet and 10 feet with one to six lamps per ballast. Because only 8-foot HO lamps are included in the definition of fluorescent lamp (10 CFR 430.2), DOE proposes to include sign ballasts that can operate 8-foot HO lamps in the scope of coverage.

c. T5 Ballasts

In the preliminary TSD, DOE considered whether to expand the scope of coverage to include ballasts that operate standard output and high output 4-foot miniBP T5 lamps. The U.S. Census reports that T5 HO ballasts comprised about 4 percent of the ballast market in 2005. Shipment data are available only for T5 high output ballasts, so the actual market share is likely larger. T5 ballast shipments have been steadily increasing since the shipments were first reported in 2002. Furthermore, DOE research indicates that T5 high output ballasts are rapidly taking market share from metal halide systems used in high-bay industrial applications. The shipment analysis confirms that T5 SO and T5 HO ballasts represent a significant portion of the market. Because higher-efficiency versions of some of these ballasts are already present in the market, DOE concluded that standards to increase the energy efficiency of these ballasts were technologically feasible. Based on LCC and NIA results in the preliminary TSD, coverage of T5 ballasts would be economically justified. For these reasons, DOE included T5 ballasts in the

[11] A notation in the form "NEMA, No. 29 at p. 2" identifies a written comment that DOE has received and has included in the docket of this rulemaking. This particular notation refers to a comment: (1) Submitted by NEMA; (2) in document number 29 of the docket, and (3) on page 2 of that document.

[12] When DOE refers to an electronic ballast throughout this document, it is referring to a high frequency ballast as defined by as defined in ANSI C82.13–2002. Similarly, when DOE refers to a magnetic ballast, it is referring to a low frequency ballast as defined by the same ANSI standard.

scope of coverage in the preliminary TSD.

DOE did not receive any adverse comment to its inclusion of T5 ballasts in the scope of coverage for the preliminary TSD. Therefore, for the reasons stated above, DOE proposes to include them in the scope in this NOPR. DOE found that T5 ballasts and lamps exist in a variety of lengths and wattages. Although standard T5 lamps include wattages ranging from 14W to 80W, and lengths ranging from nominally 2 feet to 6 feet, the primary driver of T5 ballast and lamp market share growth is substitution for currently regulated 4-foot T8 MBP ballasts and lamps. Therefore, DOE proposes to cover ballasts designed to operate nominally 4-foot lengths of standard output and high output T5 miniBP lamps.

d. Residential Ballasts

In the preliminary TSD, DOE considered whether to include residential ballasts in the scope of coverage. Residential ballasts, defined as ballasts that have a power factor less than 0.9 and are designed for use only in residential building applications, are currently exempt from existing energy conservation standards. Only magnetic residential ballast shipments are reported in the U.S. Census. The market for residential magnetic ballasts held steady at about 7 percent between 1995 and 2002, and then decreased to about 1.5 percent in 2005. In the preliminary TSD, DOE stated its belief that the 2005 market share and total shipments of residential ballasts was much higher than the 1.5 percent reported for magnetic residential ballasts in the U.S. census. First, many residential ballasts are manufactured overseas by foreign companies that do not share shipment data with the U.S. Census. Second, electronic ballasts are a common option for residential fluorescent lighting fixtures, but they were not reported in the Census data. Because of these omissions, DOE believes residential ballasts represent a more sizeable portion of the overall ballast market and represent significant potential energy savings.

DOE also found that residential ballasts exist at a range of efficiencies. They can be magnetic or electronic and exist for both T8 and T12 lamps. Therefore, DOE believed standards to increase the energy efficiency of residential ballasts were technologically feasible. Preliminary results in the LCC and NIA indicated that standards for residential ballasts were economically justified. For these reasons, DOE included residential ballasts in the scope of coverage in the preliminary TSD.

ASAP and the NEEA and NPCC agreed with DOE's decision to expand coverage to include residential ballasts. The NEEA and NPCC noted that the residential ballast market is expected to grow substantially as residential lighting energy codes become more stringent. They noted that California, Oregon, and Washington have codes that require fluorescent or higher-efficacy systems. Similarly, the 2009 International Energy Conservation Code requires that 50 percent of all permanently installed lighting in residences have a minimum efficacy of 45 lumens per watt. (ASAP, Public Meeting Transcript, No. 34 at pp. 121–122; NEEA and NPCC, No. 32 at pp. 2–3) DOE did not receive any adverse comments regarding coverage of residential ballasts. Therefore, for the reasons stated above, DOE proposes to include residential ballasts that operate 4-foot medium bipin or 2-foot U-shaped lamps in the scope of coverage for this NOPR.

e. Ballasts That Operate T8 4-Foot MBP and 2-Foot U-Shaped Lamps

Existing energy conservation standards do not apply to ballasts that operate T8 lamps. In the preliminary TSD, DOE considered whether to extend coverage to these types of ballasts. Ballasts that operate 4-foot T8 MBP and 2-foot T8 U-shaped lamps exhibit a range of efficiencies, indicating that standards to increase the energy efficiency of these ballasts are technologically feasible. According to the U.S. Census, the market share of 4-foot T8 MBP and 2-foot T8 U-shaped ballasts represented 55 percent of shipments in 2005. In addition, due to existing energy conservation standards promulgated for T12 ballasts, shipments of T8 ballasts have been increasing. T8 ballasts are being purchased and installed in applications previously popular for T12 systems. Thus, there is potential for significant energy savings by regulating the 4-foot T8 ballast market. Furthermore, preliminary results in the LCC and NIA demonstrated the potential for significant economic savings, indicating that standards for these ballasts would be economically justified. For these reasons, DOE included ballasts that operate 4-foot T8 MBP and 2-foot T8 U-shaped lamps in the scope of coverage in the preliminary TSD.

DOE did not receive any adverse comments regarding coverage of these ballasts. Therefore, for the reasons stated above, DOE proposes to include ballasts that operate 4-foot T8 MBP and 2-foot T8 U-shaped lamps in the scope of coverage for this NOPR.

f. Ballasts That Operate T8 8-Foot Slimline Lamps

Similar to ballasts that operate 4-foot T8 MBP and 2-foot T8 U-shaped lamps, ballasts that operate 8-foot T8 slimline lamps are also not subject to existing energy conservation standards. According to the U.S. Census, 8-foot slimline T8 ballasts had about 2 percent market share in 2005, while 8-foot slimline T12 ballasts had about 3 percent market share. Although the market share for 8-foot slimline T8 ballasts as reported by the U.S. Census is relatively small, the 2009 Lamps Rule will eliminate all currently commercially available T12 lamps in 2012, further increasing demand for T8 lamp-and-ballast systems. In addition, while some 8-foot slimline T12 systems are being replaced by two 4-foot T8 systems, others are being replaced by 8-foot slimline T8 systems. In addition, given that these ballasts exist at a range of efficiencies, DOE believes that energy conservation standards are technologically feasible. Thus, DOE believes there is potential for significant energy savings by covering ballasts that operate 8-foot slimline T8 lamps. Based on DOE's preliminary LCC and NIA results for these ballasts, coverage of these ballasts would be economically justified. For these reasons, in the preliminary TSD, DOE included ballasts that operate 8-foot SP slimline T8 lamps in the scope of coverage.

DOE did not receive any adverse comments regarding coverage of these ballasts. Therefore, for the reasons stated above, DOE proposes to include ballasts that operate 8-foot SP slimline T8 lamps in the scope of coverage for this NOPR.

g. Ballasts That Operate T8 8-Foot HO Lamps

In the preliminary TSD, DOE considered whether to cover ballasts designed to operate recessed double contact (RDC) HO T8 lamps. According to the U.S. Census, the market share of 8-foot HO (T8 and T12) ballasts (excluding cold temperature sign ballasts) was about 0.5 percent in 2005. Because shipments of 8-foot RDC HO lamps are mostly T12 lamps, DOE believes most of the 8-foot HO ballasts currently shipped are T12. However, according to analysis conducted for the 2009 Lamps Rule, most currently commercially available T12 HO lamps do not meet energy conservation standards that come into effect in 2012. Therefore, DOE believes that T8 HO ballast shipments will increase in response to those standards. There is a range of efficiency levels for 8-foot T8 HO ballasts currently in the market; therefore, energy conservation standards to increase the energy efficiency of these ballasts are technologically feasible. In addition, preliminary LCC and NIA results demonstrated the potential for significant economic savings. Based on these findings, DOE included 8-foot HO T8 ballasts in the scope of coverage in the preliminary TSD.

DOE did not receive any adverse comments regarding coverage of these ballasts. Therefore, for the reasons stated above, DOE proposes to include ballasts that operate 8-foot RDC HO T8 lamps in the scope of coverage for this NOPR.

h. Ballasts That Operate in EMI-Sensitive Environments

At the public meeting, Philips commented that magnetic ballasts are currently used in certain EMI-sensitive environments, and that the proposals in the preliminary TSD would not allow these types of ballasts to exist in the future. (Philips, Public Meeting Transcript, No. 34 at pp. 125–126) GE agreed with Philips and cited critical care suites, surgery suites, airport control towers, and nuclear medicine laboratories as examples of situations where ballasts that generate low or no EMI are needed. (GE, Public Meeting Transcript, No. 34 at p. 126) In written comments, NEMA stated that DOE needs to address an exemption for magnetic ballasts in EMI-sensitive applications and proposed that they should be high-performance T8 ballasts, which would be more expensive than electronic ballasts (NEMA, No. 29 at p. 2).

DOE conducted research and interviews with fluorescent lamp ballast and fixture manufacturers to identify the following applications as potentially sensitive to EMI: Medical operating room telemetry or life support systems; airport control systems; electronic test equipment; radio communication devices; radio recording studios; correctional facilities; clean rooms; facilities with low signal-to-noise ratios; and aircraft hangers or other buildings with predominantly metal construction.

To understand the specifications that ballast consumers require for different applications, DOE researched existing regulations for EMI. DOE identified EMI standards for general applications such as commercial buildings, residential buildings, naval vessels, and other spaces. These standards include (1) the Federal Communications Commission (FCC) standards in 47 CFR part 18 for conducted EMI and (2) Department of Defense MIL–STD–461F [13] CE102 limits for all applications for conducted emissions from power leads between 10kHz and 10MHz. Table III.1 below shows the existing FCC and military standards for conducted electromagnetic interference. The frequency column indicates the frequency of the electromagnetic interference rather than the frequency at which the ballast operates.

TABLE III.1—CONDUCTED EMI REQUIREMENTS FOR FLUORESCENT LAMP BALLASTS

Frequency (MHz)	FCC Title 47 Part 18 conducted EMI, Maximum RF line voltage measured with a 50 micro Henry (μH)/50 ohm line impedance stabilization network (LISN) micro volt (μV)	CE 102 MIL–STD 461F, limit level for conducted emissions for all applications (μV)
Non-consumer equipment:		
0.45 to 1.6	1,000	1,000
1.6 to 30	3,000	1,000 *Applies up to 10 MHz
Consumer equipment:		
0.45 to 2.51	250	1,000
2.51 to 3.0	3,000	1,000
3.0 to 30	250	1,000 *Applies up to 10 MHz

In addition to using low-frequency magnetic ballasts in fixtures, DOE researched other ways that fixture manufacturers can reduce EMI. It is possible to install an external EMI filter on the input side of the ballast to limit conducted EMI that escapes the ballast from continuing to propagate through the building wiring. In addition, a grid lens can be installed to cover the lamp chamber to increase the impedance to a specific frequency or to bring radiated EMI to ground. DOE received mixed feedback from manufacturers concerning whether inline filters, special lenses, grounding cages, fixture design, and other external filters would be sufficient to reduce EMI from electronic ballasts to acceptable levels for EMI-sensitive applications. Electronic ballasts typically operate at a frequency above 20 kHz, which can turn the fluorescent lamp arc into an emitter of high-frequency electromagnetic waves. The switch mode power supply within electronic ballasts can also radiate high-frequency electromagnetic waves. Because the intensity of EMI is directly proportional to its frequency, the EMI from lighting systems containing high-frequency electronic ballasts may penetrate grid lenses and may affect other equipment over a farther range than the EMI from magnetic ballasts.

DOE learned from manufacturer interviews that magnetic ballasts are typically recommended for situations in which EMI has been or is expected to be a concern. These manufacturers believe the engineering investment to develop specialty electronic ballasts for EMI-sensitive applications would be burdensome and not economically justifiable given the very limited demand. Furthermore, manufacturers indicated uncertainty over the effectiveness of these measures for each individual application. DOE was also unable to determine whether EMI related issues with electronic ballasts could be eliminated with the methods described above. Manufacturers

[13] Department of Defense MIL-STD-461F is available at *http://www.cvel.clemson.edu/pdf/MIL–STD–461F.pdf.*

suggested that an exemption for T8 magnetic ballasts would not constitute a risk for magnetic ballast substitution in current electronic ballast applications because magnetic ballasts are generally heavier, more expensive, and use more energy than electronic ballast alternatives. Customers generally prefer magnetic ballasts only in situations where EMI is a particular concern.

Based on its analysis of EMI-sensitive ballast applications, DOE proposes that T8 magnetic ballasts designed and labeled for use in EMI-sensitive environments only and shipped by the manufacturer in packages containing not more than 10 ballasts be exempt from the standards established in this NOPR. Because of the diversity in magnetic T8 ballast applications, DOE has designed the exemption similar to the previous fluorescent lamp ballast exemptions for replacement ballasts. DOE believes the exemption is necessary because in some environments, EMI can pose a serious safety concern that is best mitigated with magnetic ballast technology. DOE does not believe magnetic ballasts would likely be used as substitutes in current electronic ballast applications due to their higher cost and weight. See appendix 5E of the TSD for more details.

3. Summary of Fluorescent Lamp Ballasts to Which DOE Proposes To Extend Coverage

With the exception of the comments discussed above, DOE received no other input related to coverage of fluorescent lamp ballasts. In addition, DOE's revised analyses indicate that energy conservation standards for the ballasts to which DOE preliminarily decided to extend coverage in the preliminary TSD are still expected to be technologically feasible, economically justified, and would result in significant energy savings. Therefore, in summary, DOE is proposing to cover the following additional fluorescent lamp ballasts:

(1) Ballasts that operate 4-foot medium bipin lamps with a rated wattage [14] of 25W or more, and an input voltage at or between 120V and 277V;

(2) Ballasts that operate 2-foot medium bipin U-shaped lamps with a rated wattage of 25W or more, and an input voltage at or between 120V and 277V;

(3) Ballasts that operate 8-foot high output lamps with an input voltage at or between 120V and 277V;

(4) Ballasts that operate 8-foot slimline lamps with a rated wattage of 52W or more, and an input voltage at or between 120V and 277V;

(5) Ballasts that operate 4-foot miniature bipin standard output lamps with a rated wattage of 26W or more, and an input voltage at or between 120V and 277V;

(6) Ballasts that operate 4-foot miniature bipin high output lamps with a rated wattage of 49W or more, and an input voltage at or between 120V and 277V;

(7) Ballasts that operate 4-foot medium bipin lamps with a rated wattage of 25W or more, an input voltage at or between 120V and 277V, a power factor of less than 0.90, and are designed and labeled for use in residential applications; and

(8) Ballasts that operate 8-foot high output lamps with an input voltage at or between 120V and 277V, and operate at ambient temperatures of 20 degrees F or less and are used in outdoor signs.

B. Off Mode and Standby Mode Energy Consumption Standards

EPCA requires 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)) Because DOE is required by consent decree to publish a final rule establishing any amended standards for fluorescent lamp ballasts by June 30, 2011, this rulemaking is subject to this requirement. DOE determined that it is not possible for the ballasts at issue in this rulemaking to meet the off-mode criteria because there is no condition in which a ballast is connected to the main power source and is not in a mode already accounted for in either active or standby mode. In the test procedure addressing standby mode energy consumption, DOE determined that the only ballasts that consume energy in standby mode are those that incorporate an electronic circuit that enables the ballast to communicate with and be part of a lighting control interface (e.g., DALI-enabled ballasts). 74 FR 54445, 54447–8 (October 22, 2009). DOE believes that the only commercially available ballasts that incorporate an electronic circuit to communicate with a lighting control interface are dimming ballasts.

As discussed in section 0, DOE does not propose to expand the scope of coverage to include additional dimming ballasts. Therefore, the only covered dimming ballasts are the products that operate the four reduced-wattage lamp combinations specified in 10 CFR 430.32(m)(5). DOE research has not revealed any dimming ballasts currently on the market that operate these lamps because the gas composition of reduced-wattage lamps makes them undesirable for use in dimming applications. Additionally, these ballasts employ cathode heating to facilitate dimming and therefore operate lamps with two pins. Because 8-foot slimline lamps have only a single pin, these lamps are not suitable for use with dimming ballasts. Because DOE did not discover any dimming products that are covered by existing standards, DOE was not able to characterize standby mode energy consumption. Thus, DOE is not able to set standards for standby mode energy consumption for these ballasts in accordance with 42 U.S.C. 6295(o). DOE did not receive any comments regarding this subject in response to the preliminary TSD. Therefore, for the reasons stated above, DOE does not propose to adopt provisions to address ballast operation in standby mode as part of the energy conservation standards that are the subject of this rulemaking.

IV. General Discussion

A. Test Procedures

As noted above, DOE's current test procedures for ballasts appear at 10 CFR part 430, subpart B, appendix Q. DOE issued a NOPR in which it proposed revisions to these test procedures. 75 FR 14288 (March 24, 2010). The principal change DOE proposed to the existing test methods, in an effort to reduce measurement variation, was to eliminate photometric measurements used to determine ballast efficacy factor (BEF). Instead, DOE proposed to use electrical measurements to determine ballast efficiency (BE), which could then be converted to BEF using empirically derived transfer equations. The proposed changes also specified that the ballast operate a resistive load rather than a lamp load during performance testing. No changes were proposed for the measurement of ballast factor (which required photometric measurements) for consistency with previous methods. Finally, DOE also proposed an update to an industry standard referenced in the existing test procedure. *Id.* at 14290, 14308. DOE also proposed to add methods for testing ballasts that are not currently covered by energy conservation standards, but that DOE is considering for standards in this rulemaking. *Id.* at 14289–91. Finally, DOE proposed provisions for manufacturers to report to DOE on the compliance of their ballasts with applicable standards. *Id.* at 14289, 14290, 14309.

More recently, DOE published a supplementary NOPR in which it proposed revisions to its test procedures

[14] The 2009 Lamps Rule adopted a new definition for rated wattage that can be found in 10 CFR 430.2.

for fluorescent lamp ballasts established under EPCA. 75 FR 71570 (Nov. 24, 2010). This test procedure proposes to measure a new metric, ballast luminous efficiency (BLE), which more directly assesses the electrical losses in a ballast compared to the existing ballast efficacy factor (BEF) metric. Rather than testing a ballast while operating a resistive load, the BLE test procedure measures the performance of a ballast while it is operating a fluorescent lamp. DOE found that a resistive load can model the effective resistance of a lamp operated only at a particular ballast factor, requiring multiple ballast factor specific resistors to be specified and increasing the testing cost to manufacturers. In written comments in response to the NOPR, NEMA suggested that ballast factor be calculated using a combination of electrical measurements and reference lamp arc power values from ANSI C78.81–2010. The SNOPR proposal outlines a new method for determination of ballast factor which requires only electrical measurements.

DOE also notes that EPCA requires DOE to amend its test procedures for all covered products, including those for ballasts, to include the measurement of standby mode and off mode energy consumption, except where current test procedures fully address such energy consumption or where an integrated or separate standard is technically infeasible. (42 U.S.C. 6295(gg)(2)) As indicated above, ballasts do not operate in the off mode and DOE has already amended its test procedures for ballasts to address standby mode energy use. 74 FR 54445 (Oct. 22, 2009). As a result, DOE's current test procedure rulemaking for ballasts does not address standby or off mode energy use.

B. Technological Feasibility

1. General

In each standards rulemaking, DOE conducts a screening analysis based on information it has gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such analysis, DOE develops a list of design options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of these means for improving efficiency are technologically feasible. DOE considers technologies incorporated in commercially available products or in working prototypes to be technologically feasible. 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(i).

Once DOE has determined that particular design options are technologically feasible, it further evaluates each of these design options in light of the following additional screening criteria: (1) Practicability to manufacture, install, or service; (2) adverse impacts on product utility or availability; and (3) adverse impacts on health or safety. Section 0 of this notice discusses the results of the screening analysis for ballasts, particularly the designs DOE considered, those it screened out, and those that are the basis for the trial standard levels (TSLs) in this rulemaking. For further details on the screening analysis for this rulemaking, *see* Chapter 4 of the NOPR TSD.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt an amended standard for a type or class of covered product, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for that product. (42 U.S.C. 6295(p)(1)) Accordingly, DOE determined the maximum technologically feasible ("max tech") ballast efficiency in the engineering analysis, using the design options identified in the screening analysis (*see* chapter 5 of the NOPR TSD).

As a first step to identifying the maximum technologically feasible efficiency level, DOE conducted testing of commercially available ballasts. In the preliminary analysis, DOE was not able to identify working prototypes that had a higher efficiency than the tested products. Therefore, the "max tech" level determined for the preliminary analysis was based on the most efficient commercially available ballasts tested. DOE presented additional research in appendix 5D of the preliminary TSD to explore whether technologies used in products similar to ballasts could be used to improve the efficiency of ballasts currently on the market.

DOE received several comments regarding its determination of max tech ballast efficiency. These comments are discussed in section 0. For this NOPR, DOE conducted additional analysis to determine the appropriate max tech levels for fluorescent lamp ballasts. Based on the additional testing conducted for this NOPR, DOE has determined that TSL 3 represents the highest efficiency level that is technologically feasible for a sufficient diversity of products (spanning several ballast factors, number of lamps per ballast, and types of lamps operated) within each product class. Table IV.1 presents the max tech efficiency levels for each product class.

TABLE IV.1—MAX TECH LEVELS

Product class	Equation*
IS and RS ballasts that operate 4-foot MBP lamps. 8-foot slimline lamps.	1.32 * ln (total lamp arc power) + 86.11.
PS ballasts that operate 4-foot MBP lamps. 4-foot MiniBP SO lamps. 4-foot MiniBP HO lamps.	1.79 * ln (total lamp arc power) + 83.33.
IS and RS ballasts that operate 8-foot HO lamps.	1.49 * ln (total lamp arc power) + 84.32.
PS ballasts that operate 8-foot HO lamps.	1.46 * ln (total lamp arc power) + 82.63.
Ballasts that operate 8-foot HO lamps in cold temperature outdoor signs.	1.49 * ln (total lamp arc power) + 81.34.

*Equation includes 0.8 percent reduction for testing variation.

Although DOE identified certain ballasts that achieved efficiencies higher than TSL 3, these ballasts were suitable for only a limited range of applications within their product class. DOE does not have sufficient data at this time to determine that a higher efficiency level is technologically feasible for the full range of ballast applications with alternate ballast factors, numbers of lamps, and lamp types. Before making this determination, DOE evaluated the possibility of improving the efficiency of three selected ballasts by inserting improved components in the place of existing components of commercially available ballasts. DOE's experiments with improving ballast efficiency through component substitution did not result in prototypes with improved overall ballast efficiency.

DOE is still considering whether an efficiency level higher than TSL 3 is technologically feasible for a sufficient diversity of lamp types, ballast factors, and numbers of lamps within each product class. Although DOE was unable to improve the efficiency of commercially available ballasts, DOE recognizes that component substitution is not the only method available for incrementally improving ballast efficiency. For example, further improvements may be possible through the incorporation of newly designed integrated circuits into the new ballast designs.

In Appendix 5F of the NOPR TSD, DOE presents additional analysis on the potential for an instant-start ballast efficiency level that exceeds TSL 3. DOE requests comments on its selection of the maximum technologically feasible level and whether it is technologically feasible to attain such higher efficiencies for the full range of instant start ballast applications. Specifically, DOE seeks quantitative information regarding the potential change in efficiency, the design options employed, and the associated change in cost. Any design option that DOE considers to improve efficiency must meet the four criteria outlined in the screening analysis: technological feasibility; practicability to manufacture, install, and service; adverse impacts on product or equipment utility to consumers or availability; and adverse impacts on health or safety. DOE also requests comments on any technological barriers to an improvement in efficiency above TSL 3 for all or certain types of ballasts.

C. Energy Savings

1. Determination of Savings

DOE used its NIA spreadsheet to estimate energy savings from new or amended standards for the ballasts that are the subject of this rulemaking. (The NIA spreadsheet model is described in section 0 of this notice and in chapter 11 of the TSD.) DOE forecasted energy savings beginning in 2014, the year that compliance with any new and amended standards is proposed to be required, and ending in 2043 for each TSL. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between the standards case and the base case. The base case represents the forecast of energy consumption in the absence of new and amended mandatory efficiency standards, and considers market demand for higher-efficiency products. For example, DOE models a shift in the base case from covered fluorescent lamp ballasts toward emerging technologies such as light emitting diodes (LEDs).

The NIA spreadsheet model calculates the electricity savings in "site energy" expressed in kilowatt-hours (kWh). Site energy is the energy directly consumed by ballasts at the locations where they are used. DOE reports national energy savings on an annual basis in terms of the aggregated source (primary) energy savings, which is the savings in energy used to generate and transmit the site energy. (See NOPR TSD chapter 11) To convert site energy to source energy, DOE derived conversion factors, which change with time, from the model used to prepare the Energy Information Administration's (EIA's) *Annual Energy Outlook 2010* (*AEO2010*).

2. Significance of Savings

As noted above, under 42 U.S.C. 6295(o)(3)(B) DOE is prohibited from adopting a standard for a covered product if such standard would not result in "significant" energy savings. While the term "significant" is not defined in the Act, the 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." The energy savings for all of the TSLs considered in this rulemaking are nontrivial, and therefore DOE considers them "significant" within the meaning of section 325 of EPCA.

D. Economic Justification

1. Specific Criteria

As noted in section II.B, EPCA provides seven factors to be evaluated in determining whether a potential energy conservation standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)) The following sections discuss how DOE addresses each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of a new or amended standard on manufacturers, DOE first determines the quantitative impacts using an annual cash-flow approach. This includes both a short-term assessment—based on the cost and capital requirements during the period between the announcement of a regulation and when the regulation comes into effect—and a long-term assessment over the 30-year analysis period. The impacts analyzed include INPV (which values the industry based on of expected future cash flows), cash flows by year, changes in revenue and income, and other measures of impact, as appropriate. Second, DOE analyzes and reports the impacts on different types of manufacturers, including an analysis of impacts on small manufacturers. Third, DOE considers the impact of standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for standards to result in plant closures and loss of capital investment. DOE also takes into account cumulative impacts of different DOE regulations and other regulatory requirements on manufacturers.

For individual consumers, measures of economic impact include the changes in LCC and the PBP associated with new or amended standards. The LCC, which is separately specified as one of the seven factors to consider when determining the economic justification for a new or amended standard, (42 U.S.C. 6295(o)(2)(B)(i)(II)), is discussed in the following section. For consumers in the aggregate, DOE calculates the net present value from a national perspective of the economic impacts on consumers over the forecast period used in a particular rulemaking.

b. Life-Cycle Costs

The LCC is the sum of the purchase price of a product (including its installation) and the operating expense (including energy and maintenance and repair expenditures) discounted over the lifetime of the product. The LCC savings for the considered efficiency levels are calculated relative to a base case that reflects likely trends in the absence of new or amended standards. The LCC analysis required a variety of inputs, such as product prices, product energy consumption, energy prices, maintenance and repair costs, product lifetime, and consumer discount rates. DOE assumed in its analysis that consumers purchase the product in 2014.

To account for uncertainty and variability in specific inputs, such as product lifetime and discount rate, DOE uses a distribution of values with probabilities attached to each value. A distinct advantage of this approach is that DOE can identify the percentage of consumers estimated to achieve LCC savings or experiencing an LCC increase, in addition to the average LCC savings associated with a particular standard level. In addition to identifying ranges of impacts, DOE evaluates the LCC impacts of potential standards on identifiable sub-groups of consumers that may be disproportionately affected by a national standard.

c. Energy Savings

While significant conservation of energy is a separate statutory requirement for imposing an energy conservation standard, EPCA requires DOE, in determining the economic justification of a 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)) DOE uses the NIA spreadsheet results in its consideration of total projected savings.

d. Lessening of Utility or Performance of Products

In establishing classes of products, and in evaluating design options and the impact of potential standard levels, DOE seeks to develop standards that would not lessen the utility or performance of the products under consideration. The efficiency levels considered in today's NOPR will not affect any features valued by consumers, such as starting method, ballast factor, or cold temperature operation. Therefore, DOE believes that none of the TSLs presented in section 0 would reduce the utility or performance of the ballasts considered in the rulemaking. (42 U.S.C. 6295(o)(2)(B)(i)(IV))

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider any lessening of competition likely to result from standards. It directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a proposed standard and to transmit such determination to the Secretary, not later than 60 days after the publication of a proposed rule, 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)) DOE has transmitted a copy of today's proposed rule to the Attorney General and has requested that the Department of Justice (DOJ) provide its determination on this issue. DOE will address the Attorney General's determination in any final rule.

f. Need of the Nation to Conserve Energy

The non-monetary benefits of the proposed standards are likely to be reflected in improvements to the security and reliability of the nation's energy system. Reduced demand for electricity may also result in reduced costs for maintaining the reliability of the nation's electricity system. DOE conducts a utility impact analysis to estimate how standards may affect the Nation's needed power generation capacity.

Energy savings from the proposed standards are also likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases (GHG) associated with energy production. DOE reports the environmental effects from the proposed standards—and from each TSL it considered for ballasts—in the environmental assessment contained in the NOPR TSD. DOE also reports estimates of the economic value of reduced emissions reductions resulting from the considered TSLs.

g. Other Factors

The Act allows the Secretary of Energy to consider any other factors he or she deems relevant in determining whether a standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) Under this provision, DOE considered subgroups of consumers that may be adversely affected by the standards proposed in this rule. DOE specifically assessed the impact of standards on low-income consumers, institutions of religious worship, and institutions that serve low-income populations. In considering these subgroups, DOE analyzed variations on electricity prices, operating hours, discount rates, and baseline ballasts. See section 0 of this notice for further detail.

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii), EPCA provides for a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product that meets the standard is less than three times the value of the first-year energy (and, as applicable, water) savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values that calculate the payback period for consumers of potential new and amended energy conservation standards. These analyses include, but are not limited to, the 3-year payback period contemplated under the rebuttable presumption test. However, DOE routinely conducts an economic analysis that considers the full range of impacts 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 evaluate definitively the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section 0 of this NOPR.

V. Methodology and Discussion

DOE used two spreadsheet tools to estimate the impact of today's proposed standards. The first spreadsheet calculates LCCs and payback periods of potential new energy conservation standards. The second provides shipments forecasts and then calculates national energy savings and net present value impacts of potential new energy conservation standards. The Department also assessed manufacturer impacts, largely through use of the Government Regulatory Impact Model (GRIM).

Additionally, DOE estimated the impacts of energy efficiency standards on utilities and the environment. DOE used a version of EIA's National Energy Modeling System (NEMS) for the utility and environmental analyses. The NEMS model simulates the energy sector of the U.S. economy. EIA uses NEMS to prepare its *Annual Energy Outlook,* a widely known baseline energy forecast for the United States. The version of NEMS used for appliance standards analysis is called NEMS–BT, and is based on the *AEO2010* version with minor modifications. The NEMS–BT offers a sophisticated picture of the effect of standards, because it accounts for the interactions between the various energy supply and demand sectors and the economy as a whole.

The EIA approves the use of the name "NEMS" to describe only an *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.

A. Market and Technology Assessment

1. General

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 on publicly available information. The subjects addressed in the market and technology assessment for this rulemaking include product classes and manufacturers; historical shipments; market trends; regulatory and non-regulatory programs; and technologies or design options that could improve the energy efficiency of the product(s) under examination. *See* chapter 3 of the TSD for further discussion of the market and technology assessment.

2. Product Classes

In evaluating and establishing energy conservation standards, DOE divides covered products into classes by the type of energy used, or by capacity or other performance-related feature that justifies a different standard for products having such feature. (See 42 U.S.C. 6295(q)) In deciding whether a feature justifies a different standard, DOE must consider factors such as the utility of the feature to users. *Id.* DOE establishes energy conservation standards for different product classes based on the criteria set forth in 42 U.S.C. 6295(o).

In the preliminary TSD, DOE evaluated the performance of a ballast using the BEF metric. DOE considered several potential class-setting factors and ultimately separated product classes based on lamp length, ballast factor, lumen package, maximum number of lamps operated, starting method, and market sector. In general, when considering the above characteristics, DOE identified three main factors as affecting consumer utility: (1) The lumen package of the lamp-and-ballast system; (2) the physical constraints of the lamp-and-ballast system; and (3) the use of the ballast in an application for which other ballasts are not suitable. Philips, along with the NEEA and NPCC, generally agreed with DOE's initial determination of the product class structure. (NEEA and NPCC, No. 32 at p. 3; Philips, Public Meeting Transcript, No. 34 at pp. 153–154)

After the April 2010 public meeting, DOE received comments from interested parties that caused it to reevaluate the test method proposed in the active mode test procedure NOPR. As discussed in section 0, DOE published an SNOPR for the active mode test procedure on November 24, 2010. In that document, DOE proposed a lamp-based test procedure for measuring ballast luminous efficiency. Thus, when considering product classes in this NOPR, DOE evaluates potential class-setting factors by considering features that affect BLE instead of BEF.

a. Power Versus Efficiency Relationship

As described in section 0, DOE undertook extensive testing of fluorescent lamp ballasts to evaluate the impact of numerous ballast characteristics on BLE. In its written comments on the active mode test procedure, NEMA suggested that a relationship existed between lamp arc power and BLE such that the product class structure from the preliminary TSD could be greatly simplified. NEMA suggested that instant start ballasts with input power less than or equal to 45 W, greater than 45 W and less than or equal to 125 W, and greater than 125 W could be subject to standards of 85 percent, 88 percent, and 90 percent efficiency respectively. For programmed start ballasts, NEMA recommended standards for the same wattage bins, but with a downward adjustment of 3 percent compared to the instant start values. NEMA provided supplementary information showing that these standard levels in many cases were similar to the levels proposed by DOE in the preliminary TSD. NEMA noted it was only sharing a methodology that could be employed by DOE, not making a formal proposal. (NEMA, No. 15 at p. 9–10) [15] NEMA had previously discussed this methodology as a possible approach at a meeting with DOE in April 2010, subsequent to the public workshop.[16]

Although not a formal proposal for the energy conservation standards rulemaking, this methodology was supported by several manufacturers during interviews for this NOPR. Manufacturers indicated that ballasts that operate similar lamp powers often share similar topologies and component, and thus, should have similar efficiencies. DOE analyzed its test data to attempt to characterize a relationship between BLE and lamp arc power.

It is DOE's understanding that there are both fixed and variable losses in any fluorescent ballast. Fixed losses consist of switching losses, due to components such as transistors, and fixed voltage drops across certain components, such as diodes. These components are necessary for proper ballast operation but will always contribute some amount to overall ballast losses. In ballasts that operate at low powers, fixed losses comprise a significant amount of the power lost. Variable losses consist primarily of resistive losses (also referred to as I^2R losses) which increase as current increases. Ballasts that operate at higher powers also operate at a higher current and therefore have greater resistive losses. At a certain power level, resistive losses will be greater than fixed losses, as resistive losses continue to increase as power increases.

Using test data, DOE empirically found a relationship between the BLE metric and the natural log of lamp arc power. The logarithmic relationship is consistent with current energy conservation standards for external power supplies.[17] 42 USC 6295(u)(3)(A). In general, as lamp arc power increases, BLE increases as well. DOE believes this is because the fixed losses of a ballast become proportionally less significant at higher lamp arc powers. Using this relationship has several benefits for determining product classes compared to DOE's approach in the preliminary TSD. Equations allow DOE to set efficiency levels as a function of lamp arc power across a wide range, which simplifies the product class structure and the amount of scaling required between product classes. Furthermore, setting efficiency levels in this manner allows for greater flexibility regarding future innovation. For example, an equation would account for the introduction of new ballast factors. It would also not necessarily have to be revised if the test procedure were modified to require testing with reduced-wattage lamps. By contrast, other approaches could require separate product classes for factors that affect the total wattage operated by a ballast (such as lumen output, ballast factor, and number of lamps operated).

The sections below discuss specific class-setting factors considered in the preliminary TSD and whether product classes based on these factors are necessary given the power-efficiency relationship.

[15] This comment is from the docket for the fluorescent lamp ballast active mode test procedure, which is docket number EERE–2009–BT–TP–0016.

[16] A summary of the meeting is available at *http://www.gc.energy.gov/documents/Ex_parte_Meeting_NEMA_05_25_2010.pdf.*

[17] External power supplies perform a related function to fluorescent lamp ballasts in that they convert AC to DC, filter unwanted frequencies, and can step up or down voltage.

b. Starting Method

In the preliminary TSD, DOE considered establishing separate product classes based on starting method. DOE found RS and PS ballasts to be inherently less efficient than IS ballasts because RS and PS ballasts provide filament power to the lamp. Although some PS ballasts cut out the filament power during normal operation (using the cathode cutout technology option discussed in chapter 3 of the NOPR TSD), the extra circuitry to remove this power still consumes some amount of power. Whereas RS and IS ballasts are commonly used as substitutes for each other, PS ballasts are not. Programmed start ballasts are commonly used in combination with occupancy sensors because of their ability to maintain the lifetime of the fluorescent lamp. The lifetime of a lamp operated on a PS ballast with occupancy sensors can be as much as three times longer than the lifetime of a lamp operated on an IS or RS ballast in the same application. Thus, DOE's research indicates that use of instant start ballasts with occupancy sensors can result in a significant reduction in lamp lifetime. Because the application in which they are used significantly affects lamp lifetime, programmed start ballasts offer the user a distinct utility. In consideration of their affect on both BEF and utility, DOE established separate product classes for programmed start ballasts in the preliminary TSD.

Philips agreed that RS and PS ballasts would have lower BEFs than IS ballasts. Philips stated that cathode heating of RS and PS ballasts would make the lamps more efficient, which would increase ballast factor and therefore increase overall system efficacy, or BEF. The corresponding increase in ballast input power for these ballasts, however, would offset any overall gain in BEF. Despite this difference in BEF for RS and PS ballasts compared to IS ballasts, Philips did not think NEMA would object to the inclusion of rapid and instant start ballasts in the same product class. Whereas IS and RS ballasts offer the consumer similar utility, Philips believed PS ballasts offered consumers unique utility because of the application in which they are used. Regarding the impact of starting method on ballast efficiency, Philips pointed out that a metric of lamp arc power divided by ballast input power would consider power used to heat cathodes as losses. GE and Philips believed that this should be considered when defining product classes and setting standards. (GE, Public Meeting Transcript, No. 34 at p. 43; Philips, Public Meeting Transcript, No. 34 at pp. 44–46, 71–72)

DOE agrees with GE and Philips that cathode heating is counted as a loss in the BLE metric because it does not directly contribute to the creation of light. Thus, similar to BEF, RS and PS ballasts have lower BLEs than comparable IS ballasts. Because starting method affects BLE in the same way it affects BEF, and DOE has already established a unique utility associated with PS ballasts, DOE proposes to maintain product class divisions for starting method in this NOPR and establish separate product classes for programmed start ballasts and instant and rapid start ballasts.

c. Ballast Factor

Ballast factor (BF) is the ratio of light output of a reference lamp operated by a ballast to the light output of the same lamp operated by a reference ballast. It is typically used to adjust the lumen package of a lamp-and-ballast system. The ballasts proposed for coverage in this rulemaking are available with a variety of ballast factors. In the preliminary TSD, DOE classified a low BF as less than or equal to 0.78, a normal BF as greater than 0.78 but less than 1.1, and a high BF as greater than or equal to 1.1. In its previous analysis, DOE found that ballasts with high or low BFs had lower BEFs than ballasts with a normal ballast factor. Because BF affected the lumen output of the lamp-and-ballast system, DOE observed that consumers tended to use ballasts with different ballast factors for different applications. DOE believed this behavior constituted a unique utility. Therefore, because of the impact on BEF and utility, DOE established separate product classes in the preliminary TSD for low, normal, and high ballast factor when these products existed for covered ballast types. In the preliminary TSD, however, DOE did not establish separate product classes for high, low, and normal BF for 4-foot T5 MiniBP HO, 8-foot HO, residential, or sign ballasts because products in this category were predominantly offered in one ballast factor range.

The California Utilities commented that DOE should divide residential ballasts into high, normal, and low BF categories because test results showed that residential products existed at more than one BF. (California Utilities, No. 30 at p. 5) Philips commented that the range considered for normal BF was unreasonably large. For T8 ballasts, industry typically considers normal BF to be from 0.85 to 1.00, whereas for T5 ballasts industry considers normal BF to be about 1.00. (Philips, Public Meeting Transcript, No. 34 at p. 136–137)

Because DOE is evaluating a new metric for this NOPR, DOE analyzed the impact of ballast factor on BLE. During interviews, manufacturers stated that as ballast factor increases, BLE should also increase. This is the same observation as the one discussed in section 0, that BLE increases as overall lamp arc power increases, but on a smaller scale. As ballast factor increases, the ballast drives the lamp harder, which increases measured lamp arc power. Because the ballast operates at higher power, its fixed losses become proportionally less significant in comparison to lower BFs. Because BF affects the total power operated by a ballast, and DOE has established a relationship relating total lamp arc power to ballast efficiency, DOE believes the efficiency equation will account for any changes in BF. Thus, in this NOPR, DOE does not propose to establish separate product classes for high, low, or normal BF.

d. Lumen Package

Lumen package refers to the quantity of light that a lamp-and-ballast system provides to a consumer. To obtain a high lumen package, certain lamps are designed to operate with ballasts that run the lamps at high currents. For example, 8-foot HO lamps and 4-foot MiniBP HO lamps tend to operate at higher currents than 8-foot slimline lamps and 4-foot MiniBP SO lamps, respectively. This difference in operating design increases the quantity of light per unit of lamp length. High output lamps generally operate at higher wattages than comparable (same length, diameter) standard output lamps. In the preliminary TSD, DOE observed that this difference in lamp wattage caused ballasts that operate high output lamps to have lower BEFs than ballasts that operate comparable standard output lamps.

In addition, consumers tend to use systems with different lumen packages for different applications. For example, high-lumen-output systems may be installed in certain high-ceiling or outdoor applications where large quantities of light are needed. Alternatively, standard-lumen-output systems might be installed in lower-ceiling applications such as offices or hospitals, where the distance between the light source and the illuminated surface is not as large. Notable differences in the application of ballasts designed to operate SO lamps versus HO lamps indicate a difference in utility. Therefore, given the observed utility distinctions and notable efficiency differences, DOE established separate product classes in the preliminary TSD for ballasts that operate SO lamps and ballasts that operate HO lamps.

DOE did not receive any adverse comment to its separation of ballasts that operate HO lamps from those that operate SO lamps due to the impact of larger input powers on BEF. In this NOPR, however, DOE proposes standards based on the BLE metric. Therefore, DOE evaluated the impact of HO lamp operation versus SO lamp operation on BLE. DOE found that BLE is not dependent on system light output, but rather on the total power operated by the ballast. As HO lamps have higher rated powers than SO lamps, DOE believes ballasts that operate HO lamps would be more efficient than comparable ballasts that operate SO lamps. An analysis of test data generally confirmed this prediction. Therefore, because the power-efficiency equation accounts for HO versus SO lamp operation, DOE does not propose to establish separate product classes for ballasts that operate HO lamps, with one exception as explained in the following paragraph.

DOE found that ballasts that operate 8-foot HO lamps did not follow the expected relationship. Compared to 8-foot slimline ballasts, DOE found that 8-foot HO ballasts exhibited lower BLEs although they operated higher lamp powers. DOE believes a separate product class is necessary for 8-foot HO ballasts because there is a significant change in lumen package accompanied by a decrease in BLE. Based on manufacturer interviews, DOE believes 8-foot HO ballasts may have different topology, or circuit design, than other ballast types (*e.g.* 4-foot MBP and 8-foot slimline ballasts). Because DOE has established that lumen package offers a unique utility, and in this case a change in lumen package is accompanied by a change in BLE from what the efficiency equation would predict, DOE proposes to establish a separate product class for ballasts that operate 8-foot HO lamps. DOE requests comment on this decision in section 0.

e. Lamp Diameter

Differences in lamp diameter can be accompanied by differences in rated lamp wattage and lumen output. In the preliminary TSD, DOE observed that T8 ballasts generally had higher BEFs than T12 ballasts due to T8 lamps having a lower rated wattage than T12 lamps. DOE noted, however, that T8 lamp-and-ballast systems are commonly used as substitutes for T12 lamp-and-ballast systems, suggesting that there was no unique utility associated with T12 systems. Although the lamps have different wattages, the two systems often have the same lamp lengths and bases, offer comparable lumen output, and can fit within the same fixtures. For these reasons, DOE included T8 and T12 ballasts in the same product class in the preliminary TSD.

