[6450 01-P]

DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket Number EERE–2011–BT–STD–0060]

RIN: 1904-AC64

Energy Conservation Program: Energy Conservation Standards for Residential Dishwashers

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

ACTION: Direct final rule.

SUMMARY: The Energy Policy and Conservation Act of 1975 (EPCA), as amended, prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including residential dishwashers**.** EPCA also requires the U.S. Department of Energy (DOE) to determine whether amended standards would be technologically feasible and economically justified, and would save a significant amount of energy. In this direct final rule, DOE is adopting amended energy conservation standards for residential dishwashers. DOE has determined that the amended energy conservation standards for these products would result in significant conservation of energy, and are technologically feasible and economically justified. A notice of proposed rulemaking that proposes identical energy efficiency standards is

published elsewhere in today's Federal Register. If DOE receives adverse comment and determines that such comment may provide a reasonable basis for withdrawing the direct final rule, this final rule will be withdrawn and DOE will proceed with the proposed rule.

DATES: The effective date of this rule is **[INSERT DATE 120 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]** unless adverse comment is received by **[INSERT DATE 110 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. If adverse comments are received that DOE determines may provide a reasonable basis for withdrawal of the final rule, a timely withdrawal of this rule will be published in the Federal Register. If no such adverse comments are received, compliance with the amended standards established for residential dishwashers in today's final rule will be required on **[INSERT DATE 1 YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: The docket for this rulemaking is available for review at www.regulations.gov, including Federal Register notices, comments, and other supporting documents/materials. All documents in the docket are listed in the regulations.gov index. Not all documents listed in the index may be publicly available, however, such as information that is exempt from public disclosure.

A link to the docket web page can be found at: http://www.regulations.gov/#!docketDetail;D=EERE-2011-BT-STD-0060. The

regulations.gov web page contains instructions on how to access all documents, including public comments, in the docket.

For further information on how to review the docket, contact Ms. Brenda Edwards at (202) 586-2945 or by email: Brenda.Edwards@ee.doe.gov.

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SUPPLEMENTARY INFORMATION:

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The Secretary of Energy has approved publication of today’s direct final rule.

I. Summary of the Direct Final Rule and Its Benefits

Title III, Part B[1] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Pub. L. 94-163 (42 U.S.C. 6291-6309, as codified), established the Energy Conservation Program for Consumer Products Other Than Automobiles. Pursuant to EPCA, any new or amended energy conservation standard that DOE prescribes for certain products, such as residential dishwashers, shall 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 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 is adopting amended energy conservation standards for residential dishwashers. The amended standards, which are established in terms of maximum annual energy use and maximum per-cycle water consumption, are shown in Table I.1. These amended standards apply to all products listed in Table I.1 and manufactured in, or imported into, the United States on or after **[INSERT DATE 1 YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

Table I.1 Amended Energy Conservation Standards for Residential Dishwashers

	Compliance Date: [INSERT DATE 1 YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]	
Product Class	**Maximum Annual Energy Use***	**Maximum Per-Cycle Water Consumption**
1. Standard (≥8 place settings plus 6 serving pieces)	307 kWh/year	5.0 gallons/cycle
2. Compact (<8 place settings plus 6 serving pieces)	222 kWh/year	3.5 gallons/cycle

[1] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

*Annual energy use, expressed in kilowatt-hours (kWh) per year, is calculated as: the sum of the annual standby electrical energy in kWh and the product of (1) the representative average dishwasher use cycles per year and (2) the sum of machine electrical energy consumption per cycle in kWh, the total water energy consumption per cycle in kWh, and, for dishwashers having a truncated normal cycle, the drying energy consumption divided by 2 in kWh. A truncated normal cycle is defined as the normal cycle interrupted to eliminate the power-dry feature after the termination of the last rinse option.

These standard levels were submitted jointly to DOE by groups representing manufacturers, energy and environmental advocates, and consumer groups. This collective set of comments, titled "Agreement on Minimum Federal Efficiency Standards, Smart Appliances, Federal Incentives and Related Matters for Specified Appliances" (the "Joint Petition"[2]), recommends specific energy conservation standards for residential dishwashers that, in the commenters' view, would satisfy the EPCA requirements in 42 U.S.C. 6295(o).

A. Benefits and Costs to Consumers

Table I.2 presents DOE's evaluation of the economic impacts of today's standards on consumers of residential dishwashers, as measured by the average life-cycle cost (LCC) savings and the median payback period.

Table I.2 Impacts of Today's Standards on Consumers of Residential Dishwashers

Product Class	**Average LCC Savings (2010$)**	**Median Payback Period (years)**
Standard	$3	11.8
Compact	$12	0.3

[2] DOE Docket No. EERE–2011–BT–STD–0060, Comment 1.

B. Impact on Manufacturers

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 (2012 through 2047). Using a real discount rate of 8.5 percent, DOE estimates that the INPV for manufacturers of dishwashers is $637.5 million in 2010$. Under today's standards, DOE expects that manufacturers may lose up to 13.3 percent of their INPV, which is approximately $84.6 million. Additionally, based on DOE's interviews with the manufacturers of dishwashers, DOE does not expect any plant closings or significant loss of employment as a result of today's standards.

C. National Benefits

DOE's analyses indicate that today's standards would save a significant amount of energy and water in 2013–2047 ―an estimated 0.07 quads of cumulative energy, and 0.14 trillion gallons of water.

The cumulative national net present value (NPV) of total consumer costs and savings of today's standards in 2010$ ranges from $0.08 billion (at a 7-percent discount rate) to $0.46 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product costs for products purchased in 2013–2047, discounted to 2012.

In addition, today's standards would have significant environmental benefits. The energy savings would result in cumulative greenhouse gas emission reductions of

approximately 4.06 million metric tons (Mt) of carbon dioxide (CO_2) from 2013 through 2047. During this period, the standards would also result in emissions reductions[3] of approximately 3.54 thousand tons of nitrogen oxides (NO_X) and zero tons of mercury (Hg).[4]

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by a recent interagency process. The derivation of the SCC values is discussed in section IV.M. DOE estimates that the present monetary value of the CO_2 emissions reductions is between $16 and $242 million, expressed in 2010$ and discounted to 2012. DOE also estimates that the present monetary value of the NO_X emissions reductions, expressed in 2010$ and discounted to 2012, is $2.8 million at a 7-percent discount rate, and $5.2 million at a 3-percent discount rate.[5]

Table I.3 summarizes the national economic costs and benefits expected to result from today's standards for residential dishwashers.

[3] DOE calculates emissions reductions relative to the most recent version of the Annual Energy Outlook (AEO) Reference case forecast. As noted in TSD chapter 15, this forecast accounts for regulatory emissions reductions from in-place regulations at the time of preparation of the AEO, 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 recently finalized CAIR replacement rule, the Cross-State Air Pollution rule issued on July 6, 2011, will appear in the forecast for future rulemakings.