In contrast, DOE established separate product classes for ballasts that operate T5 lamps. DOE observed that 4-foot T5 ballasts generally had lower input powers (due to the lower wattage of the test lamp), and therefore higher BEFs, than comparable T8 or T12 ballasts. T5 lamp-and-ballast systems, however, are not always interchangeable with T8 and T12 systems. Because T5 lamps have similar total lumen output to T8 and T12 lamps over a significantly smaller surface area, T5 lamp-and-ballast systems are often marketed as too bright for use in direct lighting fixtures. Because of the impact on BEF and consumer utility, DOE established a separate product class in the preliminary TSD for ballasts that operate T5 lamps.

The California Utilities and the NEEA and NPCC supported DOE's conclusion in the preliminary TSD to include T8 and T12 ballasts in the same product class based on their use as substitutes for one another. (California Utilities, No. 30 at p. 1; NEEA and NPCC, No. 32 at p. 3) However, Philips believed that because BEF includes a measure of light output, it should be used to compare ballasts of similar light output only. Philips noted that because F96T12HO/ES lamps have a 13-percent greater lumen output than F96T8HO lamps, ballasts that operate these lamps should not be subject to the same BEF standard. NEMA agreed with Philips and supported different BEF standards for ballasts that operate these lamps. However, NEMA did comment that a single ballast efficiency standard could be set for ballasts that operate F96T8HO and F96T12HO/ES lamps. (Philips, Public Meeting Transcript, No. 34 at pp. 16, 50; NEMA, No. 29 at p. 3, 7)

In this NOPR, DOE considered the impact of lamp diameter on the BLE metric. As described above, differences in lamp diameter can be accompanied by differences in rated lamp wattage and lumen output. Because the efficiency equation sets standards specific to the total lamp power operated by the ballast of interest, the equation will also account for the impact of lamp diameter if there is an associated change in lamp arc power (as is the case with T8HO versus T12HO lamps). In addition, DOE believes that T5HO ballasts operate similar total lamp powers and employ similar technologies to 4-lamp 4-foot MBP PS ballasts that are able to meet the most efficient levels. Furthermore, 2-lamp 4-foot MBP PS ballasts operate similar total lamp power and employ similar technologies to 2-lamp T5 SO ballasts that are able to meet the most efficient levels. Therefore, DOE does not propose to establish separate product classes for ballasts that have different lamp diameters.

f. Lamp Length

Of the fluorescent ballasts DOE proposes to include in the scope of coverage, all are designed to operate lamps with lengths of 4 or 8 feet. As lamp length increases, lamp arc power tends to increase as well. In the preliminary TSD, DOE observed that this increase in lamp power resulted in lower BEFs for ballasts that operate 8-foot lamps as compared to those that operate 4-foot lamps. Furthermore, DOE concluded that because consumers are often physically constrained by their building ceiling layout, systems operating 8-foot and 4-foot lamps are not always substitutable for each other. Given the impact on both BEF and utility, DOE established separate product classes in the preliminary TSD for ballasts that operate different lamp lengths.

In this NOPR, DOE evaluates impacts of lamp length on BLE. Test data showed that ballasts that operate 8-foot slimline lamps are more efficient than comparable ballasts that operate the same number of 4-foot MBP lamps due to the increased lamp wattage operated by these ballasts. As described in section 0, DOE has developed an efficiency equation for the relationship between BLE and lamp arc power, which accounts for differences in lamp length if there is an associated change in lamp arc power. Therefore, DOE does not propose to establish separate product classes for ballasts that operate 4-foot versus 8-foot lamps.

g. Number of Lamps

Fluorescent lamp ballasts are designed to operate a certain maximum number of lamps. For example, ballasts designed to operate 4-foot MBP lamps can operate as few as one or as many as six lamps. In the preliminary TSD, DOE found that BEF decreased with each additional lamp operated because additional lamps increased the ballast's input power. DOE determined that the ability to operate different maximum number of lamps impacts utility because this capacity affects the space required by fixtures (a four-lamp fixture requires more physical space than one-lamp fixture). Given the impact on both BEF and consumer utility, DOE established separate product classes in the preliminary TSD based on the maximum number of lamps operated by a ballast.

Philips agreed that based on BEF data, 1-lamp ballasts are less efficient than 4-lamp ballasts. (Philips, Public Meeting Transcript, No. 34 at pp. 137–139) In this NOPR, DOE analyzed the impact of operating different numbers of lamps on BLE. Test data generally showed that the more lamps a ballast operates the higher the BLE for that ballast. DOE believes this is because as a ballast operates a larger total lamp power, fixed losses are diluted over a greater power. DOE believes that this relationship is accounted for in the efficiency equation described in section 0, because an increase in the number of lamps operated is associated with an increase in total lamp arc power. Therefore, DOE does not propose to establish separate product classes for ballasts that operate different numbers of lamps.

h. Residential Ballasts

Separate minimum power factor and electromagnetic interference requirements exist for residential and commercial ballasts. Residential ballasts have more stringent (or lower maximum allowable) EMI requirements than commercial ballasts; they also have less stringent (or lower minimum allowable) power factor requirements.[18] In the preliminary TSD, DOE concluded these requirements impact utility because they serve distinct market sectors and applications. In addition, DOE believed that the differing requirements caused residential ballasts to have lower BEFs than commercial ballasts. For these reasons, in the preliminary TSD, DOE established a separate product class for ballasts that are designed for use in the residential sector.

Philips agreed that the FCC has more stringent EMI requirements for residential ballasts than commercial ballasts. The NEEA and NPCC commented that they have not seen evidence of any impact on efficiency due to the FCC EMI standards. Philips disagreed, stating that the FCC Class B requirements necessitate a more sophisticated EMI filter that results in greater losses than the commercial FCC requirements. Philips noted, however, these losses are offset by the difference in power factor requirements for the two market sectors. The power losses associated with the high power factor requirements in the commercial sector are greater than the losses associated with the more stringent EMI requirements in the residential sector. As evidence, Philips indicated that compliance data from the California Energy Commission (CEC) database indicates that some residential ballasts have higher BEFs than commercial ballasts. (Philips, Public Meeting Transcript, No. 34 at p. 134–6; NEEA and NPCC, Public Meeting Transcript, No. 34 at p. 135)

In this NOPR, DOE evaluated the impact of the more stringent EMI and less stringent power factor requirements on the BLE of residential ballasts. DOE tested several residential ballasts including models with the highest reported BLEs in the CEC database. DOE found that residential ballasts achieved the same efficiencies as their commercial counterparts. DOE believes that because these two ballast types can achieve the same efficiency, it is not necessary to establish a separate product class for residential ballasts, and therefore does not propose to do so in this NOPR.

i. Sign Ballasts

Ballasts designed for use in cold temperature outdoor signs have slightly different characteristics than those ballasts that operate in the commercial sector. First, sign ballasts are designed to operate in cold temperature environments—as low as negative 20 degrees Fahrenheit (F). Second, sign ballasts are classified by the total length (in feet) of lamps they can operate as well as the total number of lamps. To operate in cold temperature environments and to be able to handle numerous lamp combinations, sign ballasts contain more robust components compared to regular 8-foot HO ballasts in the commercial sector. Thus, sign ballasts are inherently less efficient. In the preliminary TSD, DOE concluded that regular 8-foot HO ballasts cannot serve as substitutes for sign ballasts due to their inability to operate in cold temperature environments. For these reasons, DOE believes that cold temperature sign ballasts offer the consumer a distinct utility. Therefore, DOE established a separate product class for cold temperature sign ballasts in the preliminary TSD.

At the public meeting, DOE received several comments regarding which characteristics distinguish sign ballasts from regular ballasts designed to operate 8-foot HO lamps. OSI stated that a "cold temperature starting" label means the ballast can start a lamp at temperatures typically as low as −20 degrees F. (OSI, Public Meeting Transcript, No. 34 at pp. 116–117) Philips stated that there are two UL safety ratings for outdoor environments: type 1 outdoor which requires a basic moisture resistant enclosure, and type 2 outdoor which requires a hermetic enclosure to prevent all moisture from entering the ballast. However, the outdoor rating is not of concern regarding efficiency. Instead, Philips stated that a cold-temperature sign ballast delivers increased ignition voltages to the lamp, resulting in more resistive losses in the secondary transformer. If two high output ballasts have the same input power but one has a higher open circuit voltage, the ballast with the higher open circuit voltage will generally be less efficient. (Philips, Public Meeting Transcript, No. 34 at pp. 118–119, 139–140) The California Utilities, however, questioned whether cold-temperature sign ballasts were inherently less efficient because they noted some regular 8-foot HO ballasts are capable of starting lamps at temperatures of negative 20 degrees F or lower. (California Utilities, No. 30 at p. 2)

In this NOPR, DOE reviewed whether sign ballasts had different BLEs than regular 8-foot HO ballasts. Based on its test data, DOE found that sign ballasts did not achieve the expected BLE predicted by the power-efficiency relationship. Test data indicated these ballasts were not as efficient as regular 8-foot HO ballasts. DOE believes this is because sign ballasts are generally more robust and flexible. For example, sign ballasts are often specified to operate multiple-lamp-length combinations as well as both T12HO and T8HO lamps. As a result, a sign ballast is not optimized for the operation of a particular lamp whereas a regular 8-foot HO ballast is designed specifically for a T8HO or T12HO lamp. Regular 8-foot HO ballasts cannot always serve as substitutes for sign ballasts due to their lack of moisture seals and the more limited load specifications. For these reasons—and the associated differences in BLE compared to ballasts of similar lamp arc power—DOE proposes to establish separate a product class for sign ballasts.

j. Premium Features

During product research and manufacturer interviews, DOE found that several high-efficiency ballasts possess premium features such as a low temperature rating, type CC protection, lamp striation control, and small can size. Below DOE discusses each feature and considers whether to propose separate product classes for them.

[18] ANSI C82.77–2002 requires residential ballasts to have a minimum power factor of 0.5 and commercial ballasts to have a minimum power factor of 0.9.

Low Temperature Rating

DOE surveyed the market and found that all ballast types covered by this rulemaking have cold temperature ratings. This rating was typically associated with high-performance products; standard-efficiency ballasts were less likely to have this feature. Ballasts with low temperature ratings (−20 degrees F) can be used in applications such as parking garages, warehouses, and cold storage areas. In cold temperature environments, a fluorescent ballast must supply a higher starting voltage to establish the lamp arc. To create this higher voltage, the output transformer may have additional windings. In addition, components throughout the ballast must be able to withstand this higher voltage, even if only for a short amount of time. The additional windings and slightly different components may increase resistive losses.

DOE conducted research to determine how this rating might impact BLE. DOE was unable to find pairs of the same ballasts in which one had a cold temperature rating and one did not. Thus, DOE looked at groups of ballasts that achieved the same efficiency level based on its test data. The data showed no clear trend of a cold temperature rating impacting BLE. In most cases, DOE found the most efficient ballast in a particular category had the lowest rated starting temperature. Thus, DOE believes that the rated starting temperature of a ballast does not substantively impact overall efficiency. Therefore, DOE does not propose to establish a separate product class based on this feature.

Type CC

Arcing can occur when a lamp is not well connected to its socket or when it is removed from a fixture. To prevent this phenomenon, UL 1598 requires luminaires using instant start ballasts with bipin lamp holders to: (1) Include ballasts identified as Type CC, or (2) be constructed with lampholders marked with a circle "I." Ballasts labeled as Type CC include extra circuitry to monitor frequency and remove power to the lamp if any unwanted arcing is detected. Additional circuitry has the potential to increase resistive losses.

A survey of the market found that ballasts with Type CC protection were available, although far fewer models were offered with this feature than without it. Analysis of catalog data found that ballasts with Type CC protection had slightly lower BEFs than ballasts without this feature. However, as UL 1598 can be met with different lampholders rather than adding circuitry within the ballast itself, DOE believes that Type CC protection does not provide a unique utility. Therefore, DOE does not propose to establish a separate product class for ballasts with a Type CC rating.

Lamp Striation Control

Lamp striations are a series of bright and dim regions in a fluorescent lamp and are considered an undesirable visual effect. Striations are most common when ballasts operate reduced-wattage, energy-saving lamps due to their different fill-gas composition. To prevent this effect from occurring, ballasts with lamp striation control usually have additional circuitry, which has the potential to increase resistive losses.

During manufacturer interviews, DOE learned that striation control is a necessary feature for ballasts that can operate reduced-wattage, energy-saving lamps. DOE observed that most ballasts already offer lamp striation control as a standard feature on both regular and high-efficiency product lines. Test data showed that the most efficient 4-foot MBP and 8-foot slimline ballasts already included lamp striation control. Thus, this feature does not prevent ballasts from reaching the highest efficiency levels identified by this rulemaking. Therefore, DOE does not propose to establish a separate product class for ballasts with lamp striation control.

Small Case Size

During interviews, DOE learned that smaller fixtures can have reduced material costs and higher optical efficiency. Optical efficiency describes the percentage of light emanated from the lamps that exits the fixture or reaches the desired surface. Therefore, ballast manufacturers are beginning to offer ballasts with smaller case sizes than what is offered as standard in the industry. A ballast with a small case size may use different components due to size restraints.

With a limited number of small case size ballasts commercially available, DOE is uncertain of the relationship between ballast enclosure size and efficiency. Furthermore, interested parties did not provide comments on the product class structure put forward in the preliminary TSD suggesting that DOE should not include ballasts of all enclosure sizes in the same product class. Based on this uncertainty and absence of contrary comments in the preliminary TSD, DOE proposes to include ballasts of all enclosure sizes in the same product class.

k. Summary

In summary, after evaluating all potential class-setting factors, DOE decided to establish separate product classes based on starting method, ballasts that operate 8-foot HO lamps, and ballasts designed for use in cold-temperature outdoor signs. Table V.1 summarizes the five product classes.

TABLE V.1—FLUORESCENT LAMP BALLAST NOPR PRODUCT CLASSES

Description	Product class number **
IS and RS ballasts that operate 4-foot MBP lamps * 8-foot slimline lamps	1
PS ballasts that operate 4-foot MBP lamps * 4-foot MiniBP SO lamps 4-foot MiniBP HO lamps	2
IS and RS ballasts that operate 8-foot HO lamps	3
PS ballasts that operate 8-foot HO lamps	4
Ballasts that operate 8-foot HO lamps in cold temperature outdoor signs	5

* Includes both commercial and residential ballasts.
** Efficiency levels for all product classes are based on an equation.

3. Technology Options

In the technology assessment, DOE identifies technology options that appear to improve product efficiency. This assessment provides the technical background and structure on which DOE bases its screening and engineering analyses. DOE received one comment on the technology options identified in the preliminary TSD.

Philips agreed that ballasts that employ integrated circuits can have higher efficiencies but pointed out that the integrated circuit itself does not provide the efficiency, but rather integrated circuits are required by more efficient topologies. Philips also noted that integrated circuits are generally used with topologies that operate lamps in series rather than those that operate lamps in parallel. For parallel lamp operation, integrated circuits may be cost prohibitive. (Philips, Public Meeting Transcript, No. 34 at pp. 142–143)

In response, DOE agrees with Philips that in many cases inclusion of an integrated circuit does not increase efficiency on its own. DOE believes, however, that some integrated circuits directly influence BLE. For example, there is an integrated circuit that can increase ballast efficiency by replacing transistors in the direct current (DC) to alternating current (AC) inverter.[19] Therefore, DOE proposes to maintain integrated circuits as a technology option in this NOPR. Regarding the high cost of an integrated circuit, DOE does not evaluate technology options based on cost. Rather, DOE calculates prices for each efficiency level in the engineering analysis and evaluates economic impacts on consumers, manufacturers, and the nation in subsequent analyses.

B. Screening Analysis

As discussed in chapter 3 of the preliminary TSD, DOE consults with industry, technical experts, and other interested parties to develop a list of technology options for consideration. The purpose of the screening analysis is to determine which options to consider further and which to screen out. DOE uses the following four screening criteria to determine which design options are suitable for further consideration in a standards rulemaking:

1. *Technological feasibility.* DOE will consider technologies incorporated in commercially available products or in working prototypes to be technologically feasible.

2. *Practicability to manufacture, install, and service.* If mass production and reliable installation and servicing of a technology in commercial products could be achieved on the scale necessary to serve the relevant market at the time compliance with the standard is required, then DOE will consider that technology practicable to manufacture, install, and service.

3. *Adverse impacts on product utility or product availability.* If DOE determines a technology would have significant adverse impact on the utility of the product to significant subgroups of consumers, or would result in the unavailability of any covered product type with performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as products generally available in the United States at the time, it will not consider this technology further.

4. *Adverse impacts on health or safety.* If DOE determines that a technology will have significant adverse impacts on health or safety, it will not consider this technology further.

10 CFR part 430, subpart C, appendix A, (4)(a)(4) and (5)(b).

For the preliminary TSD analysis, DOE consulted with industry, technical experts, and other interested parties to develop a list of technology options for consideration. DOE identified the following technology options that could improve the efficiency of a ballast:

TABLE V.2—TECHNOLOGY OPTIONS

Technology option		Description
Electronic Ballast		Use an electronic ballast design.
Improved Components	Transformers	Use grain-oriented silicon steel, amorphous steel, or laminated sheets of amorphous steel to reduce core losses.
		Use litz wire to reduce winding losses.
	Diodes	Use diodes with lower losses.
	Capacitors	Use capacitors with a lower effective series resistance.
	Transistors	Use transistors with low drain-to-source resistance.
Improved Circuit Design	Cathode Cutout	Remove filament heating after the lamp has started.
	Integrated Circuits	Substitute discrete components with an integrated circuit.
	Starting Method	Use IS instead of RS as a starting method for lamp operation.

In the preliminary TSD, DOE screened out "using laminated sheets of amorphous steel" because this option increases the size and weight of the ballast and therefore is not "practicable to manufacture, install, and service." Larger magnetic components could cause problems in installing and servicing ballasts because the ballast could be too large to fit in a fixture. DOE also stated that this technology option could have adverse impacts on consumer utility. Specifically, increasing the size and weight of the ballast could limit the places a consumer could use the ballast in a building.

The NEEA and NPCC agreed with DOE's decision to eliminate laminated sheets of amorphous steel as a design option. (NEEA and NPCC, No. 32 at p. 4) Earthjustice commented, however, that size and weight constraints for ballasts needed to be defined before DOE could screen out a technology option based on increased size or weight. (Earthjustice, Public Meeting Transcript, No. 34 at p. 148) Regarding size constraints, the NEEA and NPCC commented that new ballasts being installed during retrofits are significantly smaller than older ballasts being removed. They believe that technology options that would result in small increases in ballast size are not necessarily problematic for retrofits because new ballasts would still fit in the fixtures designed for older ballasts. (NEEA and NPCC, Public Meeting Transcript, No. 34 at pp. 148–149) Philips disagreed with the idea that increasing ballast size was not

[19] International Rectifier. *International Rectifier Introduces Robust Self-Oscillating Electronic Ballast Lighting Control IC.* November 22, 2005. (Last accessed October 25, 2010.) *http://www.irf.com/whats-new/nr051122.html*

problematic, commenting that newer ballasts have smaller cross-sections than older ballasts. Smaller ballasts have allowed luminaire manufacturers to decrease the size and material requirements of their luminaires while also improving optics. (Philips, Public Meeting Transcript, No. 34 at pp. 149–150) Acuity Brands agreed with Philips that newer luminaires are designed around the smaller sizes of current ballasts and confirmed that the smaller designs have improved optics. Acuity Brands stated that a few luminaires could accommodate an increase in the length of the ballast, but that many luminaires are already designed around the smaller size of current ballasts. (Acuity Brands, Public Meeting Transcipt, No. 34 at p. 150)

While older ballasts can be larger than newer ones, DOE's research indicates that the overall market trend is to create increasingly smaller ballast sizes for use in smaller and more highly optimized fixtures. As the trend toward smaller fixtures has existed for a number of years, new building designs are already incorporating smaller plenum spaces. Thus, an increase in the size of a ballast could affect its ability to be used in certain existing buildings or in new construction. Accordingly, DOE considers any increase in the existing footprint of a ballast to have adverse impacts on product utility and product availability.

Based on the above discussion, DOE maintains the elimination of laminated sheets of amorphous steel as a design option because it fails to meet the screening criteria of practicality to manufacture, install, and service, and adverse impacts on product utility. DOE considers the remaining technology options as design options in the engineering analysis.

C. Engineering Analysis

1. Approach

The engineering analysis develops cost-efficiency relationships to show the manufacturing costs of achieving increased efficiency. DOE has identified the following three methodologies to generate the manufacturing costs needed for the engineering analysis: (1) The design-option approach, which provides the incremental costs of adding to a baseline model design options that will improve its efficiency; (2) the efficiency-level approach, which provides the relative costs of achieving increases in energy efficiency levels, without regard to the particular design options used to achieve such increases; and (3) the cost-assessment (or reverse engineering) approach, which provides "bottom-up" manufacturing cost assessments for achieving various levels of increased efficiency, based on detailed data as to costs for parts and material, labor, shipping/packaging, and investment for models that operate at particular efficiency levels.

In the preliminary TSD, DOE determined that an efficiency level approach paired with reverse engineering cost estimates would yield the most realistic data. In this way, DOE would not rely solely on product lists or minimum cost data supplied by manufacturers. DOE conducted teardowns for unpotted ballasts and ballasts removed from a manufacturing facility before the potting procedure because potting (a tar-like fill material) inhibits visual observation of the components). Details of the engineering analysis are in NOPR TSD chapter 5. The following discussion summarizes the general steps of the engineering analysis:

Determine Representative Product Classes. DOE first reviews covered ballasts and the associated product classes. When multiple product classes exist, DOE selects certain classes as "representative" primarily because of their high market volumes. DOE extrapolates the efficiency levels (ELs) from representative product classes to those product classes it does not analyze directly.

Select Baseline Ballasts. For each representative product class, DOE establishes baseline ballasts. The baseline serves as a reference point for each product class, against which DOE measures changes resulting from potential amended energy conservation standards. For ballasts subject to existing Federal energy conservation standards, a baseline ballast is a commercially available ballast that just meets existing standards and provides basic consumer utility. If no standard exists for that specific ballast type, the baseline ballast represents the typical ballast sold within a product class with the lowest tested ballast efficiency. To determine energy savings and changes in price, DOE compares each higher energy-efficiency level with the baseline unit.

DOE tested a range of ballasts from multiple manufacturers to identify baseline ballasts and determine their BLE. Appendix 5C of the NOPR TSD presents the test results. DOE selects specific characteristics such as starting method, ballast factor, and input voltage to characterize the most common ballast at the baseline level. DOE also selects multiple baseline ballasts in certain product classes to ensure consideration of different ballast types and their associated consumer economics.

Select Representative Ballasts. DOE selects commercially available ballasts with higher BLEs as replacements for each baseline ballast in the representative product classes by considering the design options identified in the technology assessment and screening analysis (NOPR TSD chapter 4). In general, DOE can identify the design options associated with each more efficient ballast. Where design options cannot be identified by the product number or catalog description, DOE determines the design options likely to be used in the ballast to achieve a higher BLE based on information gathered during manufacturer interviews. In identifying more efficient substitutes, DOE uses a database of commercially available ballasts. DOE then tests these ballasts to establish their appropriate BLE. Appendix 5C of the NOPR TSD presents these test results.

Because fluorescent lamp ballasts are designed to operate fluorescent lamps, DOE considers properties of the entire lamp and ballast system in the engineering analysis. Though ballasts are capable of operating several different lamp wattages, DOE chooses the most common fluorescent lamp used with each ballast for analysis. DOE also includes two substitution cases in the engineering analysis. In the first case, the consumer is not able to change the spacing of the fixture and therefore replaces one baseline ballast with a more efficient ballast. This generally represents the lighting retrofit scenario where fixture spacing is predetermined by the existing installation. In this case, light output is generally maintained to within 10 percent of the baseline system lumen output.[20] In the second case, the consumer is able to change the spacing of the fixture and either purchases more or fewer ballasts to maintain light output. This represents a new construction scenario in which the consumer has the flexibility to assign fixture spacing based on the light output of the new system. In this case, DOE normalizes the light output relative to the baseline ballast.

Determine Efficiency Levels. DOE develops ELs based on two factors: (1) The design options associated with the specific ballasts studied; and (2) the maximum technologically feasible efficiency level. As discussed in section 0, DOE's efficiency levels are based on

[20] In some instances (*e.g.*, when switching from T12 to T8 ballasts), light output exceeds these limits.

test data collected from products currently on the market.

Conduct Price Analysis. DOE generated a bill of material (BOM) by disassembling multiple manufacturers' ballasts that spanned a range of efficiency levels for some of the representative ballast types. DOE generated BOMs for two- and four-lamp T8 MBP IS, two-lamp T8 MBP PS, and 2-lamp, 8-foot slimline ballasts only because these ballasts were not filled with potting (a tar like substance). As stated previously, potting obscures the identification of individual components. The BOMs describe the products in detail, including all manufacturing steps required to make and/or assemble each part. DOE then developed a cost model that converts the BOMs for each efficiency level into manufacturer production costs (MPCs). By applying derived manufacturer markups to the MPCs, DOE calculated the manufacturer selling prices [21] and constructed industry cost-efficiency curves. In those cases where DOE was not able to generate a BOM for a given ballast, DOE estimated an MSP based on the relationship between teardown data, blue book prices, and manufacturer-supplied MSPs.

a. Metric

One change to engineering approach from the preliminary TSD is the use of a new metric, BLE. Although DOE evaluates ballast efficiency in terms of the BLE metric in this NOPR, DOE received several comments regarding the relationship between ballast efficiency (as determined by the method proposed in the active mode test procedure NOPR) and ballast efficacy factor (BEF). OSI commented that there might be variation introduced into the BEF values due to the fact that it is correlated to BE, and both of these metrics have a distribution of error. (OSI, Public Meeting Transcript, No. 34 at p. 166–167) GE agreed that there was error in the correlation equations because a BEF for a 2-lamp 4-foot normal BF IS ballast could be correlated back to 93 percent efficiency, which is higher than any efficiency measured during NEMA's round robin testing. (GE, Public Meeting Transcript, No. 34 at p. 171) The NEEA and NPCC pointed out that it is not worth discussing the measurement variation associated with the ballast efficiency metric if correlating it to BEF introduces significant error. (NEEA and NPCC, Public Meeting Transcript, No. 34 at pp. 167–168) On the other hand, Philips commented that when considering only their products, the BEFs determined by the correlation equations were very close to the values obtained during testing in their own lab. (Philips, Public Meeting Transcript, No. 34 at p. 168)

DOE agrees with stakeholders that calculating BEF as a function of ballast efficiency could introduce error into the BEF value. In the separate test procedure SNOPR, however, DOE proposes to directly evaluate ballasts using BLE, and the measurement variation present in the BLE metric is significantly less than that which existed for BEF due to the elimination of photometric measurements. More detail regarding measurement variation can be found in section 0 of this notice or in the active mode test procedure SNOPR.

b. Test Data

In the preliminary TSD, DOE conducted an extensive amount of testing in support of the active mode test procedure. DOE provided this data in appendix 5C. The appendix contained various ballast characteristics such as starting method, maximum number of lamps operated, ballast factor, and other relevant characteristics. It also contained each ballast's BEF value as measured by the existing light-output based procedure and, for some ballasts, ballast efficiency as measured by the resistor-based method proposed in the active mode test procedure NOPR. DOE provided the raw data in the appendix so that interested parties could form their own conclusions regarding the two metrics. Throughout the rest of the chapters and appendices in the preliminary TSD, however, the BEF values used in the analysis were calculated using the correlation equations specified in the active mode test procedure NOPR. DOE received several comments related to the test data.

The California Utilities, ASAP, and the NEEA and NPCC commented on the discrepancy between the tested BEF values and the values contained in other sources—such as product catalogs and the CEC database. The California Utilities cited an example of the CEC database containing several ballasts with a reported BEF higher than the max tech BEF for the relevant product class in the preliminary TSD. The NEEA and NPCC noted that the largest discrepancies existed for IS and RS ballasts that operate T12 and T8 lamps. They concluded that these differences are due to manufacturers overstating catalog data. The NEEA and NPCC believe that this practice can adversely affect a building's lighting systems to the extent that it may not meet code requirements. (California Utilities, Public Meeting Transcript, No. 34 at pp. 157–8; ASAP, Public Meeting Transcript, No. 34 at p. 160; NEEA and NPCC, No. 32 at p. 2)

DOE agrees with the above-mentioned groups that the tested BEF values are different than those presented in catalogs or the CEC database. To gather BEF values for various ballasts, DOE could have consulted manufacturer catalogs, the CEC database, or its own database of tested ballasts. It became clear during DOE's initial testing that manufacturers were overstating BEF values in their catalogs. Thus, DOE sought an alternate source of information. The CEC maintains a public database of BEF values submitted to show compliance with state-level energy conservation standards. Philips pointed out that the CEC database should, by definition, contain test data from certified laboratories whereas catalogs do not. (Philips, Public Meeting Transcript, No. 34 at pp. 162–163) Although the California Utilities pointed out that the CEC database reported higher BEFs than the max tech level reported in the preliminary TSD, Philips commented that the highest candidate standard level (CSL) in the 2-lamp 4-foot MBP IS/RS product class was close enough to the higher values in the CEC database to be within the margin of error associated with the BEF metric. (Philips, Public Meeting Transcript, No. 34 at pp. 158–159)

While the CEC database represented an improvement over catalog data, commenters voiced concern with the information in the database. Philips commented that according to the CEC database, some manufacturers reported the same BEF for multiple ballast models. (Philips, Public Meeting Transcript, No. 34 at pp. 158–9) This indicates that all ballast models listed may not have been individually tested. In addition, Philips cited several other factors to consider when reviewing data from the CEC database, such as: Different manufacturers offering their most efficient ballasts at different efficiencies, measurement variation between testing labs; and measurement variation due to the test procedure itself. (Philips, Public Meeting Transcript, No. 34 at pp. 162–163)

DOE agrees that because each manufacturer likely tested their ballasts in different labs, the CEC database does not provide the best comparison. It is less meaningful for DOE to compare the BEF of a ballast tested in lab A to the

[21] The MSP is the price at which the manufacturer can recover all production and non-production costs and earn a profit. Non-production costs include selling, general, and administration (SG&A) costs, the cost of research and development, and interest.

BEF of a different ballast tested in lab B, as measurement variation will exist between the two labs. DOE also acknowledges that there will be additional measurement variation within a lab due to tolerances allowed in the BEF test procedure. Although test procedure variation cannot be eliminated, the lab-to-lab variation can be eliminated by testing all ballasts in the same lab. Thus, in the preliminary TSD and this NOPR, DOE chose to rely on data obtained from its own testing. DOE acknowledges that manufacturers may use different labs for testing and certification purposes. Therefore, DOE accounts for both these sources of variation by decreasing efficiency levels by 0.8 percent. See section 0 for more details.

The California Utilities and the NEEA and NPCC noticed the discrepancy between DOE's test data contained in Appendix 5C and the values reported in chapter 5 of the preliminary TSD. They noted that the measured input power reported for a representative unit in the chapter 5 of the preliminary TSD did not match the input power listed in Appendix 5C for a ballast with the same BEF. In addition, all CSLs reported in the chapter 5 of the preliminary TSD for T5 standard output ballasts were lower than the BEFs reported in Appendix 5C. (California Utilities, No. 30 at p. 3; NEEA and NPCC, No. 32 at p. 5)

DOE acknowledges that the BEFs are not the same. The reason for the differences is that the data provided in Appendix 5C included DOE's test results for BEF and BE. BEF was measured according to the test procedure outlined in 10 CFR Part 430, Subpart B, Appendix Q—a procedure which includes photometric measurements. Ballast efficiency was measured according to the resistor-based method in the active mode test procedure NOPR. In chapter 5 of the preliminary TSD, DOE presented data based on its proposed test procedure—which included measuring a resistor-based ballast efficiency and using a correlation equation to calculate BEF. Thus, the BEFs presented in chapter 5 of the preliminary TSD are calculated values, whereas the BEFs presented in Appendix 5C are actual measured values.

DOE also received several comments regarding the ballasts it selected for testing. The NEEA and NPCC believed that DOE did not select any low- or high-BF products for testing. They therefore expressed concern that DOE had scaled efficiency levels to two-thirds of the product classes but had not obtained any test data for those classes. The NEEA and NPCC encouraged DOE to conduct additional testing to look at the relationship between low-, normal-, and high-ballast factor. (NEEA and NPCC, No. 32 at pp. 3, 4) For the preliminary TSD, DOE did measure BEF and resistor-based BE for low-, normal-, and high-ballast factor products. As described in the active mode test procedure NOPR, however, DOE needed to create separate correlation equations for low, normal, and high BF ballasts because all testing was conducted with resistors corresponding to normal BF. 75 FR 14288, 14303–4 (Mar. 24, 2010). For this NOPR, DOE continued to test low and high BF products in addition to those with normal BF.

The California Utilities expressed concern that DOE's testing may not have captured the entire ballast market. They stated that their alternate sources of data indicated a larger range of BEFs than the range shown by the test data contained in Appendix 5C of the preliminary TSD. (California Utilities, Public Meeting Transcript, No. 34 at pp. 157–158) DOE found after conducting its own testing for the preliminary TSD that the actual range of BEF values was much narrower than indicated by catalog values. DOE believes its testing accurately characterized the market because it selected ballasts to capture variations in manufacturer, standard and high-efficiency product lines, lamp diameter, starting method, and other relevant factors. These variations have also been captured in the lamp-based BE testing that DOE has conducted to determine efficiency levels for this NOPR.

To ensure that DOE establishes the appropriate max tech level, the California Utilities recommended DOE test the ballasts with the highest BEF values as indicated in the CEC and CEE databases. (California Utilities, No. 30 at p. 2) DOE tested the most efficient (highest BEF) ballast in the CEC database for each representative ballast type identified in this NOPR. DOE did not review the CEE database as values submitted to this program are based on catalogs. Catalog data typically is not based on the DOE test procedure for every unit presented. Instead manufacturers often assign the same BEF to a family of products or approximate the BEF based on constituent measurements such as input power.

2. Representative Product Classes

For the preliminary TSD, DOE was not able to analyze all 70 product classes. Instead, DOE selected representative product classes to analyze based primarily on their high market volumes, and then scaled its analytical findings for those representative product classes to other product classes that were not analyzed. In the preliminary TSD, DOE identified 10 product classes as representative: (1) 2-lamp 4-foot MBP normal-BF IS/RS ballasts in the commercial sector; (2) 4-lamp 4-foot MBP normal-BF IS/RS ballasts in the commercial sector; (3) 2-lamp 4-foot MBP normal-BF PS ballasts; (4) 4-lamp 4-foot MBP normal-BF PS ballasts; (5) 2-lamp 4-foot MiniBP SO normal-BF ballasts; (6) 2-lamp 4-foot MiniBP HO ballasts; (7) 2-lamp 8-foot slimline normal-BF ballasts; (8) 2-lamp 8-foot HO IS/RS ballasts; (9) 2-lamp 4-foot MBP normal-BF IS/RS ballasts in the residential sector; and (10) 4-lamp sign ballasts. For each ballast type, DOE selected product classes with the highest volume of shipments to be representative. DOE analyzed at least one representative product class for each ballast type included in the scope of coverage. For the most prevalent ballast types (*e.g.,* for ballasts that operate 4-foot MBP and 2-foot U-shaped lamps), DOE chose to analyze multiple representative product classes. While DOE received several stakeholder comments regarding methods of scaling (discussed in section 0), DOE did not receive objections to the decision to analyze certain product classes as representative and scale to those not analyzed. Thus, DOE maintains this methodology in this NOPR.

DOE also did not receive any objections to the product classes it chose as representative. Due to the changes in product class structure discussed above, however, DOE's selection of representative classes for this NOPR differs from that presented in the preliminary TSD. Instead of 70 product classes, there are now a total of 5 classes. DOE defines separate product classes based on starting method (PS and IS/RS), 8-foot HO ballasts, and sign ballasts. The first product class indicated in Table V.1 includes IS and RS ballasts that operate 4-foot MBP and 8-foot slimline lamps. According to the U.S. Census, the market share of 4-foot T8 MBP ballasts represented 55 percent of shipments in 2005. While this data is not segregated by starting method, based on product catalogs and manufacturer interviews, DOE believes that over half of the 4-foot MBP T8 ballast shipments are IS. In addition, the U.S. Census indicates that 8-foot slimline ballasts had about 5-percent market share in 2005. As these ballast types represent significant shipments relative to the overall fluorescent ballast market, DOE analyzes this product class as representative.

The third product class indicated in Table V.1 includes PS ballasts that operate 4-foot MBP, 4-foot T5 MiniBP SO, and 4-foot T5 MiniBP HO lamps. The U.S. Census reports that T5 ballasts comprised about 4 percent of the ballast market in 2005. Shipment data are available only for T5 high output ballasts, so the actual market share is likely larger. T5 ballast shipments have been steadily increasing since the shipments were first reported in 2002. Furthermore, DOE research indicates that T5 high output ballasts are rapidly taking market share from metal halide systems used in high bay industrial applications. DOE therefore concluded that T5 ballasts are a growing market segment of significant size. As mentioned above, ballasts that operate 4-foot MBP lamps represent a significant portion of the overall fluorescent ballast market. Although PS ballasts are not as popular as IS ballasts, DOE believes that 4-foot MBP PS ballasts represent a sizeable portion of the market due to the increasing use of occupancy sensors. Because of the large portion of ballast shipments contained within this product class, DOE analyzes this product class as representative.

According to the U.S. Census, the market share of 8-foot HO (T8 and T12) ballasts (excluding cold temperature sign ballasts) was about 0.5 percent in 2005. In the preliminary TSD, DOE concluded that IS and RS ballasts were more popular than PS ballasts. These conclusions were supported by product catalogs and manufacturer interviews. DOE received no adverse comment regarding its selection of the 2-lamp IS and RS 8-foot HO ballast product class as representative in the preliminary TSD and continues to analyze IS and RS 8-foot HO ballasts as representative for this NOPR. DOE identified less than five 8-foot HO PS ballasts currently being sold by major manufacturers, limiting the potential for a detailed direct analysis. Instead, DOE scaled its results from the larger 8-foot RDC HO IS and RS product class to the PS product class as described in section 0.

In the preliminary TSD, DOE analyzed 4-lamp sign ballasts, or those that operate a maximum of 32 feet of lamps, as the representative product class for that ballast type because it believed that to be the most common lamp-and-ballast system. DOE received no objection to its decision to analyze sign ballasts as a representative product class in the preliminary TSD and continues to analyze sign ballasts as a representative product class for this NOPR.

3. Baseline Ballasts

Once DOE identified the representative product classes for analysis, DOE selected representative ballast types to analyze from within each product class. For each ballast type analyzed, DOE selected a baseline ballast from which to measure improvements in efficiency. Baseline ballasts are what DOE believes to be the most common, least efficacious ballasts for each representative ballast type. For ballasts subject to existing Federal energy conservation standards, a baseline ballast is a commercially available ballast that just meets existing standards and provides basic consumer utility. If no standard exists for that specific ballast type, the baseline ballast represents the typical ballast sold within a representative ballast type with the lowest tested ballast efficiency. In cases where two types of ballasts (each operates a different lamp diameter) are included in the same representative ballast type, DOE chose multiple baseline ballasts.

DOE considered each ballast's characteristics in choosing the most appropriate baseline ballast for each ballast type. These characteristics include the ballast's starting method (*e.g.,* rapid start, instant start, or programmed start), input voltage (277 V versus 120 V), type (magnetic versus electronic), power factor (PF), total harmonic distortion, ballast factor, ballast luminous efficiency, and whether the ballast can operate at multiple voltages [22] (universal voltage) or only one (dedicated voltage).

a. IS and RS Ballasts

In this NOPR, DOE combined several product classes from the preliminary TSD into one product class. Thus, the IS and RS product class in this NOPR refers to IS and RS ballasts that operate 4-foot MBP and 8-foot slimline lamps. This product class contains the following representative product classes from the preliminary TSD: (1) 2-lamp 4-foot MBP IS and RS normal BF; (2) 4-lamp 4-foot MBP IS and RS normal BF; (3) 2-lamp 8-foot slimline normal BF; and (4) 2-lamp 4-foot MBP IS and RS ballasts in the residential sector. DOE analyzed these classes in the preliminary TSD because DOE chose at least one representative product class for each ballast type and these classes contained the highest volume of shipments. In this NOPR, DOE continues to analyze products for each ballast type included in the proposed scope of coverage. DOE also continues to analyze more than one representative ballast type if shipments suggest that there is more than one high-volume unit (e.g. DOE analyzes both 2- and 4-lamp 4-foot MBP ballasts). Thus, although several ballast types are combined within the IS and RS product class, DOE analyzes the following representative ballast types within that class: (1) Ballasts that operate two 4-foot MBP lamps; (2) ballasts that operate four 4-foot MBP lamps; (3) ballasts that operate two 8-foot slimline lamps; and (4) ballasts that operate two 4-foot MBP lamps in the residential sector.

Two 4-Foot MBP Lamps

In the preliminary TSD, DOE analyzed two baselines for 2-lamp 4-foot MBP IS and RS ballasts. Census data indicated that 2001 shipments of 4-foot MBP T12 ballasts represented 14 percent of all 4-foot MBP ballast shipments, while 4-foot MBP T8 ballasts represented 86 percent of all shipments for this ballast type.[23] Therefore, DOE analyzed both a T12 and T8 ballast as baselines. Though the 2009 Lamps Rule will eliminate all currently commercially available T12 lamps as of July 2012, DOE learned that some lamp manufacturers planned to produce a T12 lamp that just met the 2009 Lamp Rule efficacy standards. Therefore, DOE included an F34T12 lamp in its analysis, assigning it performance parameters that would comply with the 2009 Lamps Rule. DOE analyzed only those T12 ballasts that operate F34T12 lamps because only the most efficient T12 lamps will be available when compliance with any amended standards established in this ballast rulemaking is required (by June 30, 2014). For the T8 baseline, DOE analyzed only those ballasts that operate the F32T8 lamp because it is the most common 4-foot MBP T8 lamp.

The Federal minimum energy conservation standard for ballasts that operate two F34T12 lamps became effective for ballasts manufactured on or after July 1, 2009, sold by the manufacturer on or after October 1, 2009, or incorporated into a luminaire by a luminaire manufacturer after July 1, 2010. (10 CFR 430.32 (m)(5)). This energy conservation standard now effectively allows only electronic F34T12 ballasts. Therefore, DOE chose an electronic model as the F34T12 baseline ballast. Currently there is no Federal minimum energy conservation standard for ballasts that operate F32T8 lamps. Therefore, in choosing the baseline ballast for this lamp type, DOE

[22] Universal voltage ballasts can operate at 120V or 277V.

[23] More recent census data for ballasts are available. However, shipments of T12 ballasts have not been publicly released for all product classes after 2001. DOE used 2001 Census data when selecting baselines for all ballast types.

chose the most common, least efficient ballast on the market.

ASAP commented that because electronic T12 ballasts are more expensive than comparable T8 ballasts and also use a more expensive lamp, the market is going to shift to T8 ballasts, leading them to believe the T8 ballast is a more appropriate baseline. Philips agreed with ASAP that a T8 ballast was a more appropriate baseline because an electronic T8 instant start ballast is the dominant ballast sold. (ASAP, Public Meeting Transcript, No. 34 at p. 255; Philips, Public Meeting Transcript, No. 34 at p. 256) DOE agrees with Philips that, in recent years, T8 ballast shipments have overtaken T12 shipments. For this reason, DOE analyzes a T8 ballast as a baseline. DOE continues to analyze a T12 ballast as a baseline ballast, however, because while electronic T12 ballasts may have a lower shipment volume, they are the least efficient products available that operate two 2-foot MBP lamps.

Four 4-Foot MBP Lamps

Although Census data indicated that both T12 and T8 ballasts operate 4-foot MBP lamps, DOE's research found that only T8 ballasts operate four lamps. Therefore, in the preliminary TSD, DOE analyzed only a T8 ballast as a baseline for 4-lamp 4-foot MBP IS and RS ballasts. Because there is no Federal energy conservation standard, DOE chose a baseline for this ballast type that exhibits the characteristics of the least efficient and most common ballast on the market. DOE paired this ballast with an F32T8 lamp because this lamp is the most common 4-foot MBP T8 lamp. DOE did not receive any adverse comment regarding its methodology for selecting a baseline for 4-lamp 4-foot MBP IS and RS ballasts. Therefore, for these reasons, DOE maintains this methodology for this NOPR.

Two 8-Foot Slimline Lamps

For ballasts that operate two 8-foot slimline lamps, DOE analyzed two baseline ballasts in the preliminary TSD. Census data indicated that 2001 shipments of 8-foot slimline T12 ballasts represented approximately 50 percent of all shipments for this ballast type, whereas T8 ballasts represented the remaining 50 percent.[24] Therefore, DOE analyzed both a T12 and T8 ballast as baselines. The 2009 Lamps Rule will eliminate all currently commercially available T12 lamps as of July 2012. However, DOE learned that some lamp manufacturers planned to produce a T12 lamp that just meets the 2009 Lamp Rule efficacy standards. Therefore, DOE included an F96T12/ES lamp in its analysis, assigning it performance parameters that would comply with the 2009 Lamps Rule. For the T8 baseline, DOE analyzed only those ballasts that operate the F96T8 lamp because this lamp is the most common 8-foot SP slimline T8 lamp.