[4] Results for NO_X and Hg are presented in short tons. One short ton equals 2000 lbs.

[5] DOE is aware of multiple agency efforts to determine the appropriate range of values to use 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 monetizes Hg emissions reductions in its rulemakings.

Table I.3. Summary of National Economic Benefits and Costs of Residential Dishwasher Energy Conservation Standards

Category	Present Value Million 2010$	Discount Rate
Benefits		
Operating Cost Savings	600	7%
	1341	3%
CO_2 Reduction Monetized Value (at $4.9/t)*	16.09	5%
CO_2 Reduction Monetized Value (at $22.3/t)*	79.49	3%
CO_2 Reduction Monetized Value (at $36.5/t)*	133.5	2.5%
CO_2 Reduction Monetized Value (at $67.6/t)*	242.5	3%
NO_X Reduction Monetized Value (at $2,537/ton)**	2.76	7%
	5.24	3%
Total Benefits†	683	7%
	1426	3%
Costs		
Incremental Installed Costs	522	7%
	881	3%
Net Benefits		
Including CO_2 and NO_X†	161	7%
	545	3%

* The CO_2 values represent global monetized values of the SCC in 2010 under several scenarios. The values of $4.9, $22.3, and $36.5 per metric ton (t) are the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The value of $67.6/t represents the 95th percentile of the SCC distribution calculated using a 3% discount rate.
** The value represents the average of the low and high NO_X values used in DOE's analysis.
† Total Benefits for both the 3% and 7% cases are derived using the SCC value calculated at a 3% discount rate.

The benefits and costs of today's standards, for products sold in 2013–2047, can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic value, expressed in 2010$, of the benefits from operating the product (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, plus (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[6]

Although adding the value of consumer savings to the values of emission reductions provides a valuable perspective, two issues should be considered. First, the national operating cost 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 residential dishwashers shipped in 2013–2047. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one metric ton of carbon dioxide in each year. These impacts continue well beyond 2100.

Estimates of annualized benefits and costs of today's standards are shown in Table I.4. (All monetary values below are expressed in 2010$.) The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs

[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 2012, the year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of 3 and 7 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.3.From the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in 2013, that yields the same present value. This payment includes benefits to consumers which accrue after 2047 from the dishwashers purchased from 2013 to 2047. Costs incurred by manufacturers, some of which may be incurred prior to 2013 in preparation for the rule, are indirectly included as part of incremental equipment costs. The extent of these costs and benefits depends on the projected price trends of dishwashers because consumer demand of dishwashers is a function of dishwasher prices. 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 is a steady stream of payments.

other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the SCC series corresponding to a value of $22.3/ton in 2010, the cost of the standards for dishwashers in today's rule is $46 million per year in increased equipment costs, while the benefits are $53 million per year in reduced equipment operating costs, $3.9 million in CO_2 reductions, and $0.24 million in reduced NO_X emissions. In this case, the net benefit amounts to $11 million per year. Using a 3-percent discount rate for all benefits and costs and the SCC series corresponding to a value of $22.3/ton in 2010, the cost of the standards for dishwashers in today's rule is $44 million per year in increased equipment costs, while the benefits are $66 million per year in reduced operating costs, $3.9 million in CO_2 reductions, and $0.26 million in reduced NO_X emissions. In this case, the net benefit amounts to $27 million per year.

Table I.4. Annualized Benefits and Costs of Amended Standards for Residential Dishwashers Sold in 2013–2047*

	Discount Rate	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		Monetized (million 2010$/year)		
Benefits				
Operating Cost Savings	7%	53	48	59
	3%	66	59	75
CO_2 Reduction at $4.9/t**	5%	1.1	1.0	1.3
CO_2 Reduction at $22.3/t**	3%	3.9	3.5	4.7
CO_2 Reduction at $36.5/t**	2.5%	6.1	5.4	7.2
CO_2 Reduction at $67.6/t**	3%	12.0	10.8	14.2
NO_X Reduction at $2,537/ton**	7%	0.24	0.23	0.27
	3%	0.26	0.24	0.30
Total†	7% plus CO_2 range	54 to 65	49 to 59	60 to 73
	7%	57	52	64
	3% plus CO_2 range	68 to 78	60 to 70	76 to 89
	3%	70	63	80
Costs				
Incremental Product Costs	7%	46	44	43
	3%	44	41	40
Total Net Benefits				
Total†	7% plus CO_2 range	8 to 19	6 to 16	17 to 30
	7%	11	8	20
	3% plus CO_2 range	24 to 35	19 to 29	37 to 49
	3%	27	22	40

* The results include benefits to consumers which accrue after 2047 from the dishwashers purchased from 2013 through 2047. Costs incurred by manufacturers, some of which may be incurred prior to 2013 in preparation for the rule, are indirectly included as part of incremental equipment costs. The extent of the costs and benefits will depend on the projected price trends of dishwashers, because the consumer demand for dishwashers is a function of dishwasher prices. The Primary, Low Benefits, and High Benefits Estimates utilize forecasts of energy prices and housing starts from the AEO2011 Reference case, Low Estimate, and High Estimate, respectively. In addition, incremental product costs reflect a medium decline rate for projected product price trends in the Primary Estimate, a low decline rate for projected product price trends in the Low Benefits Estimate, and a high decline rate for projected product price trends in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.G.3.

** The CO_2 values represent global values (in 2010$) of the social cost of CO_2 emissions in 2010 under several scenarios. The values of $4.9, $22.3, and $36.5 per ton are the averages of SCC distributions calculated using 5-percent, 3-percent, and 2.5-percent discount rates, respectively. The value of $67.6 per ton represents the 95th percentile of the SCC distribution calculated using a 3-percent discount rate. The value for NO_X (in 2010$) 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 $22.3/t in 2010 (in 2010$). 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.

D. Conclusion

Based on the analyses culminating in this final rule, DOE found the benefits to the nation of the standards (energy savings, water savings, favorable consumer LCC savings and payback period, positive NPV of consumer benefit, and emission reductions) outweigh the burdens (profit margin impacts that could result in a reduction in INPV and increased operational risk for manufacturers). DOE has concluded that the standards in today's final rule represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in significant conservation of energy. DOE further notes that residential dishwashers achieving these standard levels are already commercially available.

II. Introduction

The following section briefly discusses the statutory authority underlying today's final rule, as well as some of the relevant historical background related to the establishment of standards for residential dishwashers.

A. Authority

Title III, Part B of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Pub. L. 94-163 (42 U.S.C. 6291-6309, as codified) established the Energy Conservation Program for Consumer Products Other Than Automobiles,[7] a program covering most major household appliances (collectively referred to as "covered products"), which includes the residential dishwashers that are the subject of this rulemaking. (42 U.S.C. 6292(a)(6)) EPCA prescribed energy conservation standards for these products (42 U.S.C. 6295(g)(1)), and directed DOE to conduct two cycles of rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(g)(4)) DOE also notes that under 42 U.S.C. 6295(m), DOE must periodically review its energy conservation standards for covered products.