The Federal minimum energy conservation standards for ballasts that operate two F96T12/ES lamps became effective for ballasts manufactured on or after July 1, 2009. (10 CFR Part 430.32 (m)(5)). This energy conservation standard effectively allowed only electronic T12 products. Therefore, DOE chose an electronic ballast as the T12 baseline for this ballast type. Currently there is no Federal minimum energy conservation standard for ballasts that operate F96T8 lamps. Therefore, DOE analyzed the most common, least efficient ballast on the market as the baseline. DOE did not receive any adverse comment regarding this methodology and maintains this approach in this NOPR.

Two 4-Foot MBP Lamps, Residential Sector

Through manufacturer interviews, DOE learned that both T12 and T8 ballasts are popular in the residential market. Therefore, DOE analyzed both a T12 and T8 ballast as baselines in the preliminary TSD. Currently there are federal minimum energy conservation standards for ballasts that operate F34T12 lamps in the residential sector. These standards became effective for ballasts manufactured on or after July 1, 2010 or sold by the manufacturer on or after October 1, 2010. (10 CFR 430.32 (m)(5–6)). This energy conservation standard now effectively allows only electronic F34T12 residential ballasts. Therefore, DOE chose an electronic model as the F34T12 baseline ballast. Because no federal minimum energy conservation standard exists for T8 residential ballasts, DOE chose the most common, least efficient ballast on the market. DOE research discovered that most ballasts sold in the residential market are sold as part of a fixture. Therefore, DOE researched the most common fixtures sold in the residential market. DOE then obtained the fixtures, removed the ballast, and tested the ballast to determine the least efficient and most common option. DOE tested a range of F32T8 ballasts from multiple ballast manufacturers and in multiple fixtures.

Though the 2009 Lamps Rule will eliminate all currently commercially available T12 lamps as of July 2012, DOE learned that some lamp manufacturers planned to produce a T12 lamp that just met the 2009 Lamps Rule efficacy standards. Therefore, DOE included an F34T12 lamp in its analysis, assigning it performance parameters that would comply with the 2009 Lamps Rule. Because only the most efficient T12 lamps will be available when compliance with any amended standards established by this ballast rulemaking is required, DOE analyzed only those T12 ballasts that operate F34T12 lamps. For the T8 baseline, DOE paired its T8 baseline ballast with an F32T8 lamp because DOE believed, based on catalogs and feedback from manufacturers, that that was the most common wattage lamp at that diameter.

DOE received several comments on its selection of a baseline in the residential sector. The California Utilities and the NEEA and NPCC believed that DOE's baseline selection underestimated the energy savings possible in the residential sector. They believed that the most common 2-lamp residential fixture had a higher ballast factor than that represented in the preliminary TSD. The NEEA and NPCC pointed out that the quality of a linear fluorescent product designed for use in a kitchen, utility room, or other inside space may be different than the quality of a shop or strip light typically used in garages. Furthermore, the NEEA and NPCC believed that because the residential market represented a frequent switching environment, programmed start ballasts should be considered. (California Utilities, No. 30 at p. 5; NEEA and NPCC, No. 32 at p. 7, 8)

DOE appreciates the comments regarding the residential baselines and reexamined the selection of baseline ballasts for this NOPR. DOE conducted additional testing in this market and found that the least efficient T12 ballast had a higher ballast factor than that presented in the preliminary TSD. Thus, the input power for this baseline ballast is also higher, which results in greater energy savings. Regarding programmed start ballasts, DOE agrees that the residential market may represent a frequent switching environment. Based on catalog data and manufacturer interviews, however, DOE continues to believe that IS and RS ballasts are the most common in this market sector. Therefore, DOE continues to analyze residential ballasts with these starting methods for this NOPR.

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[24] While more recent census data for ballasts is available, shipments of T12 ballasts have not been publicly released after 2001. T12 shipments for this ballast type also include data for the 6-foot SP slimline ballast, which DOE estimates is negligible compared to the 8-foot shipments.

b. PS Ballasts

In this NOPR, the PS product class refers to PS ballasts that operate 4-foot MBP, 4-foot MiniBP SO, and 4-foot MiniBP HO lamps. The PS product class contains the following representative product classes from the preliminary TSD: (1) 2-lamp 4-foot MBP PS normal BF; (2) 4-lamp 4-foot MBP PS normal BF; (3) 2-lamp 4-foot T5 MiniBP SO normal BF; and (4) 2-lamp 4-foot T5 MiniBP HO ballasts. DOE analyzed these classes in the preliminary TSD because DOE chose at least one representative product class for each ballast type and these classes contained the highest volume of shipments. As described in the section above, DOE continues to analyze products for each ballast type included in the proposed scope of coverage. DOE also continues to analyze more than one representative ballast type if shipments suggest that there is more than one high volume unit. Thus, although several ballast types are combined within the PS product class, DOE analyzes the following as representative ballast types within that class: (1) Ballasts that operate two 4-foot MBP lamps; (2) ballasts that operate four 4-foot MBP lamps; (3) ballasts that operate two 4-foot T5 SO lamps; and (4) ballasts that operate two 4-foot T5 HO lamps.

Two 4-Foot MBP Lamps and Four 4-Foot MBP Lamps

In the preliminary TSD, DOE analyzed one baseline for both 2-lamp and 4-lamp 4-foot MBP PS ballasts. DOE found that no T12 ballasts existed with this starting method. DOE paired the T8 baseline with an F32T8 lamp because it is the most common 4-foot MBP T8 lamp. As there are currently no Federal minimum energy conservation standards for ballasts that operate F32T8 lamps, DOE chose the most common, least efficient ballast on the market to be the baseline. DOE did not receive any adverse comment regarding its methodology for selecting a baseline for 2-lamp and 4-lamp 4-foot MBP PS ballasts and maintains this methodology for this NOPR.

Two 4-Foot T5 SO Lamps and Two 4-Foot T5 HO Lamps

In the preliminary TSD, DOE chose to analyze one baseline for both 2-lamp 4-foot T5 SO and 2-lamp 4-foot T5 HO ballasts. For ballasts that operate standard output T5 lamps, DOE believes that F28T5 lamps encompass the vast majority of these lamp sales.[25] Therefore, DOE chose a baseline ballast that operates two F28T5 lamps. For high output T5 lamps, DOE believes that F54T5HO lamps are the most common and therefore chose a baseline ballast that operates this lamp type.[26] Currently there are no federal minimum energy conservation standards for either T5 ballast type. In addition, only electronic T5 ballasts are sold on the U.S. market. In the preliminary TSD, however, DOE modeled the potential substitution of less efficient T5 ballasts by examining the difference between magnetic and electronic ballasts. Inclusion of less efficient T5 ballasts in the preliminary TSD led to increased energy consumption in the absence of standards and to increased energy savings with the adoption of T5 standards. Although DOE did not receive any comments on this methodology, for this NOPR, DOE developed baseline T5 ballasts by evaluating the difference in BLE between the baseline and more efficient replacements for 2-lamp 4-foot MBP PS ballasts. Rather than assume magnetic ballasts would be the less efficient substitute, DOE instead approximates the less efficient substitute through comparison to a similar PS product that uses inefficient electronic ballast technology.

c. 8-Foot HO Ballasts

As described in section 0, DOE analyzed the IS and RS 8-foot HO product class as representative. This product class contains IS and RS ballasts that operate a maximum of one or two 8-foot HO lamps. In the preliminary TSD, DOE estimated that the majority of 8-foot HO ballasts are 2-lamp ballasts and therefore analyzed the two-lamp model as representative. DOE received no objection to its decision to analyze 2-lamp 8-foot HO ballasts and continues to analyze these ballasts as representative in this NOPR.

In the preliminary TSD, DOE analyzed two baselines for this ballast type. DOE believes most of the 8-foot HO ballasts currently shipped are T12. Though the 2009 Lamps Rule will eliminate all currently commercially available T12 lamps as of July 2012, DOE learned that some lamp manufacturers planned to produce a T12 lamp that just met the 2009 Lamp Rule efficacy standards. Therefore, DOE included an F96T12HO/ES lamp in its analysis, assigning it performance parameters that would comply with the 2009 Lamps Rule. Therefore, DOE analyzed both T12 and T8 ballasts as baselines. The Federal minimum energy conservation standards for ballasts that operate two F96T12HO/ES lamps became effective for ballasts manufactured on or after July 1, 2009. 10 CFR Part 430.32 (m)(5). These standards did not eliminate magnetic ballasts from the market. Therefore, DOE chose a magnetic ballast for the T12 baseline. Because there are currently no Federal minimum energy conservation standards for ballasts that operate F96T8HO lamps, DOE analyzed the most common, least efficient ballast on the market. For this T8 baseline, DOE paired the ballast with an F96T8HO lamp because this lamp is the most common 8-foot HO T8 lamp. DOE received no adverse comment regarding this methodology and continues to use the same approach for this NOPR.

d. Sign Ballasts

In this NOPR, the sign ballast product class includes sign ballasts that operate 8-foot HO lamps. In the preliminary TSD, DOE found the most common lamp-and-ballast combination for this ballast type to be sign ballasts operating a maximum of four 8-foot HO cold temperature lamps. DOE received no adverse comment regarding this selection and continues to analyze 4-lamp sign ballasts as representative in this NOPR.

In the preliminary TSD, DOE research indicated that ballasts that operate in outdoor signs or in other cold temperature applications are designed for use with T12 lamps. Therefore, DOE chose a T12 ballast as a baseline for this ballast type. Current Federal energy conservation standards cover sign ballasts that operate two F96T12HO/ES lamps. These standards became effective for ballasts manufactured on or after July 1, 2010 or sold by the manufacturer on or after October 1, 2010. (10 CFR Part 430.32 (m)(5–6)). However, DOE analyzed sign ballasts that operate four 8-foot HO lamps because this is the most common lamp and ballast combination. DOE chose the most common and least efficient ballast on the market to be the baseline unit. DOE paired this baseline ballast with an F96T12HO lamp that represented the most common cold temperature lamp available on the market. DOE received no adverse comment regarding this approach and maintains this methodology in this NOPR.

4. Selection of More Efficient Ballasts

As described in the preliminary TSD, in the engineering analysis, DOE considered only "design options"—

[25] Currently only one manufacturer sells a 4-foot MiniBP T5 lamp that is not a F28T5. This lamp is a reduced wattage (F26T5).

[26] Currently only two manufacturers sell a 4-foot MiniBP T5 HO lamp that is not a F54T5HO. One manufacturer sells a reduced wattage (F51T5HO). Another manufacturer sells a F49T5HO.

technology options used to improve ballast efficiency that were not eliminated in the screening analysis. DOE's selection of design options guided its selection of ballast designs and efficiency levels. For example, DOE noted separation in efficiencies due to electronic ballast design, starting method, and improved components. All more efficient ballast alternatives DOE identified are based on commercially available ballasts.

In the preliminary TSD, for each representative product class, DOE surveyed and tested many of the manufacturers' product offerings to identify the efficiency levels corresponding to the highest number of models. DOE identified the most prevalent BEF values in the range of available products and established CSLs based on those products. To determine the max tech level in the preliminary TSD, DOE conducted a survey of the fluorescent lamp ballast market and the research fields that support the market. DOE found that within a given product class, no working prototypes existed that had a distinguishably higher BEF than currently available ballasts. Therefore, the highest CSL presented—which represented the most efficient tier of commercially available ballasts—was the max tech level that DOE determined for the preliminary TSD. DOE presented additional research in appendix 5D of the preliminary TSD to explore whether technologies used in products similar to ballasts could be used to improve the efficiency of ballasts currently on the market. DOE considered the use of active rectification (a technology used in some power supplies) and improved (lower electrical loss) components. Power supplies perform a similar power conversion function as fluorescent lamp ballasts, and improved components could potentially be substituted into the existing ballast circuit.

a. Max Tech Ballast Efficiency

DOE received several comments regarding its determination of max tech ballast efficiency. GE stated the importance of looking at ballast efficiency and converting it to BEF rather than looking at BEF catalog values and calculating the ballast efficiency. GE supported this approach because ballast efficiency test data avoids error measurement associated with the BEF test procedure and is therefore more accurate. (GE, Public Meeting Transcript, No. 34 at pp. 165–166) DOE agrees with GE's suggestion to consider tested ballast efficiency rather than calculated ballast efficiency when determining the max tech level. As discussed in the active mode test procedure SNOPR, DOE proposed a lamp-based procedure to measure ballast efficiency. 75 FR 71570, 71573 (November 24, 2010). For this NOPR, DOE evaluates standards in terms of ballast efficiency, using the BLE metric.

The California Utilities commented that in attempting to identify the max tech level commercially available, DOE should not limit itself to evaluating ballasts from the four major manufacturers. (California Utilities, Public Meeting Transcript, No. 34 at pp. 171–172) DOE agrees with the California Utilities that all manufacturers should be considered when identifying the max tech level. DOE reviewed the California Energy Commission's (CEC's) ballast database to identify the most efficient ballast in terms of BEF (because ballast efficiency data was not provided in the database) for each analyzed ballast type. DOE then tested those ballasts to ensure that it considered the most efficient products regardless of manufacturer.

DOE received several comments supporting DOE's conclusion from the preliminary TSD that commercially available ballasts are also the maximum technologically feasible. NEMA and Philips commented that premium products are approaching the point of diminishing returns. Furthermore, Philips believes that the premium products of all manufacturers are very close to max tech. In support of this point, Philips stated that fixed-output fluorescent ballasts are a mature technology and that the state-of-the-art product on the market today represents a high-performance, cost-effective product. Philips would prefer regulations that existing high-performance products can meet. If DOE were to set a standard at an efficiency higher than that achievable by commercially available products, Philips stated that engineering resources would be pulled from developing areas like control systems, solid-state lighting and new light sources. (Philips, Public Meeting Transcript, No. 34 at pp. 144–145, 155–156, 163; NEMA, No. 29 at p. 17)

In addition to commenting that DOE should not set a standard that would require a redesign of existing products, Philips commented that all major manufacturers are concentrating their resources on lighting controls. Philips cited the New York Times building as an example in which lighting controls contributed to energy savings of 60 percent. Philips stated DOE should not require manufacturers to redesign existing ballasts to pursue efficiency gains of 1 or 2 percent when they can dedicate resources to lighting controls, which have the potential to achieve 30 percent–60 percent energy savings. (Philips, Public Meeting Transcript, No. 34 at p. 156)

In contrast to the manufacturers, the California Utilities and the NEEA and NPCC commented that DOE should further consider the technology options described in Appendix 5D of the preliminary TSD. They commented that the technologies DOE identified to improve efficiency, such as improved components and active rectification, have been employed in other electronic products similar to ballasts, including power supplies. They believe that both active rectification and Schottky diodes could be incorporated into fluorescent ballasts and could generate savings in the range DOE estimated, or greater. They also believe active rectification may be becoming more common in inexpensive consumer products. Additionally, the California Utilities pointed out that savings of 1 to 2 percent are significant when considering that for many ballast types, the efficiency savings identified by DOE are about 2 to 7 percent. They suggested that DOE conduct research with manufacturers of power supplies incorporating active rectification, because cost and efficiency estimates for power supplies may be applicable to electronic ballasts as well. (California Utilities, No. 30 at p. 2; NEEA and NPCC, No. 32 at p. 4)

Osram Sylvania and NEMA stated that active rectification could potentially achieve energy savings of about one percent, depending on the line voltage and power levels of the ballast. Lower input voltage ballasts have higher currents, which can result in potentially higher energy savings due to active rectification. Because DOE's active mode test procedure proposes testing ballasts at 277 volts (and most commercial ballasts operate at 277V), the full one percent energy savings will not be realized for most ballasts covered by this rulemaking. NEMA and Philips stated that the industry is not currently using active rectification because it would be prohibitively more expensive than passive rectification. Furthermore, energy savings in one- or two-lamp ballasts have not been proven. (NEMA, No. 29 at p. 16; OSI, Public Meeting Transcript, No. 34 at p. 141; Philips, Public Meeting Transcript, No. 34 at pp. 144–145)

DOE also believed that the efficiency of commercially available ballasts could be improved by substituting more efficient components, in addition to active rectification. NEMA had several comments regarding the more efficient components identified by DOE in Appendix 5D. Philips commented that

Schottky diodes do not exist in the voltage ranges that are required for the input stage as these components tend to be low voltage devices. Osram Sylvania and NEMA commented that using silicon carbide Schottky diodes for the input rectifier stage would be about 10 times more expensive than the existing components. Using them in other parts of the circuit, such as the power factor correction stage, could save some power, but these components are much better suited to ballasts with power levels of 250 W or higher. As the majority of fluorescent ballasts are around 120 W or below, existing designs do not employ these components. (Philips, Public Meeting Transcript, No. 34 at p. 142; OSI, Public Meeting Transcript, No. 34 at p. 141; NEMA, No. 29 at p. 16)

Osram Sylvania, Philips, and NEMA commented that the improved transformer core materials cited by DOE in Appendix 5D are typically used in magnetic ballasts. These technologies are being phased out or are not in use in most newer ballast designs. The ferrite material used in transformers and other magnetic components present in electronic ballasts is appropriate for the ballasts' 45 kilohertz (kHz) operating frequency. If the operating frequency were above 500 kHz, a higher quality core material may increase ballast performance. Similarly, litz wire is used with magnetic components when the frequency is high enough to justify it. (OSI, Public Meeting Transcript, No. 34 at pp. 141–142; Philips, Public Meeting Transcript, No. 34 at pp. 146–147; NEMA, No. 29 at pp. 16–17)

NEMA also provided feedback on the use of more efficient transistors and capacitors. NEMA commented that transistors have both conductive and switching losses. Minimizing one type of losses may increase the other so the appropriate balance must be considered when selecting these components. Regarding capacitors, NEMA commented that electrolytic capacitors offer the best value when high storage capability is needed. The losses due to effective series resistance are minimal in these components and are related to ripple current. (NEMA, No. 29 at p. 17)

DOE appreciates manufacturers' comments regarding the potential energy savings due to lighting controls and agrees that adding controls to a lamp-and-ballast system significantly increases the potential energy savings of the system. EPCA requires DOE to conduct this rulemaking to determine whether to amend the existing standards for ballasts and set standards for additional ballasts. Any new or amended standards established by DOE must achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. DOE also appreciates the above comments on active rectification and improved components as a means of increasing ballast efficiency. In this NOPR, DOE determined the maximum technologically feasible efficiency level to be the highest efficiency level that is technologically feasible for a sufficient diversity of products (spanning several ballast factors, number of lamps per ballast, and types of lamps operated) within each product class. DOE's max tech efficiency levels are supported by a significant amount of DOE test data. All representative ballast types have products commercially available at the max tech ELs for their respective product classes.

Before making this determination, DOE evaluated the possibility of improving the efficiency of three selected ballasts by inserting improved components in the place of existing components of commercially available ballasts. DOE's experiments with improving ballast efficiency through component substitution did not result in prototypes with improved overall ballast efficiency. However, DOE recognizes that component substitution is not the only method available for incrementally improving ballast efficiency. For example, further improvements may be possible through the incorporation of newly designed integrated circuits into the new ballast designs. Therefore, DOE is still considering whether an efficiency level higher than TSL 3 is technologically feasible for a sufficient diversity of lamp types, ballast factors, and numbers of lamps within each product class. In Appendix 5F of the NOPR TSD, DOE presents additional analysis on the potential for an instant-start ballast efficiency level that exceeds TSL 3. DOE requests comments in section 0 on its selection of the maximum technologically feasible level and whether it is technologically feasible to attain higher efficiencies for the full range of instant start ballast applications.

b. Lumen Output

In the preliminary TSD, DOE based its engineering analysis on two substitution cases. In the first case, the consumer is not able to change the spacing of fixtures and therefore replaces one baseline ballast with a more efficient ballast. In this case, light output is maintained to within 10 percent of the light output of the baseline system, when possible. In the second case, the consumer is able to change the spacing of the fixture. To show how energy savings would change due to this change in fixture spacing, DOE provided a normalized system input power.

DOE received several comments regarding lumen output and the two analyzed substitution cases. When consumers are not able to change fixture spacing, the California Utilities and the NEEA and NPCC believe that DOE incorrectly assumed that standards-case replacements will not always maintain the baseline light level. In some cases, both the light output and system wattage increased at higher CSLs. The California Utilities believed this was highly unlikely for two reasons: (1) Higher-BEF replacements that also have high ballast factors can be redesigned to maintain efficiency at lower ballast factors and (2) lighting retrofits allow consumers to maintain lumen output at desired levels. Although the products may not exist in today's market, the California Utilities and the NEEA and NPCC assert that manufacturers will be able to provide similar-BEF products that will not require significant increases in ballast factor. In addition, the California Utilities believe that consumers can change several factors to maintain lumen output: Manufacturer, ballast factor, number of lamps, type of lamp, and fixture reflector. The NEEA and NPCC suggested that because it is possible to maintain light output during ballast replacement, DOE should simplify the analysis by analyzing normalized system input power in all cases. (California Utilities, No. 30 at pp. 3–5; NEEA and NPCC, No. 32 at pp. 6–7) Philips disagreed that light output could be maintained in all substitution cases. They specifically cited the residential sector as an example of a market in which luminaire spacing could not be changed and consumers would simply have more light output when installing a more efficient system. (Philips, Public Meeting Transcript, No. 34 at p. 227)

DOE appreciates these comments but believes, based on its test data, that light output is not always maintained when directly replacing a baseline system with a more efficient one. Although DOE acknowledges that ballast factors may be modified in the future to better maintain light output of popular lamp-and-ballast systems, DOE relied on current product offerings when selecting units for this analysis, and believes that two substitution cases do in fact exist. For this NOPR, DOE maintained this methodology for the LCC analysis, which it believes reflects anticipated product offerings facing the individual consumer in the near term (*see section*

0 below). However, DOE used normalized system input power in the NIA to reflect the ballast technology options and system configurations that could be available to consumers over the 30-year analysis period, as well as increase the simplicity and transparency of its NIA spreadsheet model (*see section 0* below).

c. Other Regulations

In the preliminary TSD, NEMA commented that several possible upcoming regulations would affect the engineering and LCC analysis for fluorescent lamp ballasts. Specifically, NEMA was concerned about four possible regulations: Safety requirements for system interconnects, safety requirements for lamp end-of-life (EOL) protection, electromagnetic field requirements, and hazardous material regulation. NEMA stated that these potential requirements could result in lower ballast efficiency and affect payback calculations. (NEMA, No. 11 at p. 6; NEMA, Public Meeting Transcript, No. 9 at pp. 133–134) DOE agreed that the above requirements could affect ballast efficiency, cost, or both. DOE requested information on the quantitative impacts of these requirements so that it could modify ballast efficiency or cost if these regulations were to become final prior to publication of the final rule.

Philips commented that the International Electrotechnical Commission (IEC) recently adopted requirements for end-of-life (EOL) circuitry for ballasts operating T8 lamps. Previously, the IEC required this circuitry only for ballasts that operate T5 or smaller diameter lamps. If CSA and UL adopted this requirement, as they adopted the requirement for T5 and smaller diameter lamps, U.S. companies would have started redesigning their products to accommodate it. The additional control circuitry required to implement an EOL regulation would decrease ballast efficiency. Ballasts that operate one or two lamps would notice a greater decrease than ballasts that operate three or four lamps because the fixed losses would be smaller relative to the total output power. (Philips, Public Meeting Transcript, No. 34 at pp. 185–186; NEMA, No. 29 at p. 10)

DOE appreciates the comments regarding EOL circuitry and acknowledges that the additional circuitry will likely decrease efficiency. During interviews, manufacturers noted that T8 lamps in the U.S. are different than the T8 lamps used in Europe. For this reason, manufacturers believe it is unlikely that EOL requirements will be adopted in the U.S. If such requirements are adopted in advance of the publication of the final rule, DOE will consider them in its analysis.

Another regulation that could potentially affect ballasts is the adoption of hazardous substance regulation in the U.S. The European Union Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2002/95/EC, usually referred to as the Restriction of Hazardous Substances Directive or RoHS, restricts the use of six hazardous materials (lead, mercury, hexavalent chromium, cadmium, polybrominated biphenyls, and polybrominated diphenyl ethers) in the manufacture of various types of electronic and electrical equipment, including fluorescent lamp ballasts. RoHS has been in force since July 2006. If these restrictions were adopted in the U.S., Philips commented that complying with RoHS would increase capital and component costs. (Philips, Public Meeting Transcript, No. 34 at pp. 186–187)

DOE appreciates Philips' comments. During interviews, some manufacturers confirmed that they already comply with RoHS as part of a proactive effort coordinated by NEMA. For these manufacturers, no adjustments to ballast efficiency and price would be necessary if hazardous material regulation were adopted prior to publication of the final rule for this rulemaking. Other manufacturers stated that if all of their products did not already comply, full compliance was expected by the time they would need to comply with any amended ballast standards. If RoHS regulations are adopted, DOE will consider whether any adjustments to its analysis are warranted.

OSI commented that stricter EMI requirements might affect ballast efficiency but did not provide any quantitative data regarding the impacts of stricter EMI requirements on efficiency or cost. (OSI, Public Meeting Transcript, No. 34 at p. 188) DOE conducted significant research regarding EMI emitted by fluorescent lamp ballasts, as discussed in section 0. DOE found that most manufacturers have not altered internal ballast designs to meet the strict standards required by a few special applications. Rather, luminaire manufacturers have employed magnetic ballasts or electronic ones in combination with an external EMI filter and modified fixture. Therefore, DOE has not been able to quantify impacts of more stringent EMI standards on ballast efficiency or price. If the U.S. adopts stricter EMI standards, DOE will consider whether adjustments to its analysis are warranted for the final rule.

5. Efficiency Levels

a. Preliminary TSD Approach

In the preliminary TSD, DOE surveyed and tested many of the manufacturers' product offerings to identify the efficiency levels corresponding to the highest number of models. DOE identified the most prevalent BEF values in the range of available products and established CSLs based on those products. Because the baseline ballasts had different BEF values and represented various design options, in some product classes CSLs affected only one of the two baseline ballasts. For example, CSL1 may have required a more efficient T12 ballast than the baseline T12 ballast, but not have required a ballast more efficient than the T8 baseline. However, the full range of CSLs ultimately specified requirements that were above the BEF values of all the baseline ballasts sold, and therefore affected all baseline ballasts. The highest CSL presented, which represents the most efficient tier of commercially available ballasts, was also the max tech level that DOE determined for the preliminary TSD.

b. NOPR Approach

Based on comments and feedback received during manufacturer interviews, DOE sought to determine whether developing an equation that relates total lamp arc power to BLE could be an effective means of setting energy conservation standards for fluorescent lamp ballasts. As discussed in section 0, DOE tested many different types of ballasts from various manufacturers. DOE conducted extensive testing of the representative ballast types as well as certain ballasts with different numbers of lamps, starting methods, and ballast factor permutations. After compiling the test data, DOE plotted BLE versus total lamp arc power for both standard- and high-efficiency product lines from multiple manufacturers. Though each product line was slightly different, DOE observed the expected positive sloping curve whose slope decreased with increasing total lamp arc power. DOE also observed distinct groupings when comparing a single manufacturer's high and standard-efficiency product families.

After developing several regression lines, DOE found that a logarithmic relationship best modeled the observed trend between total lamp arc power and BLE. A logarithmic relationship has a positive slope that is largest (steepest) at low lamp arc power levels and has a decreasing slope with increasing lamp power. Furthermore, the use of a natural logarithm to relate total lamp arc power to BLE is consistent with current energy conservation standards for external power supplies, which also use an equation to define efficiency as a function of output power.

Next, DOE plotted curves that aligned with certain key divisions in product offerings. Using an equation of the form:

BLE = coefficient * ln (total lamp arc power) + constant

DOE adjusted the coefficient and constant to delineate different efficiency levels. In general, DOE found that ballasts that generate a total lamp arc power of 50 W or less had a greater range of efficiency than ballasts that operated a total lamp arc power of 50 W or more. DOE also found that the more efficient ballast product lines generally had a reduced (flatter) slope than the standard-efficiency products. To reflect this observation, DOE decreased the coefficient of the more efficient EL equations and increased the coefficient of the less efficient EL equations. Based on analysis of test data for representative ballast types, DOE identified certain natural divisions in BLE and generated curves that corresponded to these divisions. The equations presented in the following sections also reflect a 0.8 percent reduction to account for lab-to-lab variation and the compliance requirements. This reduction is discussed in more detail in section 0.

i. IS and RS Ballasts

DOE developed three efficiency levels for the IS and RS product class. DOE found commercially available ballasts for all representative ballast types in these product classes. The least efficient level (EL1) takes the form:

BLE = 2.98 * ln(total lamp arc power) + 72.61

While the least efficient 2-lamp MBP T8 electronic ballasts (commercial and residential) would meet this level, 2-lamp T12 MBP electronic ballasts would not. The least efficient 4-lamp MBP and 2-lamp T12 slimline ballasts already meet EL1. Next, EL2 takes the form:

BLE = 2.48 * ln(total lamp arc power) + 79.16

The least efficient universal voltage 4-foot MBP T8 and 8-foot T8 slimline ballasts would meet this level. The least efficient universal voltage 2-lamp MBP T8 ballast (in the commercial sector) also meets EL2. Finally, EL3 takes the form:

BLE = 1.32 * ln(total lamp arc power) + 86.11

EL3 represents a level met by high efficiency 4-foot MBP T8 (commercial and residential) and 8-foot T8 slimline ballasts.

ii. PS Ballasts

For the PS product class, DOE developed three efficiency levels. The least efficient level (EL1) takes the form:

BLE = 2.48 * ln(total lamp arc power) + 77.87

After plotting the test data, DOE observed three distinct efficiency levels in addition to a baseline level. The least efficient T5 standard and high output ballasts (as calculated by section 0) and the least efficient 4-foot MBP ballasts (those that had BLEs between 82 and 86 percent) would not meet this EL. DOE did not identify any 2-lamp 4-foot MBP PS ballasts at the efficiency level represented by EL1, but did identify ballasts of this type at higher efficiency levels. Next, EL2 took the form:

BLE = 2.48 * ln(total lamp arc power) + 78.86

EL2 represents high efficiency 4-foot MBP, T5 SO, and T5 HO ballasts. DOE did not identify any 4-lamp, 4-foot MBP PS ballasts at the efficiency level represented by EL2, but did identify ballasts of this type at the highest efficiency level. Finally, DOE developed EL3, which took the form:

BLE = 1.79 * ln(total lamp arc power) + 83.33

EL3 is designed to represent the most efficient PS ballasts tested by DOE. The single most efficient 2-lamp T5 standard output, 2-lamp T5 high output, 2-lamp MBP PS and 4-lamp MBP PS ballasts tested meet this level.

iii. 8-foot HO Ballasts

For the 8-foot HO IS and RS product class, DOE developed three efficiency levels. For this product class, DOE tested ballasts that operate two lamps, the most popular lamp-and-ballast combination. Because the resulting test data did not provide a sufficient range in total lamp arc power for DOE to develop EL equations directly using the same methodology as for the IS and RS, PS, and sign ballast product classes, DOE used the shape of the curves developed for the sign ballast product class. For EL1, EL2, and EL3, DOE used the coefficient of the sign ballast EL1 equation. One- and 2-lamp sign ballasts operate similar lamp powers as regular 8-foot HO ballasts and use the same starting methods (IS and RS). Based on the similarity in lamp power and starting method, DOE believes the coefficient of the equation that represents the most efficient IS electronic sign ballasts is a reasonable approximation of the coefficient for 8-foot HO ballasts. EL1 took the form:

BLE = 1.49 * ln(total lamp arc power) + 72.22

The least efficient T12 electronic ballasts meet EL1. EL2 took the form:

BLE = 1.49 * ln(total lamp arc power) + 83.33

EL2 is met with T8 electronic HO ballasts and represents a division in efficiency between the most efficient T12 electronic ballasts and the high-efficiency T8 electronic ballast. Finally, DOE developed EL3, a standard level that represents the most efficient 2-lamp, 8-foot HO ballast tested by DOE. EL3 took the form:

BLE = 1.49 * ln(total lamp arc power) + 84.32

iv. Sign Ballasts

For the sign ballast product class, DOE identified one efficiency level. The sign ballast market is primarily comprised of magnetic and electronic ballasts that operate T12 HO lamps. DOE tested sign ballasts that operate up to one, two, three, four, or six 8-foot T12 HO lamps. The test data showed that sign ballasts exist at two levels of efficiency. Therefore, DOE analyzed a baseline and one efficiency level above that baseline. Using its test data, DOE developed an equation for EL1 that was met by the most efficient 4-lamp sign ballast (representative ballast type) and the corresponding 1-lamp sign ballast. This EL represents an electronic sign ballast efficiency level and the most efficient sign ballast tested for the representative ballast type. EL1 took the form:

BLE = 1.49 * ln(total lamp arc power) + 81.34

c. Measurement Variation and Compliance

In the preliminary TSD, DOE calculated the average ballast efficiency for a sample size of three ballasts. DOE then used this average value to represent the efficiency of a model when analyzing data to determine efficiency levels. DOE received several comments regarding this approach. Regarding sample size, Philips stated that a sample size of three is not statistically significant, especially when ballasts are purchased from one location and may all have the same date code. The California Utilities encouraged DOE to increase the sample size of tested models. Philips commented that although a larger sample size is necessary to obtain a statistically significant average, testing a large number of ballasts would be highly burdensome. (Philips, Public Meeting Transcript, No. 34 at pp. 176–178, 180–181; California Utilities, No. 30 at p. 2)

In this NOPR, DOE modified its approach to testing in light of these comments. For the representative ballast types analyzed in this NOPR, DOE tested five samples of each model number and used the average to represent the overall efficiency of the model. For non-representative ballast types, DOE maintained its approach from the preliminary TSD to use the average of three samples. DOE believes that testing five ballasts for its representative product classes improves the reliability of the efficiency calculated for the representative ballast types.

DOE received several comments regarding its specification of efficiency levels using the ballast's average efficiency. Earthjustice noted that in the preliminary TSD, DOE did not follow the compliance testing requirements when it determined efficiency levels. Philips commented that DOE cannot use average values to specify an efficiency level and then require that 95 percent of products meet that level. When determining an efficiency level, Philips also encouraged DOE to consider measurement error. Because of measurement error inherent in the test procedure, Philips believed it was inappropriate for DOE to require all manufacturers to meet the highest claimed tested value when setting standards. Products that do not meet that highest measurement value are not necessarily out of compliance, but rather may be within the test procedure's range of accuracy. Philips encouraged DOE to adjust efficiency levels such that high-efficiency products would comply with the level even with the expected measurement variation. (Earthjustice, Public Meeting Transcript, No. 34 at p. 177; Philips, Public Meeting Transcript, No. 34 at pp. 173–174, 176, 177–178)

DOE acknowledges that compliance requirements and measurement variation affect reported efficiency. The current and proposed active mode test procedure requires manufacturers to report the lower of either the sample average or the value calculated by an equation intended to account for small sample sizes. DOE's analysis of its own test data showed that it was more likely that manufacturers would be reporting the result of the compliance equation, as this proved to be the lower of the two values. Thus, DOE calculated how much lower the value determined by the compliance equation was compared to the sample mean and reduced the efficiency levels, based on average BLEs, by this value.

Furthermore, DOE also agrees with manufacturers that measurement variation should be considered when determining efficiency levels. DOE tested ballasts at more than one lab and found that tested efficiencies for the ballast models sent to the independent lab were slightly lower than the values measured at the main test facility. Therefore, DOE evaluated the data to determine the average variation between the independent facilities.

Combined with the adjustment for using the compliance equation, DOE calculated that a 0.8 percent reduction was necessary. The 0.8 percent reduction corresponds to a 0.6 percent average difference in efficiency between data collected at the two laboratories used by DOE, and a reported value that is on average 0.2 percent less than the average of the samples included in testing. Therefore, in this NOPR, DOE adjusts the efficiency levels, which are based on average ballast efficiency data, downward by 0.8 percent to account for compliance requirements and lab-to-lab measurement variation.

6. Price Analysis

In the preliminary TSD, developing the manufacturer selling price for different fluorescent lamp ballasts involved two main inputs, a teardown analysis to develop the manufacturer production costs and a markup analysis to arrive at the MSP.

DOE summed the cost of direct materials, labor, and overhead costs used to manufacture a product to calculate the MPC.[27] Direct material costs represent the direct purchase price of components (resistors, connecting wires, etc.). DOE estimated the manufacturer overhead from a representative electronic fabrication company's U.S. Securities and Exchange Commission (SEC) 10–k's aggregated confidential manufacturer selling prices. DOE believed that the teardown prices reflected the long term average and were independent of long term commodity prices. For more detail, *see* chapter 5 and appendix 5A of the preliminary TSD.

DOE selected ballasts for the teardown analysis to estimate manufacturer production costs. DOE mapped out a matrix of product specifications and selected ballasts so that comparisons could be made among ballasts that differed by only one characteristic (such as starting method or input voltage). Ballasts are described by a long list of specifications, so DOE concentrated on those that were expected to have the greatest impact on efficiency—high versus regular advertised efficiency, maximum number of lamps driven, starting method, and universal versus single input voltage. DOE conducted teardown analyses on 13 ballasts. When possible, in the preliminary TSD, DOE assigned the MPC from the teardown directly to the CSL.

DOE notes that it was able to select only unpotted ballasts for the teardown analysis. As explained previously, some ballast manufacturers add potting, a type of black pitch, to the ballast enclosure to improve durability and manage heat distribution. Because the sticky potting inhibits visual observation of the components, DOE was unable to reverse engineer potted ballasts through a teardown analysis.

To estimate MPCs for ballasts that were not submitted for teardowns, DOE used online ballast supplier pricing to develop ratios relating online prices to teardown-sourced MPCs. After developing a ratio specific to each manufacturer, DOE then estimated the MPC for a particular CSL. DOE identified ballasts from multiple manufacturers that just meet the CSL and then marked down the online prices to the MPC using the manufacturer-specific MPC ratio. DOE averaged the MPCs for all the ballasts just meeting the CSL to calculate the MPC.

The last step in determining preliminary TSD manufacturer selling prices was developing markups to scale the MPCs assigned to each CSL to MSPs. DOE relied on income statements found in 10–K reports from publicly owned ballast manufacturing companies. Using multi-year average financial data, DOE used the ratio of net sales to cost of goods sold to mark up the MPC to the MSP.

NEMA and Philips commented that a teardown analysis is an unreliable way to develop manufacturer production costs. They stated that it is difficult even for a ballast manufacturer to determine prices of competitors' ballasts using this method. As an example, Philips and NEMA pointed out that DOE's teardown analysis determined that the most efficient ballast was cheaper than a less efficient ballast. NEMA strongly disagreed with DOE's conclusion. At the public meeting, Philips stated that NEMA was attempting to provide industry-average incremental MPC values for all efficiency levels. (NEMA, Public Meeting Transcript, No. 34 at p. 17; Philips, Public Meeting Transcript, No. 34 at pp. 183–184, 204; NEMA, No. 29 at p. 19) ASAP commented that it is valuable to have industry provide that kind of pricing information, but

[27] When viewed from the company-wide perspective, the sum of all material, labor, and overhead costs equals the company's sales cost, also referred to as the cost of goods sold (COGS).

encouraged DOE to continue with a teardown approach as well. (ASAP, Public Meeting Transcript No. 34 at pp. 184–185) Regarding scaling from retail prices to MSP, the NEEA and the NPCC agreed that DOE's scaling methods to determine MSPs are valid (NEEA and NPCC, No. 32 at p. 6). OSI agreed, citing an example that a T12 electronic ballast (price determined using retail scaling method) is generally more expensive than a T8 electronic ballast (OSI, No. 34 at p. 254).

DOE agrees that a teardown analysis may be sensitive to the dynamic nature of the electrical component market, but believes the teardown results should still be used considering limited pricing information is publicly available. In the NOPR, DOE amended its teardown approach such that incremental differences between two efficiency levels were based on increments between single manufacturers' ballasts rather than basing prices directly from teardowns of different manufacturers. DOE notes that the industry was unable to provide average incremental MPC values. Instead, some manufacturers provided confidential data on an individual basis.

For the NOPR, DOE developed prices using three main inputs. The first input was teardown data from the preliminary TSD. DOE compared teardown-sourced MSPs from the same manufacturer to establish incremental costs between ELs for a representative ballast type. The second input was blue book prices from manufacturer price lists. DOE estimated MSPs from these blue-book prices by using manufacturer-specific ratios between blue book prices and teardown- or aggregated manufacturer-sourced MSPs. The third input was confidential manufacturer-supplied MSPs and incremental MPC values. DOE aggregated these inputs to establish MSPs for efficiency levels of representative ballast types for which all data were available. DOE used ratios of online supplier retail prices to scale to ELs where both teardown and blue book prices were unavailable. In general, DOE used a combination of the teardown- and blue book-sourced prices throughout the analysis and used the aggregated manufacturer-supplied MSPs for normalization and comparison purposes.

For the teardown-sourced prices, DOE used the teardown data generated during the preliminary TSD. As discussed in section 0, DOE revised the manufacturer markup (used to convert MPC to MSP) from 1.5 to 1.4 based on inputs from manufacturer interviews. As a result, the teardown-sourced MSPs decreased slightly from the values presented in the preliminary TSD. In the preliminary TSD, DOE used the teardown-sourced MSP that corresponded directly to the representative ballast at each efficiency level. DOE noticed, however, that teardowns of ballasts from different manufacturers sometimes resulted in different MSPs, although they had approximately the same measured BLE. DOE believed this could potentially be due to differences in the brand of component used in the ballasts. As a result, DOE normalized the teardown-sourced MSPs so that the incremental difference between ELs would be less impacted by differences in component prices from one manufacturer to another. Using this technique, DOE assigned teardown-sourced MSPs to efficiency levels at which a ballast was torn down.

For the blue book-sourced MSPs, DOE developed manufacturer-specific discount ratios between blue book prices and either teardown-sourced MSPs or aggregated manufacturer-supplied MSPs. If teardown-sourced MSPs were available, DOE used these values to create discount ratios; otherwise, DOE used an aggregated manufacturer-supplied MSP. When a blue book value was not available from any manufacturer for a particular EL, DOE used a retail price scaling technique. DOE scaled the blue book-sourced price of an adjacent efficiency level using a ratio of retail prices (from a single online supplier) between ballasts in the adjacent EL and the EL without a blue book-sourced price. For example, if a blue book value was not available for EL2, a ratio of retail prices between EL2 and EL3 could be used to scale the blue book-sourced MSP from EL3 to EL2.

In the NOPR, DOE assigned MSPs to efficiency levels for representative ballast types according to the following methodology. For representative ballast type ELs with teardown-sourced MSPs, DOE averaged the teardown-sourced MSP with the blue book-sourced MSP. For the representative ballast type efficiency levels without teardown-sourced MSPs, DOE used the blue-book sourced MSP directly. For the two theoretical inefficient T5 baselines, neither a teardown- nor blue book-sourced MSP was available. As discussed in section 0, DOE established T5 standard output and high output baselines to model the situation in which inefficient T5 ballast entered the market in future years. To establish a price for the T5 standard output baseline, DOE scaled the EL1 blue book-sourced MSP using the ratio of the baseline and EL2 blue book-sourced MSPs for the 2-lamp, 4-foot MBP PS representative ballast type. To establish a price for the T5 high output baseline, DOE scaled the EL1 blue book-sourced MSP using the ratio of the baseline and EL1 blue book-sourced MSPs for the 4-lamp, 4-foot MBP PS representative ballast type. More detail on this methodology is provided in chapter 5 of the NOPR TSD.

In the preliminary TSD, DOE mentioned several possible regulations that could affect the price of fluorescent ballasts. NEMA expressed concern that safety requirements for system interconnects and safety requirements for lamp end-of-life protection could result in lower ballast efficiency and affect payback calculations. NEMA also commented that current internationally accepted EMI levels may be modified, which could lower the efficiency of commercially available ballasts. NEMA identified a final issue concerning hazardous material regulations that may be implemented which would affect component availability and raise the cost of ballasts. The NEEA and NPCC believe that the costs of the EOL and EMI features are very small or non-existent once they are engineered into most or all products (NEEA and NPCC, No. 32 at p. 6). They also believe the lead-free solder would affect ballasts of different efficiency levels equally and should therefore be ignored from the purposes of this rulemaking (NEEA and NPCC, No. 32 at p. 6). DOE appreciates these comments. Because none of these potential regulations have been promulgated, however, DOE has not included the effect of these potential regulations on ballast price or efficiency in this rulemaking. DOE will consider making changes to its analysis for the final rule if any of these potential regulations are adopted.

7. Results

In this NOPR, DOE changed its methodology from that presented in the preliminary TSD. DOE proposes to set standards in terms of an equation that relates total lamp arc power to BLE. For both the IS and RS product class and PS product class, DOE developed three efficiency levels and analyzed four representative ballast types. For the 8-foot HO IS and RS product class, DOE developed three efficiency levels and analyzed one representative ballast type. Finally, for sign ballasts, DOE developed one efficiency level and analyzed one representative ballast type. For each EL of each representative ballast type, DOE specified characteristics of a representative unit at that level and calculated an MSP. These values were used in the LCC, NIA, and

MIA analyses to model the impact of setting standards on consumers, the nation, and manufacturers, respectively. The table below summarizes the efficiency levels developed by DOE for each representative product class based on average tested BLE and total lamp arc power values. The efficiency level equations presented in Table V.3 incorporate the 0.8 percent reduction for lab to lab testing variation and compliance requirements and are the equations used to establish energy conservation standards for fluorescent lamp ballasts.

TABLE V.3—NOPR EFFICIENCY LEVELS FOR REPRESENTATIVE PRODUCT CLASSES WITH 0.8 PERCENT VARIATION REDUCTION

Representative product class	Efficiency level	BLE
IS and RS ballasts that operate	EL1	2.98 * n(total lamp arc power) + 72.61.
4-foot MBP lamps	EL2	2.48 * n(total lamp arc power) + 79.16.
8-foot slimline lamps	EL3	1.32 * n(total lamp arc power) + 86.11.
PS ballasts that operate	EL1	2.48 * n(total lamp arc power) + 77.87.
4-foot MBP lamps	EL2	2.48 * n(total lamp arc power) + 78.86.
4-foot MiniBP SO lamps	EL3	1.79 * n(total lamp arc power) + 83.33.
4-foot MiniBP HO lamps		
IS and RS ballasts that operate 8-foot HO lamps	EL1	1.49 * n(total lamp arc power) + 72.22.
	EL2	1.49 * n(total lamp arc power) + 83.33.
	EL3	1.49 * n(total lamp arc power) + 84.32.
Ballasts that operate 8-foot HO lamps in cold temperature outdoor signs	EL1	1.49 * n(total lamp arc power) + 81.34.

8. Scaling to Product Classes Not Analyzed

As discussed above, DOE identified and selected certain product classes as "representative" product classes where DOE would concentrate its analytical effort. DOE chose these representative product classes and the representative units within them primarily because of their high market volumes. The following section discusses how DOE scaled efficiency standards from those product classes it analyzed to those it did not.

In the preliminary TSD, DOE created scaling relationships for number of lamps, starting method, and ballast factor. DOE used extensive test data obtained for ballasts that operate 4-foot MBP lamps and developed equations relating total rated lamp power to BEF for each ballast type. DOE identified a reduction to apply to the BEF of an IS ballast to calculate the BEF of a comparable programmed start ballast. DOE also determined a relationship between ballasts with low, normal, and high ballast factor. Both high and low BF ballasts were found to have, on average, lower BEFs than comparable normal BF ballasts. Therefore, DOE applied a discount factor to calculate the appropriate BEFs for ballasts with low and high ballast factors. When applying this scaling methodology, DOE first scaled by number of lamps, then starting method, and finally ballast factor. DOE received several comments on its scaling methodology and results presented in the preliminary TSD.

Philips stated that DOE's scaling techniques were valid based on an analysis using data contained in the CEC's ballast database. (Philips, Public Meeting Transcript, No. 34 at pp. 17, 155) As discussed in the paragraphs that follow, however, manufacturers recommended adjustments to bring the scaled results more in line with actual data.

For number of lamps, Philips requested a greater allowance for one-lamp ballasts because the difference between one- and two-lamp ballasts was greater than indicated by DOE's scaling. Philips found the average BEF of one-lamp ballasts to be 3.5 percent lower than that of comparable two-lamp ballasts. Philips also commented that they found ballasts that operate four lamps to be about two percent more efficient than those that operate two lamps. In contrast, the NEEA and NPCC found that DOE's scaling factors for number of lamps seemed valid because there seems to be a strong correlation between BEF and lamp power. (Philips, Public Meeting Transcript, No. 34 at pp. 17, 103–104, 137–139; NEEA and NPCC, No. 32 at p. 5)

DOE also received several comments related to its ballast factor scaling techniques. Philips commented that high-BF ballasts do not necessarily have lower BEFs than normal-BF ballasts, and tend to be more efficient. Philips believes that DOE's results indicating that normal-BF ballasts have the highest BEF may be due to DOE's measurement procedures using the same resistors for low-, normal-, and high-BF ballasts. Philips also commented that low-BF ballasts do have lower BEF than normal-BF ballasts and that they may seek a larger reduction for those ballasts than that applied in the preliminary TSD. Based on the data in the CEC database, Philips concluded that a low-BF ballast is about one percent less efficient than a normal-BF ballast, whereas a high-BF ballast is about one percent more efficient than a normal-BF ballast. (Philips, Public Meeting Transcript, No. 34 at pp. 17–18, 103–104, 137) The California Utilities also noted that, based on the data provided in Appendix 5C, DOE's scaling factors did not accurately capture the relationship between BF and BEF. The NEEA and NPCC agreed, noting that while DOE used a very consistent set of scaling factors to scale the test results from normal ballast factor products to low- and high-ballast factor products, the test data was not nearly as consistent as the scaling factors. They did not believe that high ballast factor ballasts necessarily had lower BEFs than normal ballast factor products. The NEEA and NPCC believed DOE should proceed in a way that eliminates the need to use scaling factors to determine baseline models and efficiency levels for the low- and high-BF products. For example, if efficiency increased with ballast factor, it would be reasonable to set standards as a function of ballast factor, similar to the way refrigeration products are regulated in terms of refrigerated volume. (California Utilities, No. 30 at p. 3; NEEA and NPCC, No. 32 at pp. 3, 5)

Regarding starting method, GE commented that DOE's scaling yields slightly higher efficiency ratings for some programmed start ballasts compared to instant start ballasts, which is not consistent with what is found in the industry. Philips' analysis found that the scaling factor for programmed start should be 3 percent relative to instant start ballasts instead of the 2.2 percent calculated by DOE. The NEEA and NPCP suggested that DOE re-verify its scaling factor for starting method in light of the differences between DOE's scaling factors and those found by Philips. (GE, Public Meeting Transcript, No. 34 at pp. 25–26; Philips, Public Meeting Transcript, No. 34 at p. 190; NEEA and NPCC, No. 32 at p. 6)

As discussed in section 0, DOE found that BLE could be modeled as a function of total lamp arc power. In this NOPR, DOE proposes to set standards in terms of an equation that assigns a BLE value based on the total rated lamp power operated by the ballast. This equation eliminates the need for scaling relationships based on number of lamps and ballast factor that were necessary in the preliminary TSD. A scaling factor was still necessary for starting method, as described below.

Although DOE set efficiency levels for some PS ballasts directly, DOE did not analyze 8-foot HO PS ballasts directly. Thus, it was necessary to develop a scaling relationship for this starting method. To do so, DOE compared 4-foot MBP IS ballasts to their PS counterparts. DOE found the average reduction in BLE to be 2 percent. Thus, DOE proposes to apply this scaling factor to the efficiency levels for 8-foot HO IS ballasts to determine the appropriate values for programmed start products.

D. Markups To Determine Product Price

By applying markups to the MSPs estimated in the engineering analysis, DOE estimated the amounts consumers would pay for baseline and more efficient products. At each step in the distribution channel, companies mark up the price of the product to cover business costs and profit margin. Identifying the appropriate markups and ultimately determining consumer product price depend on the type of distribution channels through which the product moves from manufacturer to consumer.

1. Distribution Channels

Before it could develop markups, DOE needed to identify distribution channels (*i.e.,* how the products are distributed from the manufacturer to the end user) for the ballast designs addressed in this rulemaking. Most ballasts used in commercial and industrial applications pass through one of two types of distribution channels—an original equipment manufacturer (OEM) channel and a wholesaler channel. The OEM distribution channel applies to ballasts installed in fixtures. In this distribution channel, the ballast passes from the manufacturer to a fixture OEM who in turn sells it to an electrical wholesaler (*i.e.,* distributor); from the wholesaler it passes to a contractor, and finally to the end user. The wholesaler distribution channel applies to ballasts not installed in fixtures (*e.g.,* replacement ballasts). In this distribution channel, the ballast passes from the manufacturer to an electrical wholesaler, then to a contractor, and finally to the end user.

The NEEA and NPCC asked why DOE had not considered a distribution channel for residential ballasts in its preliminary TSD. (NEEA and NPCC, Public Meeting Transcript, No. 12 at p. 225; NEEA and NPCC, No. 32 at p. 8) The NEEA and NPCC and Philips noted that end users of residential ballasts would typically purchase an entire new fixture rather than replace a ballast in an existing fixture; GE questioned this generalization. (NEEA and NPCC, Public Meeting Transcript, No. 22 at pp. 225–226; Philips, Public Meeting Transcript, No. 7 at p. 258; GE, Public Meeting Transcript, No. 16 at p. 259) DOE agreed that a separate distribution channel is applicable for residential ballasts, and included it in the revised markups analysis. Because DOE could not obtain retailer sales data detailing the breakdown between fixture ballasts and replacement ballasts, however, DOE assumed for the markups analysis that the manufacturer sells the residential ballast to a fixture OEM who in turn sells it in a fixture to a home improvement retailer, where it is purchased by the end user.

2. Estimation of Markups

Publicly-owned companies must disclose financial information regularly through filings with the U.S. Securities and Exchange Commission (SEC). Filed annually, SEC form 10-K provides a comprehensive overview of the company's business and financial conditions. To estimate OEM, wholesaler, and retailer markups, DOE used financial data from 10-K reports from publicly owned lighting fixture manufacturers, electrical wholesalers, and home improvement retailers.

DOE's markup analysis developed both baseline and incremental markups to transform the ballast MSP into an end user equipment price. DOE used the baseline markups to determine the price of baseline designs. Incremental markups are coefficients that relate the change in the MSP of higher-efficiency designs to the change in the OEM, wholesaler, and retailer sales prices. These markups refer to higher-efficiency designs sold under market conditions with new energy conservation standards. The calculated average baseline markups for fixture OEM companies, electrical wholesalers, and home improvement retailers were 1.50, 1.23, and 1.51, respectively. The average incremental markups for OEMs, wholesalers, and home improvement retailers were 1.17, 1.05, and 1.15, respectively.

Several commenters expressed concern that markups based on companies' overall financial data might not represent actual markups for ballasts. (Osram Sylvania, Public Meeting Transcript, No. 2 at p. 205; NEEA and NPCC, No. 32 at p. 6; NEMA, No. 29 at pp. 12–13) In contrast, ASAP supported DOE's markups estimation method, citing the public availability of SEC data. (ASAP, No. 2 at p. 207) While recognizing that SEC form 10-K data is not product-specific, DOE assumes that actual product markups are generally business-sensitive. DOE contacted the National Association of Electrical Distributors (NAED) and received feedback from two NAED member companies, both confirming that DOE's calculated wholesaler markups were consistent with their actual ballast markups. With assistance from NEMA, DOE sought a similar evaluation of ballast markups from several representative fixture OEMs, but did not receive feedback in time for publication of the proposed rule. DOE will consider any data received in response to this NOPR in developing markups for the final rule.

To estimate markups for residential ballast designs, DOE requested financial data for representative home improvement retailers. The NEEA and NPCC commented that Home Depot and Lowe's together account for a significant portion of the home improvement retail market. (NEEA and NPCC, Public Meeting Transcript, No. 12 at p. 225) Philips corroborated this point. (Philips, Public Meeting Transcript, No. 7 at p. 258) DOE contacted Home Depot and Lowe's regarding price markups for fluorescent lighting products, but both organizations declined to comment, citing competition concerns. Consequently, DOE based its retailer markups on financial data from 10-K reports.

For ballasts used in commercial and industrial applications, DOE adjusted the calculated average baseline and incremental markups to reflect estimated proportions of ballasts sold through the OEM and wholesaler distribution channels. DOE assumed ballasts in the fixture OEM channel represent 63 percent of the market and ballasts in the wholesaler channel represent 37 percent. These percentages are from chapter 3 (engineering analysis) of the final TSD for the 2000 Ballast Rule and were based on a comment submitted by NEMA for that rulemaking. DOE then multiplied the resulting weighted average markups by a contractor markup of 1.13 (also from the 2000 Ballast Rule, and used in the 2009 Lamps Rule) and sales tax to develop total weighted baseline and incremental markups, which reflect all individual markups incurred in the ballast distribution channels. For residential ballasts, DOE assumed that end users purchased ballasts—already installed in fixtures—directly from home improvement retailers with no contractor involvement or markup. DOE used OEM and retailer markups and sales tax to calculate total baseline and incremental markups for residential ballasts.

The sales tax represents state and local sales taxes applied to the end user equipment price. DOE derived state and local taxes from data provided by the Sales Tax Clearinghouse.[28] These data represent weighted averages that include state, county and city rates. DOE then derived population-weighted average tax values for each census division and large State, and then derived U.S. average tax values using a population-weighted average of the census division and large State values. This approach provided a national average tax rate of 7.25 percent.

3. Summary of Markups

Table V.4 summarizes the markups at each stage in the distribution channel and the overall baseline and incremental markups, and sales taxes, for each of the three identified channels. For commercial and industrial ballasts, weighting the markups in each channel by the share of shipments in that channel yields an average overall baseline markup of 1.96 and an average overall incremental markup of 1.41. For residential ballasts, DOE calculated an overall baseline markup of 2.43 and an overall incremental markup of 1.43.

TABLE V.4—SUMMARY OF BALLAST DISTRIBUTION CHANNEL MARKUPS

VI.	Commercial/industrial ballasts				Residential ballasts	
	OEM distribution (ballasts in fixtures)		Wholesaler distribution (ballasts only)		Retailer distribution (ballasts in fixtures)	
	Baseline	Incremental	Baseline	Incremental	Baseline	Incremental
Fixture OEM	1.50	1.17			1.50	1.17
Electrical Wholesaler (Distributor)	1.23	1.05	1.23	1.05		
Home Improvement Retailer					1.51	1.15
Contractor or Installer	1.13	1.13	1.13	1.13		
Sales Tax	1.07		1.07		1.07	
Overall	2.24	1.48	1.49	1.27	2.43	1.43
Assumed Market Percentage	63		37		100	
Overall (Weighted)	1.96 (Baseline)		1.41 (Incremental)		2.43	1.43

Using these markups, DOE generated ballast end user prices for each efficiency level it considered, assuming that each level represents a new minimum efficiency standard. Chapter 7 of the TSD provides additional detail on the markups analysis.

A. Energy Use Analysis

For the energy use analysis, DOE estimated the energy use of ballasts in the field (*i.e.,* as they are actually used by consumers). The energy use analysis provided the basis for other DOE analyses, particularly assessments of the energy savings and the savings in consumer operating costs that could result from DOE's adoption of new and amended standard levels.

To develop annual energy use estimates, DOE multiplied annual usage (in hours per year) by the lamp-and-ballast system input power (in watts). DOE characterized representative lamp-and-ballast systems in the engineering analysis, which provided measured and normalized system input power ratings (the latter used to compare baseline- and standards-case systems on an equal light-output basis). To characterize the country's average use of lamp-and-ballast systems for a typical year, DOE developed annual operating hour distributions by sector, using data published in the U.S. Lighting Market Characterization: Volume I (LMC),[29] the Commercial Building Energy Consumption Survey (CBECS),[30] the Manufacturer Energy Consumption Survey (MECS),[31] and the Residential Energy Consumption Survey (RECS).[32] DOE assumed, based on its market and technology assessment, that PS ballasts operating 4-foot MBP T8 lamps in the commercial sector were operated on occupancy sensors. Based on its survey of available literature, DOE assumed that occupancy sensors would result, on average, in a 30-percent reduction in annual operating hours.

The NEEA and NPCC generally approved of DOE's analysis of lighting end-use profiles and the resulting annual operating hour estimates. (NEEA and NPCC, No. 32 at p. 7) NEMA agreed, but asked if the commercial average operating hours accounted for retailers

[28] The Sales Tax Clearinghouse. Available at *https://thestc.com/STRates.stm.* (Last accessed July 20, 2010.)

[29] 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://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/lmc_vol1.pdf.*

[30] 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 *http://www.eia.doe.gov/emeu/cbecs/public_use.html.*

[31] U.S. Department of Energy, Energy Information Agency. *Manufacturing Energy Consumption Survey, Table 1.4: Number of Establishments Using Energy Consumed for All Purpose.* 2006. Available at *http://www.eia.doe.gov/emeu/mecs/mecs2006/2006tables.html.*

[32] U.S. Department of Energy, Energy Information Agency. *Residential Energy Consumption Survey: File 1: Housing Unit Characteristics.* 2005. Available at *http://www.eia.doe.gov/emeu/recs/recspubuse05/pubuse05.html.*

with longer or continuous daily operations. (NEMA, No. 29 at p. 11) As noted in the LMC final report, some expected data points are lost in the averaging process. For example, 24-hour retailers are outweighed in the commercial sector by the volume of office and retail space that does not operate 24 hours per day. For the proposed rule, DOE retained its approach for estimating average sector operating hours, the values for which changed slightly based on updated census data inputs.

Based on a range of published estimates, DOE assumed energy savings of 30 percent for lamp-and-ballast systems using occupancy sensors in the commercial sector. To account for these energy savings, DOE reduced average operating hours for analyzed PS ballast systems by 30 percent. Lutron's literature review indicated savings from 17 percent–60 percent, and they agreed that 30 percent was a reasonable average value. (Lutron, Public Meeting Transcript, No. 4 at p. 206) While noting that the use of occupancy sensors is not limited to the commercial sector, NEMA agreed with DOE's assumption that PS ballasts were used with occupancy sensors and commented that DOE's 30-percent savings estimate was conservative. (NEMA, No. 29 at p. 12) DOE agrees that occupancy sensor use is not limited to the commercial sector, but notes that the analyzed PS ballast designs (which operate 4-foot MBP T8 lamps) are intended primarily for commercial applications. The analyzed ballasts for 4-foot MiniBP T5 lamps (SO and HO) are also PS designs; however, unlike T8 systems, PS ballast design is intrinsic to T5 systems and not conditioned on occupancy sensor use. Therefore, DOE did not assume operating hour reductions for T5 SO (commercial sector) and T5 HO (industrial sector) lamp-and-ballast systems in its energy use analysis.

Chapter 6 of the TSD provides a more detailed description of DOE's energy use analysis for ballasts.

B. Life-Cycle Cost and Payback Period Analyses

DOE conducted LCC and PBP analyses to evaluate the economic impacts of potential energy conservation standards for ballasts on individual consumers. The LCC is the total consumer expense over the life of a product, consisting of purchase and installation costs and operating costs (expenses for energy use, maintenance, and repair). To compute the operating costs, DOE discounted future operating costs to the time of purchase and summed them over the lifetime of the product. The PBP is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of a more efficient product through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost (normally higher) by the change in average annual operating cost (normally lower) that results from the more efficient standard.

For any given efficiency or energy use level, DOE measures the PBP and the change in LCC relative to an estimated base-case product efficiency or energy use level. The base-case estimate reflects the market without new or amended mandatory energy conservation standards, including the market for products that exceed the current energy conservation standards.

Inputs to the calculation of total installed cost include the cost of the product—which includes MSPs, distribution channel markups, and sales taxes—and installation costs. Inputs to the calculation of operating expenses include annual energy consumption, energy prices and price projections, repair and maintenance costs, product lifetimes, discount rates, and the year that proposed standards take effect. To account for uncertainty and variability, DOE created value distributions for selected inputs, including: operating hours, electricity prices, discount rates and sales tax rates, and disposal costs. For example, DOE created a probability distribution of annual energy consumption in its energy use analysis, based in part on a range of annual operating hours. The operating hour distributions capture variation across census divisions and large States, building types, and lamp-and-ballast systems for three sectors (commercial, industrial, and residential). In contrast, ballast MSPs were specific to the representative ballast designs evaluated in DOE's engineering analysis; and price markups were based on limited publicly available financial data. Consequently, DOE used discrete values instead of distributions for these inputs.

The computer model DOE uses to calculate the LCC and PBP, which incorporates Crystal Ball (a commercially available software program), relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations randomly sample input values from the probability distributions and ballast user samples, performing more than 10,000 iterations per simulation run. The NOPR TSD chapter 8 and its appendices provide details on the spreadsheet model and of all the inputs to the LCC and PBP analyses.

Table V.5 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations for the preliminary TSD as well as the changes made for today's NOPR. The subsections that follow discuss the initial inputs and DOE's changes to them. In addition, as noted in section 0 "Issues on Which DOE Seeks Comment", DOE seeks comment on the appropriateness of including T12 ballasts in the baseline analysis for life cycle costs.

TABLE V.5—SUMMARY OF INPUTS AND KEY ASSUMPTIONS IN THE LCC AND PBP ANALYSES*

Inputs	Preliminary TSD	Changes for the proposed rule
Product Cost	Derived by multiplying ballast MSPs by distribution channel markups and sales tax.	No change.
Installation Cost	Derived costs using estimated labor times, and applicable labor rates from *RS Means Electrical Cost Data* (2007) and U.S. Bureau of Labor Statistics.	Updated labor rates from 2008$ to 2009$.
Annual Energy Use	Determined operating hours by associating building type-specific operating hours with regional distributions of various building types using lighting market and building energy consumption survey data (see section 0 above).	Used the most recent available versions of building energy consumption survey data: LMC (2002), CBECS (2003), MECS (2006), and RECS (2005).
Energy Prices	Electricity: Based on EIA's Form 861 data for 2007 Variability: Regional energy prices determined for 13 regions.	Electricity: Updated using Form 826 data for 2009. Variability: Energy prices determined at state level.

TABLE V.5—SUMMARY OF INPUTS AND KEY ASSUMPTIONS IN THE LCC AND PBP ANALYSES*—Continued

Inputs	Preliminary TSD	Changes for the proposed rule
Energy Price Projections	Forecasted using Annual Energy Outlook 2009 *AEO2009*.	Forecasts updated using *AEO2010*.
Replacement and Disposal Costs	Commercial/Industrial: Included labor and materials costs for lamp replacement, and disposal costs for failed lamps. Residential: Included only materials cost for lamps, with no lamp disposal costs.	Updated labor rates from 2008$ to 2009$. Variability: Assumed commercial and industrial consumers pay recycling costs in approximately 30 percent of lamp failures and 5 percent of ballast failures.
Product Lifetime	Ballasts: Lifetime based on average lifetimes from the 2000 Ballast Rule (and used in the 2009 Lamps Rule). Lamps: assumed as 91 percent–94 percent of rated life, to account for lamp type and relamping practices.	No change.
Discount Rates	Commercial/Industrial: Estimated cost of capital to affected firms and industries; developed weighted average of the cost to the company of equity and debt financing. Residential: Estimated by examining all possible debt or asset classes that might be used to purchase ballasts.	Variability: Developed a distribution of discount rates for each end-use sector.
Compliance Date of Standards	2014	No change.
Ballast Purchasing Events	Assessed two events: Ballast failure and new construction/renovation.	No change.

* References for the data sources mentioned in this table are provided in the sections following the table or in chapter 8 of the NOPR TSD.

1. Product Cost

To calculate consumer product costs, DOE multiplied the MSPs developed in the engineering analysis by the distribution channel markups described above (along with sales taxes). DOE used different markups for baseline products and higher-efficiency products, because the markups estimated for incremental costs differ from those estimated for baseline models. In response to comments on the preliminary TSD, DOE's revised analysis included a distribution channel with corresponding markups for residential ballasts.

On February 22, 2011, DOE published a Notice of Data Availability (NODA, 76 FR 9696) stating that DOE may consider improving regulatory analysis by addressing equipment price trends. Consistent with the NODA, DOE examined historical producer price indices (PPI) for fluorescent ballasts and found both positive and negative real price trends depending on the specific time period examined. Therefore, in the absence of a definitive trend, DOE assumes in its price forecasts for this NOPR that the real prices of fluorescent ballasts are constant in time and that fluorescent ballast prices will trend the same way as prices in the economy as a whole. DOE is aware that there have been significant changes in both the regulatory environment and mix of fluorescent ballast technologies during this period that create analytical challenges for estimating longer-term product price trends from the product-specific PPI data. DOE performed price trends sensitivity calculations to examine the dependence of the analysis results on different analytical assumptions. A more detailed discussion of price trend modeling and calculations is provided in Appendix 8A of the TSD. DOE invites comment on methods to improve its equipment price forecasting for fluorescent lamp ballasts beyond the assumption of constant real prices, as well as any data supporting alternate methods.

2. Installation Cost

The installation cost is the total cost to the consumer to install the equipment, excluding the marked-up consumer product price. Installation costs include labor, overhead, and any miscellaneous materials and parts. As detailed in the preliminary TSD, DOE considered the total installed cost of a lamp-and-ballast system to be the consumer product price (including sales taxes) plus the installation cost. DOE applied installation costs to lamp-and-ballast systems installed in the commercial and industrial sectors, treating an installation cost as the product of the average labor rate and the time needed for installation. Using the same approach, DOE assumed that residential consumers must pay for the installation of a fixture containing a lamp-and-ballast system, and calculated installation price in the same manner.

3. Annual Energy Use

As discussed above, DOE estimated the annual energy use of representative lamp-and-ballast systems using system input power ratings and sector operating hours. The annual energy use inputs to the LCC and PBP analyses are based on average annual operating hours, whereas the Monte Carlo simulation draws on a distribution of annual operating hours to determine annual energy use.

4. Energy Prices

For the LCC and PBP, DOE derived average energy prices for 13 U.S. geographic areas consisting of the nine census divisions, with four large States (New York, Florida, Texas, and California) treated separately. For census divisions containing one of these large States, DOE calculated the regional average excluding the data for the large State. The derivation of prices was based on data from EIA Form 861, "Annual Electric Power Industry Database," and EIA Form 826, "Monthly Electric Utility Sales and Revenue Data."

5. Energy Price Projections

To estimate the trends in energy prices for the preliminary TSD, DOE used the price forecasts in *AEO2009.* To arrive at prices in future years, DOE multiplied current average prices by the forecast of annual average price changes in *AEO2009.* Because *AEO2009* forecasts prices to 2035, DOE followed past EIA guidelines and used the average rate of change from 2020 to 2035 to estimate the price trend for electricity after 2035. For today's proposed rule, DOE used the same approach, but updated its energy price forecasts using *AEO2010.* DOE intends to update its energy price forecasts for the final rule based on the latest available *AEO.* In addition, the spreadsheet tools that DOE used to conduct the LCC and PBP analyses allow users to select price forecasts from *AEO's* low-growth, high-growth, and reference case scenarios to estimate the sensitivity of the LCC and PBP to different energy price forecasts.

The California Utilities commented that DOE should address the time-dependent value of energy to account for the potentially higher value of energy savings that occur during peak demand periods. (California Utilities, No. 30 at p. 5) DOE acknowledges that using peak and off-peak electricity prices in estimating the value of energy savings is consistent with using marginal electricity prices to assign value to energy savings, with the assumption that standards reduce energy consumption at the margin. A 1999 DOE report presents a procedure for deriving marginal prices for rulemaking and compares resulting marginal prices to average prices in the commercial and residential sectors.[33] Even though the variation in differences between marginal and average prices was high (from −85 percent to 51 percent), marginal prices were lower than average prices by 5.2 percent on average; the median value for the difference was 3.3 percent. For the proposed rule, DOE's analytical tools allow users to select between the low, high, and reference case scenario *AEO.* DOE believes this approach captures variation in energy prices (and in the value of energy savings) within a range similar to the difference between marginal and average prices.

6. Replacement and Disposal Costs

In its preliminary TSD, DOE addressed lamp replacements occurring within the analysis period as part of operating costs for considered lamp-and-ballast system designs. Replacement costs in the commercial and industrial sectors included the labor and materials costs associated with replacing a lamp at the end of its lifetime, discounted to $2011. For the residential sector, DOE assumed that consumers would install their own replacement lamps and incur no related labor costs.

Some consumers recycle failed lamps and ballasts, thus incurring a disposal cost. In its research, DOE found average disposal costs of 10 cents per linear foot for GSFL and $3.50 for each ballast.[34] A 2004 report by the Association of Lighting and Mercury Recyclers noted that approximately 30 percent of lamps used by businesses and 2 percent of lamps in the residential sector are recycled nationwide.[35] Consistent with the 2009 Lamps Rule, DOE considered the 30-percent lamp-recycling rate to be significant and incorporated lamp disposal costs into the LCC analysis for commercial and industrial consumers. DOE was not able to obtain ballast recycling rate data, but assumed that higher disposal costs would largely discourage voluntary ballast recycling by commercial and industrial consumers, and did not include ballast disposal costs in the LCC analysis. Given the very low (2 percent) estimated lamp recycling rate in the residential sector, DOE assumed that residential consumers would be even less likely to voluntarily incur the higher disposal costs for ballasts. Therefore, DOE excluded the disposal costs for lamps or ballasts from the LCC analysis for residential ballast designs.

DOE received no comments on the preliminary TSD concerning these assumed recycling rates, disposal costs, and their application in the LCC analysis. The Monte Carlo simulation for the proposed rule allowed DOE to examine variability in recycling practices; consequently, DOE assumed that commercial and industrial consumers pay recycling costs in 5 percent of ballast failures—as well as the 30 percent of lamp failures assumed in the LCC analysis. As in the LCC analysis, DOE assumed that residential lamp and ballast disposal rates were insignificant, and excluded the related disposal costs from the Monte Carlo simulation for residential ballast designs.

7. Product Lifetime

Chapter 8 of the preliminary TSD detailed DOE's basis for average ballast lifetimes, which were based on assumptions used in the 2000 Ballast Rule and the 2009 Lamps Rule. For ballasts in the commercial and industrial sectors, DOE used an average ballast lifetime of 49,054 hours that, when combined the respective average annual operating hours, yielded average ballast lifetimes of approximately 13 years and 10 years, respectively. Consistent with the 2000 Ballast Rule and the 2009 Lamps Rule, DOE assumed an average ballast lifetime of approximately 15 years in the residential sector, which corresponds with 11,835 hours total on an assumed 789 hours per year operating schedule. To account for a range of group and spot relamping practices, DOE assumed that lamps operated, on average, for 91 percent–94 percent of rated life, depending on lamp type.

DOE received several general comments on ballast design and lifetime. Philips and NEMA noted that lead-free solder used per RoHS directives could affect ballast lifetime, but that its effects on reliability were still largely unknown. (Philips, Public Meeting Transcript, No. 8 at p. 187; NEMA, No. 29 at p. 14) Philips agreed with DOE's assumption that lifetime would not increase with more efficient ballast designs, based in part on the trend toward smaller luminaires and higher operating temperatures. (Philips, Public Meeting Transcript, No. 18 at pp. 231–232) In contrast, the NEEA and NPCC saw no reason to assume that ballast lifetime would be affected by luminaire or ballast enclosure size, but conceded that related ballast failure data is limited. (NEEA and NPCC, No. 32 at p. 8) There was general agreement that ballast lifetime can vary widely and encompasses both physical failure and economic lifetime (*e.g.,* replacement of functioning ballasts due to retrofits). (NEMA, Public Meeting Transcript, No. 20 at pp. 244–246; NEEA and NPCC, No. 32 at p. 8) However, NEMA agreed with DOE's assumed average ballast lifetimes of 10 − 15 years used in the LCC analysis. (NEMA, No. 29 at p. 14)

Based on comments received to date, DOE believes that its assumed average ballast lifetimes are appropriate and applied these lifetimes in the LCC analysis for today's proposed rule. DOE also agrees that ballast lifetimes can vary due to both physical failure and economic factors (*e.g.,* early replacements due to retrofits). Consequently, DOE accounted for variability in lifetime in LCC and PBP via the Monte Carlo simulation, and in the shipments and NIA analyses by assuming a Weibull distribution for lifetimes to accommodate failures and replacement.

8. Discount Rates

The discount rate is the rate at which future expenditures are discounted to estimate their present value. In its preliminary TSD, DOE derived separate discount rates for commercial,

[33] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. *Marginal Energy Prices Report.* July 1999. Available at *http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/marg_eprice_0799.pdf.*

[34] Environmental Health and Safety Online's fluorescent lights and lighting disposal and recycling Web page—Recycling Costs. Available at *http://www.ehso.com/fluoresc.php.* (Last accessed Sept. 26, 2010.)

[35] Association of Lighting and Mercury Recyclers, "National Mercury-Lamp Recycling Rate and Availability of Lamp Recycling Services in the U.S." Nov. 2004.

industrial, and residential consumers. For commercial and industrial consumers, DOE estimated the cost of capital to affected firms and industries, from which it developed a weighted average of the cost to the company of equity and debt financing. DOE estimated the discount rate for residential consumers by looking across all possible debt or asset classes that might be used to purchase ballasts. For the proposed rule, DOE also developed a distribution of discount rates for each end-use sector from which the Monte Carlo simulation samples.

For the industrial and commercial sectors, DOE assembled data on debt interest rates and the cost of equity capital for representative firms that use ballasts. DOE determined a distribution of the weighted-average cost of capital for each class of potential owners using data from the Damodaran online financial database.[36] DOE used the same distribution of discount rates for the commercial and industrial sectors. The average discount rates in DOE's analysis, weighted by the shares of each rate value in the sectoral distributions, are 6.86 percent for commercial end users and 7.15 percent for industrial end users.

For the residential sector, DOE assembled a distribution of interest or return rates on various equity investments and debt types from a variety of financial sources, including the Federal Reserve Board's "Survey of Consumer Finances" (SCF) in 1989, 1992, 1995, 1998, 2001, and 2004. DOE added 2007 SCF data for today's proposed rule and assigned weights in the distribution based on the shares of each financial instrument in household financial holdings according to SCF data. The weighted-average discount rate for residential product owners is 5.55 percent.

In response to the preliminary LCC analysis, NEMA commented that DOE should examine the effects of applying higher discount rates to the value of projected energy savings, contending that consumers will discount future benefits heavily and place greater emphasis on a product's first cost. (NEMA, Public Meeting Transcript, No. 2 at p. 251) DOE believes that its weighted-average discount rates are representative and appropriate for the LCC analysis because they are grounded in a vetted, transparent methodology and publicly-available financial data. DOE lacks a defensible basis for estimating a representative, individual discount rate, which would vary significantly by company and product type. However, DOE also considered a distribution of discount rates (lower and higher than the average) in its Monte Carlo simulation for today's proposed rule.

9. Compliance Date of Standards

The compliance date is the date when a covered product is required to meet a new or amended standard. EPCA requires that any amended standards established in this rule apply to products manufactured after a date that is five years after—(i) the effective date of the previous amendment; or (ii) if the previous final rule did not amend the standards, the earliest date by which a previous amendment could have been effective; except that in no case may any amended standard apply to products manufactured within three years after publication of the final rule establishing such amended standard. (42 U.S.C. 6295(g)(7)(C)). DOE is required by consent decree to publish any amended standards for ballasts by June 30, 2011. As a result, and in compliance with 42 U.S.C. 6295(g)(7)(C), DOE expects the compliance date to be three years after the publication of any final amended standards, by June 30, 2014. DOE received no comments on its expected effective date of June 2014 and calculated the LCC for all end users as if each one would purchase a new ballast in the year compliance with the standard is required.

10. Ballast Purchasing Events

DOE designed the LCC and PBP analyses for this rulemaking around scenarios where consumers need to purchase a ballast. Each of these events may give the consumer a different set of ballast or lamp-and-ballast designs and, therefore, a different set of LCC savings for a certain efficiency level. The two scenarios were (1) ballast failure and (2) new construction/renovation. In the ballast failure scenario, DOE assumed that the consumer would generally select a standards-compliant lamp-and-ballast combination such that the system light output never drops below 10 percent of the baseline system. For new construction/renovation, DOE assumed that consumers were not constrained by existing fixture layouts, and could design a new installation that matched the overall light output of a base-case system, independent of individual system light output. DOE used rated system input power to calculate annual energy use for the ballast failure scenario. For new construction/renovation, DOE used normalized system input power, adjusted to yield equivalent light output from both the base-case and substitute systems.

The California Utilities stated that failure replacements were rare and commented that DOE should include a separate ballast purchasing event for retrofits in its LCC analysis, as the California Utilities consider that the more common purchasing event. (California Utilities, No. 30 at p. 4) In its review of available studies and *EIA* data, DOE found that predicted retrofit rates for the nation were comparatively low (*i.e.,* less than 5 percent). DOE assumes that retrofit rates in areas with utility incentive programs would typically be higher; however, DOE could not substantiate extending these higher retrofit rates to all consumers and therefore did not consider a separate retrofit scenario in its LCC analysis.

As discussed in section 0 above, the California Utilities and the NEEA and NPCC and the California Utilities believe that DOE was incorrect in assuming consumers would not be able to normalize individual system light output in a ballast failure replacement scenario. Both sets of commenters contended that ballast designs will be available that maintain efficiency across different ballast factors and system light outputs. The California Utilities also noted that users can also maintain system light output by adjusting the number of lamps, lamp type, or fixture reflectors. To simplify the analysis, the NEEA and NPCC suggested that DOE should analyze normalized system input power in all scenarios. (California Utilities, No. 30 at pp. 3–5; NEEA and NPCC, No. 32 at pp. 6–7) Philips disagreed that light output could be maintained in all substitution cases. (Philips, Public Meeting Transcript, No. 34 at p. 227)

For this NOPR, DOE maintained the input power distinction (*i.e.,* rated versus normalized) for purchasing scenarios in the LCC analysis, which it believes reflects product offerings facing the individual consumer in the near term (*i.e.,* 2014). With the exception of system input power, the ballast failure and new construction/renovation scenarios differ only slightly, with the latter scenario requiring an additional 2.5 minutes of labor for installing a luminaire disconnect. The results for the new construction/renovation scenario could, therefore, be considered similar to a ballast failure replacement scenario based on normalized system input power. For the proposed rule, DOE used normalized system input power only in the NIA, for reasons discussed in section 0 below.

[36] The data are available at *http://pages.stern.nyu.edu/~adamodar.*

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

DOE's NIA assessed the national energy savings (NES) and the national net present value (NPV) of total consumer costs and savings that they would be expect to result from new or amended standards at specific efficiency levels. ("Consumer" in this context refers to consumers of the regulated product.)

DOE used an MS Excel spreadsheet model to calculate the energy savings and the national consumer costs and savings from each TSL. In addition, the TSD and other documentation that DOE provides during the rulemaking help explain the models and how to use them, allowing interested parties to review DOE's analyses by changing various input quantities within the spreadsheet.

DOE used the NIA spreadsheet to calculate the NES and NPV, based on the annual energy consumption and total installed cost data from the energy use and LCC analyses. DOE forecasted the energy savings, energy cost savings, product costs, and NPV of consumer benefits for each product class for products sold from 2014 through 2043. The forecasts provided annual and cumulative values for all four output parameters. DOE examines sensitivities in the NIA by analyzing different efficiency scenarios, such as Roll-up and Shift.

DOE evaluated the impacts of new and amended standards for ballasts by comparing base-case projections with standards-case projections. The base-case projections characterize energy use and consumer costs for each product class in the absence of new or amended energy conservation standards. DOE compared these projections with projections characterizing the market for each product class if DOE adopted new or amended standards at specific energy efficiency levels (*i.e.,* the TSLs or standards cases) for that class. In characterizing the base and standards cases, DOE considers historical shipments, the mix of efficiencies sold in the absence of new standards, and how that mix may change over time. Additional information about the NIA spreadsheet is in NOPR TSD chapter 11.

Table V.6 summarizes the approach and data DOE used to derive the inputs to the NES and NPV analyses for the preliminary TSD, as well as the changes to the analyses for the proposed rule. A discussion of selected inputs and changes follows. See chapter 11 of the NOPR TSD for further details.

TABLE V.6—APPROACH AND DATA USED FOR NATIONAL ENERGY SAVINGS AND CONSUMER NET PRESENT VALUE ANALYSES

Inputs	Preliminary TSD	Changes for the proposed rule
Shipments	Derived annual shipments from shipments model.	*See* Table V.7.
Compliance Date of Standard	2014	No change.
Annual Energy Consumption per Unit	Established in the energy use characterization (preliminary TSD chapter 6).	Energy use characterization updated using most recent available inputs; based annual unit energy consumption on normalized system input power.
Rebound Effect	1 percent in commercial and industrial sectors, 8.5 percent in residential sector.	No change.
Electricity Price Forecast	*AEO2008*	*AEO2010*.
Energy Site-to-Source Conversion Factor	Used average conversion factors based on *AEO2008*.	Used marginal conversion factors generated by NEMS–BT; factors held constant after 2035.
Discount Rate	3% and 7% real	No change.
Present Year	2009	2011.

1. Annual Energy Consumption per Unit

As discussed in section 0 above, the California Utilities and the NEEA and NPCC suggested that both individual ballast failure replacements and system installations for new construction/renovation could be normalized for light output at any given efficiency level. This could be accomplished through foreseeable ballast design options and/or lighting system modifications (*e.g.,* number of lamps, lamp type, or fixture reflector). NEEA and NPCC contended that DOE could then simplify its analyses by applying normalized system input power throughout. (California Utilities, No. 30 at pp. 3–5; NEEA and NPCC, No. 32 at pp. 6–7)

In its preliminary analysis, DOE used both rated and normalized system input power in determining the annual unit energy consumption for the NIA. As in the LCC analysis, ballast shipments for failure replacements were assigned rated system input power, and this assumption was applied across the entire 30-year analysis period. DOE agrees that the lighting system modifications noted by the California Utilities can have the practical effect of normalizing light output for individual replacement systems. Therefore, DOE believes that normalized system input power provides a reasonable basis for estimating future energy savings.

For the proposed rule, DOE revised the shipments and NIA spreadsheet models to reflect the revised product class structure, and provide increased flexibility and transparency for the spreadsheet user. Using only normalized system input power also simplified the accounting functions within the NIA model, compared to the combined (rated and normalized input power) approach used in the preliminary analysis.

DOE also examined the relative effects of applying normalized versus rated input power in determining energy savings. Normalizing the input power of replacement systems typically reduces the differences in input power between the baseline system and replacement systems; consequently, DOE found that normalized values resulted in lower energy savings estimates than those based on rated input power. However, DOE believes that the differences in estimated NES between a normalized-only and combined approach would be minor, particularly compared to the range of NES bounded by DOE's two ballast shipment scenarios (existing and emerging technologies, discussed in section 0 below).

In summary, DOE believes that its revised NIA using normalized system input power produces a range of estimated NES that captures the potential—and significant—energy savings for ballasts.

2. Shipments

Product shipments are an important component of any estimate of the future impact of a standard. Using a three-step process, DOE developed the shipments portion of the NIA spreadsheet, a model that uses historical data as a basis for projecting future ballast shipments. First, DOE used 1990–2005 shipment data from the U.S. Census Bureau to estimate the total historical shipments for each ballast type analyzed. Second, DOE calculated an installed stock for each ballast type based on an assumed service lifetime distribution. Third, by modeling ballast market segments (*i.e.,* purchasing events) and applying growth rate, lifetime distribution, and emerging technologies penetration rate assumptions, DOE developed annual shipment projections for the analysis period 2014–2043. In projecting ballast shipments, DOE accounted for two market segments: (1) Replacement of failed equipment and (2) retrofits/renovation and new construction. Table V.7 summarizes the approach and data DOE used to derive the inputs to the shipments analysis for the preliminary TSD and the changes DOE made for today's proposed rule. A discussion of these inputs and changes follows. For details on the shipments analysis, *see* chapter 10 of the NOPR TSD.

TABLE V.7—APPROACH AND DATA USED FOR THE SHIPMENTS ANALYSIS

Inputs	Preliminary TSD	Changes for the proposed rule
Historical Shipments	Used historical shipments for 1990–2005 to develop shipments and stock projections for the analysis period; growth pattern exhibited oscillations in shipments projections for some ballast types.	Used same historical data and changed lifetime distribution and growth assumptions, mitigating oscillations in shipment projections.
Ballast Stock	Based projections on the shipments that survive up to a given date; assumed simplified lifetime distribution.	No change for projection methodology; assumed Weibull lifetime distribution.
Growth	Assumed the same growth rate for commercial/industrial and residential floorspace.	Updated using 2010 *AEO* projections for floorspace growth.
Base Case Scenarios	Analyzed both existing technology and emerging technology scenarios.	No change.
Standards Case Scenarios	Analyzed Shift and Roll-up scenarios based on both existing and emerging technology cases.	No change.

a. Historical Shipments

For the preliminary TSD, DOE used U.S. Census Bureau Current Industrial Reports (CIR) to estimate historical shipments for affected ballast designs. The census CIR data cover the period 1990–2005 and contain NEMA shipments for individual ballast designs (*e.g.,* 2-lamp F96T8), as well as aggregated shipments for multiple designs to prevent disclosing data for individual companies. For some ballast designs, the CIR withheld shipments data entirely to avoid disclosing data for individual companies.

For CIR reporting years for which specific shipments data were aggregated or unavailable, DOE estimated historical shipments using trends within the available data and/or market trends identified in ballast manufacturer interviews, the 2009 Lamps Rule, and the 2000 Ballast Rule. DOE then increased these estimates to account for the volume of ballasts that non-NEMA companies import or manufacture. To validate its estimation methods for the preliminary TSD, DOE requested historical ballast and residential fixture shipments from NEMA, but was unable to obtain these data due to confidentiality concerns of some affected manufacturers.