Pursuant to 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. Subject to certain criteria and conditions, DOE is required 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,

[7] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

DOE must use these test procedures to determine whether the products comply with standards adopted pursuant to EPCA. Id. The DOE test procedure for residential dishwashers currently appear at title 10 of the Code of Federal Regulations (CFR) part 430, subpart B, appendix C.

DOE must follow specific statutory 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, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6295(o)(3)) In deciding whether an amended 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 make this determination after receiving comments on the proposed standard and 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 allows DOE to issue a final rule (hereinafter referred to as a "direct final rule") establishing an energy conservation standard on receipt of a statement submitted jointly by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered products, States, and efficiency advocates) as determined by the Secretary, that contains recommendations with respect to an energy conservation standard that are in accordance with the provisions of 42 U.S.C. 6295(o). A notice of proposed rulemaking (NOPR) that proposes an identical energy efficiency standard must be published simultaneously with the final rule, and DOE must provide a public comment period of at least 110 days. 42 U.S.C. 6295(p)(4). Not later than 120 days after issuance of the direct final rule, if one or more adverse comments or an alternative joint recommendation are received relating to the direct final rule, the Secretary must determine whether the comments or alternative recommendation may provide a reasonable basis for withdrawal under 42 U.S.C. 6295(o) or other applicable

law. If the Secretary makes such a determination, DOE must withdraw the direct final rule and proceed with the simultaneously published notice of proposed rulemaking. DOE must publish in the Federal Register the reason why the direct final rule was withdrawn. Id.

Furthermore, EPCA, 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))

EPCA also 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).

Additionally, 42 U.S.C. 6295(q)(1) specifies requirements when promulgating a standard for a type or class of covered product that has two or more subcategories. DOE must specify a different standard level than that which applies generally to such type or class of products for any group of covered products that have the same function or intended use, if products within such group – (A) consume a different kind of energy from that consumed by other covered products within such type (or class); or (B) have a capacity or other performance-related feature which other products within such type (or class) do not have and such feature justifies a higher or lower standard than applies or will apply to the other products within that type or class. Id. 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 such a 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 may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions set forth under 42 U.S.C. 6297(d)).

Any final rule for new or amended energy conservation standards promulgated after July 1, 2010, must address standby mode and off mode energy use. (42 U.S.C.

6295(gg)(3)) Specifically, when DOE adopts a standard for a covered product after that date, it must, if justified by the criteria for adoption of standards under EPCA (42 U.S.C. 6295(o)), incorporate standby mode and off mode energy use into the standard, or, if that is not feasible, adopt a separate standard for such energy use for that product. (42 U.S.C. 6295(gg)(3)(A)-(B)) The standards established in today's direct final rule address standby and off mode energy use.

DOE notes that it is also required to amend its test procedures to integrate measures of standby mode and off mode energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor for each covered product unless the current test procedure already fully accounts for and incorporates standby and off mode energy consumption or such integration is technically infeasible. (42 U.S.C. 6295(gg)(2)) DOE is currently considering amendments to the test procedure at appendix C to incorporate measures of off mode energy consumption in addition to the existing measures of standby mode energy use. 75 FR 75290 (Dec. 2, 2010); 76 FR 58346 Sept. 20, 2011)

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011 (76 FR 3281, Jan. 21, 2011). Executive Order 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (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.

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that today's direct final rule is consistent with these principles, including that, to the extent permitted by law, agencies adopt a regulation only upon a reasoned determination that its benefits justify its costs and select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits.

Consistent with EO 13563, and the range of impacts analyzed in this rulemaking, the energy conservation standards adopted herein by DOE achieve maximum net benefits.

B. Background

1. EISA 2007 Standards

EPCA, as amended by EISA 2007, prescribed energy conservation standards for residential dishwashers manufactured on or after January 1, 2010. 42 U.S.C. 6295(g)(10) These standards are set forth in Table II.1.

Table II.1 Energy Conservation Standards for Residential Dishwashers Established by EISA 2007

Product Class	**Annual Energy Use (kWh/year)**	**Per-Cycle Water Consumption(gallons/cycle)**
Standard	355	6.5
Compact	260	4.5

The EPCA amendments in EISA 2007 also require DOE to publish a final rule no later than January 1, 2015 determining whether to amend the standards in effect for dishwashers manufactured on or after January 1, 2018. (42 U.S.C. 6295(g)(10)(B)(i)) Today's final rule fulfills this statutory requirement.

2. History of Standards Rulemaking for Residential Dishwashers

The National Appliance Energy Conservation Act of 1987 (NAECA), Pub. L. 100-12 (March 17, 1989), amended EPCA and required that dishwashers be equipped with an option to dry without heat. NAECA further required that DOE conduct two

cycles of rulemakings to determine if amended standards are justified. (42 U.S.C. 6295(g)(1) and (4))

On May 14, 1991, DOE issued a final rule establishing performance standards for dishwashers to complete the first required rulemaking cycle (56 FR 22250). Compliance with the new standards, codified at 10 CFR 430.32(f), was required on May 14, 1994.

DOE then conducted a second standards rulemaking for dishwashers. DOE issued an advance notice of proposed rulemaking (ANOPR) on November 14, 1994 to consider amending the energy conservation standards for clothes washers, dishwashers, and clothes dryers. 59 FR 56423. Subsequently, DOE published a Notice of Availability of the Rulemaking Framework for Commercial Clothes Washers and Residential Dishwashers, Dehumidifiers, and Cooking Products. 71 FR 15059 (Mar. 27, 2006). On November 15, 2007, DOE published a second ANOPR (hereafter, the November 2007 ANOPR) addressing energy conservation standards for these products. 72 FR 64432. On December 19, 2007, Congress enacted EISA 2007, which, among other things, established maximum energy and water use levels for residential dishwashers manufactured on or after January 1, 2010. (42 U.S.C. 6295(g)(10)) DOE codified the statutory standards for these products in a final rule published March 23, 2009. 74 FR 12058.

EPCA, as amended by EISA 2007, further requires that DOE publish a final rule no later than January 1, 2015, to determine whether to amend the standards in effect for

dishwashers manufactured on or after January 1, 2018. (42 U.S.C. 6295(g)(10)(B)(i)) This rulemaking fulfills this statutory requirement.