In their comments on the preliminary shipments analysis, the NEEA and NPCC noted that census CIR data are incomplete, do not address non-NEMA shipments, and should not be relied on if their deficiencies cannot be remedied. (NEEA and NPCC, No. 32 at p. 10) NEMA agreed in general with DOE's modeled shipment trends in the preliminary TSD. (NEMA, No. 29 at p. 15) DOE acknowledges the shortcomings of CIR data, which are truncated at 2005 (the U.S. Census Bureau discontinued ballast CIR reports in 2006), but believes that census data are the only practical basis for estimating shipments because actual shipments data are either withheld by manufacturers due to confidentiality concerns or not retained in company records, as discussed below. DOE also notes that it accounted for imports and other non-NEMA manufacturers in its preliminary historical shipments analysis, and provides additional discussion in chapter 10 of the NOPR TSD.

To validate its NOPR analysis, DOE again requested historical ballast shipment data from NEMA, but was informed that neither NEMA nor its member companies typically retain data of the vintage in question (1990–2005). Where possible, DOE refined its historical shipment estimates with additional data collected in manufacturer interviews during the NOPR analysis. Based on review of available data and NEMA's general validation of the preliminary shipments model, DOE concludes that census data remain the most reasonable basis for estimating historical ballast shipments, and retains this approach for today's proposed rulemaking.

b. Ballast Stock Projections

In its preliminary shipments analysis, DOE calculated the installed ballast stock using historical shipments estimated from U.S. Census Bureau CIR data (1990–2005) and projected shipments for future years. DOE typically estimates the installed stock during the analysis period by taking ballast shipments and calculating how many will survive up to a given year based on a lifetime distribution for each ballast type. The estimated historical shipments for electronic ballasts exhibited striking growth in 1990–2005, a trend not consistent with a mature market. For the preliminary TSD, DOE reasoned that this significant growth in shipments did not translate to equivalent growth in ballast stock, assuming instead a 2-percent annual growth rate in shipments for new construction and attributing the additional shipments to retrofits.

NEMA, as well as the NEEA and NPCC, questioned attributing the historical growth in electronic ballast shipments to retrofits, rather than of absolute growth in ballast stock. (NEMA, Public Meeting Transcript, No. 7 at p. 248; NEEA and NPCC, No. 32 at p. 9) NEMA contended that strong growth in non-residential construction explained a larger share of new ballast demand than assumed by DOE. (NEMA, Public Meeting Transcript, No. 14 at p. 248) Philips noted that DOE did not account for a corresponding decline in shipments of magnetic ballasts during the period 1990–2005. (Philips, Public Meeting Transcript, No. 6 and No. 15 at p. 244) However, commenters also acknowledged the continuing influence of retrofits driven by utility incentive programs and new lighting technologies. (NEEA and NPCC, Public Meeting Transcript, No. 20 at pp. 246–247; NEMA, Public Meeting Transcript, No. 11 at p. 248)

In its revised analysis, DOE examined census data for ballast shipments and confirmed that magnetic ballast shipments declined significantly in 1990–2005, corresponding with the increase in electronic ballast shipments during the same period. These trends suggest that electronic ballasts (*e.g.,* for 4-foot MBP T8 systems) were eroding shipments of magnetic ballasts (*e.g.,* for 4-foot MBP T12 systems) for retrofits and new construction. Available data do not support NEMA's claim of strong non-residential construction growth in 1990–2005; according to EIA estimates (*e.g.,* in *AEO1996* and *AEO2000*), commercial floorspace growth averaged approximately 1.35 percent annually during this period. A recent DOE lighting report suggests that replacements of failed lighting equipment and lighting retrofits contribute more to shipments than new construction.[37] Based on available information, DOE maintains that the growth rate for historical ballast stock was less than the growth rate for historical shipments of electronic ballasts, which instead reflected a market transition from magnetic to electronic ballasts.

c. Projected Shipments

By modeling ballast market segments and applying lifetime distribution, growth and emerging technologies penetration rate assumptions, and efficiency scenarios, DOE developed annual shipment projections for the analysis period (2014–2043). DOE could not obtain historical ballast shipments data from NEMA to validate its preliminary or NOPR analyses; however, NEMA agreed with DOE's preliminary TSD shipment trends and emerging technology forecasts in general. (NEMA, No. 29 at p. 2; NEMA No. 29 at p. 15) The subsections below address the lifetime, emerging technology, market trend, and efficiency scenario issues that DOE considered in its shipments analysis for the proposed rule.

i. Shipment Patterns and Ballast Lifetime Assumptions

Estimated historical shipments varied from year to year and, when combined with preliminary assumptions for ballast lifetimes, lifetime distributions and floorspace growth, produced periodic oscillations in shipment projections for some ballast types (*e.g.,* ballasts operating 4-foot MBP T8 lamps). For the preliminary TSD, DOE assumed that ballast lifetimes were distributed across the last 3 years of the average physical lifetime for each analyzed ballast type.

DOE received multiple comments regarding the oscillations in its preliminary shipment projections and its underlying assumptions about average ballast lifetimes and lifetime distributions. NEMA commented that the oscillations were too pronounced to be attributed to historical market trends or ballast performance. (NEMA, Public Meeting Transcript, No. 18 at pp. 248–249) The NEEA and NPCC agreed with NEMA that the oscillations were not realistic and suggested that the shipment patterns might stem from DOE's narrow assumed lifetime distributions. (NEEA and NPCC, No. 32 at p. 8) NEMA agreed with DOE's assumed average physical lifetimes for ballasts, but other commenters noted that ballast lifetime distributions should encompass "economic lifetime" (*e.g.,* retrofits of functioning ballasts) as well as physical lifetime (*e.g.,* replacement of failed ballasts). (NEMA, No. 29 at p. 14; Philips, Public Meeting Transcript, No. 25 at pp. 245–246; NEEA and NPCC, No. 32 at p. 9)

DOE agrees that its preliminary ballast shipment projections did not account for a sufficient range of economic and physical lifetimes. In its revised shipment analysis, DOE retained the original average physical lifetimes and used Weibull distributions for ballast lifetimes to better accommodate failures and retrofits. In combination with DOE's revised growth assumptions, the expanded lifetime distributions largely eliminated the pronounced shipment oscillations seen for some ballast types in the preliminary TSD.

ii. Emerging Technology Shipment Forecasts

In its preliminary TSD, DOE modeled the impacts of emerging solid-state lighting (SSL) technologies on shipments of analyzed ballasts used in the commercial sector (*e.g.,* ballasts operating 4-foot MBP T8 lamps). Philips commented that some projections showed SSL technologies capturing as much as 50 percent of the lighting market within 10 years. (Philips, Public Meeting Transcript, No. 22 at pp. 18–19) NEMA agreed with the overall trends in DOE's emerging technology shipment forecasts (excluding oscillations); however, Philips noted that DOE had not included sign ballasts in the same forecasts. (NEMA, No. 29 at p. 2; Philips, Public Meeting Transcript, No. 24 at pp. 234–235) While acknowledging some SSL market penetration, the NEEA and NPCC contended that fluorescent technologies would retain a large share of the signage market, particularly in backlighting applications. (NEEA and NPCC, No. 32 at p. 3)

For its revised shipments analysis, DOE retained its original emerging technology assumptions, with SSL penetration increasing to a maximum of 40 percent by 2028, resulting in decreased shipments for affected ballast types. DOE added sign ballasts to its revised emerging technology shipment forecasts, but agrees that SSL will have only limited penetration of backlit signage applications that currently use linear fluorescent sources based on DOE's previous research of SSL niche applications, which indicated that SSL is viable for neon and channel letter signage but is not yet suitable for fluorescent backlighting applications. Consequently, DOE assumed lower SSL penetration for sign ballast shipments, increasing to a maximum of 20 percent by 2028.

iii. Anticipated Market Trends

DOE also received comments about anticipated market trends for the period 2014–2043, addressing utility incentive programs, ballast replacement options, and new construction and renovation. NEEA and NPCC observed that utility incentive programs have driven lighting retrofits for many years and suggested that this trend would continue as more locations adopted incentive programs. (NEEA and NPCC, No. 32 at p. 9) NEEA and NPCC also commented that (1) new commercial construction will remain depressed but will be accompanied by an upsurge in major renovation and

[37] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. *Energy Savings Potential of Solid-State Lighting in General Illumination Applications, 2010 to 2030.* February 2010. Available at *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_energy-savings-report_10-30.pdf.*

lighting retrofits, and (2) overall ballast shipments may hold steady, exclusive of emerging technology penetration. (NEEA and NPCC, No. 32 at p. 10) At the same time, NEEA and NPCC were concerned that DOE lacked adequate market data to apportion ballast shipments between failure replacements and retrofits/new construction; further, they suggested that DOE should eliminate these distinctions if they have significant effects on selection of TSLs or final standards. (NEEA and NPCC, No. 32 at p. 7) However, NEMA supported DOE's assumption that replacements would dominate future shipments of these ballasts, contending that the majority of building owners that already use T8 fluorescent systems would not retrofit their fixtures. (NEMA, Public Meeting Transcript, No. 10 at p. 250) The NEEA and NPCC believed that the market for ballasts in the residential sector would grow substantially as residential energy codes became more stringent and contended that DOE underestimated the associated savings potential for this product class. (NEEA and NPCC, No. 32 at pp. 2–3)

DOE agrees that retrofits (incentive-induced, efficiency-induced, or both) will continue to contribute to future ballast shipments. For owners of existing improved lighting systems (*e.g.,* 4-foot MBP T8, commercial sector), DOE agrees that these consumers will be less likely to retrofit their systems than to replace failed ballasts in kind because incremental efficiency gains would not justify the expense of system retrofits. DOE's research of available economic data also indicates that new commercial construction will remain relatively flat during the period 2014–2043. DOE agrees that residential energy codes will drive the market toward higher efficacy lighting systems, such as fluorescent; however, DOE believes that the related market growth will be greater for CFL-based fixtures than for 4-foot MBP fluorescent systems. DOE's review of available residential fixture surveys confirms that linear fluorescent fixtures are typically relegated to utility room, laundry, and some kitchen applications. Recent California tracking reports for residential lamps no longer address linear fluorescent lamps, given the dramatically increased adoption of screw- base CFLs, and a comparison of residential lighting data for 2005 [38] and 2009 [39] shows no significantly increased penetration for linear fluorescent systems. Viewing these trends in combination, DOE believes it has a reasonable basis for the market segments underlying its shipment projections (*i.e.,* replacements of failed ballasts, retrofits, and new construction), and believes that these trends will contribute to modest future growth in ballast shipments and stock (exclusive of SSL penetration).

iv. Efficiency Scenarios

Several of the inputs for determining NES (*e.g.,* the annual energy consumption per unit) and NPV (*e.g.,* the total annual installed cost and the total annual operating cost savings) depend on product efficiency. For the preliminary analysis, DOE developed two shipment efficiency scenarios: "Roll-up" and "Shift." The Roll-up scenario represents a standards case in which all product efficiencies in the base case that do not meet the standard would roll up to meet the new standard level. Consumers in the base case who purchase ballasts above the standard level are not affected as they are assumed to continue to purchase the same base-case ballast or lamp-and-ballast system. The Roll-up scenario characterizes consumers primarily driven by the first-cost of the analyzed products.

In contrast, the Shift scenario models a standards case in which the standard affects all base-case consumer purchases (regardless of whether their base-case efficiency is below the standard). In this scenario, any consumer may purchase a more efficient ballast, preserving the same relationship to the baseline ballast efficiency. For example, if a consumer purchased a ballast one efficiency level above the baseline, he would do the same after a standard is imposed. For this rulemaking, DOE assumed product efficiencies in the base case that do not meet the standard would roll up to meet the new standard level, as in a roll-up scenario. However, product efficiencies at or above the new standard level would shift to higher efficiency levels. As the standard level increases, market share incrementally accumulates at the highest standard level because it represents max tech (*i.e.,* moving beyond this efficiency level is not achievable with today's technology).

DOE received no comments to the preliminary TSD regarding its Roll-up and Shift efficiency scenarios, and retained this approach for the proposed rule shipments analysis.

3. Site-to-Source Energy Conversion

To estimate the national energy savings expected from appliance standards, DOE uses a multiplicative factor to convert site energy consumption (at the home or commercial building) into primary or source energy consumption (the energy required to convert and deliver the site energy). These conversion factors account for the energy used at power plants to generate electricity and losses in transmission and distribution, as well as for natural gas losses from pipeline leakage and energy used for pumping. For electricity, the conversion factors vary over time due to projected changes in generation sources (*i.e.,* the types of power plants projected to provide electricity to the country). The factors that DOE developed are marginal values, which represent the response of the system to an incremental decrease in consumption associated with appliance standards.

In the ballasts preliminary analysis, DOE used annual site-to-source conversion factors based on the version of NEMS that corresponds to *AEO2009.* For today's NOPR, DOE updated its conversion factors based on the NEMS that corresponds to *AEO2010,* which provides energy forecasts through 2035. For 2036–2043, DOE used conversion factors that remain constant at the 2035 values.

Section 1802 of the Energy Policy Act of 2005 (EPACT 2005) directed DOE to contract a study with the National Academy of Science (NAS) to examine whether the goals of energy efficiency standards are best served by measurement of energy consumed, and efficiency improvements, at the actual point of use or through the use of the full fuel cycle, beginning at the source of energy production. (Pub. L. 109–58 (Aug. 8, 2005)) NAS appointed a committee on "Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards" to conduct the study, which was completed in May 2009. The NAS committee defined full-fuel-cycle (FFC) energy consumption as including, in addition to site energy use, the following: Energy consumed in the extraction, processing, and transport of primary fuels such as coal, oil, and natural gas; energy losses in thermal combustion in power generation plants; and energy losses in transmission and distribution to homes and commercial buildings.[40]

[38] RLW Analytics, "2005 California statewide residential lighting and appliance efficiency saturation study, Final Report." August 2005. Available at: *http://www.calmac.org/.*

[39] Abstract for ongoing KEMA California residential lighting inventory and metering study available at: *http://www.cee1.org/eval/db_pdf/1268.pdf.*

[40] The National Academies, Board on Energy and Environmental Systems, Letter to Dr. John Mizroch, Acting Assistant Secretary, U.S. DOE, Office of EERE from James W. Dally, Chair, Committee on

Continued

In evaluating the merits of using point-of-use and FFC measures, the NAS committee noted that DOE uses what the committee referred to as "extended site" energy consumption to assess the impact of energy use on the economy, energy security, and environmental quality. The extended site measure of energy consumption includes the energy consumed during the generation, transmission, and distribution of electricity; unlike the FFC measure, however, it does not include the energy consumed in extracting, processing, and transporting primary fuels. A majority of the NAS committee concluded that extended site energy consumption understates the total energy consumed to make an appliance operational at the site. As a result, the NAS committee recommended that DOE consider shifting its analytical approach over time to use a FFC measure of energy consumption when assessing national and environmental impacts, especially with respect to the calculation of GHG emissions. The NAS committee also recommended that DOE provide more comprehensive information to the public through labels and other means, such as an enhanced Web site. For those appliances that use multiple fuels (*e.g.,* water heaters), the NAS committee indicated that measuring FFC energy consumption would provide a more complete picture of energy consumption and would allow comparisons across many different appliances as well as an improved assessment of impacts.

In response to the NAS recommendations, DOE issued, on August 20, 2010, a Notice of Proposed Policy proposing to incorporate an FFC analysis into the methods it uses to estimate the likely impacts of energy conservation standards on energy use and emissions. Specifically, DOE proposed to use FFC measures of energy and GHG emissions, rather than the primary (extended site) energy measures it currently uses. Additionally, DOE proposed to work collaboratively with the Federal Trade Commission (FTC) to make FFC energy and GHG emissions data publicly available, which would enable consumers to make cross-class comparisons. On October 7, 2010, DOE held an informal public meeting to discuss and receive comments on its planned approach. The Notice, a transcript of the public meeting and all public comments received by DOE are available at *http://www.regulations.gov/search/Regs/home.html#docketDetail?R=EERE-2010-BT-NOA-0028.* Following the close of the public comment period, DOE intends to develop a final policy statement on these subjects and then take steps to implement that policy in rulemakings and other activities.

Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards, May 15, 2009.

D. Consumer Sub-Group Analysis

In analyzing the potential impact of new or amended standards on consumers, DOE evaluates the impact on identifiable sub-groups of consumers (*e.g.,* low-income households) that a national standard may disproportionately affect. DOE received no comments regarding specific sub-groups and, therefore, evaluated the same sub-groups addressed in the 2009 Lamps Rule, assuming that consumers using GSFL would share similar characteristics with ballast consumers. Specifically, DOE evaluated the following consumer sub-groups for the proposed rule: Low-income households; institutions of religious worship; and institutions that serve low-income populations (*e.g.,* small nonprofits).

The NOPR TSD chapter 12 presents the consumer subgroup analysis.

E. Manufacturer Impact Analysis

1. Overview

DOE performed a manufacturer impact analysis (MIA) to estimate the financial impact of new and amended energy conservation standards on manufacturers of ballasts, and to calculate the impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects. The quantitative part of the MIA primarily relies on the GRIM, an industry cash-flow model using inputs specific to this rulemaking. The key GRIM inputs are data on the industry cost structure, product costs, shipments, and assumptions about markups and conversion expenditures. The key output is the industry net present value (INPV). Different sets of shipment and markup assumptions (scenarios) will produce different results. The qualitative part of the MIA addresses factors such as product characteristics, characteristics of and impacts on particular sub-groups of firms, as well as important market and product trends. Chapter 13 of the NOPR TSD outlines the complete MIA.

DOE conducted the MIA for this rulemaking in three phases. In Phase 1, Industry Profile, DOE prepared an industry characterization. Phase 2, Industry Cash Flow, focused on the financial aspects of the industry as a whole. In this phase, DOE used the GRIM to prepare an industry cash-flow analysis based on publicly available information gathered in Phase 1. This information enabled DOE to adapt the GRIM structure to analyze the impact of new and amended standards on ballast manufacturers specifically. In Phase 3, Sub-Group Impact Analysis, the Department conducted structured, detailed interviews with a representative cross-section of manufacturers that represent more than 90 percent of domestic ballast sales. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics specific to each company, and obtained each manufacturer's view of the industry as a whole. The interviews provided valuable information that the Department used to evaluate the impacts of new and amended standards on manufacturers' cash flows, manufacturing capacities, and employment levels. Each of these phases is discussed in further detail below.

a. Phase 1: Industry Profile

In Phase 1 of the MIA, DOE prepared a profile of the ballast industry based on the market and technology assessment prepared for this rulemaking. Before initiating the detailed impact studies, DOE collected information on the present and past structure and market characteristics of the industry. This information included market share data, product shipments, manufacturer markups, and the cost structure for various manufacturers. The industry profile includes: (1) Further detail on the overall market and product characteristics; (2) estimated manufacturer market shares; (3) financial parameters such as net plant, property, and equipment; selling, general, and administrative (SG&A) expenses; cost of goods sold; and other parameters; and (4) trends in the ballast market, including the number of firms, technology, sourcing decisions, and pricing.

The industry profile included a top-down cost analysis of ballast manufacturers that DOE used to derive preliminary financial inputs for the GRIM (*e.g.,* revenues; material, labor, overhead, and depreciation expenses; SG&A expenses; and research and development (R&D) expenses). DOE also used public sources of information to further calibrate its initial characterization of the industry, including Security and Exchange Commission 10–K filings (available at *http://www.sec.gov*), Standard & Poor's stock reports (available at *http://www2.standardandpoors.com*), and corporate annual reports. DOE supplemented this public information with data released by privately held companies.

b. Phase 2: Industry Cash-Flow Analysis

Phase 2 of the MIA focused on the financial impacts of the potential new and amended energy conservation standards on the industry as a whole. New or amended energy conservation standards can affect manufacturer cash flow in three distinct ways: (1) By creating a need for increased investment, (2) by raising production costs per unit, and (3) by altering revenue due to higher per-unit prices and possible changes in sales volumes. To quantify these impacts, in Phase 2 DOE used the GRIM to perform a preliminary cash-flow analysis of the ballast industry. In performing this analysis, DOE used the financial values determined during Phase 1 and the shipment scenarios used in the NIA.

c. Phase 3: Sub-Group Impact Analysis

In Phase 3, DOE conducted interviews with manufacturers and refined its preliminary cash-flow analysis. Many of the manufacturers interviewed also participated in interviews for the engineering analysis. As indicated above, the MIA interviews broadened the discussion from primarily technology-related issues to include business-related topics. One key objective for DOE was to obtain feedback from the industry on the assumptions used in the GRIM and to isolate key issues and concerns. *See* section 0 for a description of the key issues manufacturers raised during the interviews.

Using average cost assumptions to develop an industry cash-flow estimate does not adequately assess differential impacts of new or amended standards among manufacturer sub-groups. For example, small manufacturers, niche manufacturers, or manufacturers exhibiting a cost structure that largely differs from the industry average could be more negatively affected. To address this possible impact, DOE used the results of the industry characterization analysis in Phase 1 to group manufacturers that exhibit similar production and cost structure characteristics. Furthermore, interview discussions that focused on financial topics specific to each manufacturer allowed DOE to gauge the potential for differential impacts on any sub-groups of manufacturers.

DOE identified two sub-groups for a separate impact analysis—small manufacturers and sign ballast manufacturers. For its small business manufacturer sub-group analysis DOE used the small business size standards published by the Small Business Administration (SBA) to determine whether a company is considered a small business 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. To be categorized as a small business, a fluorescent lamp ballast manufacturer and its affiliates may employ a maximum of 750 employees. The 750-employee threshold includes all employees in a business's parent company and any other subsidiaries. Based upon this classification, DOE identified at least ten small fluorescent lamp ballast manufacturers that qualify as small businesses per the applicable SBA definition.

DOE investigated sign ballast manufacturers as a second sub-group. Unlike the traditional fluorescent lamp ballast market, which is dominated by four large manufacturers with high-volume product lines, the sign ballast market is significantly more fragmented, with many small manufacturers providing products in low volumes to distinct markets. The fluorescent lamp ballast sub-groups are discussed in chapter 13 of the TSD and in section 0 of today's notice, and small business impacts are analyzed in section VII.B.

2. GRIM Analysis

DOE uses the GRIM to quantify the changes in cash flow that result in a higher or lower industry value. The GRIM analysis uses a standard, annual cash-flow analysis that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs, and models changes in costs, investments, and manufacturer margins that would result from new and amended energy conservation standards. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning with the base year of the analysis, 2011, and continuing to 2043. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For ballasts, DOE uses a real discount rate of 7.4 percent for all products. DOE's discount rate estimate was derived from industry financials then modified according to feedback during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between a base case and various TSLs (the standards cases). The difference in INPV between the base case and a standards case represents the financial impact of the amended standard on manufacturers. As discussed previously, DOE collected this information on the critical GRIM inputs from a number of sources, including publicly available data and interviews with a number of manufacturers (described in the next section). The GRIM results are shown in section 0. Additional details about the GRIM can be found in chapter 13 of the TSD.

DOE typically presents its estimates of industry impacts by groups of the major product types served by the same manufacturers. In the fluorescent lamp ballast industry, four major manufacturers sell the vast majority of shipments in nearly all product classes, with the exception of sign ballasts, although some major manufacturers sell into that market as well. As such, DOE decided to present the GRIM results for all four analyzed product classes in one product grouping. The impacts on sign ballast manufacturers are broken out separately as a sub-group analysis in section 0.

a. GRIM Key Inputs

i. Manufacturer Production Costs

Manufacturing a higher-efficiency product is typically more expensive than manufacturing a baseline product due to the use of more complex components, which are more costly than baseline components. The changes in the MPCs of the analyzed products can affect the revenues, gross margins, and cash flow of the industry, making these product cost data key GRIM inputs for DOE's analysis.

To calculate MPCs at each EL, DOE followed a two-step process. First, DOE derived MSPs for each analyzed product and efficiency level from blue book, online retail, and teardown-sourced prices as described in section 0 above. Next, DOE discounted these MSPs by the manufacturer markup to arrive at the MPCs. For all product classes, DOE used a 1.4 manufacturer markup based on manufacturer feedback. DOE also used confidential information from manufacturer interviews to verify its MPC estimates. In addition, DOE used teardown cost data to disaggregate the MPCs into material, labor, and overhead costs.

ii. Base-Case Shipments Forecast

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of these values by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment forecasts from 2011 to 2043, the end of the analysis period. In the shipments analysis, DOE also estimated the distribution of efficiencies in the base case for all product classes. *See* chapter 10 of the TSD for additional details.

iii. Product and Capital Conversion Costs

New and amended energy conservation standards will cause manufacturers to incur conversion costs to bring their production facilities and product designs into compliance. For the MIA, DOE classified these conversion costs into two major groups: (1) Product conversion costs and (2) capital conversion costs. Product conversion costs are investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with the new or amended energy conservation standard. Capital conversion costs are investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new product designs can be fabricated and assembled.

DOE's interviews with manufacturers revealed that the majority of the conversion costs manufacturers expect to incur at various TSLs derive from the need to develop new and improved circuit designs, rather than the purchase of new capital equipment. Due to the flexible nature of most ballast production equipment, manufacturers do not expect new or amended standards to strand a significant share of their production assets. As opposed to other more capital-intensive appliance industries, much of the cash outlay required to achieve higher efficiency levels would be expensed through research and development, engineering, and testing efforts.

DOE based its estimates of the product conversion costs that would be required to meet each TSL on information obtained from manufacturer interviews, the engineering analysis, the NIA shipment analysis, and market information about the number of models and stock-keeping units (SKUs) each major manufacturer supports. DOE estimated the product development costs manufacturers would incur for each model that would need to be converted in response to new or amended energy conservation standards based on the necessary engineering and testing resources required to redesign each model. The R&D resources required to reach the efficiency levels represented at each TSL varied according to whether models could be converted based on minor upgrades, redesigns based on existing topologies, or full redesigns. In addition to per-model R&D costs, DOE considered testing and validation costs for every SKU, which included internal testing, UL testing, additional certifications, pilot runs, and product training. DOE then multiplied these per-model and per-SKU estimates by the total number of ballast models and SKUs offered based on information from manufacturer catalogs and interviews to calculate the total potential costs each manufacturer could incur to redesign its products. Next, to assign these costs to particular representative product classes, DOE multiplied this total for each manufacturer by the percentage of models in each product class based on the NIA shipment analysis and manufacturer feedback. Lastly, to consider the models manufacturers offered that already met efficiency levels above baseline, DOE multiplied the total costs for each product class by the percentage of models DOE determined would need to be redesigned at each efficiency level based on data from the engineering analysis and manufacturer catalogs.

This methodology derived total product conversion cost estimates for most product classes and efficiency levels. For residential ballasts, DOE assumed a smaller redesign cost per model. According to manufacturer interviews, the residential ballast market does not support manufacturer attempts to differentiate through better designs, product variation, or additional value-added features. As such, suppliers, often Asian manufacturers selling directly to fixture manufacturers, make little attempt to compete on anything other than price. Interviews suggested suppliers would leverage R&D invested in the larger, more valuable commercial market, making minor design adjustments to meet minimum requirements of the residential market. For sign ballasts, DOE determined the number of magnetic models on the market based on manufacturer catalogs and estimated testing and redesign costs for each of these models. DOE's estimates of the product conversion costs for fluorescent lamp ballasts addressed in this rulemaking can be found in section 0, below and in chapter 13 of the NOPR TSD.

As discussed above, DOE also estimated the capital conversion costs manufacturers would incur to comply with potential amended energy conservation standards represented by each TSL. During interviews, DOE asked manufacturers to estimate the capital expenditures required to expand the production of higher-efficiency products. These estimates included the required tooling and plant changes that would be necessary if product lines meeting the potential required efficiency level did not currently exist. Estimates for capital conversion costs varied greatly from manufacturer to manufacturer, as manufacturers anticipated different paths to compliance based on the modernity, flexibility, and level of automation of the equipment already existing in their factories. However, all manufacturers DOE interviewed indicated that capital costs would be relatively moderate compared to the required engineering effort. The modular nature of ballast production and the flexibility of the necessary production capital allows for significant equipment sharing across product lines. Based on interviews, DOE assumed that for most manufacturers, design changes would require moderate product conversion costs but would not require significant changes to existing production lines and equipment. It is therefore unlikely that most manufacturers would require high levels of capital expenditures compared to ordinary capital additions or existing net plants, property, and equipment (PPE).

To calculate its estimates of capital conversion costs, DOE aggregated its estimated capital costs for the major players in the industry rather than scaled up a "typical" manufacturer's expected conversion costs. Two considerations drove this choice in methodology. First, manufacturer feedback varied widely, making it impossible to characterize a "typical" manufacturer for conversion cost purposes. Second, the expected costs often depended upon the timing of the manufacturers' last redesign efforts and its strategy regarding the capital intensity of their plants and sourcing decisions. DOE estimated that some manufacturers would incur very minor capital expenditures per product class for testing equipment, even at max tech levels, as their factories' capital equipment would not require significant modification to produce higher-efficiency ballasts. For other manufacturers, DOE assumed greater investments would be necessary to upgrade lines for each product class with new wave solder equipment, reflow solder systems and surface mount device placement machines. The placement machines become increasingly important as ballasts become more complex with additional circuitry and components. DOE estimates capital conversion costs would rise most rapidly at high-efficiency levels not only because of the new production and testing equipment described above but also because manufacturers would need to expand capacity to account for lower throughput on high-efficiency lines.

For residential ballasts, DOE assumed the same magnitude of conversion costs as for commercial ballasts of the same starting method. While residential ballasts are generally not produced by the major four manufacturers, the Asian manufacturers who source them to domestic companies would be required to make similar modifications to their production lines in response to standards. For sign ballasts, DOE was unable to interview a representative sample of the industry. However, DOE recognizes that magnetic ballast lines have more capital exposure to changes in efficiency standards than electronic lines due to the change in technology. Because several manufacturers produce magnetic sign ballasts, DOE assumed new lines would be needed to convert magnetic products to electronic ballasts and scaled these line costs to the entire sign ballast market for this product class.

Finally, DOE estimated industry capital conversion costs for all analyzed product classes other than residential ballasts and sign ballasts by extrapolating the interviewed manufacturers' costs for each product class to account for the companies that DOE did not interview. DOE's estimates of the capital conversion costs for fluorescent lamp ballasts can be found in section 0, below and in chapter 13 of the NOPR TSD.

b. GRIM Scenarios

i. Shipment Scenarios

In the NIA, DOE modeled a roll-up and a shift scenario to represent two possible standards case efficiency distributions for the years beginning 2014, the year that compliance with revised standards is proposed to be required, through 2043. The GRIM uses each of these forecasts as alternative scenarios. The roll-up scenario represents the case in which all shipments in the base case that do not meet the new standard roll up to meet the new standard level. Consumers in the base case who purchase ballasts above the standard level are not affected as they are assumed to continue to purchase the same base-case ballast or lamp-and-ballast system in the standards case. In contrast, in a shift scenario, DOE assumes that any consumer may purchase a more efficient ballast. The shift scenario models a standards case in which all base-case consumer purchases are affected by the standard (regardless of whether their base-case efficiency is below the standard). As the standard level increases, market share migrates to, and accumulates at, the highest efficiency level because it represents "max tech" for each representative ballast type (*i.e.,* moving beyond it is impossible given available technology options). *See* chapter 10 of the NOPR TSD for more information on the ballasts standards-case shipment scenarios.

ii. Technology Scenarios

Each shipment scenario (roll-up and shift) described above is modeled in combination with the existing and emerging technologies base case shipment scenarios, resulting in four sets of shipments. The GRIM uses each set of shipment results to separately model impacts on INPV. In the existing technologies scenario, no technologies outside of those covered by this rulemaking were analyzed for market penetration. However, DOE recognizes that rapidly emerging new lighting technologies could penetrate the fluorescent lighting market and significantly affect ballast shipment forecasts. Therefore, in the emerging technologies scenario, DOE calculated the market penetration of light emitting diode (LED) and ceramic metal halide (CMH) systems annually through 2043, assessing each sector separately. DOE decreased the analyzed market size in each year in each sector by the amount that corresponded to the highest level of market penetration achieved by LED or CMH systems. The assumptions and methodology that drive these scenarios and the details specific to each are described in chapter 10 of the NOPR TSD.

iii. Markup Scenarios

As discussed above, manufacturer selling prices include direct manufacturing production costs (*i.e.,* labor, material, and overhead estimated in DOE's MPCs) and all non-production costs (*i.e.,* SG&A, R&D, and interest), along with profit. To calculate the MSPs in the GRIM, DOE applied markups to the MPCs estimated in the engineering analysis for each product class and efficiency level. Modifying these markups in the standards case yields different sets of impacts on manufacturers. For the MIA, DOE modeled two standards-case markup scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards: (1) A preservation of operating profit markup scenario, and (2) a two-tier markup scenario. These scenarios lead to different markups values, which, when applied to the inputted MPCs, result in varying revenue and cash flow impacts.

DOE implemented the preservation of operating profit markup scenario because manufacturers stated that they do not expect to be able to markup the full cost of production given the highly competitive market, in the standards case. The preservation of operating profit markup scenario assumes that manufacturers are able to maintain only the base-case total operating profit in absolute dollars in the standards case, despite higher product costs and investment. The base-case total operating profit is derived from marking up the cost of goods sold for each product by a flat percentage (the baseline markup, discussed in chapter 5 of the NOPR TSD) to cover standard SG&A expenses, R&D expenses, and profit. To derive this percentage, DOE evaluated publicly available financial information for manufacturers of ballasts. DOE also requested feedback on this value during manufacturer interviews. DOE adjusted the manufacturer markups in the GRIM at each TSL to yield approximately the same earnings before interest and taxes in the standards case in the year after the compliance date of the amended standards as in the base case. DOE assumed that the industry-wide impacts would occur under the new minimum efficiency levels. DOE altered the markups only for the minimally compliant products in this scenario, with margin impacts not occurring for products that already exceed the amended energy conservation standard. The preservation of operating profit markup scenario represents the upper bound of industry profitability following amended energy conservation standards. Under this scenario, while manufacturers are not able to yield additional operating profit from higher production costs and the investments required to comply with the amended energy conservation standard, they are able to maintain the same operating profit in the standards case as was earned in the base case.

DOE also modeled a lower bound profitability scenario. During interviews, multiple manufacturers stated that they offer two tiers of product lines that are differentiated, in part, by efficiency level. The higher-efficiency tier typically earns a premium over the baseline efficiency tier. Several manufacturers suggested that the premium currently earned by the higher-efficiency tier would erode under new or amended standards due to the disappearance of the baseline efficiency tier, which would significantly harm profitability. Because of this pricing dynamic described by manufacturers and because of the pressure from luminaire manufacturers to commoditize the baseline efficiency tier, DOE also modeled a two-tier markup scenario. In this scenario, DOE assumed that the markup on fluorescent lamp ballasts varies according to two efficiency tiers in both the base case and the standards case. During the MIA interviews, manufacturers provided information on the range of typical efficiency levels in those two tiers and the change in profitability at each level. DOE used this information, retail prices derived in its product price determination, and industry average gross margins to estimate markups for fluorescent lamp ballasts under a two-tier pricing strategy in the base case. In the standards case, DOE modeled the situation in which portfolio reduction squeezes the margin of higher-efficiency products as they become the new baseline, presumably high-volume products. This scenario is consistent with information submitted during manufacturing interviews and responds to manufacturers' concern that DOE standards could severely disrupt profitability.

3. Discussion of Comments

During the April 2010 public meeting, interested parties commented on the assumptions and results of the preliminary TSD. Oral and written comments discussed several topics, including conversion costs, impact on competition, potential benefits to ballast manufacturers, and manufacturer information. DOE addresses these comments below.

a. Conversion Costs

Several manufacturers expressed concerns about the capital and product conversion costs that would be necessary to meet particular efficiency levels. Philips stated that improvements would yield only minor efficiency gains, but may require redesigning entire product lines. As such, the manufacturer questioned whether the potential returns merited these large investments in time and resources. Philips noted that this phenomenon of diminishing returns is particularly true for those efficiency levels DOE identified as max tech. (Philips, Public Meeting Transcript, No. 12 at p. 155–156)

In this NOPR, DOE estimates the capital and product conversion costs required to meet all TSLs, including the max tech level. These conversion costs are a key input into the GRIM and directly impact the change in INPV (which is outputted from the model) due to standards. DOE conducts the manufacturing impact analysis, including the calculation of conversion costs, regardless of the energy savings that result from a given TSL. When determining which TSL to propose, DOE weighs the benefits, such as energy savings, against the burdens, such as loss of INPV, to determine the highest TSL that is both technologically feasible and economically justified.

Philips and NEMA also expressed concern that the investments made to meet new or amended energy conservation standards may never be recouped because of potential changes to the lighting market landscape. Philips stated that the industry is transitioning from traditional fixed light output lighting to alternatives such as control systems and solid-state lighting, so the opportunity for investment payback will be severely diminished. (Philips, Public Meeting Transcript, No. 12 at p. 274–275) NEMA similarly stated that the additional cost required to meet max tech standard levels would be a burden for manufacturers without subsequent benefit because the demand for fixed output ballasts is expected to significantly decline in the future. (NEMA, No. 29 at p. 17–18)

As stated in section 0 above, DOE recognizes that rapidly emerging new lighting technologies, such as LEDs, could penetrate the fluorescent lighting market and significantly affect ballast shipment forecasts. Therefore, DOE modeled an emerging technologies scenario in its shipments analysis. DOE input this scenario into the GRIM to demonstrate the impact that reduced demand could have on fluorescent lamp ballast manufacturers. The INPV results presented under the emerging technologies scenario show the impacts of the capital and product conversion costs required to meet each TSL under the base-case assumption that emerging lighting technologies will penetrate the ballast market. The INPV results for the existing and emerging technologies scenarios are shown in section 0, and more information on the methodology behind these scenarios can be found in chapter 10 of the NOPR TSD.

NEMA was also concerned about the conversion costs required for a particular product class. NEMA noted that for 8-foot HO lamps product offerings are limited and the power levels involved can make development of a reliable product more time-consuming than the other product categories considered. (NEMA, No. 29 at p. 7) DOE takes development time into account in its product conversion cost estimates. The increased development time for 8-foot HO lamps is reflected through higher estimated R&D costs due to the need to put more resources toward product design for a longer period of time.

b. Impact on Competition

NEMA stated that adoption of NEMA Premium levels for national requirements could impose a disproportionate burden on companies that do not currently have product lines compliant with the NEMA Premium program, which could unfairly impact the competitive nature of the marketplace. (NEMA, No. 29 at p. 4) Similarly, NEMA stated that adoption of the max tech levels in the preliminary analysis could impose a disproportionate burden on companies that do not currently have product lines utilizing the latest technology from the major manufacturers. (NEMA, No. 29 at p. 6)

According to a NEMA Premium publication[41] that lists qualifying electronic ballast models, at least fourteen ballast manufacturers already have product lines compliant with the NEMA Premium program. These manufacturers represent both large manufacturers, with over 90 percent of fluorescent lamp ballast market share, and smaller, niche manufacturers. While DOE will solicit the views of the Attorney General on impacts of these proposed standards as required by EPCA, DOE does not believe at this time that setting standards at NEMA Premium levels would unfairly impact competition in the ballast market because a large quantity and variety of manufacturers already offer NEMA Premium models. DOE agrees, however, that adoption of max tech levels presented in the preliminary analysis could impose a disproportionate burden on smaller manufacturers. During manufacturer interviews, DOE questioned whether any firms held intellectual property that gave them a competitive advantage. DOE did not learn of any technologies that some manufacturers employ that enable them to meet max tech levels that other manufacturers cannot. However, DOE believes that smaller manufacturers may not be able to redesign all of their product offerings within the 3-year compliance period because of limited R&D resources and low shipment volumes over which to spread out conversion costs. *See* the Regulatory

[41] *http://www.nema.org/gov/energy/efficiency/upload/nema_premium_electronic_ballast_program.pdf.*

Flexibility Analysis in section 0 for a full discussion on DOE's assessment of potential impacts on small manufacturers.

c. Potential Benefits to Ballast Manufacturers

Earthjustice stated that if DOE concludes that amended standards for fluorescent lamp ballasts would result in a market shift to other lighting products such as LEDs, DOE must take into account any positive impacts of that market shift on fluorescent lamp ballast manufacturers who also produce those substitute technologies. Earthjustice further commented that EPCA requires DOE to consider positive impacts (due to revenues from substitute products) in addition to any negative impacts from new or amended standards because DOE must consider the impact on the entire company rather than only the ballasts division. (Earthjustice, No. 31 at p. 1–2)

DOE does believe that there is potential for the market to increasingly migrate from traditional fixed light output fluorescent lamp ballasts to alternate technologies such as LEDs. For this reason, DOE models the emerging technologies shipment scenario as described in section 0 above and in chapter 10 of the NOPR TSD. This market shift to emerging technologies occurs in the base case. That is, the shift is not standards-induced. DOE excludes the revenue from substitute technologies earned by manufacturers who produce ballasts in the GRIM since the revenue stream would be present in both the base case and the standards case, resulting in no impact on the change in INPV.

4. Manufacturer Interviews

DOE interviewed manufacturers representing more than 90 percent of fluorescent lamp ballast sales. These interviews were in addition to those DOE conducted as part of the engineering analysis. The information gathered during these interviews enabled DOE to tailor the GRIM to reflect the unique financial characteristics of the ballasts industry. All interviews provided information that DOE used to evaluate the impacts of potential new and amended energy conservation standards on manufacturer cash flows, manufacturing capacities, and employment levels. Appendix 13A of the NOPR TSD contains the interview guides DOE used to conduct the MIA interviews.

During the manufacturer interviews, DOE asked manufacturers to describe their major concerns about this rulemaking. The following sections describe the most significant issues identified by manufacturers. DOE also includes additional concerns in chapter 13 of the TSD.

a. Component Shortage

An ongoing shortage of electronic components critical to the production of ballasts remains a key concern for all ballast manufacturers. Because the shortage is particularly acute for those components critical to high efficiency ballasts, new and amended standards could exacerbate the market situation, according to manufacturers.

During the recent economic downturn, component suppliers significantly scaled back production. When demand recovered as the recession ended, electronics suppliers lacked the capacity to meet demand beginning in the fall of 2009. Since then, component suppliers have been reluctant to invest in additional capacity because of concerns that the downturn has not actually ended. Additionally, component manufacturers have seen customers place duplicate orders with several suppliers (only to later cancel the orders with all but one supplier), a practice that has reinforced supplier skepticism over market demand. Electrolytic capacitors and transistors, which are produced almost entirely in Asia, are key examples of ballast components in relatively short supply. The fact that these components are shared among many electronics industries has exacerbated the problem for the ballast industry. Manufacturers of more expensive electronic applications, such as televisions and cell phones, can more easily absorb what for them are relatively smaller cost increases. In turn, these other industries can afford to pay more and receive priority over the ballast industry.

As a result, manufacturers have faced longer lead times and higher rush-order charges to fill their own customers' orders. Manufacturers predicted the component shortage will last at least into 2011 and were concerned that energy conservation standards for fluorescent lamp ballasts would exacerbate the ongoing component shortage.

b. Market Erosion

Manufacturers stated that emerging technologies are penetrating the fluorescent lamp ballasts market. Several manufacturers worried that new and amended energy conservation standards for ballasts would force them to invest in a shrinking market. Depending on the pace of market penetration of emerging technologies—such as LEDs—these investments might never be recouped. Also, manufacturers were concerned that new and amended standards on ballasts could hasten the switch to emerging technologies by lowering the difference in their first-cost price. If the standard did increase the natural migration toward new technology, manufacturers said they would be less likely to make the substantial investments to modify ballasts production equipment for some of their product lines. (To address emerging technologies issues discussed by manufacturers, DOE included several shipment scenarios in both the NIA and the GRIM. *See* chapter 10 and chapter 13 of the NOPR TSD for a discussion of the shipment scenarios used in the respective analyses.)

c. Opportunity Cost of Investments

Manufacturers also stated that the financial burden of developing products to meet amended energy conservation standards has an opportunity cost due to the limited pool of capital and R&D dollars. Currently, manufacturers are reinvesting a significant share of the cash flow from fluorescent lamp ballast operations into emerging technologies such as LEDs and control systems. Any investments incurred to meet amended ballast standards would therefore reflect foregone investments in these emerging technologies, which the industry believes offer both better prospects for market growth and greater potential for energy savings than traditional fixed-light-output fluorescent lamp ballasts. Compared to these emerging technologies, manufacturers stated that they have little room for efficiency improvements within their ballast product lines.

d. Maintaining Product Tiers

Several manufacturers stated that they would not want standards to be so stringent that they eliminate the ability to carry two efficiency tiers within a product class. Most manufacturers—and all major manufacturers—currently offer both standard-efficiency and high-efficiency product lines. The standard-efficiency product lines are typically lower cost and lower margin. These high-volume products provide economies of scale and, by establishing a market presence and brand, enhance manufacturers' ability to enter the more profitable retrofit and aftermarket sales. Meanwhile, the high-efficiency product lines allow manufacturers to bundle other features within these products, which allows them to command a better margin. Utility rebates and other similar programs also play a large role in driving the purchase of higher efficiency ballasts.

If DOE set standards that did not leave room for a high-efficiency product to differentiate itself from a baseline product, manufacturers believe the new standard would commoditize these now-premium products. In turn, prices of the high-efficiency ballasts would fall to the level of what were formerly the lower-tier products, harming manufacturer profitability. Utility companies and other programs would have little incentive to offer rebates for these former upper-tier products, which would then be baseline units. Without rebate incentives, sales to the energy retrofit market could decrease greatly due to cost, which would diminish the potential for energy savings due to the standard.

e. Adequate Compliance Periods

A number of manufacturers expressed concern about the timing between the announcement of the standard and the compliance date of the standard. Manufacturers stated that they need adequate time to develop products that meet the amended efficiency standards. Without enough development time, manufacturers may not have the resources to redesign and test all of their product lines before the required compliance date, which could result in lost sales opportunities in the market.

F. Employment Impact Analysis

DOE considers employment impacts in the domestic economy as one factor in selecting a proposed standard. Employment impacts consist of direct and indirect impacts. Direct employment impacts are any changes in the number of employees working for manufacturers of the appliance products that are the subject of this rulemaking, their suppliers, and related service firms. Indirect employment impacts are changes in employment within the larger economy that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more efficient appliances. The MIA addresses the direct employment impacts that concern ballast manufacturers in section 0.

The indirect employment impacts of standards consist of the net jobs created or eliminated in the national economy, outside of the manufacturing sector being regulated, due to: (1) Reduced spending on energy by end users; (2) reduced spending on new energy supplies by the utility industry; (3) increased spending on new products to which the new standards apply; 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, and expects these shifts in spending and economic activity to affect the demand for labor in the short term, as explained below.

One method for assessing the possible effects of such shifts in economic activity on the demand for labor is to compare sector employment statistics developed by the Labor Department's Bureau of Labor Statistics (BLS). (Data on industry employment, hours, labor compensation, value of production, and the implicit price deflator for output for these industries are available upon request by calling the Division of Industry Productivity Studies (202–691–5618) or by sending a request by e-mail to *dipsweb@bls.gov.* These data are also available at *http://www.bls.gov/news.release/prin1.nr0.htm.*) The BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy. There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital intensive and less labor intensive than other sectors. *See* Bureau of Economic Analysis, Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II), Washington, DC, U.S. Department of Commerce, 1992.

Energy conservation standards have the effect of reducing consumer utility bills. Because reduced consumer expenditures for energy likely lead to increased expenditures in other sectors of the economy, the general effect of efficiency standards is to shift economic activity from a less labor-intensive sector (*i.e.,* the utility sector) to more labor-intensive sectors (*e.g.,* the retail and manufacturing sectors). Thus, based on the BLS data alone, the Department believes net national employment will increase due to shifts in economic activity resulting from new and amended standards for ballasts.

In developing today's proposed standards, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies (ImSET). 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. (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.*) 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 (Lawson, Ann M., Kurt S. Bersani, Mahnaz Fahim-Nader, and Jiemin Guo, "Benchmark Input-Output Accounts of the U.S. Economy, 1997," *Survey of Current Business* (Dec. 2002) pp. 19–117), specially aggregated to the 188 sectors. DOE estimated changes in expenditures using the NIA spreadsheet. Using ImSET, DOE estimated the net national, indirect-employment impacts on employment by sector of potential new efficiency standards for ballasts. For more details on the employment impact analysis, see NOPR TSD chapter 15.

G. Utility Impact Analysis

The utility impact analysis estimates the effects of the adopting new or amended standards on the utility industry. For this analysis, DOE used the NEMS–BT model to generate forecasts of electricity consumption, electricity generation by plant type, and electric generating capacity by plant type that would result from each TSL. DOE conducted the impact analysis as a scenario that departed from the latest *AEO* reference case. In other words, the estimated impacts of a standard are the differences between values forecasted by NEMS–BT and the values in the *AEO2010* reference case.

Chapter 14 of the TSD accompanying this notice presents results of the utility impact analysis.

H. Environmental Assessment

Pursuant to the National Environmental Policy Act of 1969 and the requirements of 42 U.S.C. 6295(o)(2)(B)(i)(VI) and 6316(a), DOE has prepared a draft environmental assessment (EA) of the impacts of the potential standards for the fluorescent lamp ballasts in today's proposed rule, which it has included as chapter 16 of the NOPR TSD.

In the EA, DOE estimated the reduction in power sector emissions of carbon dioxide (CO_2), nitrogen oxides (NO_X), and mercury (Hg) using the NEMS–BT computer model. In the EA, NEMS–BT is run similarly to the AEO NEMS, except that ballast energy use is reduced by the amount of energy saved (by fuel type) due to each TSL. The inputs of national energy savings come from the NIA spreadsheet model, while the output is the forecasted physical emissions. The net benefit of each TSL in today's proposed rule is the difference between the forecasted emissions estimated by NEMS–BT at each TSL and the *AEO 2010* Reference Case. NEMS–BT tracks CO_2 emissions using a detailed module that provides results with broad coverage of all sectors and inclusion of interactive effects. For today's NOPR, DOE used the *AEO2010.* For the final rule, DOE intends to revise the emissions analysis using the most current version of NEMS.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs, and DOE has preliminarily determined that these programs create uncertainty about the potential amended standards' impact on SO_2 emissions. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (DC). SO_2 emissions from 28 eastern states and D.C. are also limited under the Clean Air Interstate Rule (CAIR; 70 FR 25162 (May 12, 2005)), which created an allowance-based trading program. Although CAIR has been remanded to EPA by the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit), *see North Carolina* v. *EPA,* 550 F.3d 1176 (D.C. Cir. 2008), it remains in effect temporarily, consistent with the D.C. Circuit's earlier opinion in *North Carolina* v. *EPA,* 531 F.3d 896 (D.C. Cir. 2008). On July 6, 2010, EPA issued the Transport Rule proposal, a replacement for CAIR, which would limit emissions from EGUs in 32 states, potentially through the interstate trading of allowances, among other options. 75 FR 45210 (Aug. 2, 2010).

The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, and under the Transport Rule if it is finalized, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the imposition of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by any regulated EGU. However, if the amended standards resulted in a permanent increase in the quantity of unused emissions allowances, there would be an overall reduction in SO_2 emissions from the standards. While there remains some uncertainty about the ultimate effects of efficiency standards on SO_2 emissions covered by the existing cap-and-trade system, the NEMS–BT modeling system that DOE uses to forecast emissions reductions currently indicates that no physical reductions in power sector emissions would occur for SO_2.

A cap on NO_X emissions, affecting electric generating units in the CAIR region, means that the energy conservation standards for ballasts may have little or no physical effect on NO_X emissions in the 28 eastern States and the DC covered by CAIR or any States covered by the proposed Transport Rule if the Transport Rule if finalized. The proposed standards would, however, reduce NO_X emissions in those 22 states not affected by the CAIR. As a result, DOE used NEMS–BT to forecast emission reductions from the standards considered for today's NOPR.

Similar to emissions of SO_2 and NO_X, future emissions of Hg would have been subject to emissions caps. In May 2005, EPA issued the Clean Air Mercury Rule (CAMR). 70 FR 28606 (May 18, 2005). CAMR would have permanently capped emissions of mercury for new and existing coal-fired power plants in all states by 2010. However, on February 8, 2008, the D.C. Circuit issued a decision in *New Jersey* v. *Environmental Protection Agency,* 517 F.3d 574 (D.C. Cir. 2008), in which it vacated CAMR. EPA has decided to develop emissions standards for power plants under Section 112 of the Clean Air Act, consistent with the DC Circuit's opinion on CAMR. *See http://www.epa.gov/air/mercuryrule/pdfs/certpetition_withdrawal.pdf.* Pending EPA's forthcoming revisions to the rule, DOE is excluding CAMR from its environmental assessment. In the absence of CAMR, a DOE standard would likely reduce Hg emissions and DOE used NEMS–BT to estimate these reductions. However, DOE continues to review the impact of rules that reduce energy consumption on Hg emissions, and may revise its assessment of Hg emission reductions in future rulemakings.

I. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this proposed rule, DOE considered the estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that are expected to result from each of the TSLs considered. In order to make this calculation similar to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped in the forecast period for each TSL. This section summarizes the basis for the monetary values used for each of these emissions and presents the values considered in this rulemaking.

For today's NOPR, DOE is relying on a set of values for the social cost of carbon (SCC) that was developed by an interagency process. A summary of the basis for these values is provided below, and a more detailed description of the methodologies used is provided as an appendix to chapter 16 of the TSD.

1. Social Cost of Carbon

Under section 1(b) of Executive Order 12866, agencies must, to the extent permitted by law, "assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs." The purpose of the SCC estimates presented here is to allow agencies to incorporate the monetized social benefits of reducing CO_2 emissions into cost-benefit analyses of regulatory actions that have small, or "marginal," impacts on cumulative global emissions. The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts.

As part of the interagency process that developed these SCC estimates, technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. The main objective of this process was to develop a range of SCC values using a defensible set of input assumptions grounded in the existing scientific and economic literatures. In this way, key uncertainties and model differences transparently and consistently inform the range of SCC estimates used in the rulemaking process.

a. Monetizing Carbon Dioxide Emissions

The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Estimates of the SCC are provided in dollars per metric ton of carbon dioxide.

When attempting to assess the incremental economic impacts of carbon dioxide emissions, the analyst faces a number of serious challenges. A recent report from the National Research Council[42] points out that any assessment will suffer from uncertainty, speculation, and lack of information about (1) Future emissions of greenhouse gases, (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise serious questions of science, economics, and ethics and should be viewed as provisional.

Despite the serious limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing carbon dioxide emissions. Consistent with the directive in Executive Order 12866 quoted above, the purpose of the SCC estimates presented here is to make it possible for Federal agencies to incorporate the social benefits from reducing carbon dioxide emissions into cost-benefit analyses of regulatory actions that have small, or "marginal," impacts on cumulative global emissions. Most Federal regulatory actions can be expected to have marginal impacts on global emissions.

For such policies, the agency can estimate the benefits from reduced (or costs from increased) emissions in any future year by multiplying the change in emissions in that year by the SCC value appropriate for that year. The net present value of the benefits can then be calculated by multiplying each of these future benefits by an appropriate discount factor and summing across all affected years. This approach assumes that the marginal damages from increased emissions are constant for small departures from the baseline emissions path, an approximation that is reasonable for policies that have effects on emissions that are small relative to cumulative global carbon dioxide emissions. For policies that have a large (non-marginal) impact on global cumulative emissions, there is a separate question of whether the SCC is an appropriate tool for calculating the benefits of reduced emissions. This concern is not applicable to this notice, and DOE does not attempt to answer that question here.

At the time of the preparation of this notice, the most recent interagency estimates of the potential global benefits resulting from reduced CO_2 emissions in 2010, expressed in 2009$, were $4.9, $22.1, $36.3, and $67.1 per metric ton avoided. For emissions reductions that occur in later years, these values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects,[43] although preference is given to consideration of the global benefits of reducing CO_2 emissions.

It is important to emphasize that the interagency process is committed to updating these estimates as the science and economic understanding of climate change and its impacts on society improves over time. Specifically, the interagency group has set a preliminary goal of revisiting the SCC values within 2 years or at such time as substantially updated models become available, and to continue to support research in this area. In the meantime, the interagency group will continue to explore the issues raised by this analysis and consider public comments as part of the ongoing interagency process.

b. Social Cost of Carbon Values Used in Past Regulatory Analyses

To date, economic analyses for Federal regulations have used a wide range of values to estimate the benefits associated with reducing carbon dioxide emissions. In the final model year 2011 CAFE rule, the U.S. Department of Transportation (DOT) used both a "domestic" SCC value of $2 per ton of CO_2 and a "global" SCC value of $33 per ton of CO_2 for 2007 emission reductions (in 2007$), increasing both values at 2.4 percent per year.[44] DOT also included a sensitivity analysis at $80 per ton of CO_2. *See Average Fuel Economy Standards Passenger Cars and Light Trucks Model Year 2011,* 74 FR 14196 (March 30, 2009) (Final Rule); Final Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015 at 3–90 (Oct. 2008) (Available at: *http://www.nhtsa.gov/fuel-economy*). A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in carbon dioxide emissions, while a global SCC value is meant to reflect the value of damages worldwide.

A 2008 regulation proposed by DOT assumed a domestic SCC value of $7 per ton of CO_2 (in 2006$) for 2011 emission reductions (with a range of $0–$14 for sensitivity analysis), also increasing at 2.4 percent per year. *See Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015,* 73 FR 24352 (May 2, 2008) (Proposed Rule); Draft Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015 at 3–58 (June 2008) (Available at: *http://www.nhtsa.gov/fuel-economy*). A regulation for packaged terminal air conditioners and packaged terminal heat pumps finalized by DOE in October of 2008 used a domestic SCC range of $0 to $20 per ton CO_2 for 2007 emission reductions (in 2007$). 73 FR 58772, 58814 (Oct. 7, 2008) In addition, EPA's 2008 Advance Notice of Proposed Rulemaking for Greenhouse Gases identified what it described as "very preliminary" SCC estimates subject to revision. *See Regulating Greenhouse Gas Emissions Under the Clean Air Act,* 73 FR 44354 (July 30, 2008). EPA's global mean values were $68 and $40 per ton CO_2 for discount rates of approximately 2 percent and 3 percent, respectively (in 2006$ for 2007 emissions).

In 2009, an interagency process was initiated to offer a preliminary assessment of how best to quantify the benefits from reducing carbon dioxide emissions. To ensure consistency in how benefits are evaluated across agencies, the Administration sought to develop a transparent and defensible method, specifically designed for the rulemaking process, to quantify avoided climate change damages from reduced CO_2 emissions. The interagency group did not undertake any original analysis. Instead, it combined SCC estimates from the existing literature to use as interim values until a more comprehensive analysis could be conducted. The outcome of the preliminary assessment by the interagency group was a set of five interim values: global SCC estimates for 2007 (in 2006$) of $55, $33, $19, $10, and $5 per ton of CO_2. These interim values represent the first sustained interagency effort within the U.S. government to develop an SCC for use in regulatory analysis. The results of this preliminary effort were presented in several proposed and final rules and were offered for public comment in connection with proposed rules, including the joint EPA–DOT fuel economy and CO_2 tailpipe emission proposed rules.

[42] National Research Council. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use.* National Academies Press: Washington, DC (2009).

[43] It is recognized that this calculation for domestic values is approximate, provisional, and highly speculative. There is no a priori reason why domestic benefits should be a constant fraction of net global damages over time.

[44] Throughout this section, references to tons of CO_2 refer to metric tons.

c. Current Approach and Key Assumptions

Since the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates, which were considered for this proposed rule. Specifically, the group considered public comments and further explored the technical literature in relevant fields. The interagency group relied on three integrated assessment models (IAMs) commonly used to estimate the SCC: The FUND, DICE, and PAGE models.[45] These models are frequently cited in the peer-reviewed literature and were used in the last assessment of the Intergovernmental Panel on Climate Change. Each model was given equal weight in the SCC values that were developed.

Each model takes a slightly different approach to model how changes in emissions result in changes in economic damages. A key objective of the interagency process was to enable a consistent exploration of the three models while respecting the different approaches to quantifying damages taken by the key modelers in the field. An extensive review of the literature was conducted to select three sets of input parameters for these models: climate sensitivity, socio-economic and emissions trajectories, and discount rates. A probability distribution for climate sensitivity was specified as an input into all three models. In addition, the interagency group used a range of scenarios for the socio-economic parameters and a range of values for the discount rate. All other model features were left unchanged, relying on the model developers' best estimates and judgments.

The interagency group selected four SCC values for use in regulatory analyses. Three values are based on the average SCC from three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth value, which represents the 95th percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. For emissions (or emission reductions) that occur in later years, these values grow in real terms over time, as depicted in Table V.8.

TABLE V.8—SOCIAL COST OF CO_2, 2010–2050 (IN 2007 DOLLARS PER METRIC TON)

VII.	Discount rate			
	5% Avg	3% Avg	2.5% Avg	3% 95th
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable since they will evolve with improved scientific and economic understanding. The interagency group also recognizes that the existing models are imperfect and incomplete. The National Research Council report mentioned above points out that there is tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. There are a number of concerns and problems that should be addressed by the research community, including research programs housed in many of the Federal agencies participating in the interagency process to estimate the SCC.

DOE recognizes the uncertainties embedded in the estimates of the SCC used for cost-benefit analyses. As such, DOE and others in the U.S. Government intend to periodically review and reconsider those estimates to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling. In this context, statements recognizing the limitations of the analysis and calling for further research take on exceptional significance.

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the most recent values identified by the interagency process, adjusted to 2009$ using the GDP price deflator values for 2008 and 2009. For each of the four cases specified, the values used for emissions in 2010 were $4.9, $22.1, $36.3, and $67.1 per metric ton avoided (values expressed in 2009$).[46] To monetize the CO_2 emissions reductions expected to result from amended standards for ballasts, DOE used the values identified in Table A1 of the "Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866," which is reprinted in appendix 16–A of the NOPR TSD, appropriately adjusted to 2009$. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the four cases using the specific discount rate that had been used to obtain the SCC values in each case.

1. Valuation of Other Emissions Reductions

DOE investigated the potential monetary benefit of reduced NO_X emissions from the TSLs it considered. As noted above, new or amended energy conservation standards would reduce NO_X emissions in those 22 states that are not affected by the CAIR. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for today's NOPR based on environmental damage estimates found in the relevant scientific literature. Available estimates suggest a very wide range of monetary values, ranging from $370 per ton to $3,800 per ton of NO_X from stationary sources, measured in 2001$ (equivalent to a range of $447 to $4,591 per ton in 2009$).[47] In accordance with OMB guidance, DOE conducted two calculations of the monetary benefits derived using each of the economic values used for NO_X, one using a real discount rate of 3 percent and another using a real discount rate of 7 percent.[48]

DOE is aware of multiple agency efforts to determine the appropriate range of values used in evaluating the potential economic benefits of reduced Hg emissions. DOE has decided to await further guidance regarding consistent valuation and reporting of Hg emissions before it once again monetizes Hg emissions in its rulemakings.

Commenting on the preliminary TSD, NEEA and NPCC supported DOE monetizing emissions reductions, but urged that the monetary values be accounted for in the NIA, and not used only as a qualitative decision factor. (NEEA and NPCC, No. 32 at p. 11) In contrast, NEMA advocated keeping the environmental assessment and NIA separate, citing the ranges of emission dollar values and other uncertainties in DOE's emissions monetization

[45] The models are described in appendix 16–A of the TSD.

[46] Table A1 presents SCC values through 2050. For DOE's calculation, it derived values after 2050 using the 3-percent per year escalation rate used by the interagency group.

[47] For additional information, refer to U.S. 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.

[48] OMB, Circular A–4: Regulatory Analysis (Sept. 17, 2003).

approach. (NEMA, No. 29 at p. 18) In the NIA, DOE estimates the national net present value of total consumer costs and savings that would be expected to result from new or amended standards at specific efficiency levels. Separately, DOE considers the estimated monetary benefits likely to result from the reduced emissions of CO_2 and other pollutants that are expected to result from each of the considered TSLs. The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the consumer savings calculated for each TSL considered in this rulemaking. In section 0 of today's NOPR, DOE presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each TSL considered in this rulemaking, at both a 7-percent and 3-percent discount rate.

VIII. Analytical Results

A. Trial Standard Levels

DOE analyzed the benefits and burdens of a number of TSLs for the ballasts that are the subject of today's proposed rule. Table VIII.1 presents the trial standard levels and the corresponding product class efficiency levels. See the engineering analysis in section 0 of this NOPR for a more detailed discussion of the efficiency levels.

In this section, DOE presents the analytical results for the TSLs of the product classes that DOE analyzed directly (the "representative product classes"). DOE scaled the standards for these representative product classes to create standards for other product classes that were not directly analyzed (programmed start ballasts that operate 8-foot HO lamps), as set forth in chapter 5 of the TSD.

TABLE VIII.1—TRIAL STANDARD LEVELS

Representative product class	TSL 1	TSL 2	TSL 3
IS and RS ballasts that operate:			
4-foot MBP lamps, 8-foot slimline lamps	EL1	EL2	EL3
PS ballasts that operate:			
4-foot MBP lamps, 4-foot MiniBP SO lamps, 4-foot MiniBP HO lamps	EL1	EL2	EL3
IS and RS ballasts that operate 8-foot HO lamps	EL1	EL2	EL3
Ballasts that operate 8-foot HO lamps in cold temperature outdoor signs	EL1	EL1	EL1

TSL 1, which would set energy conservation standards at EL1 for all product classes, would eliminate currently available 2-lamp MBP T12 RS (commercial and residential), low-efficiency 2-lamp 4-foot MBP T8 PS, magnetic 8-foot HO, and magnetic sign ballasts. TSL 1 would require IS and RS 2-lamp MBP ballasts that operate T8 lamps. TSL 1 does not impact 8-foot slimline or 4-lamp MBP IS and RS ballasts. TSL 1 also prevents the baseline inefficient T5 standard and high output ballasts from becoming prevalent in future years. For the reasons explained in section 0, sign ballasts have only one EL, so TSL 1 represents the max tech level for the sign ballast representative product class. TSL 2 and TSL 3 also require EL1 for sign ballasts.

TSL 2 would set energy conservation standards at EL2 for the IS and RS, PS, and 8-foot HO IS and RS product classes. This level would eliminate standard-efficiency, dedicated voltage 2-lamp MBP T8 IS ballasts (commercial and residential), but can be met with standard-efficiency universal input voltage 2-lamp MBP T8 IS ballasts commercial ballasts and high-efficiency dedicated input voltage 2-lamp MBP T8 IS residential ballasts. TSL 2 eliminates the least efficient T12 2-lamp slimline ballasts, and is just met by the least efficient T8 8-foot slimline ballasts. TSL 2 does not affect 4-lamp MBP T8 IS ballasts. For PS ballasts, high-efficiency 4-foot MBP and high-efficiency T5 standard and high output ballasts are required at TSL 2. This TSL would eliminate the least efficient currently available standard and high output T5 ballasts. TSL 2 for the 8-foot HO IS and RS product class results in the elimination of current T12 electronic ballasts, but can be met with T8 electronic ballasts. All three of these ELs represent the elimination of the least efficient T8 electronic ballasts.

TSL 3 would set energy conservation standards at EL3 for the IS and RS, PS, and 8-foot HO IS and RS product class. TSL 3 represents the highest EL analyzed in all representative product classes and is the max tech TSL. Ballasts that meet TSL 3 represent the most efficient models tested by DOE in their respective representative product classes.

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

a. Life-Cycle Cost and Payback Period

Consumers affected by new or amended standards usually experience higher purchase prices and lower operating costs. Generally, these impacts on individual consumers are best captured by changes in LCCs and by the payback period. Therefore, DOE calculated the LCC and PBP analyses for the potential standard levels considered in this rulemaking. DOE's LCC and PBP analyses provide key outputs for each TSL, which are reported by product class in Table VIII.2–Table VIII.15 below. Each table includes the average total LCC and the average LCC savings, as well as the fraction of product consumers for which the LCC will either decrease (net benefit), or increase (net cost) relative to the base-case forecast. The last outputs in the tables are the median PBPs for the consumer that is purchasing a design compliant with the TSL. Negative PBP values indicate standards that reduce both operating costs and installed costs. Entries of "N/A" indicate standard levels that do not reduce operating costs; which prevents the consumer from recovering the increased purchase cost. This occurred with residential ballasts operating 4-foot MBP lamps (T8 baseline), where the system input power ratings for the standards-case replacements were greater than that for the baseline system. As discussed in section 0 above, the replacement systems use more energy but produce more light with greater efficiency than the baseline T8 system.

The results for each TSL are relative to the energy use distribution in the base case (no amended standards), based on energy consumption under conditions of actual product use. The rebuttable presumption PBP is based on test values under conditions prescribed by the DOE test procedure, as required by EPCA. (42 U.S.C. 6295(o)(2)(B)(iii))

TABLE VIII.2—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (COMMERCIAL, T12 BASELINE): LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
	Baseline	64.63	234.65	299.28				
1	1	55.91	225.82	281.73	17.54	0.0	100.0	−8.99
2	2	58.58	215.70	274.27	25.00	0.0	100.0	−2.88
3	3	59.16	197.70	256.87	42.41	0.0	100.0	−1.35
Event II: New Construction/Renovation								
	Baseline	67.02	234.65	301.66				
1	1	58.30	199.89	258.19	43.47	0.0	100.0	−2.29
2	2	60.97	191.12	252.09	49.58	0.0	100.0	−1.27
3	3	61.55	187.43	248.98	52.68	0.0	100.0	−1.06

*Negative PBP values indicate standards that reduce operating costs and installed costs.

TABLE VIII.3—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (COMMERCIAL, T8 BASELINE): LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
1	Baseline/1	55.08	225.82	280.90				
2	2	57.74	215.70	273.44	7.46	0.0	100.0	2.43
3	3	58.33	197.70	256.03	24.87	0.0	100.0	1.07
Event II: New Construction/Renovation								
1	Baseline/1	57.47	225.82	283.29				
2	2	60.13	215.79	275.92	7.37	0.0	100.0	2.46
3	3	60.72	211.57	272.28	11.00	0.0	100.0	2.11

TABLE VIII.4—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (RESIDENTIAL, T12 BASELINE): LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
	Baseline	52.99	67.73	120.72				
1	1	45.02	56.40	101.42	19.29	0.0	100.0	−7.60
2, 3	3	46.24	57.30	103.53	17.18	0.0	100.0	−6.99
Event II: New Construction/Renovation								
	Baseline	55.38	67.73	123.10				
1	1	47.41	56.00	103.40	19.70	0.0	100.0	−7.34
2, 3	3	48.63	53.54	102.16	20.94	0.0	100.0	−5.14

* Negative PBP values indicate standards that reduce operating costs and installed costs.

TABLE VIII.5—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (RESIDENTIAL, T8 BASELINE): LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
1	Baseline/1	44.11	56.40	100.51				
2, 3	3	45.33	57.30	102.63	−2.11	100.0	0.0	N/A
Event II: New Construction/Renovation								
1	Baseline/1	46.50	56.40	102.90				
2, 3	3	47.72	53.93	101.65	1.26	10.6	89.4	5.37

* Entries of "N/A" indicate standard levels that do not reduce operating costs.

TABLE VIII.6—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE FOUR 4-FOOT MBP LAMPS: LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
1, 2	Baseline/2	76.77	407.73	484.49				
3	3	79.33	398.46	477.79	6.70	0.0	100.0	2.56
Event II: New Construction/Renovation								
1, 2	Baseline/2	79.16	407.73	486.88				
3	3	81.72	402.21	483.94	2.95	0.7	99.3	4.31

TABLE VIII.7—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 8–FOOT SLIMLINE LAMPS (T12 BASELINE): LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
1	Baseline/1	90.06	434.50	524.56				
2	2	89.34	413.71	503.05	21.50	0.0	100.0	−0.31
3	3	89.68	401.02	490.69	33.86	0.0	100.0	−0.10
Event II: New Construction/Renovation								
1	Baseline/1	92.45	434.50	526.94				
2	2	91.73	420.63	512.37	14.58	0.0	100.0	−0.47
3	3	92.07	414.38	506.45	20.50	0.0	100.0	−0.17

* Negative PBP values indicate standards that reduce operating costs and installed costs.

TABLE VIII.8—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 8-FOOT SLIMLINE LAMPS (T8 BASELINE): LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
1, 2	Baseline/2	90.03	413.71	503.74				
3	3	90.37	401.02	491.38	12.36	0.0	100.0	0.24
Event II: New Construction/Renovation								
1, 2	Baseline/2	92.42	413.71	506.13				
3	3	92.75	407.57	500.33	5.80	0.0	100.0	0.50

TABLE VIII.9—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS: LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
	Baseline	57.92	202.24	260.16				
1, 2	2	59.17	188.88	248.04	12.12	0.0	100.0	1.07
3	3	59.60	186.40	246.00	14.17	0.0	100.0	1.22
Event II: New Construction/Renovation								
	Baseline	60.31	202.24	262.55				
1, 2	2	61.55	188.79	250.34	12.21	0.0	100.0	1.06
3	3	61.99	186.62	248.60	13.95	0.0	100.0	1.23

TABLE VIII.10—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE FOUR 4-FOOT MBP LAMPS: LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
	Baseline	75.31	372.68	448.00				
1	1	79.20	368.71	447.92	0.08	71.7	28.3	11.27
2, 3	3	81.28	359.20	440.48	7.52	1.3	98.7	5.09
Event II: New Construction/Renovation								
	Baseline	77.70	372.68	450.39				
1	1	81.59	340.40	421.99	28.39	0.0	100.0	1.39
2, 3	3	83.67	332.50	416.17	34.22	0.0	100.0	1.71

TABLE VIII.11—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE TWO 4-FOOT MINIBP SO LAMPS: LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
	Baseline	63.45	252.21	315.66				

TABLE VIII.11—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE TWO 4-FOOT MINIBP SO LAMPS: LCC AND PBP RESULTS—Continued

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience: Net cost	Percent of consumers that experience: Net benefit	
1	1	63.55	238.21	301.76	13.90	0.0	100.0	0.06
2	2	65.04	228.05	293.09	22.57	0.0	100.0	0.61
3	3	69.84	243.99	313.83	1.83	39.1	60.9	7.19
Event II: New Construction/Renovation								
	Baseline	65.84	252.21	318.05				
1	1	65.94	238.21	304.15	13.90	0.0	100.0	0.06
2	2	67.43	236.07	303.50	14.55	0.0	100.0	0.91
3	3	72.23	230.07	302.30	15.75	0.0	100.0	2.67

TABLE VIII.12—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE TWO 4-FOOT MINIBP HO LAMPS: LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience: Net cost	Percent of consumers that experience: Net benefit	
Event I: Replacement								
	Baseline	63.55	338.93	402.49				
1	1	67.70	315.58	383.28	19.21	0.0	100.0	1.28
2	2	70.65	310.87	381.52	20.96	0.0	100.0	1.82
3	3	73.52	308.29	381.81	20.68	0.0	100.0	2.34
Event II: New Construction/Renovation								
	Baseline	65.94	338.93	404.88				
1	1	70.08	315.58	385.67	19.21	0.0	100.0	1.28
2	2	73.04	312.98	386.02	18.85	0.0	100.0	1.97
3	3	75.91	310.04	385.95	18.92	0.0	100.0	2.48

TABLE VIII.13—PRODUCT CLASS 3—IS AND RS BALLASTS THAT OPERATE TWO 8-FOOT HO LAMPS (T12 BASELINE): LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience: Net cost	Percent of consumers that experience: Net benefit	
Event I: Replacement								
	Baseline	116.92	619.03	735.95				
1	1	111.77	554.36	666.13	69.82	0.0	100.0	−0.57
2	2	96.97	404.53	501.51	234.45	0.0	100.0	−0.67
3	3	101.02	398.16	499.18	236.77	0.0	100.0	−0.52
Event II: New Construction/Renovation								
	Baseline	119.31	619.03	738.34				
1	1	114.15	574.24	688.39	49.95	0.0	100.0	−0.83
2	2	99.36	499.29	598.65	139.69	0.0	100.0	−1.21
3	3	103.41	494.49	597.89	140.45	0.0	100.0	−0.93

* Negative PBP values indicate standards that reduce operating costs and installed costs.

TABLE VIII.14—PRODUCT CLASS 3—IS AND RS BALLASTS THAT OPERATE TWO 8-FOOT HO LAMPS (T8 BASELINE): LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
1, 2	Baseline/2	94.07	404.53	498.61				
3	3	98.12	398.16	496.28	2.33	13.2	86.8	4.57
Event II: New Construction/Renovation								
1, 2	Baseline/2	96.46	404.53	501.00				
3	3	100.51	400.71	501.22	−0.22	70.4	29.6	7.62

TABLE VIII.15—PRODUCT CLASS 5—BALLASTS THAT OPERATE FOUR 8-FOOT HO LAMPS IN COLD TEMPERATURE OUTDOOR SIGNS: LCC AND PBP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event I: Replacement								
	Baseline	163.93	1,403.06	1,566.99				
1, 2, 3	1	157.45	1,019.63	1,177.07	389.91	0.0	100.0	−0.16
Event II: New Construction/Renovation								
	Baseline	166.32	1,403.06	1,569.38				
1, 2, 3	1	159.84	1,177.81	1,337.64	231.73	0.0	100.0	−0.27

* Negative PBP values indicate standards that reduce operating costs and installed costs.

b. Consumer Sub-Group Analysis

Using the LCC spreadsheet model, DOE determined the impact of the trial standard levels on the following consumer sub-groups: Low-income consumers, institutions of religious worship, and institutions that serve low-income populations. Representative ballast designs used in the industrial sector (*e.g.,* ballasts operating HO lamps) are not typically used by the identified sub-groups, and were not included in the sub-group analysis. Similarly, DOE assumed that low-income consumers use residential ballasts only, and did not include commercial ballast designs in the LCC analysis for this sub-group. DOE assumed that institutions of religious worship and institutions that serve low-income populations use commercial ballasts only, and did not include residential ballast designs in their sub-group analysis.

To reflect conditions faced by the identified subgroups, DOE adjusted particular inputs to the LCC model. For low-income consumers, DOE adjusted electricity prices to represent rates paid by consumers living below the poverty line. DOE assumed that institutions of religious worship have lower annual operating hours than the commercial sector average used in the main LCC analysis. For institutions serving low-income populations, DOE assumed that the majority of these institutions are small nonprofits, and used a higher discount rate of 10.7 percent (versus 6.9 percent for the main commercial sector analysis).

Table VIII.16 through Table VIII.25 below show the LCC impacts and payback periods for identified sub-groups that purchase ballasts. Negative PBP values indicate standards that reduce operating costs and installed costs. Entries of "N/A" indicate standard levels that do not reduce operating costs. In general, the average LCC savings for the identified sub-groups at the considered efficiency levels are not significantly different from the average for all consumers.

TABLE VIII.16—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (COMMERCIAL, T12 BASELINE): LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Sub-Group: Institutions of Religious Worship								
Event I: Replacement								
	Baseline	64.63	185.70	250.33	....	....	....	....
1	1	55.91	178.85	234.76	15.57	0.0	100.0	−15.61
2	2	58.58	170.82	229.40	20.93	0.0	100.0	−5.00
3	3	59.16	156.54	215.71	34.62	0.0	100.0	−2.35
Event II: New Construction/Renovation								
	Baseline	67.02	185.70	252.72	....	....	....	....
1	1	58.30	158.28	216.58	36.14	0.0	100.0	−3.98
2	2	60.97	151.32	212.29	40.43	0.0	100.0	−2.21
3	3	61.55	148.39	209.95	42.77	0.0	100.0	−1.84
Sub-Group: Institutions Serving Low-Income Populations								
Event I: Replacement								
	Baseline	64.63	198.59	263.22	....	....	....	....
1	1	55.91	191.11	247.02	16.20	0.0	100.0	−8.99
2	2	58.58	182.54	241.12	22.10	0.0	100.0	−2.88
3	3	59.16	167.32	226.48	36.74	0.0	100.0	−1.35
Event II: New Construction/Renovation								
	Baseline	67.02	198.59	265.61	....	....	....	....
1	1	58.30	169.17	227.47	38.14	0.0	100.0	−2.29
2	2	60.97	161.75	222.71	42.90	0.0	100.0	−1.27
3	3	61.55	158.63	220.18	45.43	0.0	100.0	−1.06

*Negative PBP values indicate standards that reduce operating costs and installed costs.

TABLE VIII.17—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (COMMERCIAL, T8 BASELINE): LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Sub-Group: Institutions of Religious Worship								
Event I: Replacement								
1	Baseline/1	55.08	178.85	233.93	....	....	....	....
2	2	57.74	170.82	228.56	5.37	0.1	99.9	4.23
3	3	58.33	156.54	214.87	19.06	0.0	100.0	1.86
Event II: New Construction/Renovation								
1	Baseline/1	57.47	178.85	236.32	....	....	....	....
2	2	60.13	170.89	231.02	5.29	0.1	99.9	4.27
3	3	60.72	167.54	228.26	8.06	0.0	100.0	3.66
Sub-Group: Institutions Serving Low-Income Populations								
Event I: Replacement								
1	Baseline/1	55.08	191.11	246.19	....	....	....	....
2	2	57.74	182.54	240.29	5.90	0.0	100.0	2.43
3	3	58.33	167.32	225.64	20.54	0.0	100.0	1.07

TABLE VIII.17—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (COMMERCIAL, T8 BASELINE): LCC AND PBP SUB-GROUP RESULTS—Continued

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period * *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Event II: New Construction/Renovation								
1	Baseline/1	57.47	191.11	248.58				
2	2	60.13	182.62	242.75	5.82	0.0	100.0	2.46
3	3	60.72	179.05	239.77	8.81	0.0	100.0	2.11

TABLE VIII.18—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (RESIDENTIAL, T12 BASELINE): LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period * *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Sub-Group: Low-Income Consumers								
Event I: Replacement								
	Baseline	52.99	67.85	120.84				
1	1	45.02	56.51	101.53	19.31	0.0	100.0	−7.60
2, 3	3	46.24	57.41	103.64	17.20	0.0	100.0	−6.99
Event II: New Construction/Renovation								
	Baseline	55.38	67.85	123.23				
1	1	47.41	56.10	103.51	19.72	0.0	100.0	−7.43
2, 3	3	48.63	53.64	102.27	20.96	0.0	100.0	−5.14

* Negative PBP values indicate standards that reduce operating costs and installed costs.

TABLE VIII.19—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS (RESIDENTIAL, T8 BASELINE): LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period * *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Sub-Group: Low-Income Consumers								
Event I: Replacement								
1	Baseline/1	44.11	56.51	100.62				
2, 3	3	45.33	57.41	102.74	−2.12	100.0	0.0	N/A
Event II: New Construction/Renovation								
1	Baseline/1	46.50	56.51	103.01				
2, 3	3	47.72	54.03	101.75	1.26	10.6	89.4	5.37

* Entries of "N/A" indicate standard levels that do not reduce operating costs.

TABLE VIII.20—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE FOUR 4-FOOT MBP LAMPS: LCC AND PBP RESULTS: LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Sub-Group: Institutions of Religious Worship								
Event I: Replacement								
1, 2	Baseline/2	76.77	323.00	399.77				
3	3	79.33	315.65	394.98	4.78	0.3	99.7	4.45
Event II: New Construction/Renovation								
1, 2	Baseline/2	79.16	323.00	402.16				
3	3	81.72	318.63	400.35	1.81	13.7	86.3	7.48
Sub-Group: Institutions Serving Low-Income Populations								
Event I: Replacement								
1, 2	Baseline/2	76.77	345.04	421.81				
3	3	79.33	337.21	416.54	5.27	0.0	100.0	2.56
Event II: New Construction/Renovation								
1, 2	Baseline/2	79.16	345.04	424.20				
3	3	81.72	340.38	422.10	2.10	6.7	93.3	4.31

TABLE VIII.21—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 8-FOOT SLIMLINE LAMPS (T12 BASELINE): LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period* *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Sub-Group: Institutions of Religious Worship								
Event I: Replacement								
1	Baseline/1	90.06	343.91	433.97				
2	2	89.34	327.51	416.86	17.12	0.0	100.0	−0.55
3	3	89.68	317.44	407.12	26.85	0.0	100.0	−0.18
Event II: New Construction/Renovation								
1	Baseline/1	92.45	343.91	436.36				
2	2	91.73	333.01	424.74	11.68	0.0	100.0	−0.81
3	3	92.07	328.05	420.11	16.25	0.0	100.0	−0.30
Sub-Group: Institutions Serving Low-Income Populations								
Event I: Replacement								
1	Baseline/1	90.06	367.73	457.79				
2	2	89.34	350.13	439.48	18.31	0.0	100.0	−0.31
3	3	89.68	339.39	429.07	28.72	0.0	100.0	−0.10
Event II: New Construction/Renovation								
1	Baseline/1	92.45	367.73	460.18				
2	2	91.73	355.99	447.72	12.45	0.0	100.0	−0.47
3	3	92.07	350.70	442.77	17.41	0.0	100.0	−0.17

* Negative PBP values indicate standards that reduce operating costs and installed costs.

TABLE VIII.22—PRODUCT CLASS 1—IS AND RS BALLASTS THAT OPERATE TWO 8-FOOT SLIMLINE LAMPS (T8 BASELINE): LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Sub-Group: Institutions of Religious Worship								
Event I: Replacement								
1, 2	Baseline/2	90.03	327.51	417.55				
3	3	90.03	317.44	407.81	9.74	0.0	100.0	0.42
Event II: New Construction/Renovation								
1, 2	Baseline/2	92.42	327.51	419.93				
3	3	92.75	322.64	415.40	4.54	0.0	100.0	0.88
Sub-Group: Institutions Serving Low-Income Populations								
Event I: Replacement								
1, 2	Baseline/2	90.03	350.13	440.16				
3	3	90.37	339.39	429.76	10.41	0.0	100.0	0.24
Event II: New Construction/Renovation								
1, 2	Baseline/2	92.42	350.13	442.55				
3	3	92.75	344.94	437.69	4.86	0.0	100.0	0.50

TABLE VIII.23—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE TWO 4-FOOT MBP LAMPS: LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
Sub-Group: Institutions of Religious Worship								
Event I: Replacement								
	Baseline	57.92	147.32	205.24				
1, 2	2	59.17	137.56	196.73	8.51	0.0	100.0	1.85
3	3	59.60	135.76	195.35	9.89	0.0	100.0	2.11
Event II: New Construction/Renovation								
	Baseline	60.31	147.32	207.63				
1, 2	2	61.55	137.50	199.05	8.58	0.0	100.0	1.84
3	3	61.99	135.91	197.90	9.73	0.0	100.0	2.14
Sub-Group: Institutions Serving Low-Income Populations								
Event I: Replacement								
	Baseline	57.92	161.44	219.37				
1, 2	2	59.17	150.78	209.94	9.42	0.0	100.0	1.07
3	3	59.60	148.80	208.40	10.97	0.0	100.0	1.22
Event II: New Construction/Renovation								
	Baseline	60.31	161.44	221.76				
1, 2	2	61.55	150.71	212.26	9.49	0.0	100.0	1.06
3	3	61.99	148.97	210.96	10.79	0.0	100.0	1.23

TABLE VIII.24—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE FOUR 4-FOOT MBP LAMPS: LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience: Net cost	Percent of consumers that experience: Net benefit	
Sub-Group: Institutions of Religious Worship								
Event I: Replacement								
	Baseline	75.31	271.57	346.88				
1	1	79.20	268.67	347.87	−0.99	94.4	5.6	19.57
2, 3	3	81.28	261.72	343.01	3.88	22.4	77.6	8.84
Event II: New Construction/Renovation								
	Baseline	77.70	271.57	349.27				
1	1	81.59	248.00	329.60	19.67	0.0	100.0	2.41
2, 3	3	83.67	242.23	325.91	23.36	0.0	100.0	2.97
Sub-Group: Institutions Serving Low-Income Populations								
Event I: Replacement								
	Baseline	75.31	297.48	372.80				
1	1	79.20	294.31	373.52	-0.72	89.3	10.7	11.27
2, 3	3	81.28	286.72	368.00	4.79	11.2	88.8	5.09
Event II: New Construction/Renovation								
	Baseline	77.70	297.48	375.18				
1	1	81.59	271.72	353.31	21.87	0.0	100.0	1.39
2, 3	3	83.67	265.41	349.08	26.10	0.0	100.0	1.71

TABLE VIII.25—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE TWO 4-FOOT MINIBP SO LAMPS: LCC AND PBP SUB-GROUP RESULTS

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience: Net cost	Percent of consumers that experience: Net benefit	
Sub-Group: Institutions of Religious Worship								
Event I: Replacement								
	Baseline	63.45	199.70	263.15				
1	1	63.55	188.59	252.15	11.01	0.0	100.0	0.11
2	2	65.04	180.53	245.58	17.57	0.0	100.0	1.06
3	3	69.84	193.18	263.02	0.13	72.9	27.1	12.49
Event II: New Construction/Renovation								
	Baseline	65.84	199.70	265.54				
1	1	65.94	188.59	254.53	11.01	0.0	100.0	0.11
2	2	67.43	186.89	254.33	11.21	0.0	100.0	1.58
3	3	72.23	182.14	254.37	11.17	0.5	99.5	4.64
Sub-Group: Institutions Serving Low-Income Populations								
Event I: Replacement								
	Baseline	63.45	213.44	276.90				
1	1	63.55	201.60	265.15	11.75	0.0	100.0	0.06
2	2	65.04	193.00	258.05	18.85	0.0	100.0	0.61
3	3	69.84	206.49	276.33	0.57	67.0	33.0	7.19
Event II: New Construction/Renovation								
	Baseline	65.84	213.44	279.29				
1	1	65.94	201.60	267.54	11.75	0.0	100.0	0.06

TABLE VIII.25—PRODUCT CLASS 2—PS BALLASTS THAT OPERATE TWO 4-FOOT MINIBP SO LAMPS: LCC AND PBP SUB-GROUP RESULTS—Continued

Trial standard level	Efficiency level	Life-cycle cost *2009$*			Life-cycle cost savings			Median payback period *years*
		Installed cost	Discounted operating cost	LCC	Average savings *2009$*	Percent of consumers that experience		
						Net cost	Net benefit	
2	2	67.43	199.79	267.22	12.07	0.0	100.0	0.91
3	3	72.23	194.72	266.94	12.34	0.0	100.0	2.67

c. Rebuttable Presumption Payback

As discussed above, EPCA provides a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase 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. DOE's LCC and PBP analyses generate values that calculate the payback period for consumers of potential energy conservation standards, which includes, but is not limited to, the 3-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 on consumers, manufacturers, the nation, and the environment—as required under 42 U.S.C. 6295(o)(2)(B)(i).