On July 30, 2010, DOE received the Joint Petition, a comment submitted by groups representing manufacturers (the Association of Home Appliance Manufacturers (AHAM), Whirlpool Corporation (Whirlpool), General Electric Company (GE), Electrolux, LG Electronics, Inc. (LG), BSH Home Appliances (BSH), Alliance Laundry Systems (ALS), Viking Range, Sub-Zero Wolf, Friedrich A/C, U-Line, Samsung, Sharp Electronics, Miele, Heat Controller, AGA Marvel, Brown Stove, Haier, Fagor America, Airwell Group, Arcelik, Fisher & Paykel, Scotsman Ice, Indesit, Kuppersbusch, Kelon, and DeLonghi); energy and environmental advocates (American Council for an Energy Efficient Economy (ACEEE), Appliance Standards Awareness Project (ASAP), Natural Resources Defense Council (NRDC), Alliance to Save Energy (ASE), Alliance for Water Efficiency (AWE), Northwest Power and Conservation Council (NPCC), and Northeast Energy Efficiency Partnerships (NEEP)); and consumer groups (Consumer Federation of America (CFA) and the National Consumer Law Center (NCLC)) (collectively, the "Joint Petitioners"). The Joint Petitioners recommended specific energy conservation standards for residential dishwashers that, in their view, would satisfy the EPCA requirements in 42 U.S.C. 6295(o). Earthjustice submitted a comment affirming its support for the Joint Petition. (Earthjustice, No. 2 at p. 1)[8]

[8] A notation in the form "Earthjustice, No. 2 at p. 1" identifies a written comment that DOE has received and has included in the docket of the standards rulemaking for residential dishwashers (Docket No. EERE-2011-BT-STD-0060). This particular notation refers to a comment (1) submitted by Earthjustice, (2) in document number 2 in the docket of that rulemaking, and (3) appearing on page 1 of document number 2.

After careful consideration of the Joint Petition containing a consensus recommendation for amended energy conservation standards for residential dishwashers, the Secretary has determined that this "Consensus Agreement" has been submitted by interested persons who are fairly representative of relevant points of view on this matter. Congress provided some guidance within the statute itself by specifying that representatives of manufacturers of covered products, States, and efficiency advocates are relevant parties to any consensus recommendation. (42 U.S.C. 6295(p)(4)(A)) As delineated above, the Consensus Agreement was signed and submitted by a broad cross-section of the manufacturers who produce the subject products, their trade associations, and environmental, energy efficiency and consumer advocacy organizations. Although States were not signatories to the Consensus Agreement, they did not express any opposition to it. Moreover, DOE does not read the statute as requiring absolute agreement among all interested parties before the Department may proceed with issuance of a direct final rule. By explicit language of the statute, the Secretary has discretion to determine when a joint recommendation for an energy or water conservation standard has met the requirement for representativeness (i.e., "as determined by the Secretary"). Accordingly, DOE will consider each consensus recommendation on a case-by-case basis to determine whether the submission has been made by interested persons fairly representative of relevant points of view.

Pursuant to 42 U.S.C. 6295(p)(4), the Secretary must also determine whether a jointly-submitted recommendation for an energy or water conservation standard is in accordance with 42 U.S.C. 6295(o) or 42 U.S.C. 6313(a)(6)(B), as applicable. This

determination is exactly the type of analysis that DOE conducts whenever it considers potential energy conservation standards pursuant to EPCA. DOE applies the same principles to any consensus recommendations it may receive to satisfy its statutory obligation to ensure that any energy conservation standard that it adopts achieves the maximum improvement in energy efficiency that is technologically feasible and economically justified and will result in significant conservation of energy. Upon review, the Secretary determined that the Consensus Agreement submitted in the instant rulemaking comports with the standard-setting criteria set forth under 42 U.S.C. 6295(o). Accordingly, the consensus agreement levels were included as trial standard level (TSL) 2 in today's rule for residential dishwashers, the details of which are discussed at relevant places throughout this document. The definition of the TSLs considered in this direct final rule is discussed in section V.A.

In sum, as the relevant criteria under 42 U.S.C. 6295(p)(4) have been satisfied, the Secretary has determined that it is appropriate to adopt amended energy conservation standards for residential dishwashers through this direct final rule.

As required by the same statutory provision, DOE is also simultaneously publishing a NOPR which proposes the identical standard levels contained in this direct final rule and is providing for a 110-day public comment period. DOE will consider whether any comment received during this comment period is sufficiently "adverse" as to provide a reasonable basis for withdrawal of the direct final rule and continuation of this rulemaking under the NOPR. Typical of other rulemakings, it is the substance, rather than

the quantity, of comments that will ultimately determine whether a direct final rule will be withdrawn. To this end, the substance of any adverse comment(s) received will be weighed against the anticipated benefits of the Consensus Agreement and the likelihood that further consideration of the comment(s) would change the results of the rulemaking. DOE notes that to the extent an adverse comment had been previously raised and addressed in the rulemaking proceeding, such a submission will not typically provide a basis for withdrawal of a direct final rule.

3. Issues on which DOE seeks Comment

As stated previously, in promulgating today's direct final rule pursuant to 42 U.S.C. 6295(p)(4), DOE carefully considered the Joint Petition submitted to DOE, which contained a consensus recommendation for amended energy conservation standards for residential dishwashers. For the reasons stated in this direct final rule, the Secretary determined that the "Consensus Agreement" was submitted by interested persons who are fairly representative of relevant points of view on this matter. The Secretary also determined, for the reasons set forth in this direct final rule, that the standards contained in the Consensus Agreement comport with the standard-setting criteria set forth under 42 U.S.C. 6295(o). Therefore, the Secretary promulgates this direct final rule establishing the amended energy conservation standards for residential dishwashers.

As required by EPCA, DOE is also simultaneously publishing a NOPR and providing for a 110-day public comment period. 42 U.S.C. 4295(p)(4). Should DOE determine to proceed with the NOPR, or to gather additional data for future energy

conservation standards activities for residential dishwashers, DOE will consider any comments and data received on the direct final standards. Although comments are welcome on all aspects of this rulemaking, DOE is particularly interested in comments on the following:

(1) Impacts of the standards that may lessen or improve the utility or performance of the covered products. These impacts may include increased cycle times to wash dishware, ability to achieve good wash performance (e.g., cleaning, rinsing) and drying performance, increase in noise, and other potential impacts. As discussed in section IV.I.3, manufacturers noted in interviews that any potential utility impacts may be more significant at efficiency levels above those adopted in today's direct final rule. DOE also seeks information on utility impacts at higher efficiency levels and will consider such information in any future rulemaking for dishwashers.

(2) The 2013 compliance date for the proposed standards and whether this compliance date adequately considers the typical dishwasher model design cycle for manufacturers.

(3) Whether repair costs for residential dishwashers would increase at the efficiency levels indicated in today's rule due to any changes in the design and materials and components used in order to comply with the new efficiency standards.

(4) Where there would be any anticipated changes in the consumption of complementary goods (e.g., dishwasher detergent, rinse aid) that may result from the proposed standards.

(5) The 215 cycles per year estimate of consumer usage for residential dishwashers, as well as the estimated 1-hour cycle time, which includes all cycles available on the unit.

(6) The product lifetime for dishwashers assumed in the analysis and the method used to derive the mean age of 15 years.

DOE has prepared a technical support document (TSD) in support of this direct final rule. The TSD, which is available at the rulemaking website,[9] provides an overview of the activities DOE undertook in developing standards for residential dishwashers. It presents and describes in detail each analysis DOE performed, including descriptions of inputs, sources, methodologies, and results. These analyses are as follows:

(1) A market and technology assessment addresses the scope of this rulemaking, identifies the dishwasher product classes, characterizes the markets for the products, and reviews techniques and approaches for improving their efficiency.

(2) A screening analysis reviews technology options to improve the efficiency of residential dishwashers and weighs those options against DOE's four prescribed screening criteria.

(3) An engineering analysis develops the relationship between increased manufacturer price and increased efficiency.

(4) A markups analysis establishes markups for converting manufacturer prices to customer product costs.

[9] The rulemaking website for residential dishwashers is located at http://www1.eere.energy.gov/buildings/appliance_standards/residential/dishwashers.html.

(5) An energy use analysis generates energy-use estimates for residential dishwashers as a function of efficiency levels.

(6) A life-cycle cost analysis calculates the effects of standards on individual customers and compares the life-cycle costs (LCC) and payback period (PBP) of products with and without higher efficiency standards.

(7) A shipments analysis forecasts shipments with and without higher efficiency standards.

(8) A national impact analysis forecasts the national energy savings (NES), and the national net present value of total consumer costs and savings, expected to result from specific, potential energy conservation standards for residential dishwashers.

(9) A consumer subgroup analysis discusses the effects of standards on different subgroups of consumers.

(10) A manufacturer impact analysis discusses the effects of standards on the finances and profitability of product manufacturers.

(11) An employment impact analysis discusses the indirect effects of standards on national employment.

(12) A utility impact analysis discusses the effects of standards on electric and gas utilities.

(13) An emissions analysis discusses the effects of standards on three pollutants—sulfur dioxide (SO_2), nitrogen oxides (NO_x), and mercury—as well as carbon dioxide emissions.

(14) A regulatory impact analysis discusses the impact of non-regulatory alternatives to efficiency standards.

4. Test Procedure History

As discussed in section II.A, the DOE test procedure for residential dishwashers is found at Title 10 of the CFR, part 430, subpart B, appendix C. DOE originally established its test procedure for dishwashers in 1977. 42 FR 39964 (Aug. 8, 1977). In 1983, DOE amended the test procedure to revise the representative average-use cycles to more accurately reflect consumer use and to address dishwashers that use 120 degrees Fahrenheit (°F) inlet water. 48 FR 9202 (March 3, 1983). DOE amended the test procedure again in 1984 to redefine the term "water heating dishwasher." 49 FR 46533 (Nov. 27, 1984). In 1987, DOE amended the test procedure to address models that use 50 °F inlet water. 52 FR 47549 (Dec. 15, 1987). In 2001, DOE revised the test procedure's testing specifications to improve testing repeatability, changed the definitions of "compact dishwasher" and "standard dishwasher," and reduced the average number of use cycles per year from 322 to 264. 66 FR 65091, 65095–97 (Dec. 18, 2001). In 2003, DOE again revised the test procedure to more accurately measure dishwasher efficiency, energy use, and water use. The 2003 dishwasher test procedure amendments included the following revisions: (1) the addition of a method to rate the efficiency of soil-sensing products; (2) the addition of a method to measure standby power; and (3) a reduction in the average-use cycles per year from 264 to 215. 68 FR 51887, 51899–903 (August 29, 2003). The current version of the test procedure includes provisions for determining estimated annual energy use (EAEU), estimated annual operating cost (EAOC), energy

factor (EF) expressed in cycles per kilowatt-hour (kWh), and water consumption expressed in gallons per cycle. 10 CFR 430.23(c). As discussed in section II.A, DOE is currently considering amendments the test procedure to incorporate measures of off mode energy consumption in addition to the existing measures of standby mode energy use.

III. General Discussion

A. Product Classes and Scope of Coverage

When evaluating and establishing energy conservation standards, DOE divides covered products into product classes by the type of energy used or by capacity or other performance-related features that justifies a different standard. In making a determination whether a performance-related feature justifies a different standard, DOE must consider such factors as the utility to the consumer of the feature and other factors DOE determines are appropriate. (42 U.S.C. 6295(q))

Existing energy conservation standards divide residential dishwashers into two product classes based on the capacity, i.e., the number of place settings and serving pieces that can be loaded in the product.

- Standard (capacity equal to or greater than eight place settings plus six serving pieces)
- Compact (capacity less than eight place settings plus six serving pieces)

The Joint Petition proposes energy conservation standard levels for standard and compact product classes based on the same capacity definitions. (Joint Petition, No. 1 at p. 11) In this final rule, DOE maintains the existing standard and compact product classes for residential dishwashers. Based on a survey of products available on the market, DOE determined that compact dishwasher provide unique utility in their countertop or drawer configurations.

B. Technological Feasibility

1. General

In each standards rulemaking, DOE conducts a screening analysis based on information 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 an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those 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).

After DOE has determined that particular technology options are technologically feasible, it further evaluates each technology option 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 IV.B of this rule discusses the results of the screening analysis for residential dishwashers, particularly the designs DOE considered, those it screened out, and those that are the basis for the TSLs in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the direct final rule 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 such product. (42 U.S.C. 6295(p)(1)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible ("max-tech") improvements in energy efficiency for residential dishwashers, using the design parameters for the most efficient products available on the market or in working prototypes. (See chapter 5 of the direct final rule TSD.) The max-tech levels that DOE determined for this rulemaking are described in section IV.C.2 of this final rule.

C. Energy Savings

1. Determination of Savings

DOE used its national impact analysis (NIA) spreadsheet model to estimate energy savings from amended standards for the products that are the subject of this rulemaking.[10] For each TSL, DOE forecasted energy savings beginning in the year that manufacturers would be required to comply with amended standards, and ending in 2047. DOE quantified the energy savings attributable to each TSL as the difference in energy

[10] The NIA spreadsheet model is described in section IV.G of this notice.

consumption between the standards case and the base case. The base case represents the forecast of energy consumption in the absence of amended mandatory efficiency standards, and considers market demand for more efficient products.

The NIA spreadsheet model calculates the electricity savings in site energy expressed in kilowatt-hours (kWh). Site energy is the energy directly consumed by appliances 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 the energy that is used to generate and transmit the site energy. (See chapter 10 of the direct final rule TSD). To convert site energy to source energy, DOE derived annual conversion factors from the model used to prepare the Energy Information Administration's (EIA) Annual Energy Outlook 2011 (AEO2011).

2. Significance of Savings

As noted above, 42 U.S.C. 6295(o)(3)(B) prevents DOE from adopting a standard for a covered product unless such standard would result in "significant" energy savings. Although 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 (presented in section V.3.a) 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.A, 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 has addressed each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of an amended standard on manufacturers, DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year analysis period. The industry-wide impacts analyzed include industry net present value (INPV), which values the industry on the basis 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 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. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

For individual consumers, measures of economic impact include the changes in life-cycle cost (LCC) and payback period (PBP) associated with new or amended standards. The LCC, which is specified separately in EPCA as one of the seven factors to be considered in 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 also calculates the national net present value of the economic impacts throughout the forecast period applicable to 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, 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 market trends in the absence of amended standards. The LCC analysis requires a variety of inputs, such as product prices, product energy consumption, energy prices, maintenance and repair costs, product lifetime, and consumer discount rates. In its analysis, DOE assumed that consumers will purchase the considered products in the first year of compliance with amended standards.