In the present case, DOE calculated a rebuttable presumption payback period for each TSL. Rather than using distributions for input values, DOE used discrete values and, as required by EPCA, based the calculation on the assumptions in the DOE test procedures for ballasts. As a result, DOE calculated a single rebuttable presumption payback value, rather than a distribution of payback periods, for each TSL. Table VIII.26 shows the rebuttable presumption payback periods that are less than 3 years. Negative PBP values indicate standards that reduce operating costs and installed costs.

While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for today's rule are economically justified through a more detailed analysis of the economic impacts of these levels pursuant to 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE to evaluate the economic justification for a potential standard level definitively (thereby supporting or rebutting the results of any preliminary determination of economic justification).

TABLE VIII.26—BALLAST EFFICIENCY LEVELS WITH REBUTTABLE PAYBACK PERIOD LESS THAN THREE YEARS

IX. Product class	X. Ballast type	XI. Efficiency level	Mean payback period* *years*	
			Event I: Replacement	Event II: New construction/ renovation
1	IS and RS ballasts that operate:			
	Two 4-foot MBP lamps (commercial, T12 baseline).	1	−8.99	−2.29
		2	−2.88	−1.27
		3	−1.35	−1.06
	Two 4-foot MBP lamps (commercial, T8 baseline).	2	2.43	2.46
		3	1.07	2.11
	Two 4-foot MBP lamps (residential, T12 baseline).	1	−7.60	−7.34
		2, 3	−6.99	−5.14
	Four 4-foot MBP lamps	3	2.56	
	Two 8-foot slimline lamps (T12 baseline).	2	−0.31	−0.47
		3	−0.10	−0.17
	Two 8-foot slimline lamps (T8 baseline).	3	0.24	0.50
2	PS ballasts that operate:			
	Two 4-foot MBP lamps	1, 2	1.07	1.06
		3	1.22	1.23
	Four 4-foot MBP lamps	1		1.39
		3		1.71
	Two 4-foot MiniBP SO lamps	1	0.06	0.06
		2	0.61	0.91
		3		2.67
	Two 4-foot MiniBP HO lamps	1	1.28	1.28
		2	1.82	1.97
		3	2.34	2.48
3	IS and RS ballasts that operate:			
	Two 8-foot HO lamps (T12 baseline)	1	−0.57	−0.83
		2	−0.67	−1.21

TABLE VIII.26—BALLAST EFFICIENCY LEVELS WITH REBUTTABLE PAYBACK PERIOD LESS THAN THREE YEARS—Continued

IX. Product class	X. Ballast type	XI. Efficiency level	Mean payback period * *years*	
			Event I: Replacement	Event II: New construction/ renovation
		3	−0.52	−0.93
5	Ballasts that operate: Four 8-foot HO lamps in cold temperature outdoor signs.	1, 2, 3	−0.16	−0.27

* Negative PBP values indicate standards that reduce operating costs and installed costs.

1. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of fluorescent lamp ballasts. The section below describes the expected impacts on manufacturers at each TSL. Chapter 13 of the TSD explains the analysis in further detail.

The tables below depict the financial impacts (represented by changes in INPV) of amended energy standards on manufacturers as well as the conversion costs that DOE estimates manufacturers would incur at each TSL. DOE shows the results for all product classes in one group, as most product classes are generally made by the same manufacturers. DOE breaks out results for the sign ballast manufacturer sub-group in section 0 below. To evaluate the range of cash flow impacts on the ballast industry, DOE modeled eight different scenarios using different assumptions for markups, shipments, and technologies that correspond to the range of anticipated market responses to new and amended standards. Each scenario results in a unique set of cash flows and corresponding industry value at each TSL. Two of these scenarios are presented below, corresponding to the bounds of a range of market responses that DOE anticipates could occur in the standards case. In the following discussion, the INPV results refer to the difference in industry value between the base case and the standards case that result from the sum of discounted cash flows from the base year (2011) through the end of the analysis period. The results also discuss the difference in cash flow between the base case and the standards case in the year before the compliance date for new and amended energy conservation standards. This figure represents how large the required conversion costs are relative to the cash flow generated by the industry in the absence of new and amended energy conservation standards. In the engineering analysis, DOE presents its findings of the common technology options that achieve the efficiencies for each of the representative product classes. To refer to the description of technology options and the required efficiencies at each TSL, see section 0 of today's notice.

a. Industry Cash-Flow Analysis Results

The set of results below shows two tables of INPV impacts: The first table reflects the lower (less severe) bound of impacts and the second represents the upper bound. To assess the lower end of the range of potential impacts, DOE modeled the preservation of operating profit markup scenario. As discussed in section 0, the preservation of operating profit markup scenario assumes that in the standards case, manufacturers would be able to earn the same operating margin in absolute dollars in the standards case as in the base case. In general, the larger the product price increases, the less likely manufacturers are to preserve the cash flow from operations calculated in this scenario because it is less likely that manufacturers would be able to markup these larger cost increases to the same degree.

DOE also incorporated the existing technologies scenario and the shift shipment scenario to assess the lower bound of impacts. Under the existing technologies scenario, base-case shipments of fluorescent lamp ballasts are not impacted by any emerging technologies that could potentially penetrate the market over the analysis period. Under the shift shipment scenario, all base-case consumer purchases are affected by the standard (regardless of whether their base-case efficiency is below the standard) as consumers may seek to shift to a higher efficiency level. Of all the scenario combinations analyzed in the MIA, conditions for generating cash flow are greatest under the preservation of operating profit markup, existing technologies, and shift shipment scenarios—the annual shipment volume, efficiency mix, and the ability to preserve operating margins is greatest. Thus, this scenario set yields the greatest modeled industry profitability.

Through its discussions with manufacturers, DOE found that many manufacturers typically offer two tiers of product lines differentiated by efficiency level, with the higher efficiency tier earning a premium over the baseline efficiency tier. Several manufacturers expected that the premium currently earned by the higher efficiency tier would erode under new or amended standards due to the disappearance of the baseline efficiency tier. The market effect would be to commoditize the higher tier product line (the new baseline in the standards case), which would significantly harm profitability. Therefore, to assess the higher (more severe) end of the range of potential impacts, DOE modeled a two-tier markup scenario in which higher energy conservation standards result in lower manufacturer markups for products that earn a premium in the base case. In this scenario, DOE assumed that the markup on fluorescent lamp ballasts varies according to two efficiency tiers in both the base case and the standards case. In the standards case, DOE modeled the situation in which portfolio reduction squeezes the margin of higher-efficiency products as they become lower-relative-efficiency-tier products. This commoditization would occur for several reasons. The large fixture manufacturers have substantial purchasing power due to the share of the market they represent (approximately two-thirds of the ballast market) and the high-volume orders placed by the largest fixture OEMs. Ballast manufacturers must compete aggressively for this business, not simply because of the volume of sales, but also because of the need to keep factories utilized and achieve economies of scale. By manufacturing in high volumes, ballast manufacturers can drive down fixed costs per unit, as they spread overhead over more volume. Manufacturers can also lower variable costs per unit. Large volumes allow manufacturers to order from their component suppliers in large quantities, enabling better purchasing terms, thereby reducing per unit costs.

Price is often the primary rationale in purchasing decisions for fixture manufacturers, so ballast manufacturers face intense pressure to make their baseline models as cost-competitive as possible, even if the baseline model was once a premium model. To meet the needs of these price-driven customers by reducing costs, ballast manufacturers may have to remove features in the new baseline models that had commanded a price premium when bundled with high-efficiency. Without being able to use these extra features as a selling point, margins could decrease even further. As a result, ballast manufacturers would earn the same markup on these new high-volume baseline models as they did on their lower efficiency, former baseline models. This scenario represents the upper end (more severe) of the range of potential impacts on manufacturers because units that commanded a higher markup under the base case earn a lower markup under the standards case.

DOE also incorporated the emerging technologies scenario and the roll-up shipment scenario to assess the upper bound of impacts. Under the emerging technologies scenario fluorescent lamp ballasts lose market share to emerging technologies such as LEDs over the analysis period. Under the roll-up shipment scenario, no consumer purchases beyond those that do not meet the new standard level are affected by the standard, so premium pricing tiers are not continually maintained. Thus, under the two-tier markup scenario, emerging technologies scenario, and roll-up shipment scenario, the quantity of annual shipments is lowest and manufacturers have the least ability to pass on costs to consumers.

TABLE VIII.27—MANUFACTURER IMPACT ANALYSIS FOR FLUORESCENT LAMP BALLASTS—PRESERVATION OF OPERATING PROFIT MARKUP, EXISTING TECHNOLOGIES, AND SHIFT SHIPMENT SCENARIO

XII.	Units	Base case	Trial standard level		
			1	2	3
INPV	(2009$ millions)	1,241	1,221	1,189	1,145
Change in INPV	(2009$ millions)		(19.4)	(51.6)	(95.3)
	(%)		−1.6%	−4.2%	−7.7%
Product Conversion Costs	(2009$ millions)		5	24	57
Capital Conversion Costs	(2009$ millions)		11	25	34
Total Conversion Costs	(2009$ millions)		17	49	91

TABLE VIII.28—MANUFACTURER IMPACT ANALYSIS FOR FLUORESCENT LAMP BALLASTS—TWO-TIER MARKUP, EMERGING TECHNOLOGIES, AND ROLL-UP SHIPMENT SCENARIO

XIII.	Units	Base case	Trial standard level		
			1	2	3
INPV	(2009$ millions)	853	740	635	557
Change in INPV	(2009$ millions)		(112.7)	(217.9)	(296.2)
	(%)		−13.2%	−25.5%	−34.7%
Product Conversion Costs	(2009$ millions)		5	24	57
Capital Conversion Costs	(2009$ millions)		11	25	34
Total Conversion Costs	(2009$ millions)		17	49	91

TSL 1 represents EL1 for all four representative product classes. At TSL 1, DOE estimates impacts on INPV to range from −$19.4 million to −$112.7 million, or a change in INPV of −1.6 percent to −13.2 percent. At this proposed level, industry free cash flow is estimated to decrease by approximately 11.9 percent to $43.8 million, compared to the base-case value of $49.7 million in the year leading up to the proposed energy conservation standards.

The INPV impacts at TSL 1 are relatively minor, in part because the vast majority of shipments already meet EL1. DOE estimates that in 2014, the year in which compliance with any new and amended standards is proposed to be required, 98 percent of product class 1 shipments, 69 percent of product class 2 shipments, 88 percent of product class 3 shipments, and 64 percent of product class 5 shipments would meet EL1 or higher in the base case. The majority of shipments that are at baseline efficiency levels and would need to be converted at TSL 1 are 2-lamp, 4-foot MBP IS/RS residential ballasts in product class 1, 2-lamp and 4-lamp, 4ft MBP PS ballasts in product class 4, and 4-lamp sign ballasts in product class 5.

Because most fluorescent lamp ballast shipments already meet the efficiency levels analyzed at TSL 1, DOE expects conversion costs to be small compared to the industry value. DOE estimates product conversion costs of $5 million due to the research, development, testing, and certification costs needed to upgrade product lines that do not meet TSL 1. For capital conversion costs, DOE estimates $11 million for the industry, largely driven by the cost of converting all magnetic sign ballast production lines to electronic sign ballast production lines.

Under the preservation of operating profit markup scenario, impacts on manufacturers are marginally negative because while manufacturers earn the same operating profit as is earned in the base case for 2015 (the year following the compliance date of amended standards), they are faced with $17 million in conversion costs. INPV impacts on manufacturers are not as significant under this scenario as in other scenarios because despite most shipments already meeting TSL 1, the shift shipment scenario moves products beyond the eliminated baseline to higher-price (and higher gross profit) levels. This results in a shipment-weighted average MPC increase of 7.8 percent applied to a growing market over the analysis period. While total shipments increase under both technology scenarios, shipments under the existing technologies scenario are 216 percent greater than shipments under the emerging technologies scenario by the end of the analysis period. At TSL 1, the moderate price increase applied to a large quantity of shipments lessens the impact of the minor conversion costs estimated at TSL 1, resulting in slightly negative impacts at TSL 1 under the preservation of operating profit markup scenario.

Under the two-tier markup scenario, manufacturers are not able to fully pass on additional costs to consumers and are not guaranteed base-case operating profit levels. Rather, products that once earned a higher-than-average markup at EL1 become commoditized once baseline products are eliminated at TSL 1. Thus, the average markup drops below the base-case average markup (which is equal to the flat manufacturer markup of 1.4). There is a slight increase in shipment-weighted average MPC (less than 1 percent) under the roll-up scenario, but this increase is much smaller than under the shift scenario because shipments above the baseline do not move to higher efficiencies with greater costs. This MPC increase is outweighed by a lower average markup of 1.38 and $17 million in conversion costs, resulting in more negative impacts at TSL 1 under the two-tier markup scenario. These impacts increase on a percentage basis under the emerging technologies scenario relative to the existing technologies scenario because the base-case INPV against which changes are compared is 31 percent lower.

TSL 2 represents EL1 for product class 5 (4-lamp sign ballasts). For product classes 1 (4-foot MBP IS/RS and 8-foot SP Slimline), 2 (4-foot MBP PS, 4-foot T5 MiniBP SO, and 4-foot T5 MiniBP HO),and 3 (2-lamp 8-foot HO), TSL 2 represents EL2. At TSL 2, DOE estimates impacts on INPV to range from −$51.6 million to −$217.9 million, or a change in INPV of −4.2 percent to −25.5 percent. At this proposed level, industry free cash flow is estimated to decrease by approximately 32.9 percent to $33.3 million, compared to the base-case value of $49.7 million in the year leading up to the proposed energy conservation standards.

Because product class 5 remains at EL1 at TSL 2, the additional impacts at TSL 2 relative to TSL 1 result from increasing product classes 1, 2, and 3 to EL2. At TSL 2, DOE estimates that 40 percent of product class 1 shipments, 13 percent of product class 2 shipments, and 27 percent of product class 3 shipments would meet EL2 or higher in the base case. Since product class 3 represents only 0.1 percent of the fluorescent lamp ballast market, the vast majority of impacts at TSL 2 relative to TSL 1 result from changes in product classes 1 and 2.

At TSL 2, conversion costs nearly triple compared to TSL 1 but remain small compared to the industry value. Product conversion costs increase to $24 million due to the increase in the number of product lines within product classes 1 and 2 that would need to be redesigned at TSL 2. Capital conversion costs grow to $25 million at TSL 2 because manufacturers would need to invest in additional testing equipment and convert some production lines.

Under the preservation of operating profit markup scenario, INPV impacts are negative because manufacturers are not able to fully pass on higher product costs to consumers. The shipment-weighted average MPC increases by 11.1 percent compared to the baseline MPC, but this increase does not generate enough cash flow to outweigh the $49 million in conversion costs at TSL 2, resulting in a −4.2 percent change in INPV at TSL 2 compared to the base case.

Under the two-tier markup scenario, more products are commoditized to a lower markup at TSL 2. The impact of this lower average markup of 1.36 outweighs the impact of a 10.3 percent increase in shipment-weighted average MPC, resulting in a negative change in INPV at TSL 2. The $49 million in conversion costs further erodes profitability, and the lower base case INPV against which the change in INPV is compared under the emerging technologies scenario increases impacts on a percentage basis.

TSL 3 represents EL1 for product class 5 and EL3 for product classes 1, 2, and 3. At TSL 3, DOE estimates impacts on INPV to range from −$95.3 million to −$296.2 million, or a change in INPV of −7.7 percent to −34.7 percent. At this proposed level, industry free cash flow is estimated to decrease by approximately 57.4 percent to $21.2 million, compared to the base-case value of $49.7 million in the year leading up to the proposed energy conservation standards.

Because product class 5 remains at EL1 at TSL 3, the additional impacts at TSL 3 relative to TSL 2 result from increasing product classes 1, 2, and 3 to EL3. At TSL 3, DOE estimates that only 20 percent of product class 1 shipments, 5 percent of product class 2 shipments, and 2 percent of product class 3 shipments would meet the efficiency levels proposed by TSL 3 or higher in the base case.

At TSL 3, conversion costs nearly double again compared to TSL 2. Product conversion costs increase to $57 million because a far greater number of product lines within product classes 1, 2, and 3 would need to be redesigned at TSL 3. Capital conversion costs rise to $34 million at TSL 3 because manufacturers would need to invest in equipment such as surface-mount device placement machinery and solder machines to convert production lines for the manufacturing of more efficient ballast designs.

Under the preservation of operating profit markup, existing technologies, and shift shipment scenarios, INPV decreases by 7.7 percent at TSL 3 compared to the base case, which is nearly double the percentage impact at TSL 2. The shipment-weighted average MPC increases by 19.5 percent, but manufacturers are not able to pass on the full amount of these higher costs to consumers. This MPC increase is outweighed by the $91 million in conversion costs at TSL 3.

Under the two-tier markup scenario, at TSL 3, products are commoditized to a lower markup to an even greater extent. The impact of this lower average markup of 1.34 outweighs the impact of a 19.3 percent increase in shipment-weighted average MPC, resulting in a negative change in INPV at TSL 3 compared to TSL 2. Profitability is further impacted by the $91 million in conversion costs and the lower base-case INPV over which change in INPV is compared under the emerging technologies scenario.

a. Impacts on Employment

DOE typically presents modeled quantitative estimates of the potential changes in production employment that could result following amended energy conservation standards. However, for this rulemaking, DOE determined that none of the major manufacturers, which compose more than 90 percent of the market, have domestic fluorescent lamp ballast production. Although a few niche manufacturers have relatively limited domestic production, based on interviews, DOE believes there are very few domestic production employees in the United States Because many niche manufacturers did not respond to interview requests, DOE is unable to fully quantify domestic production employment. Therefore, while DOE qualitatively discusses potential employment impacts below, DOE did not model direct employment impacts explicitly because the results would not be meaningful given the very low number of domestic production employees.

Based on interviews, DOE believes that direct employment impacts of relatively significant magnitude would only occur in the event that one or more businesses chose to exit the market due to new standards. Discussions with manufacturers indicated that, at the highest efficiency level (TSL 3), some small manufacturers will be faced with the decision to make the investments necessary to remain in the market based on their current technical capabilities. In general, however, DOE believes that TSL 3, the level proposed in today's notice, will not have significant adverse impacts on employment because achieving these levels is within the expertise of most manufacturers, including small manufacturers, due to the lack of intellectual property restrictions and similarity of products among manufacturers.

In summary, however, given the low number of production employees and the unlikelihood that manufacturers would exit the market at the efficiency levels proposed in today's notice, DOE does not expect a significant impact on direct employment following new and amended energy conservation standards.

DOE notes that the employment impacts discussed here are independent of the employment impacts from the broader U.S. economy, which are documented in chapter 15, Employment Impact Analysis, of the NOPR TSD.

b. Impacts on Manufacturing Capacity

Manufacturers stated that new and amended energy conservation standards could harm manufacturing capacity due to the current component shortage discussed in section 0 above. Manufacturers presently are struggling to produce enough fluorescent lamp ballasts to meet demand because of a worldwide shortage of electrical components. The components most affected by this shortage are high-efficiency parts, for which demand would increase even further following new and amended conservation standards. The increased demand could exacerbate the component shortage, thereby impacting manufacturing capacity in the near term. While DOE recognizes that the component shortage is currently a significant issue for manufacturers, DOE believes it is a relatively short term phenomenon to which component suppliers will ultimately adjust. According to manufacturers, suppliers have the ability to ramp up production to meet ballast component demand by the compliance date of potential new standards, but those suppliers have hesitated to invest in additional capacity due to economic uncertainty and skepticism about the sustainability of demand. The state of the macroeconomic environment through 2014 will likely impact the duration of the component shortage. However, potential mandatory standards could create more certainty for suppliers about the eventual demand for these components. Additionally, the components at issue are not new technologies; rather, they have simply not historically been demanded in large quantities by ballast manufacturers.

c. Impacts on Sub-Groups of Manufacturers

As discussed in section 0, using average cost assumptions to develop an industry cash-flow estimate is inadequate to assess differential impacts among manufacturer sub-groups. DOE used the results of the industry characterization to group ballast manufacturers exhibiting similar characteristics. DOE identified two sub-groups that would experience differential impacts: Small manufacturers and sign ballast manufacturers. For a discussion of the impacts on the small manufacturer sub-group, see the Regulatory Flexibility Analysis in section 0 and chapter 13 of the NOPR TSD.

DOE is not presenting results under the two-tier markup scenario for sign ballasts because it did not observe this two-tier effect in the sign ballast market. Electronic ballasts at EL1 neither command a higher price nor a higher markup in the base case. Additionally, roll-up and shift scenarios do not have separate impacts for sign ballasts because there are no higher ELs above the new baseline to which products could potentially shift in the standards case. As such, the tables below present the cash-flow analysis results under the preservation of operating profit markup and roll-up shipment scenarios with existing or emerging technologies for sign ballast manufacturers.

TABLE VIII.29—MANUFACTURER IMPACT ANALYSIS FOR SIGN BALLASTS—PRESERVATION OF OPERATING PROFIT MARKUP, EXISTING TECHNOLOGIES, AND ROLL-UP SHIPMENT SCENARIO

XIV.	Units	Base case	Trial standard level		
			1	2	3
INPV	(2009$ millions)	142	138	138	138
Change in INPV	(2009$ millions)		(4.2)	(4.2)	(4.2)
	(%)		−2.9%	−2.9%	−2.9%
Product Conversion Costs	(2009$ millions)		2	2	2
Capital Conversion Costs	(2009$ millions)		6	6	6
Total Conversion Costs	(2009$ millions)		8	8	8

TABLE VIII.30—MANUFACTURER IMPACT ANALYSIS FOR SIGN BALLASTS—PRESERVATION OF OPERATING PROFIT MARKUP, EMERGING TECHNOLOGIES, AND ROLL-UP SHIPMENT SCENARIO

XV.	Units	Base case	Trial standard level		
			1	2	3
INPV	(2009$ millions)	116	111	111	111
Change in INPV	(2009$ millions)		(5.1)	(5.1)	(5.1)
	(%)		−4.4%	−4.4%	−4.4%.
Product Conversion Costs	(2009$ millions)		2	2	2
Capital Conversion Costs	(2009$ millions)		6	6	6

TABLE VIII.30—MANUFACTURER IMPACT ANALYSIS FOR SIGN BALLASTS—PRESERVATION OF OPERATING PROFIT MARKUP, EMERGING TECHNOLOGIES, AND ROLL-UP SHIPMENT SCENARIO—Continued

XV.	Units	Base case	Trial standard level		
			1	2	3
Total Conversion Costs	(2009$ millions)		8	8	8

For sign ballasts (product class 5), DOE analyzed only one efficiency level; thus, the results are the same at each TSL. TSLs 1 through 3 represent EL1 for product class 5. At TSLs 1 through 3, DOE estimates impacts on INPV to range from −$4.2 million to −$5.1 million, or a change in INPV of −2.9 percent to −4.4 percent. At these proposed levels, industry free cash flow is estimated to decrease by approximately 38.4 percent to $4.9 million, compared to the base-case value of $7.9 million in the year leading up to the proposed energy conservation standards.

As shown by the results, DOE expects sign ballast manufacturers to face small negative impacts under TSLs 1 through 3. DOE estimates that 64 percent of product class 5 shipments would meet EL1 in the base case. This means that many manufacturers already produce electronic sign ballasts, which is the design option represented by EL1. However, many other manufacturers produce only magnetic T12 sign ballasts and therefore would face significant capital exposure moving from magnetic to electronic to meet TSLs 1 through 3. For that reason, DOE estimates relatively high capital conversion costs of $6 million for sign ballast manufacturers. Product redesign and testing costs are expected to total $2 million for sign ballasts.

Unlike most product classes, sign ballasts are expected to decrease rather than increase in price moving from baseline to EL1 by a shipment-weighted average decrease in MPC of 4.5 percent. This is because electronic ballasts are a cheaper alternative to magnetic ballasts, even though the industry has not fully moved toward electronic production yet. During interviews, manufacturers stated that consumers were reluctant to convert to electronic ballasts although there were no technical barriers to doing so. Under the preservation of operating profit markup scenario, however, manufacturers are able to maintain the base-case operating profit for the year following the compliance date of amended standards despite lower production costs, so the average markup increases slightly to 1.41 to account for the decrease in MPC. Despite this markup increase, revenue is lower at TSLs 1 through 3 than in the base case because of the lower average unit price, and the $8 million in conversion costs increases the negative impact. When the preservation of operating profit markup is combined with the existing technologies scenario rather than the emerging technologies scenario, the impact of this maximized revenue per unit is greatest because it is applied to a larger total quantity of shipments.

a. Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of recent or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. In addition to energy conservation standards, other regulations can significantly affect manufacturers' financial operations. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

During previous stages of this rulemaking DOE identified a number of requirements, in addition to amended energy conservation standards for ballasts, that manufacturers of these products will face for products and equipment they manufacture within approximately 3 years prior to and 3 years after the anticipated compliance date of the amended standards. The following section briefly addresses comments DOE received with respect to cumulative regulatory burden and summarizes other key related concerns that manufacturers raised during interviews.

NEMA stated that the effects of most safety, electromagnetic interference (EMI), and toxic materials regulations are the same on all ballast manufacturers. (NEMA, No. 29 at p. 9) DOE agrees that all ballast manufacturers are subject to the same requirements as described in this section and in chapter 13 of the NOPR TSD. Small manufacturers may be impacted differentially and are therefore analyzed as a manufacturer sub-group in section 0.

NEMA also stated that regulatory actions generally limit competitiveness and force ballast manufacturers to add cost to their base designs to comply with the regulatory requirements. (NEMA, No. 29 at p. 9) DOE asked manufacturers to quantify impacts of regulatory actions where possible, and in the engineering analysis, DOE modified the ballast efficiency, cost, or both at each analyzed efficiency level according to the impacts of these regulations. These specific regulatory actions and DOE's treatment of their impacts are discussed below and in section 0.

NEMA further suggested that regulatory pressure on traditional ballasts takes investments away from efforts to further develop dimming ballasts and their related controls. (NEMA, No. 29 at p. 12) DOE recognizes that there is an opportunity cost associated with any investment, and this opportunity cost is reflected in the discount rate used in the GRIM. In deciding which TSL to propose, DOE weighs the potential benefits of new and amended energy conservation standards against the potential burdens, including the impact on manufacturers, to determine which TSL is technologically feasible and economically justified.

Several manufacturers expressed concern during interviews about the overall volume of DOE energy conservation standards with which they must comply. Most fluorescent lamp ballast manufacturers also make a full range of lighting products and share engineering and other resources with these other internal manufacturing divisions for different products (including certification testing for regulatory compliance). For example, DOE amended standards in 2009 for general service fluorescent lamps and incandescent reflector lamps for which compliance will be required in 2012. Manufacturers were concerned that the other products facing new or amended energy conservation standards would compete for the same engineering and financial resources.

DOE takes into account the cost of compliance with other published Federal energy conservation standards, such as those established in the 2009 lamps rule, in weighing the benefits and burdens of today's proposed rulemaking. These costs and the extent to which they could be incurred by fluorescent lamp ballast manufacturers are provided in chapter 13 of the NOPR TSD. DOE does not include the impacts of standards that have not yet been finalized because any impacts would be speculative.

Several manufacturers noted the safety requirements ballast manufacturers must meet. NEMA described the need to add a line voltage disconnect to certain lighting systems and the need to use UL Type CC rated (anti-arcing) ballasts or high temperature circle "I" rated lampholders in OEM fixtures and UL-marked retrofit kits. The Type CC rating requires control circuitry to implement, and these circuits will consume system power, which decreases overall ballast electrical efficiency. (NEMA, No. 29 at p. 9) DOE appreciates this information on safety requirements, but DOE has not adjusted its engineering analysis according to these potential impacts. The burden for line voltage disconnect requirements falls solely on luminaire manufacturers rather than on ballast manufacturers. For anti-arcing protection, most fixture manufacturers comply with UL 1598 by using circle "I" lampholders. Fixture manufacturers can also comply by purchasing premium Type CC rated ballasts, which are often bundled with high-efficiency to command a higher markup. Because providing Type CC ballasts to fixture manufacturers is not required, DOE does not believe UL 1598 warrants adjustment of the TSLs proposed in today's notice. *See* section 0 in the engineering analysis for more information on Type CC protection. Further detail on UL 1598 and the burden it imposes is provided in chapter 13 of the NOPR TSD.

Manufacturers also discussed requirements regarding EMI. Currently, ballasts are tested only for conducted emissions under FCC Part 18, which is not as rigorous as the CISPR 15 requirements effective in Europe. The burden of proof for existing EMI tests rests with the luminaire manufacturers. (NEMA, No. 29 at p. 10) Manufacturers noted that they could be required to comply with the model European EMI regulation in the future, which would result in design changes that could decrease efficiency. (NEMA, No. 29 at p. 10; OSI, Public Meeting Transcript, No. 12 at p. 188) DOE has not adjusted its estimates for ballast efficiency or price because NEMA's comment refers to potential EMI regulations, but DOE will consider adjusting its analysis for the final rule if these regulations are required prior to issuance of the final rule.

Manufacturers also stated that lamp end-of-life (EOL) requirements are a regulatory burden. T5 ballasts are required to have EOL protection systems that detect characteristic electrical signals of a lamp in distress and activate control functions in the ballast to limit energy supplied to the lamp. Compliance with EOL requirements has added cost and design complexity to these systems. (NEMA, No. 29 at p. 9–10) In the future, T8 and T12 ballasts could also require EOL protection, which could add cost and decrease efficiency. (NEMA, No. 29 at p. 10; Philips, Public Meeting Transcript, No. 12 at p. 185–186) DOE agrees that EOL requirements have affected the cost and design of T5 ballasts, but because all T5 ballasts on the market, including those selected as representative ballast types for DOE's engineering analysis, already include these EOL protection systems, the effects of this requirement are already taken into account. As stated in section 0, DOE does not expect EOL protection to be required for T8 and T12 ballasts in the United States as required in Europe due to significant differences between the lamps used in the United States and Europe. If EOL requirements change prior to the issuance of the final rule, DOE will consider adjusting its analysis.

Manufacturers also expressed concern about the increasing stringency of international energy efficiency standards and materials requirements. Compliance with many regulations such as the Restriction of Hazardous Substances (RoHS) directive in Europe on the use of lead-based solder and other toxic materials is currently optional but could become a requirement in the future. Compliance with toxic material regulations could result in cost increases, component shortages, and product quality concerns. (NEMA, No. 29 at p. 10, 13; Philips, Public Meeting Transcript, No. 12 at p. 186–188; GE, Public Meeting Transcript, No. 12 at p. 243–244) As described in section 0, DOE does not believe any adjustment to ballast price or efficiency is necessary to comply with toxic material regulations because compliance is optional, but DOE will consider adjusting its analysis for the final rule if these regulations are required prior to issuance of the final rule.

DOE discusses these and other requirements, and includes the full details of the cumulative regulatory burden analysis, in chapter 13 of the NOPR TSD.

2. National Impact Analysis

a. Significance of Energy Savings

To estimate the energy savings through 2043 attributable to potential standards for ballasts, DOE compared the energy consumption of these products under the base case to their anticipated energy consumption under each TSL. The table below presents DOE's forecasts of the national energy savings for each TSL, calculated using the *AEO2010* energy price forecast. This table presents the results of the two scenarios that represent the maximum and minimum energy savings resulting from all the scenarios analyzed. Chapter 11 of the NOPR TSD describes these estimates in more detail.

TABLE VIII.31—SUMMARY OF CUMULATIVE NATIONAL ENERGY SAVINGS FOR BALLASTS (2014–2043)

XVI. Trial standard level	XVII. Product class and ballast type	National energy savings quads	
		Existing technologies, shift	Emerging technologies, roll-up
1	1—IS and RS ballasts that operate:		
	Two 4-foot MBP lamps (commercial)	1.42	0.002
	Two 4-foot MBP lamps (residential)	0.22	0.01
	Four 4-foot MBP lamps	0	0
	Two 8-foot slimline lamps	0	0
	2—PS ballasts that operate:		
	Two 4-foot MBP lamps	0.19	0.09

TABLE VIII.31—SUMMARY OF CUMULATIVE NATIONAL ENERGY SAVINGS FOR BALLASTS (2014–2043)—Continued

XVI. Trial standard level	XVII. Product class and ballast type	National energy savings quads	
		Existing technologies, shift	Emerging technologies, roll-up
	Four 4-foot MBP lamps	0.45	0.22
	Two 4-foot MiniBP SO lamps	0.37	0.18
	Two 4-foot MiniBP HO lamps	0.20	0.19
	3—IS and RS ballasts that operate:		
	Two 8-foot HO lamps	0.0003	0.0003
	5—Ballasts that operate:		
	Four 8-foot HO lamps in cold temperature outdoor signs	0.90	0.68
	Total	3.74	1.38
2	1—IS and RS ballasts that operate:		
	Two 4-foot MBP lamps (commercial)	1.42	0.68
	Two 4-foot MBP lamps (residential)	0.23	0.21
	Four 4-foot MBP lamps	0	0
	Two 8-foot slimline lamps	0.02	0.001
	2—PS ballasts that operate:		
	Two 4-foot MBP lamps	0.19	0.09
	Four 4-foot MBP lamps	0.55	0.29
	Two 4-foot MiniBP SO lamps	0.72	0.32
	Two 4-foot MiniBP HO lamps	0.36	0.32
	3—IS and RS ballasts that operate:.		
	Two 8-foot HO lamps	0.0003	0.0002
	5—Ballasts that operate:		
	Four 8-foot HO lamps in cold temperature outdoor signs	0.90	0.68
	Total	4.39	2.59
3	1—IS and RS ballasts that operate:		
	Two 4-foot MBP lamps (commercial)	1.97	1.02
	Two 4-foot MBP lamps (residential)	0.23	0.21
	Four 4-foot MBP lamps	0.32	0.17
	Two 8-foot slimline lamps	0.02	0.02
	2—PS ballasts that operate:		
	Two 4-foot MBP lamps	0.22	0.11
	Four 4-foot MBP lamps	0.55	0.29
	Two 4-foot MiniBP SO lamps	1.52	0.71
	Two 4-foot MiniBP HO lamps	0.52	0.49
	3—IS and RS ballasts that operate:		
	Two 8-foot HO lamps	0.0006	0.0005
	5—Ballasts that operate:		
	Four 8-foot HO lamps in cold temperature outdoor signs	0.90	0.68
	Total	6.25	3.70

a. Net Present Value of Consumer Costs and Benefits

DOE estimated the cumulative NPV to the nation of the total costs and savings for consumers that would result from particular standard levels for ballasts. In accordance with the OMB's guidelines on regulatory analysis (OMB Circular A–4, section E, September 17, 2003), 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. In addition, DOE used the 3-percent rate to capture the potential effects of standards on private consumption (*e.g.,* through higher prices for products 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 table below shows the consumer NPV results for each TSL DOE considered for ballasts, using both a 7-percent and a 3-percent discount rate. Similar to the results presented for NES, this table presents the results of the two scenarios that represent the maximum and minimum NPV resulting from all the scenarios analyzed. See chapter 11 of the NOPR TSD for more detailed NPV results.

TABLE VIII.32—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR BALLASTS (2014–2043)

XVIII. Trial standard level	XIX. Product class and ballast type	Net present value (billion 2009$)			
		Existing technologies, shift		Emerging technologies, roll-up	
		7 Percent discount rate	3 Percent discount rate	7 Percent discount rate	3 Percent discount rate
1	1—IS and RS ballasts that operate:				
	Two 4-foot MBP lamps (commercial)	3.11	6.82	0.004	0.006
	Two 4-foot MBP lamps (residential)	0.44	0.97	0.15	0.24
	Four 4-foot MBP lamps	0	0	0	0
	Two 8-foot slimline lamps	0	0	0	0
	2—PS ballasts that operate:				
	Two 4-foot MBP lamps	0.48	0.93	0.27	0.50
	Four 4-foot MBP lamps	0.97	2.10	0.58	1.16
	Two 4-foot MiniBP SO lamps	0.88	1.95	0.56	1.08
	Two 4-foot MiniBP HO lamps	0.32	0.66	0.32	0.66
	3—IS and RS ballasts that operate:				
	Two 8-foot HO lamps	0.02	0.03	0.001	0.001
	5—Ballasts that operate:				
	Four 8-foot HO lamps in cold temperature outdoor signs.	2.72	5.12	2.33	4.27
	Total	8.93	18.58	4.21	7.91
2	1—IS and RS ballasts that operate:				
	Two 4-foot MBP lamps (commercial)	3.11	6.82	1.79	3.65
	Two 4-foot MBP lamps (residential)	0.45	0.98	0.45	0.98
	Four 4-foot MBP lamps	0	0	0	0
	Two 8-foot slimline lamps	0.06	0.11	0.01	0.01
	2—PS ballasts that operate:				
	Two 4-foot MBP lamps	0.48	0.93	0.27	0.50
	Four 4-foot MBP lamps	1.15	2.50	0.71	1.45
	Two 4-foot MiniBP SO lamps	1.06	2.50	0.67	1.38
	Two 4-foot MiniBP HO lamps	0.26	0.60	0.26	0.59
	3—IS and RS ballasts that operate:				
	Two 8-foot HO lamps	0.03	0.04	0.03	0.04
	5—Ballasts that operate:				
	Four 8-foot HO lamps in cold temperature outdoor signs.	2.72	5.12	2.33	4.27
	Total	9.31	19.62	6.51	12.88
3	1—IS and RS ballasts that operate:				
	Two 4-foot MBP lamps (commercial)	4.52	9.84	2.84	5.73
	Two 4-foot MBP lamps (residential)	0.45	0.98	0.45	0.98
	Four 4-foot MBP lamps	0.44	1.02	0.28	0.62
	Two 8-foot slimline lamps	0.06	0.12	0.06	0.12
	2—PS ballasts that operate:				
	Two 4-foot MBP lamps	0.53	1.04	0.31	0.58
	Four 4-foot MBP lamps	1.15	2.50	0.71	1.45
	Two 4-foot MiniBP SO lamps	1.31	3.42	0.88	2.07
	Two 4-foot MiniBP HO lamps	0.25	0.63	0.25	0.63
	3—IS and RS ballasts that operate:				
	Two 8-foot HO lamps	0.03	0.04	0.03	0.04
	5—Ballasts that operate:				
	Four 8-foot HO lamps in cold temperature outdoor signs.	2.72	5.12	2.33	4.27
	Total	11.43	24.71	8.13	16.49

a. Impacts on Employment

DOE develops estimates of the indirect employment impacts of potential standards on the economy in general. As discussed above, DOE expects energy conservation standards for ballasts to reduce energy bills for ballast customers and the resulting net savings to be redirected to other forms of economic activity. These shifts in spending and economic activity could affect the demand for labor. As described in section 0 above, DOE used an input/output model of the U.S. economy to estimate these effects.

The input/output model suggests that today's proposed standards are likely to increase the net demand for labor in the economy. However, the gains would most likely be very small relative to total national employment, and neither the BLS data nor the input/output model DOE uses includes the quality or wage level of the jobs. As discussed in section 0 above, the major manufacturers interviewed for this rulemaking indicate they have no domestic ballast production. DOE believes, therefore, that new and amended standards for ballasts will not have a significant impact on the limited number of production workers directly employed by ballast manufacturers in the U.S.

Table VIII.33 presents the estimated net indirect employment impacts from the TSLs that DOE considered in this rulemaking. *See* NOPR TSD chapter 15 for more detailed results.

TABLE VIII.33—NET CHANGE IN JOBS FROM INDIRECT EMPLOYMENT EFFECTS UNDER BALLAST TSLs

XX. Analysis period year	XXI. Trial standard level	Net national change in jobs (thousands)	
		Existing technologies, shift	Emerging technologies, roll-up
2020	1	12.64	3.67
	2	2.89	2.59
	3	3.63	3.31
2043	1	123.75	31.79
	2	63.21	37.07
	3	89.47	51.06

1. Impact on Utility or Performance of Products

As presented in section 0 of this notice, DOE concluded that none of the TSLs considered in this notice would reduce the utility or performance of the products under consideration in this rulemaking. Furthermore, manufacturers of these products currently offer ballasts that meet or exceed the proposed standards. (42 U.S.C. 6295(o)(2)(B)(i)(IV))

2. Impact of Any Lessening of Competition

DOE has also considered any lessening of competition that is likely to result from new and amended standards. The Attorney General determines the impact, if any, of any lessening of competition likely to result from a proposed standard, and transmits such determination to the Secretary, 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))

To assist the Attorney General in making such determination, DOE has provided DOJ with copies of this notice and the TSD for review. DOE will consider DOJ's comments on the proposed rule in preparing the final rule, and DOE will publish and respond to DOJ's comments in that document.

3. Need of the Nation To Conserve Energy

An improvement in the energy efficiency of the products subject to today's rule is likely to improve the security of the nation's energy system by reducing overall demand for energy. Reduced electricity demand may also improve the reliability of the electricity system. As a measure of this reduced demand, Table VIII.34 presents the estimated reduction in generating capacity in 2043 for the TSLs that DOE considered in this rulemaking.

TABLE VIII.34—REDUCTION IN ELECTRIC GENERATING CAPACITY IN 2043 UNDER BALLAST TSLs

XXII. Trial standard level	Reduction in electric generating capacity (gigawatts)	
	Existing technologies, shift	Emerging technologies, roll-up
1	4.17	1.51
2	5.20	2.99
3	7.22	4.37

Energy savings from amended standards for ballasts could also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table VIII.35 provides DOE's estimate of cumulative CO_2, NO_X, and Hg emissions reductions projected to result from the TSLs considered in this rulemaking. DOE reports annual CO_2, NO_X, and Hg emissions reductions for each TSL in the environmental assessment in chapter 16 of the NOPR TSD.

TABLE VIII.35—SUMMARY OF EMISSIONS REDUCTION ESTIMATED FOR BALLAST TSLs

[Cumulative for 2014 through 2043]

XXIII. Trial standard level	Cumulative reduction in emissions (2014 through 2043)					
	Existing technologies, shift			Emerging technologies, roll-up		
	CO_2 MMt	NO_X kt	Hg t	CO_2 MMt	NO_X kt	Hg t
1	70	26	0.96	14	11	0.20
2	87	32	1.20	27	22	0.40

TABLE VIII.35—SUMMARY OF EMISSIONS REDUCTION ESTIMATED FOR BALLAST TSLs—Continued

[Cumulative for 2014 through 2043]

XXIII. Trial standard level	Cumulative reduction in emissions (2014 through 2043)					
	Existing technologies, shift			Emerging technologies, roll-up		
	CO_2 MMt	NO_X kt	Hg t	CO_2 MMt	NO_X kt	Hg t
3	121	44	1.67	40	32	0.59

As discussed in section 0, DOE did not report sulfur dioxide (SO_2) emissions reductions from power plants because there is uncertainty about the effect of energy conservation standards on the overall level of SO_2 emissions in the United States due to SO_2 emissions caps. DOE also did not include NO_X emissions reduction from power plants in States subject to CAIR because an energy conservation standard would not affect the overall level of NO_X emissions in those States due to the emissions caps mandated by CAIR.

As part the analysis for this proposed rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that DOE estimated for each of the TSLs considered. As discussed in section 0, DOE used values for the SCC developed by an interagency process. The four values for CO_2 emissions reductions resulting from that process (expressed in 2007$) are $4.7/ton (the average value from a distribution that uses a 5-percent discount rate), $21.4/ton (the average value from a distribution that uses a 3-percent discount rate), $35.1/ton (the average value from a distribution that uses a 2.5-percent discount rate), and $64.9/ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). These values correspond to the value of emission reductions in 2010; the values for later years are higher due to increasing damages as the magnitude of climate change increases. For each TSL, DOE calculated the global present values of CO_2 emissions reductions, using the same discount rate as was used in the studies upon which the dollar-per-ton values are based. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values.

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions 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 change. DOE, together with other Federal agencies, will continue to review various methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing 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. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this NOPR the most recent values and analyses resulting from the ongoing interagency review process.

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X and Hg emissions reductions anticipated to result from amended ballast standards. Estimated monetary benefits for CO_2, NO_X and Hg emission reductions are detailed in chapter 16 of the NOPR TSD.

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the consumer savings calculated for each TSL considered in this rulemaking. Table VIII.36 shows an example of the calculation of the combined NPV including benefits from emissions reductions for the case of TSL 3 for ballasts. The CO_2 values used in the table correspond to the four scenarios for the valuation of CO_2 emission reductions presented in section 0.