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. Using this approach, DOE identifies the percentage of consumers estimated to receive LCC savings or experience 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 subgroups of consumers that may be affected disproportionately by a national standard.

c. Energy Savings

Although 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 energy 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 developed standards for residential dishwashers that would not lessen the utility or performance of those products. (42 U.S.C. 6295(o)(2)(B)(i)(IV)) The TSL adopted in today's direct final rule will not reduce the utility or performance of the dishwashers under consideration in this rulemaking.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider any lessening of competition that is likely to result from standards. It also directs the Attorney General of the United States (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 within 60 days of the publication of a direct final rule and simultaneously published proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii)) DOE published the proposed rule containing energy conservation standards identical to those set forth in today's direct final rule and transmitted a copy of today's direct final rule and the accompanying TSD to the Attorney General, requesting that the Department of Justice (DOJ) provide its determination on this issue. DOE will consider DOJ's comments on the rule in determining whether to proceed with the direct final rule. DOE will also publish and respond to DOJ's comments in the Federal Register in a separate notice.

f. Need for National Energy Conservation

The energy savings from new or amended standards are likely to provide improvements to the security and reliability of the nation's energy system. Reductions in the demand for electricity also may 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 today's standards also are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production. DOE reports the environmental effects from today's standards, and from each TSL it considered, in the emissions analysis contained in chapter 15 in the direct final rule TSD and in section V.B.6 of this notice. DOE also

reports estimates of the economic value of emissions reductions resulting from the considered TSLs.

g. Other Factors

EPCA allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) In developing this direct final rule, DOE has also considered the submission of the Joint Petition, which DOE believes sets forth a statement by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered products, and efficiency advocates) and contains recommendations with respect to an energy conservation standard that are in accordance with 42 U.S.C. 6295(o). (Although States were not signatories to the Consensus Agreement, they did not express any opposition to it.) DOE has encouraged the submission of consensus agreements as a way to bring diverse interested parties together, to develop an independent and probative analysis useful in DOE standard setting, and to expedite the rulemaking process. DOE also believes that standard levels recommended in the Consensus Agreement may increase the likelihood for regulatory compliance, while decreasing the risk of litigation.

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii), EPCA creates 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's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values used to calculate the effect potential amended energy conservation standards would have on the payback period for consumers. These analyses include, but are not limited to, the 3-year payback period contemplated under the rebuttable-presumption test. In addition, DOE routinely conducts an economic analysis that considers the full range of impacts to consumers, manufacturers, the nation, and the environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE's evaluation of 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 IV.F.11 of this direct final rule and chapter 8 of the direct final rule TSD.

IV. Methodology and Discussion

DOE used two spreadsheet tools to estimate the impact of today's direct final rule. The first spreadsheet calculates LCCs and PBPs of potential new energy conservation standards. The second provides shipments forecasts and then calculates impacts of potential energy conservation standards on national energy savings and net present value. The two spreadsheets are available online at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/dishwashers.html The Department also assessed manufacturer impacts, largely through use of the Government Regulatory Impact Model (GRIM).

Additionally, DOE estimated the impacts on utilities and the environment of energy conservation standards for residential dishwashers. 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. 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.

The version of NEMS used for appliance standards analysis, which makes minor modifications to the AEO version, is called NEMS-BT.[11] NEMS-BT offers a sophisticated picture of the effect of standards, because it accounts for the interactions among the various energy supply and demand sectors and the economy as a whole.

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 primarily on

[11] 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.)

publicly available information. The subjects addressed in the market and technology assessment for this rulemaking include products covered by the rulemaking, quantities and types of products sold and offered for sale, retail market trends, product classes and manufacturers, regulatory and non-regulatory programs, and technology options that could improve the energy efficiency of the product(s) under examination. See chapter 3 of the direct final rule TSD for further discussion of the market and technology assessment.

2. Products Included in this Rulemaking

DOE defines "dishwasher" under EPCA as "a cabinet-like appliance which with the aid of water and detergent, washes, rinses, and dries (when a drying process is included) dishware, glassware, eating utensils, and most cooking utensils by chemical, mechanical and/or electrical means and discharges to the plumbing drainage system." (10 CFR 430.2) DOE considers this definition to encompass built-in, portable, and countertop dishwashers.

3. Product Classes

Existing energy conservation standards divide residential dishwashers into two product classes based on capacity: (1) standard; and (2) compact. As mentioned previously in section III.A, DOE is maintaining these product classes for this rulemaking.

4. Non-Regulatory Programs

As part of the market and technology assessment, DOE reviews non-regulatory programs promoting energy efficient residential appliances in the United States. Non-regulatory programs that DOE considers in its market and technology assessment include ENERGY STAR and the Consortium for Energy Efficiency (CEE) Super-Efficient Home Appliance Initiative (SEHA).

ENERGY STAR is a voluntary labeling program administered jointly by the U.S. Environmental Protection Agency (EPA) and DOE. ENERGY STAR identifies energy efficient products through a qualification process.[12] To qualify, a product must exceed Federal minimum standards by a specified amount, or if no Federal standard exists, a product must exhibit select energy-saving features. ENERGY STAR specifications currently exist for residential dishwashers.

The CEE SEHA program develops initiatives for its North American members to promote the manufacture and purchase of energy efficient products and services.[13] The program establishes efficiency tiers beyond the DOE energy conservation standards and the ENERGY STAR specifications. Currently, CEE has set two efficiency tiers above the ENERGY STAR specification for standard dishwashers, and one efficiency tier above the ENERGY STAR specification for compact dishwashers.

[12] For more information, please visit www.energystar.gov.
[13] For more information, please visit http://www.cee1.org.
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5. Technology Options

As part of the market and technology assessment, DOE developed a list of technologies to consider for improving the efficiency of residential dishwashers, as shown in Table IV.1. These technologies encompass all those DOE believes would improve energy efficiency and are technologically feasible, most of which were identified for the November 2007 ANOPR. 72 FR 64432, 64451 (Nov. 15, 2007). In addition to those technology options identified in the November 2007 ANOPR, DOE also considered the use of control strategies to decrease energy and water consumption. This technology option is a change in the product's operation. For instance, a manufacturer may lower the temperature of a wash or rinse cycle to decrease the amount of internal water heating required. Often, decreases in water temperatures or water use are combined with longer cycles to limit the impact on wash performance.

Table IV.1 Initial Technology Options for Residential Dishwashers

1. Condenser drying
2. Control Strategies
3. Fan/jet drying
4. Flow-through heating
5. Improved fill control
6. Improved food filter
7. Improved motor efficiency
8. Improved spray-arm geometry
9. Increased insulation
10. Low-standby-loss electronic controls
11. Microprocessor controls and fuzzy logic, including adaptive or soil-sensing controls
12. Modified sump geometry, with and without dual pumps
13. Reduced inlet-water temperature
14. Supercritical carbon dioxide washing
15. Ultrasonic washing
16. Variable washing pressures and flow rates

B. Screening Analysis

DOE uses the following four screening criteria to determine which technology options are suitable for further consideration.

1) Technological feasibility. DOE will consider technologies incorporated in commercial products or in working prototypes to be technologically feasible. (The technological feasibility of options was discussed in the preceding section as part of the market and technology assessment.)

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 the standard comes into effect, 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)).

Technologies that pass through the screening analysis are referred to as "design options" in the engineering analysis. Details of the screening analysis are provided in chapter 4 of the direct final rule TSD.

Based on the preliminary determinations made in the November 2007 ANOPR (72 FR 64432, 64454–55 (Nov. 15, 2007)), and further analysis of the initial technology options, DOE retained the design options shown in Table IV.2 for its subsequent analyses. These remaining design options met all of the screening criteria listed above.

Table IV.2 Design Options Retained for Engineering Analysis

1. Condenser drying
2. Control Strategies
3. Fan/jet drying
4. Flow-through heating
5. Improved fill control
6. Improved food filter
7. Improved motor efficiency
8. Improved spray-arm geometry
9. Increased insulation
10. Low-standby-loss electronic controls
11. Microprocessor controls and fuzzy logic, including adaptive or soil-sensing controls
12. Modified sump geometry, with and without dual pumps
13. Variable washing pressures and flow rates

C. Engineering Analysis

In the engineering analysis, DOE evaluates a range of product efficiency levels and their associated manufacturing costs. The purpose of the analysis is to estimate the incremental manufacturer production costs (MPCs) associated with increasing efficiency levels above that of the baseline model in each product class. The engineering analysis considers technologies not eliminated in the screening analysis, designated as design options, in developing cost-efficiency curves, which subsequently are used for the LCC and PBP analyses.

DOE has identified the following three methodologies for generating 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 regarding costs for parts and material, labor, shipping/packaging, and investment for models that operate at particular efficiency levels.

DOE conducted the engineering analyses for the standard product class in this rulemaking using the efficiency-level approach, combined with the cost-assessment approach, to develop a manufacturing cost for each efficiency level. DOE chose this

approach because the efficiency levels considered in the engineering analysis are attainable using technologies currently available on the market for residential dishwashers. This approach involved physically disassembling commercially available products, consulting with outside experts, reviewing publicly available cost and performance information, and modeling equipment costs.

Given the data available for the compact product class, DOE used the design-option approach to develop the cost-efficiency relationship. There are very few, disparate platforms (i.e., countertop units and dishdrawers) available on the market for this product class. Therefore, DOE developed the cost-efficiency relationship by estimating the incremental costs of adding specific design options to a baseline model that would provide sufficient improvement in efficiency to achieve the higher efficiency levels considered for the analysis. DOE weighted the costs at each efficiency level by market share of each platform.

To provide interested parties with additional information about DOE's assumptions and results and the ability to perform independent analyses for verification, DOE associated each efficiency level with specific technologies that manufacturers might use. Chapter 5 of the direct final rule TSD describes the methodology and results of the efficiency level analysis used to derive the cost-efficiency relationships.

1. Baseline Efficiency Levels

The baseline efficiency levels for both the standard and compact product classes are based on the current DOE energy conservation standards for annual energy use and per-cycle water consumption. These standards took effect for residential dishwashers manufactured on or after January 1, 2010. (42 U.S.C. 6295 (g)(10)) Table IV.3 below shows the baseline efficiency level for each residential dishwasher product class.

Table IV.3 Baseline Efficiency Levels for Residential Dishwasher Analysis

Product Class	**Annual Energy Use (kWh/year)**	**Per-Cycle Water Consumption (gallons/cycle)**
Standard	355	6.5
Compact	260	4.5

2. Higher Efficiency Levels

DOE considered efficiency levels higher than baseline levels based on specifications prescribed by ENERGY STAR and CEE's Super-Efficient Home-Appliances Initiative. The highest efficiency levels were defined by the maximum available technology that DOE could identify on the market. (DOE did not identify any working prototypes that were more efficient than the maximum available technology on the market.) Where the increments between adjacent efficiency levels were large, DOE proposed to add an intermediate "gap-fill" level. Efficiency Level 2 for standard dishwashers and Efficiency Level 1 for compact dishwashers correspond to the efficiency levels proposed in the Consensus Agreement discussed in section II.B.2. Table IV.4 and Table IV.5 show the efficiency levels analyzed in today's direct final rule, based on annual energy use and per-cycle water consumption.

Table IV.4 Efficiency Levels for Standard Residential Dishwasher Analysis

Level	Efficiency Level Reference Source	Efficiency Level	
		Annual Energy Use (kWh/year)	**Per-Cycle Water Consumption** (gal/cycle)
Baseline	DOE Standard	355	6.5
EL 1	ENERGY STAR (effective August 11, 2009)	324	5.8
EL 2	CEE Tier 1/Consensus Agreement	307	5.0
EL 3	CEE Tier 2/Upcoming ENERGY STAR (effective January 20, 2012)	295	4.25
EL 4	Gap Fill*	234	3.8
EL 5	Maximum Available*	180	1.6

*Source: ENERGY STAR-qualified dishwashers as of January 30, 2011.

Table IV.5 Efficiency Levels for Compact Residential Dishwasher Analysis

Level	Efficiency Level Description	Annual Energy Use* (kWh/year)	Per-Cycle Water Consumption (gal/cycle)
Baseline	DOE Standard	260	4.5
EL 1	Consensus Agreement/Upcoming ENERGY STAR (effective January 20, 2012)	222	3.5
EL 2	Maximum Available*	154	2.1

*Source: ENERGY STAR-qualified dishwashers as of January 30, 2011.

3. Proprietary Designs

In its engineering and economic analyses DOE considers all design options that are commercially available or present in a working prototype, including proprietary designs and technologies. DOE will consider a proprietary design in the subsequent analyses only if the achieved efficiency level can also be reached using other nonproprietary design options. If the proprietary design is the only approach available to

achieve a given efficiency level, then DOE will reject that efficiency level to avoid impacts on competition that would likely result. DOE solicited comment on any proprietary design options during its manufacturer interviews, and although manufacturers mentioned several technologies that are currently in development, these technologies are not required to meet the efficiency levels considered in this analysis. Therefore, DOE believes that all efficiency levels in today's direct final rule can be achieved without the use of proprietary designs.