TABLE VIII.36—ADDING NET PRESENT VALUE OF CONSUMER SAVINGS TO PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS AT TSL 3 FOR BALLASTS (EXISTING TECHNOLOGIES, SHIFT)

Category	Present value million 2009$	Discount rate (%)
Benefits		
Operating Cost Savings	16,858	7
	35,284	3
CO_2 Reduction Monetized Value (at $4.7/Metric Ton)*	429	5
CO_2 Reduction Monetized Value (at $21.4/Metric Ton)*	2,185	3
CO_2 Reduction Monetized Value (at $35.1/Metric Ton)*	3,699	2.5
CO_2 Reduction Monetized Value (at $64.9/Metric Ton)*	6,668	3
NO_X Reduction Monetized Value (at $2,519/Ton)*	35	7
	65	3
Total Monetary Benefits **	19,078	7
	37,534	3
Costs		
Total Incremental Installed Costs	5,425	7
	10,573	3

TABLE VIII.36—ADDING NET PRESENT VALUE OF CONSUMER SAVINGS TO PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS AT TSL 3 FOR BALLASTS (EXISTING TECHNOLOGIES, SHIFT)—Continued

Category	Present value million 2009$	Discount rate (%)
Net Benefits/Costs		
Including CO_2 and NO_X**	13,653 26,961	7 3

* These values represent global values (in 2007$) of the social cost of CO_2 emissions in 2010 under several scenarios. The values of $4.7, $21.4, and $35.1 per ton are the averages of SCC distributions calculated using 5 percent, 3 percent, and 2.5 percent discount rates, respectively. The value of $64.9 per ton represents the 95th percentile of the SCC distribution calculated using a 3 percent discount rate. See section 0 for details.

** Total Monetary Benefits for both the 3 percent and 7 percent cases utilize the central estimate of social cost of CO_2 emissions calculated at a 3 percent discount rate (averaged across three IAMs), which is equal to $21.4/ton in 2010 (in 2007$).

Although adding the value of consumer savings to the values of emission reductions provides a valuable perspective, the following should be considered: (1) The national consumer savings are domestic U.S. consumer monetary savings found in market transactions, while the values of emissions reductions are based on estimates of marginal social costs, which, in the case of CO_2, are based on a global value; and (2) the assessments of consumer savings and emission-related benefits are performed with different computer models, leading to different timeframes for analysis. For ballasts, the present value of national consumer savings is measured for the period in which units shipped (2014–2043) continue to operate. However, the time frames of the benefits associated with the emission reductions differ. For example, the value of CO_2 emissions reductions reflects the present value of all future climate-related impacts due to emitting a ton of CO_2 in that year, out to 2300.

Chapter 16 of the NOPR TSD presents calculations of the combined NPV including benefits from emissions reductions for each TSL.

A. Proposed Standards

DOE recognizes that when it considers proposed standards, it is subject to the EPCA requirement that any new or amended energy conservation standard for any type (or class) of covered product 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)) 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, in light of the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i)) The new or amended standard must also result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)(B))

DOE considered the impacts of standards at each trial standard level, beginning with the maximum technologically feasible level, to determine whether that level met the evaluation criteria. If the max tech level was not justified, DOE then considered the next most efficient level and undertook the same evaluation until it reached the highest efficiency level that is both technologically feasible and economically justified and saves 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 0) such as national energy savings, net present value (discounted at 7 and 3 percent), emissions reductions, industry net present value, life-cycle cost, and consumers' installed price increases. Beyond the quantitative results, DOE also considers other burdens and benefits that affect economic justification, including how technological feasibility, manufacturer costs, and impacts on competition may affect the economic results presented.

To aid the reader as DOE discusses the benefits and burdens of each trial standard level, DOE has included tables below that present a summary of the results of DOE's quantitative analysis for each TSL. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification. Section 0 presents the estimated impacts of each TSL for these subgroups.

TABLE VIII.37—SUMMARY OF RESULTS FOR BALLASTS

[Existing Technologies, Shift]

Category	TSL 1	TSL 2	TSL 3
National Energy Savings (quads)	3.74	4.39	6.25.
NPV of Consumer Benefits (2009$ billion)			
3% discount rate	18.58	19.62	24.71.
7% discount rate	8.93	9.31	11.43.
Industry Impacts			
Industry NPV (2009$ million)	1,221	1,189	1,145.
Industry NPV (% change)	−1.6%	−4.2%	−7.7%.

TABLE VIII.37—SUMMARY OF RESULTS FOR BALLASTS—Continued

[Existing Technologies, Shift]

Category	TSL 1	TSL 2	TSL 3
Cumulative Emissions Reduction			
CO_2 (MMt)	70	87	121.
NO_X (kt)	26	32	44.
Hg (t)	0.96	1.20	1.67.
Value of Cumulative Emissions Reduction			
CO_2 (2009$ billion) *	0.25 to 3.85	0.31 to 4.80	0.43 to 6.67.
NO_X—3% discount rate (2009$ million)	37	47	65.
NO_X—7% discount rate (2009$ million)	20	25	35.
Mean LCC Savings (replacement event) ** (2009$)			
Product Class 1			
IS and RS ballasts that operate:			
Two 4-foot MBP lamps (commercial)	17.54 to 19.29	−2.11 to 25.00	−2.11 to 42.41.
Two 4-foot MBP lamps (residential).			
Four 4-foot MBP lamps.			
Two 8-foot slimline lamps.			
Product Class 2			
PS ballasts that operate:			
Two 4-foot MBP lamps	0.08 to 19.21	7.52 to 22.57	1.83 to 20.68.
Four 4-foot MBP lamps.			
Two 4-foot MiniBP SO lamps.			
Two 4-foot MiniBP HO lamps.			
Product Class 3			
Ballasts that operate:			
Two 8-foot HO lamps	69.82	234.45	2.33 to 236.77.
Product Class 5			
Ballasts that operate:			
Four 8-foot HO lamps in cold-temperature outdoor signs	389.91	389.91	389.91.
Median PBP (replacement event) * (years)**			
Product Class 1	−8.99 to −7.60	−6.99 to N/A	−6.99 to N/A.
Product Class 2	0.06 to 11.27	0.61 to 5.09	1.22 to 7.19.
Product Class 3	−0.57	−0.67	−0.52 to 4.57.
Product Class 5	−0.16	−0.16	−0.16.
Distribution of Consumer LCC Impacts (see Table VIII.16 through Table VIII.25 above)			
Generation Capacity Reduction (GW) †	4.17	5.20	7.22.
Employment Impacts			
Indirect Domestic Jobs (thousands) †	123.75	63.21	89.47.

* Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
** For LCCs, a negative value means an increase in LCC by the amount indicated.
*** For PBPs, negative values indicate standards that reduce operating costs and installed costs; "N/A" indicates standard levels that do not reduce operating costs.
† Changes in 2043.

TABLE VIII.38—SUMMARY OF RESULTS FOR BALLASTS

[Emerging Technologies, Roll-up]

Category	TSL 1	TSL 2	TSL 3
National Energy Savings (quads)	1.38	2.59	3.70.
NPV of Consumer Benefits (2009$ billion)			
3% discount rate	7.91	12.88	16.49.
7% discount rate	4.21	6.51	8.13.
Industry Impacts			
Industry NPV (2009$ million)	740	635	557.
Industry NPV (% change)	−13.2%	−25.5%	−34.7%.

TABLE VIII.38—SUMMARY OF RESULTS FOR BALLASTS—Continued

[Emerging Technologies, Roll-up]

Category	TSL 1	TSL 2	TSL 3
Cumulative Emissions Reduction			
CO_2 (MMt)	14	27	40.
NO_X (kt)	11	22	32.
Hg (t)	0.20	0.40	0.59.
Value of Cumulative Emissions Reduction			
CO_2 (2009$ billion) *	0.06 to 0.90	0.13 to 1.79	0.18 to 2.62.
NO_X—3% discount rate (2009$ million)	14	29	42.
NO_X—7% discount rate (2009$ million)	7	13	19.
Mean LCC Savings (replacement event) ** (2009$)			
Product Class 1			
IS and RS ballasts that operate:			
Two 4-foot MBP lamps (commercial)	17.54 to 19.29	−2.11 to 25.00	−2.11 to 42.41.
Two 4-foot MBP lamps (residential).			
Four 4-foot MBP lamps.			
Two 8-foot slimline lamps.			
Product Class 2			
PS ballasts that operate:			
Two 4-foot MBP lamps	0.08 to 19.21	7.52 to 22.57	1.83 to 20.68.
Four 4-foot MBP lamps.			
Two 4-foot MiniBP SO lamps.			
Two 4-foot MiniBP HO lamps.			
Product Class 3			
Ballasts that operate:			
Two 8-foot HO lamps	69.82	234.45	2.33 to 236.77.
Product Class 5			
Ballasts that operate:			
Four 8-foot HO lamps in cold-temperature outdoor signs	389.91	389.91	389.91.
Median PBP (replacement event) * (years)**			
Product Class 1	−8.99 to −7.60	−6.99 to N/A	−6.99 to N/A.
Product Class 2	0.06 to 11.27	0.61 to 5.09	1.22 to 7.19.
Product Class 3	−0.57	−0.67	−0.52 to 4.57.
Product Class 5	−0.16	−0.16	−0.16.
Distribution of Consumer LCC Impacts (see Table VIII.16 through Table VIII.25 above)			
Generation Capacity Reduction (GW)†	1.51	2.99	4.37.
Employment Impacts			
Indirect Domestic Jobs (thousands)†	31.79	37.07	51.06.

* Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
** For LCCs, a negative value means an increase in LCC by the amount indicated.
*** For PBPs, negative values indicate standards that reduce operating costs and installed costs; "N/A" indicates standard levels that do not reduce operating costs.
† Changes in 2043.

As discussed in previous DOE standards rulemakings and a recent Notice of Data Availability (76 FR 9696, Feb. 22, 2011), DOE also notes that the economics literature provides a wide-ranging discussion of how consumers trade off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. This undervaluation suggests that regulation that promotes energy efficiency can produce significant net private gains (as well as producing social gains by, for example, reducing pollution). There is evidence that consumers undervalue future energy savings as a result of (1) a lack of information, (2) a lack of sufficient savings to warrant delaying or altering purchases (*e.g.,* an inefficient ventilation fan in a new building or the delayed replacement of a water pump), (3) inconsistent (*e.g.,* excessive short-term) weighting of future energy cost savings relative to available returns on other investments, (4) computational or other difficulties associated with the evaluation of relevant tradeoffs, and (5) a divergence in incentives (*e.g.,* renter versus owner; builder vs. purchaser). Other literature indicates that with less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher than expected rate between current consumption and uncertain future energy cost savings. In the abstract, it may be difficult to say how a welfare gain from correcting under-investment compares in magnitude to the potential welfare losses associated with no longer purchasing a machine or switching to an imperfect substitute, both of which still exist in this framework.

Other literature indicates that with less than perfect foresight and uncertainty about the future, consumers may trade off these types of investments at a higher than expected rate between current consumption and uncertain future energy cost savings. Some studies suggest that this seeming undervaluation may be explained in certain circumstances by differences between tested and actual energy savings, or by uncertainty and irreversibility of energy investments.

The mix of evidence in the empirical literature suggests that if feasible, analysis of regulations mandating energy efficiency improvements should explore the potential for both welfare gains and losses and move toward fuller economic framework where all relevant changes can be quantified.[49] While DOE is not prepared at present to provide a fuller quantifiable framework for this discussion, DOE seeks comments on how to assess these possibilities.[50]

1. Trial Standard Level 3

DOE first considered the most efficient level, TSL 3, which would save an estimated total of 3.7 to 6.3 quads of energy through 2043—a significant amount of energy. For the nation as a whole, TSL 3 would have a net savings of $8.1 billion–$11.4 billion at a 7-percent discount rate, and $16.5 billion–24.7 billion at a 3-percent discount rate. The emissions reductions at TSL 3 are estimated at 40–121 MMt of CO_2, 32–44 kilotons (kt) of NO_X, and 0.59–1.67 tons of Hg. Total generating capacity in 2043 is estimated to decrease compared to the reference case by 4.37–7.22 gigawatts under TSL 3. As seen in section 0, for almost all representative ballast types, consumers have available ballast designs which result in positive LCC savings, ranging from $1.83–$389.91, at TSL 3. The consumers that experience negative LCC savings at TSL 3 are those that currently have a 2-lamp 8-foot HO T8 ballast (for the new construction/renovation event only) or a 2-lamp 4-foot MBP T8 ballast in the residential sector (for the replacement event only). The projected change in industry value would range from a decrease of $95.3 million to a decrease of $296.2 million, or a net loss of 7.7 percent to a net loss of 34.7 percent in INPV.

DOE based TSL 3 on the most efficient commercially available products for each representative ballast type analyzed. This TSL represents the highest efficiency level that is technologically feasible for a sufficient diversity of products (spanning several ballast factors, number of lamps per ballast, and types of lamps operated) within each product class. Although consumers that currently have a 2-lamp 8-foot HO T8 ballast or a 2-lamp 4-foot MBP T8 ballast in the residential sector experience negative LCC savings of −$0.22 and −$2.11 respectively, overall LCC savings for consumers of these ballast types are positive.

After considering the analysis, comments on the preliminary analysis, and the benefits and burdens of TSL 3, the Secretary has reached the following tentative conclusion: TSL 3 offers the maximum improvement in efficiency that is technologically feasible and economically justified, and will result in significant conservation of energy. The Secretary has reached the initial conclusion that the benefits of energy savings, emissions reductions (both in physical reductions and the monetized value of those reductions), the positive net economic savings to the nation, and positive life-cycle cost savings would outweigh the potentially large reduction in INPV for manufacturers and increased LCC for a small subset of consumers. Therefore, DOE today proposes to adopt the energy conservation standards for ballasts at TSL 3. DOE seeks comment on its proposal of TSL 3. DOE will consider the comments and information received in determining the final energy conservation standards.

B. Backsliding

As discussed in section 0, EPCA contains what is commonly known as an "anti-backsliding" provision, which 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. (42 U.S.C. 6295(o)(1)) Because DOE is evaluating amended standards in terms of ballast luminous efficiency, DOE converted the existing BEF standards to BLE to verify that the proposed standards did not constitute backsliding. The following describes how DOE completed this comparison.

Ballast efficacy factor is defined as ballast factor divided by input power times 100. Ballast factor, in turn, is currently defined as the test system light output divided by a reference system light output. As mentioned in section 0, the active mode test procedure SNOPR proposed a new method for calculating ballast factor. 75 FR 71570, 71577–8 (November 24, 2010). The new methodology entails measuring the lamp arc power of the test system and dividing it by the lamp arc power of the reference system. Because this new method calculates a ballast factor equivalent to the existing method, DOE believes this definition can be incorporated into the equation for BEF. After this substitution, BEF can be converted to BLE by dividing by 100 and multiplying by the appropriate reference arc power. Table VIII.39 below contains the existing standard in terms of BEF, the existing standard in terms of BLE, and the proposed standard in terms of BLE.

TABLE VIII.39—EXISTING FEDERAL BEF STANDARDS AND THE CORRESPONDING BLE

Application for operation of	BEF standard	Equivalent BLE		Proposed BLE standard*
		Low freq	High freq	
One F40T12 lamp	2.29	80.4	83.2	89.9
Two F40T12 lamps	1.17	82.1	85.0	91.0
Two F96T12 lamps	0.63	85.1	89.7	92.2
Two F96T12/HO lamps	0.39	74.4	78.0	90.4
One F34T12 lamp	2.61	75.2	77.8	89.4
Two F34T12 lamps	1.35	77.8	80.5	90.6
Two F96T12/ES lamps	0.77	83.9	88.4	91.8

[49] A good review of the literature related to this issue can be found in Gillingham, K., R. Newell, K. Palmer. (2009). "Energy Efficiency Economics and Policy," *Annual Review of Resource Economics,* 1: 597–619; and Tietenberg, T. (2009). "Energy Efficiency Policy: Pipe Dream or Pipeline to the Future?" *Review of Environmental Economics and Policy.* Vol. 3, No. 2: 304–320.

[50] A draft paper, "Notes on the Economics of Household Energy Consumption and Technology Choice," proposes a broad theoretical framework on which an empirical model might be based and is posted on the DOE Web site along with this notice at *http://www.eere.energy.gov/buildings/appliance_standards.*

TABLE VIII.39—EXISTING FEDERAL BEF STANDARDS AND THE CORRESPONDING BLE—Continued

Application for operation of	BEF standard	Equivalent BLE		Proposed BLE standard*
		Low freq	High freq	
Two F96T12/HO/ES lamps	0.42	68.0	71.3	90.1

* For ballast types that could be in more than one product class, this table presents the lowest standard the ballast would be required to meet. For example, 8-foot HO ballasts can have a PS starting method in addition to IS or RS. Therefore, DOE presents the standard for the PS product class as it is the lowest. The proposed BLE standard includes a 0.8 percent reduction for lab to lab variation and compliance requirements.

As seen in the table above, the standards proposed in this NOPR are higher than the existing standards, regardless of low or high frequency operation. As such, the proposed standards do not decrease the minimum required energy efficiency of the covered products and therefore do not violate the anti-backsliding provision in EPCA.

XXIV. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

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 that it intends to address, including, where applicable, the failures of private markets or public institutions that warrant new agency action, as well as to assess the significance of that problem. The problems that today's standards address are as follows:

(1) There is a lack of consumer information and/or information processing capability about energy efficiency opportunities in the lighting market.

(2) There is asymmetric information (one party to a transaction has more and better information than the other) and/or high transactions costs (costs of gathering information and effecting exchanges of goods and services).

(3) There are external benefits resulting from improved energy efficiency of ballasts that are not captured by the users of such equipment. These benefits include externalities related to environmental protection and energy security that are not reflected in energy prices, such as reduced emissions of greenhouse gases.

In addition, DOE has determined that today's regulatory action is an "economically significant regulatory action" under section 3(f)(1) of Executive Order 12866. Accordingly, section 6(a)(3) of the Executive Order requires that DOE prepare a regulatory impact analysis (RIA) on today's rule and that the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB) review this rule. DOE presented to OIRA for review the draft rule and other documents prepared for this rulemaking, including the RIA, and has included these documents in the rulemaking record. The assessments prepared pursuant to Executive Order 12866 can be found in the technical support document (Chapter 17) for this rulemaking. They are available for public review in the Resource Room of DOE's Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011 (76 FR 3281, Jan. 21, 2011). EO 13563 is supplemental to and reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by these Executive Orders to, among other things: (1) Propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. For the reasons stated in the preamble, DOE believes that today's proposed rule is consistent with these principles.

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 (IRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. 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*). DOE reviewed the potential standard levels considered in today's NOPR under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003.

As a result of this review, DOE has prepared an IRFA for fluorescent lamp ballasts, a copy of which DOE will transmit to the Chief Counsel for Advocacy of the SBA for review under 5 U.S.C. 605(b). As presented and discussed below, the IFRA describes potential impacts on small ballast manufacturers associated with the required capital and product conversion costs at each TSL and discusses alternatives that could minimize these impacts.

A statement of the reasons for the proposed rule, and the objectives of, and legal basis for, the proposed rule, are set forth elsewhere in the preamble and not repeated here.

1. Description and Estimated Number of Small Entities Regulated

a. Methodology for Estimating the Number of Small Entities

For manufacturers of fluorescent lamp ballasts, the Small Business

Administration (SBA) has set a size threshold, which defines those entities classified as "small businesses" for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30850 (May 15, 2000), as amended at 65 FR 53533, 53545 (Sept. 5, 2000) and codified at 13 CFR part 121.The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf.* Fluorescent lamp ballast manufacturing is classified under NAICS 335311, "Power, Distribution and Specialty Transformer Manufacturing." The SBA sets a threshold of 750 employees or less for an entity to be considered as a small business for this category.

To estimate the number of companies that could be small business manufacturers of products covered by this rulemaking, DOE conducted a market survey using all available public information to identify potential small manufacturers. DOE's research involved industry trade association membership directories (including NEMA), product databases (*e.g.,* CEC and CEE databases), individual company Web sites, and market research tools (*e.g.,* Dun and Bradstreet reports) to create a list of every company that manufactures or sells fluorescent lamp ballasts covered by this rulemaking. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers during manufacturer interviews and at previous DOE public meetings. DOE contacted select companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered fluorescent lamp ballasts. DOE screened out companies that did not offer products covered by this rulemaking, did not meet the definition of a "small business," or are foreign owned and operated.

DOE initially identified at least 54 potential manufacturers of fluorescent lamp ballasts sold in the U.S. DOE reviewed publically available information on these 54 potential manufacturers and determined 30 were large manufacturers, manufacturers that are foreign owned and operated or did not manufacture ballasts covered by this rulemaking. DOE then attempted to contact the remaining 24 companies that were potential small business manufacturers. Though many companies were unresponsive, DOE was able to determine that approximately 10 meet the SBA's definition of a small business and likely manufacture ballasts covered by this rulemaking.

b. Manufacturer Participation

Before issuing this NOPR, DOE attempted to contact the small business manufacturers of fluorescent lamp ballasts it had identified. Two of the small businesses consented to being interviewed during the MIA interviews, and DOE received feedback from one additional small business through a survey response. DOE also obtained information about small business impacts while interviewing large manufacturers.

c. Fluorescent Lamp Ballast Industry Structure

Four major manufacturers with non-domestic production supply the vast majority of the marketplace. None of the four major manufacturers is considered a small business. The remaining market share is held by foreign manufacturers and several smaller domestic companies with relatively negligible market share. Even for these U.S.-operated firms, most production is outsourced to overseas vendors or captive overseas manufacturing facilities. Some very limited production takes place in the United States—mostly magnetic ballasts for specialty applications. DOE is unaware of any fluorescent lamp ballast companies, small or large, that produce only domestically. *See* chapter 3 of the TSD for further details on the fluorescent lamp ballast market.

d. Comparison Between Large and Small Entities

The four large manufacturers typically offer a much wider range of designs of covered ballasts than small manufacturers. Ballasts can be designed, or optimized, to operate different lamp lengths and numbers of lamps under various start methods, often in combination with various additional features. Large manufacturers typically offer many SKUs per product line to meet this wide range of potential specifications. Generally, one product family shares some fundamental characteristic (i.e., lamp diameter, number of lamps, etc.) and hosts a large number of SKUs that are manufactured with minor variations on the same product line. Some product lines, such as the 4-foot MBP IS ballast, are manufactured in high volumes, while other products may be produced in much lower volumes but can help manufacturers meet their customers' specific needs and provide higher margin opportunities. For their part, small manufacturers generally do not have the volume to support as wide a range of products.

Beyond variations in ballast types and features, the large manufacturers also offer multiple tiers of efficiency, typically including a baseline efficiency product and a high-efficiency product within the same family. On the other hand, some small manufacturers frequently only offer one efficiency level in a given product class to reduce the number of SKUs and parts they must maintain. This strategy is important to small-scale manufacturers because many product development costs (*e.g.,* testing, certification, and marketing) are relatively fixed per product line.

Small manufacturers are able to compete in the fluorescent lamp ballast industry despite the dominance of the four major manufacturers due, in large part, to the fragmented nature of the fixture industry. The largest four fixture manufacturers compose about 60 percent of the industry, while as many as 200 smaller fixture manufacturers hold the remaining share. Many small ballast manufacturers have developed relationships with these small fixture manufacturers, whose production volumes may not be attractive to the larger players. The same structure applies to the electrical distributor market—while small ballast manufacturers often cannot compete for the business of the largest distributors, they are able to successfully target small distributors, often on a regional basis.

Lastly, like the major manufacturers, small manufacturers usually offer products in addition to those fluorescent lamp ballasts covered by this rulemaking, such as additional dimming ballasts, LED drivers, and compact fluorescent ballasts.

2. Description and Estimate of Compliance Requirements

At TSL 3, the level proposed in today's notice, DOE estimates capital conversion costs of $0.3 million and product conversion costs of $1.3 million for a typical small manufacturer, compared to capital and product conversion costs of $7.6 million and $12.7 million, respectively, for a typical large manufacturer. These costs and their impacts are described in detail below.

a. Capital Conversion Costs

Those small manufacturers DOE interviewed did not expect increased capital conversion costs to be a major concern because most of them source all or the majority of their products from Asia. Those that source their products would likely not make the direct capital investments themselves. Small manufacturers experience the impact of sourcing their products through a higher cost of goods sold, and thus a lower operating margin, as compared to large manufacturers. The capital costs estimated are largely associated with those small manufacturers producing magnetic ballasts. DOE estimates capital costs of approximately $340,000 for a typical small manufacturer at TSL 3, based on the cost of converting magnetic production lines, such as sign ballasts, to electronic production lines.

Another challenge facing the industry is the component shortage discussed in the section 0. As with large manufacturers, the component shortage is a significant issue for small manufacturers, but some small manufacturers stated that the shortage does not differentially impact them. At times, they actually can obtain components more easily than large manufacturers: because their volumes are lower, they generally pay higher prices for parts than their larger competitors, which incentivizes suppliers to fill small manufacturers' orders relatively quickly. The lower-volume orders also allow small manufacturers to piggyback off the orders for certain components that are used throughout the consumer electronics industry.

b. Product Conversion Costs

While capital conversion costs were not a large concern to the small manufacturers DOE interviewed, product conversion costs could adversely impact small manufacturers at TSL 3, the level proposed in today's notice. To estimate the differential impacts of the proposed standard on small manufacturers, DOE compared their cost of compliance with that of the major manufacturers. First, DOE examined the number of basic models and SKUs available from each manufacturer to determine an estimate for overall compliance costs. The number of basic models and SKUs attributed to each manufacturer is based on information obtained during manufacturer interviews and an examination of the different models advertised by each on company Web sites. DOE assumed that the product conversion costs required to redesign basic models and test and certify all SKUs to meet the standard levels presented in today's notice would be lower per model and per SKU for small manufacturers, as detailed below. (A full description of DOE's methodology for developing product conversion costs is found in section 0 above and in chapter 13 of the NOPR TSD.) The table below compares the estimated product conversion costs of a typical small manufacturer as a percentage of annual R&D expense to those of a typical large manufacturer.

TABLE XXIV.1—COMPARISON OF A TYPICAL SMALL AND LARGE MANUFACTURER'S PRODUCT CONVERSION COSTS TO ANNUAL R&D EXPENSE

XXV.	Large manufacturer		Small manufacturer	
	Product conversion costs for a typical large manufacturer (2009$ millions)	Product conversion costs as a percentage of annual R&D expense (%)	Product conversion costs for a typical small manufacturer (2009$ millions)	Product conversion costs as a percentage of annual R&D expense (%)
Baseline	$0.00	0	$0.00	0
TSL 1	1.48	17	0.15	39
TSL 2	10.19	116	1.05	269
TSL 3	12.73	145	1.31	336

Based on discussions with manufacturers, DOE estimated that the cost to fully redesign every ballast model for large manufacturers is approximately $120,000 per model and the cost to test and certify every SKU is approximately $20,000 per SKU. A typical major manufacturer offers approximately 80 basic covered models and 300 SKUs. Based on DOE's GRIM analysis, a typical major manufacturer has an annual R&D expense of $8.6 million. Because not all products would need to be redesigned at TSL 3, DOE estimates $12.7 million in product conversion costs for a typical major manufacturer at TSL 3 (compared to $15.5 million if all products had to be fully redesigned), which represents 145 percent of its annual R&D expense. This means that a typical major manufacturer could redesign its products in under a year and a half if it were to devote its entire R&D budget for fluorescent lamp ballasts to product redesign and could retain the engineering resources.

On the other hand, DOE's research indicated that a typical small manufacturer offers approximately 50 basic covered models and 100 SKUs. However, based on manufacturer interviews, DOE does not believe that small manufacturers would incur the same level of costs per model and SKU as large manufacturers. Small manufacturers would not be as likely to redesign models in-house as large manufacturers. Instead, they would source and rebrand products from the Asian manufacturers who supply their ballasts. As a result, DOE assumed a lower R&D investment, in absolute dollars, per model. Because this design is effectively sourced, DOE believes smaller manufacturers would face a higher level of cost of goods sold (i.e. a higher MPC). Therefore, in a competitive environment, small manufacturers would earn a lower markup than their larger peers and consequently operate at lower margins. Small manufacturers would also have to test and certify every SKU they offer, but they would not conduct the same extent of pilot runs and internal testing as large manufacturers because less production takes place in internal factories. As such, DOE estimates that their testing and certification costs are expected to be $10,000 per SKU for UL and other certifications. Thus, the product conversion costs for a typical small manufacturer could total $1.6 million, but because not all products would need to be fully redesigned at TSL 3, DOE estimates product conversion costs of $1.3 million at TSL 3. Based on scaling GRIM results to an average small-manufacturer market share of 1.0 percent, DOE assumed that a small manufacturer has an annual R&D expense of $0.4 million, so the estimated product conversion costs at TSL 3 would represent 336 percent of its annual R&D expense. This means that a typical small manufacturer could redesign its products in a little over the three year compliance period if it were to devote its entire R&D budget for fluorescent lamp ballasts to product redesign and could retain the engineering resources.

a. Summary of Compliance Impacts

Although the conversion costs required can be considered substantial for all companies, the impacts could be relatively greater for a typical small manufacturer because of much lower production volumes and the relatively fixed nature of the R&D resources required per model. The table below compares the total conversion costs of a typical small manufacturer as a percentage of annual revenue and earnings before taxes and interest (EBIT) to those of a typical large manufacturer.

TABLE XXIV.2—COMPARISON OF A TYPICAL SMALL AND LARGE MANUFACTURER'S TOTAL CONVERSION COSTS TO ANNUAL REVENUE AND EBIT

XXVI.	Large manufacturer			Small manufacturer		
	Total conversion costs for a typical large mfr. (2009$ millions)	Total conversion costs as a percentage of annual revenue (%)	Total conversion costs as a percentage of annual EBIT (%)	Total conversion costs for a typical small mfr. (2009$ millions)	Total conversion costs as a percentage of annual revenue (%)	Total conversion costs as a percentage of annual EBIT (%)
Baseline	$0.00	0	0	$0.00	0	0
TSL 1	4.06	2	21	0.27	3	38
TSL 2	15.85	7	81	1.30	12	184
TSL 3	20.33	9	104	1.65	16	233

As seen in the table above, the impacts for a typical small manufacturer are relatively greater than for a large manufacturer at TSL 3. Total conversion costs represent 233 percent of annual EBIT for a typical small manufacturer compared to 104 percent of annual EBIT for a typical large manufacturer. DOE believes these estimates reflect a worst-case scenario because they assume small manufacturers would redesign all proprietary models immediately, and not take advantage of the industry's supply chain dynamics or take other steps to mitigate the impacts. However, DOE anticipates that small manufacturers would take several steps to mitigate the costs required to meet new and amended energy conservation standards.

At TSL 3, it is more likely that ballast manufacturers may temporarily reduce the number of SKUs they offer as in-house designs to keep their product conversion costs at manageable levels in the year preceding the compliance date. As noted above, the typical small manufacturer business model is not predicated on the supply of a wide range of models and specifications. They frequently either focus on a few niche markets or on customers seeking only basic, low-cost solutions. They therefore can satisfy the needs of their customers with a smaller product portfolio than large manufacturers who often compete on brand reputation and the ability to offer a full product offering. As such, DOE believes that under the proposed standards small businesses would likely selectively upgrade existing product lines to offer products that are in high demand or offer strategic advantage. Small manufacturers could then spread out further investments over a longer time period by upgrading some product lines prior to the compliance date while sourcing others until resources allow—and the market supports—in-house design. Furthermore, while the initial redesign costs are relatively large, the estimates assume small manufacturers would bring compliant designs to market in concert with large manufacturers. In reality, there is a possibility some small manufacturers would conserve resources by selectively upgrading certain products until new baseline designs become commonplace to the point where their in-house development is less resource-intensive. The commonality of many consumer electronics components, designs, and products fosters considerable sharing of experience throughout the electronics supply chain, particularly when unrestricted by proprietary technologies. DOE did not find any intellectual property restrictions that would prevent small manufacturers from achieving the technologies necessary to meet today's proposed levels.

DOE seeks comment on the potential impacts of amended standards on the small fluorescent lamp ballast manufacturers. (See Issue 0 under "Issues on Which DOE Seeks Comment" in section 0 of this NOPR.)

1. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the rule being considered today.

2. Significant Alternatives to the Proposed Rule

The Manufacturer Impact Analysis discussion in Section VI.B.2 analyzes impacts on small businesses that would result from the other TSLs DOE considered. Though TSLs lower than the proposed TSLs are expected to reduce the impacts on small entities, DOE is required by EPCA to establish standards that achieve the maximum improvement in energy efficiency that are technically feasible and economically justified, and result in a significant conservation of energy. As discussed in Section VI.C, DOE has weighed the costs and benefits of the TSLs considered in today's proposed rule and rejected the lower TSLs based on the criteria set forth in EPCA and set forth in Section II.A.

In addition to the other TSLs being considered, the NOPR TSD includes a regulatory impact analysis in chapter 17. For fluorescent lamp ballasts, this report discusses the following policy alternatives: (1) No standard, (2) consumer rebates, (3) consumer tax credits, (4) manufacturer tax credits, and (5) early replacement. DOE does not intend to consider these alternatives further because they are either not feasible to implement, or not expected to result in energy savings as large as those that would be achieved by the standard levels under consideration.

DOE continues to seek input from businesses that would be affected by this rulemaking and will consider comments received in the development of any final rule.

B. Review Under the Paperwork Reduction Act

Manufacturers of fluorescent lamp ballasts must certify to DOE that their product complies with any applicable energy conservation standard. In certifying compliance, manufacturers must test their product according to the DOE test procedure for fluorescent lamp ballasts, including any amendments adopted for that test procedure. DOE has proposed regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including ballasts. 75 FR 56796 (Sept. 16, 2010). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been submitted to OMB for approval. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Public comment is sought regarding: whether this proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information shall have practical utility; the accuracy of the burden estimate; ways to enhance the quality, utility, and clarity of the information to be collected; and ways to minimize the burden of the collection of information, including through the use of automated collection techniques or other forms of information technology. Send comments on these or any other aspects of the collection of information to Dr. Tina Kaarsberg (*see* **ADDRESSES**) and by e-mail to *Christine_J._Kymn@omb.eop.gov.*

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

C. Review Under the National Environmental Policy Act of 1969

DOE has prepared a draft environmental assessment (EA) of the impacts of the proposed rule pursuant to the National Environmental Policy Act of 1969 (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 National Environmental Policy Act of 1969 (10 CFR part 1021). This assessment includes an examination of the potential effects of emission reductions likely to result from the rule in the context of global climate change, as well as other types of environmental impacts. The draft EA has been incorporated into the NOPR TSD as chapter 16. Before issuing a final rule for fluorescent lamp ballasts, DOE will consider public comments and, as appropriate, determine whether to issue a finding of no significant impact (FONSI) as part of a final EA or to prepare an environmental impact statement (EIS) for this rulemaking.

D. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (August 10, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) No further action is required by Executive Order 13132.

E. 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," 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. 61 FR 4729 (Feb. 7, 1996). 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, this proposed rule meets the relevant standards of Executive Order 12988.

F. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, section 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed "significant intergovernmental mandate," and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *http://www.gc.doe.gov.*

Although today's proposed rule does not contain a Federal intergovernmental mandate, it may impose expenditures of $100 million or more on the private sector. Specifically, the proposed rule will likely result in a final rule that could impose expenditures of $100 million or more. Such expenditures may include (1) investment in research and development and in capital expenditures by fluorescent lamp ballast manufacturers in the years between the final rule and the compliance date for the new standard, and (2) incremental additional expenditures by consumers to purchase higher-efficiency ballasts, starting in 2014.

Section 202 of UMRA authorizes an agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the proposed rule. 2 U.S.C. 1532(c). The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of the notice of proposed rulemaking and the "Regulatory Impact Analysis" section of the TSD for this proposed rule respond to those requirements.

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. 2 U.S.C. 1535(a). DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the rule unless DOE publishes an explanation for doing otherwise or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(h) and (o), 6313(e), and 6316(a), today's proposed rule would establish energy conservation standards for fluorescent lamp ballasts that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in the "Regulatory Impact Analysis" section of the TSD for today's proposed rule.

G. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

H. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights" 53 FR 8859 (March 18, 1988), that this regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

I. Review Under the Treasury and General Government Appropriations Act, 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. 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 NOPR under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

J. 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 OIRA at OMB, a Statement of Energy Effects for any proposed significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy, or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has tentatively concluded that today's regulatory action, which sets forth energy conservation standards for fluorescent lamp ballasts, is not a significant energy action because the proposed standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on the proposed rule.

K. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, OMB, in consultation with the Office of Science and Technology (OSTP), issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are "influential scientific information," which the Bulletin defines as "scientific information the agency reasonably can determine will have or does have a clear and substantial impact on important public policies or private sector decisions." 70 FR 2667.

In response to OMB's Bulletin, DOE conducted formal in-progress 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. Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. The "Energy Conservation Standards Rulemaking Peer Review Report" dated February 2007 has been disseminated and is available at the following Web site: *http://www1.eere.energy.gov/buildings/appliance_standards/peer_review.html.*

XXVII. Public Participation

A. Attendance at Public Meeting

The time, date and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this document. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *Brenda.Edwards@ee.doe.gov.* As explained in the **ADDRESSES** section, foreign nationals visiting DOE Headquarters are subject to advance security screening procedures.

In addition, you can attend the public meeting via webinar. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's Web site (*http://www1.eere.energy.gov/buildings/appliance_standards/residential/fluorescent_lamp_ballasts.html*). Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the **ADDRESSES** section at the beginning of this NOPR. The request and advance copy of statements must be received at least one week before the public meeting and may be e-mailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via e-mail. Please include a telephone number to enable DOE staff to make a follow-up contact, if needed.

C. Conduct of Public Meeting

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. After the public meeting, interested parties may submit further comments on the proceedings as well as on any aspect of the rulemaking until the end of the comment period.

The public meeting will be conducted in an informal, conference style. DOE will present summaries of comments received before the public meeting, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will permit, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for the proper conduct of the public meeting.

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this notice. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments using any of the methods described in the **ADDRESSES** section at the beginning of this notice.

Submitting comments via regulations.gov. The regulations.gov Web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to regulations.gov information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (CBI)). Comments submitted through regulations.gov cannot be claimed as CBI. Comments received through the Web site will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through regulations.gov before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that regulations.gov provides after you have successfully uploaded your comment.

Submitting comments via e-mail, hand delivery, or mail. Comments and documents submitted via e-mail, hand delivery, or mail also will be posted to regulations.gov. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information on a cover letter. Include your first and last names, e-mail address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. E-mail submissions are preferred. If you submit via mail or hand delivery, please provide all items on a CD, if feasible. It is not necessary to submit printed copies. No facsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, written in English and are free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via e-mail, postal mail, or hand delivery two well-marked copies: one copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. Submit these documents via e-mail or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

E. Issues on Which DOE Seeks Comment

The Department is particularly interested in receiving comments and views of interested parties concerning:

(1) The appropriateness of creating an exemption for T8 magnetic ballasts as a solution to the problems caused by excessive EMI from electronic ballasts in EMI sensitive environments;

(2) The appropriateness of establishing efficiency standards using an equation dependent on lamp-arc power;

(3) The appropriateness of combining several product classes from the preliminary TSD. In particular, DOE requests feedback on the decision to include several IS and RS ballasts (IS and RS ballasts that operate 4-foot MBP and 8-foot slimline lamps) and PS ballasts in the same product class (PS ballasts that operate 4-foot MBP and 4-foot T5 lamps);

(4) The appropriateness of including residential ballasts in the same product class as those that operate in the commercial sector;

(5) The appropriateness of establishing a separate product class for ballasts that operate 8-foot HO lamps;

(6) The methodology DOE used to calculate manufacturer selling prices;

(7) The efficiency levels DOE considered for fluorescent ballasts, in particular the efficiency level identified for sign ballasts.

(8) The selection of the maximum technologically feasible level and whether it is technologically feasible to attain such higher efficiencies for the full range of instant start ballast applications. Specifically, DOE seeks quantitative information regarding the potential change in efficiency, the design options employed, and the associated change in cost. Any design option that DOE considers to improve efficiency must meet the four criteria outlined in the screening analysis: technological feasibility; practicability to manufacture, install, and service; adverse impacts on product or equipment utility to consumers or availability; and adverse impacts on health or safety. DOE also requests comments on any technological barriers to an improvement in efficiency above TSL 3 for all or certain types of ballasts.

(9) Typical markups, as well as ballast pricing data, that it could use to verify the price markups it developed for the proposed rule;

(10) The appropriateness of including T12 ballasts in the baseline analysis for life cycle costs.

(11) The magnitude and timing of its forecasted ballast shipment trends (*e.g.,* rising and declining shipments, plateaus, etc.) as well as the impacts of current regulatory initiatives on future ballast shipments;

(12) The methodology and inputs DOE used for the manufacturer impact analysis—specifically, DOE's assumptions regarding markups, capital costs, and conversion costs;

(13) The potential impacts of amended standards on the small fluorescent lamp ballast manufacturers.

(14) The appropriateness of the TSLs DOE considered for fluorescent ballasts, in particular the combinations of efficiency levels for each product class;

(15) The proposed standard level for fluorescent ballasts;

(16) Potential approaches to maximize energy savings while mitigating impacts to certain fluorescent ballast consumer subgroups;

XXVIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's proposed rule.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Intergovernmental relations, Small businesses.

Issued in Washington, DC, on March 24, 2011.

Henry Kelly,

Acting Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE proposes to amend chapter II, subchapter D, of title 10 of the Code of Federal Regulations, 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 adding the definition of "Ballast luminous efficiency" in alphabetical order to read as follows:

§ 430.2 Definitions.

* * * * *

Ballast luminous efficiency means the total fluorescent lamp arc power divided by the fluorescent lamp ballast input power multiplied by the appropriate frequency adjustment factor.

* * * * *

3. Section 430.32 is amended by:

a. Revising paragraph (m)(1) introductory text.

b. Adding paragraphs (m)(8), (m)(9), and m(10).

These revisions and additions read as follows:

§ 430.32 Energy and water conservation standards and their effective dates.

* * * * *

(m)(1) *Fluorescent lamp ballasts (other than specialty application mercury vapor lamp ballasts).* Except as provided in paragraphs (m)(2), (m)(3), (m)(4), (m)(5), (m)(6), (m)(7), (m)(8), (m)(9), and (m)(10) of this section, each fluorescent lamp ballast—

* * * * *

(8) Except as provided in paragraph (m)(9) of this section, each fluorescent lamp ballast—

(i) Manufactured on or after [date 3 years after publication of the Fluorescent Lamp—Ballast Energy Conservation Standard final rule];

(ii) Designed—

(A) To operate at nominal input voltages of 120 or 277 volts;

(B) To operate with an input current frequency of 60 Hertz; and

(C) For use in connection with fluorescent lamps (as defined in § 430.2)

(iii) Shall have—

(A) A power factor of 0.9 or greater except for those ballasts defined in paragraph (m)(8)(iii)(B) of this section;

(B) A power factor of 0.5 or greater for residential ballasts, which meet FCC consumer limits as set forth in 47 CFR part 18 and are designed and labeled for use only in residential applications;

(C) A ballast luminous efficiency of not less than the following:

Description	Shall have a minimum ballast luminous efficiency of—
Instant start and rapid start ballasts that are designed to operate:	
4-foot linear or 2-foot U-shaped medium bipin lamps	1.32 * ln (total lamp arc power) + 86.11.
8-foot slimline lamps.	
Programmed start ballasts that are designed to operate:	
4-foot linear or 2-foot U-shaped medium bipin lamps	1.79 * ln (total lamp arc power) + 83.33.
4-foot miniature bipin standard output lamps.	
4-foot miniature bipin high output lamps.	
Instant start and rapid start ballasts that are designed to operate:	
8-foot HO lamps	1.49 * ln (total lamp arc power) + 84.32.
Programmed start ballasts that are designed to operate:	
8-foot HO lamps	1.46 * ln (total lamp arc power) + 82.63.
Ballasts that are designed to operate:	
8-foot high output lamps at ambient temperatures of −20 °F or less that are used in outdoor signs.	1.49 * ln (total lamp arc power) + 81.34.

(9) The standards described in paragraph (m)(8) of this section do not apply to:

(i) A ballast that is designed for dimming to 50 percent or less of the maximum output of the ballast except for those specified in m(10); and

(ii) A low frequency ballast that:

(A) Is designed to operate T8 diameter lamps;

(B) Is designed and labeled for use in EMI-sensitive environments only;

(C) Is shipped by the manufacturer in packages containing not more than 10 ballasts.

(10) Each fluorescent lamp ballast—

(i) Manufactured on or after [Date 3 Years after publication of the Fluorescent Lamp Ballast Energy Conservation Standard final rule];

(ii) Designed—

(A) To operate at nominal input voltages of 120 or 277 volts;

(B) To operate with an input current frequency of 60 Hertz; and

(C) For use in connection with fluorescent lamps (as defined in § 430.2);

(D) For dimming to 50 percent or less of the maximum output of the ballast

(iii) Shall have—

(A) A power factor of 0.9 or greater except for those ballasts defined in paragraph (m)(8)(iii)(B) of this section;

(B) A power factor of 0.5 or greater for residential ballasts, which meet FCC Part B consumer limits and are designed and labeled for use only in residential applications;

(C) A ballast luminous efficiency of not less than the following:

Designed for the operation of	Ballast input voltage	Total nominal lamp watts	Ballast luminous efficiency	
			Low frequency ballasts	High frequency ballasts
One F34T12 lamp	120/277	34	75.2	77.8
Two F34T12 lamps	120/277	68	77.8	80.5
Two F96T12/ES lamps	120/277	120	83.9	88.4
Two F96T12HO/ES lamps	120/277	190	68.0	71.3

* * * * *

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