4. Reverse Engineering

Based on product teardowns and cost modeling, DOE developed overall cost-efficiency relationships for the standard and compact product classes. Table IV.6 and Table IV.7 show DOE's estimates of incremental manufacturing costs for improvement of dishwasher efficiency above the baseline. Chapter 5 of the direct final rule TSD provides details on DOE's engineering analysis and development of the cost-efficiency curves.

Table IV.6 Cost-Efficiency Relationship for Standard Residential Dishwashers

Efficiency Level	**Annual Energy Use** (kWh/year)	**Per-Cycle Water Consumption** (gal/cycle)	**Incremental Manufacturing Cost**		
			(2010$)	($/kWh/yr)	($/gal/cycle)
Baseline	355	6.5	-	-	-
EL 1	324	5.8	$18.27	$0.59	$26.10
EL 2	307	5.0	$31.82	$0.66	$21.21
EL 3	295	4.25	$69.23	$1.15	$30.77
EL 4	234	3.8	$75.18	$0.62	$27.85
EL 5	180	1.6	$82.95	$0.47	$16.93

Table IV.7 Cost-Efficiency Relationship for Compact Residential Dishwashers

Efficiency Level	Annual Energy Use (kWh/year)	Per-Cycle Water Consumption (gal/cycle)	Incremental Manufacturing Cost		
			(2010$)	($/kWh/yr)	($/gal/cycle)
Baseline	260	4.5	-	-	-
EL 1	222	3.5	$1.00	$0.03	$1.00
EL 2	154	2.1	$12.11	$0.11	$5.05

D. Markups Analysis

The markups analysis develops appropriate markups in the distribution chain to convert the estimates of manufacturer cost derived in the engineering analysis to consumer prices. At each step in the distribution channel, companies mark up the price of the product to cover business costs and profit margin. For dishwashers, the main parties in the distribution chain are manufacturers and retailers.

DOE developed an average manufacturer markup by examining the annual Securities and Exchange Commission (SEC) 10-K reports filed by publicly traded manufacturers primarily engaged in appliance manufacturing and whose combined product range includes residential dishwashers.

For retailers, DOE developed separate markups for baseline products (baseline markups) and for the incremental cost of more efficient products (incremental markups). Incremental markups are coefficients that relate the change in the manufacturer sales price of higher-efficiency models to the change in the retailer sales price. DOE relied on

economic data from the U.S. Census Bureau to estimate average baseline and incremental markups.[14]

Chapter 6 of the direct final rule TSD provides details on DOE's development of markups for dishwashers.

E. Energy and Water Use Analysis

DOE's energy and water use analysis estimated the range of energy and water use of dishwashers in the field, i.e., as they are actually used by consumers. The energy and water use analysis provided the basis for other analyses DOE performed, particularly assessments of the energy and water savings and the savings in consumer operating costs that could result from DOE's adoption of amended standards.

DOE determined a range of annual energy and per-cycle water consumption of dishwashers by multiplying the per-cycle energy use and per-cycle water use of each considered design by the number of cycles per year in a representative sample of U.S. households.

DOE estimated the per-cycle energy use by subtracting the annual energy use associated with standby power from the total annual energy use and dividing the result by the national average number of dishwasher cycles per year. DOE used data provided by AHAM on the total annual dishwasher energy use and the standby power use for each considered efficiency level.

[14] U.S. Census, 2002 Business Expenditure Survey (BES), Electronics and Appliance Stores sectors

DOE analyzed per-cycle energy consumption based on two components: (1) water-heating energy, and (2) machine (motor) and drying energy. The largest component of dishwasher energy consumption is water-heating energy use, which is the energy required to heat the inlet water to the temperature for dishwashing. The machine energy consists of the motor energy (for water pumping and food disposal) and drying energy consists of energy to dry cleaned dishes.

DOE estimated the per-cycle water-heating energy consumption based on DOE's dishwasher test procedure (which refers to this quantity as "water energy consumption"). DOE estimated this energy consumption for dishwashers that operate with a nominal inlet water temperature of 120 ºF, the most common situation in U.S. homes. For a dishwasher using electrically heated water, the water energy consumption, expressed in kWh per cycle, is equal to the water consumption per cycle times a nominal water heater temperature rise of 70 ºF times the specific heat of water (0.0024 kWh per gallon per ºF).[15] For a dishwasher using gas-heated or oil-heated water, the calculation is the same, but also incorporates a nominal water heater recovery efficiency of 0.75.[16]

The per-cycle machine and drying energy was determined by subtracting the per-cycle water-heating energy consumption from the per-cycle total energy consumption.

[15] The water heater temperature rise of 70 ºF assumes an average water heater inlet temperature of 50 ºF, as specified as the national average in the dishwasher test procedure..

[16] The recovery efficiency indicates how efficient a water heater is at heating water. The DOE test procedure for dishwashers specifies a recovery efficiency of 0.75 for gas-fired water heating, which is representative of gas water heaters currently in the housing stock.

DOE determined the standby annual energy consumption by multiplying the energy use in standby mode per hour by the hours the dishwasher is in standby mode, which is the difference between the number of hours in a year and the active hours, which is equal to the number of dishwasher cycles per year multiplied by cycle time, which is estimated to be one hour.[17]

DOE estimated the per-cycle water use by efficiency level in its engineering analysis, as described in chapter 5 of the direct final rule TSD.

To estimate the number of cycles per year in a representative sample of U.S. households, DOE analyzed data from the Energy Information Administration (EIA)'s 2005 Residential Energy Consumption Survey (RECS), which was the most recent such survey available at the time of DOE's analysis.[18] RECS is a national sample survey of housing units that collects statistical information on the consumption of and expenditures for energy in housing units along with data on energy-related characteristics of the housing units and occupants. Of the more than 4,800 households in RECS, almost 2,500 have dishwashers. For each household using a dishwasher, RECS provides data on the number of dishwasher cycles in the following bins: (1) less than once per week, (2) once per week, (3) 2–3 times per week, (4) 4-6 times per week, (5) at least once per day. DOE converted the above to annual values and created a triangular or uniform distribution for each bin. DOE randomly assigned a specific numerical value from within the appropriate

[17] The one-hour cycle time is an estimate of the typical cycle time for a dishwasher. Actual cycle times vary based on wash selection, load, and model of dishwasher. .
[18] For information on RECS, see www.eia.doe.gov/emeu/recs/.

bin to each household in the dishwasher sample. The average number of cycles per year derived from the RECS 2005 data is 174.

DOE also analyzed a review of survey data[19] to estimate the average number of dishwasher cycles per year. In the review, survey data on consumers' dishwasher usage habits were collected from a number of sources including several dishwasher manufacturers, detergent manufacturers, energy and consumer interest groups, independent researchers, and government agencies. These data were also used to develop the 2003 dishwasher test procedure amendments, which included a reduction in the average cycles per year from 264 to 215.[20] Because the survey data are more comprehensive than the RECS data, for today's rule DOE chose an average usage of 215 cycles per year as the most representative value for average dishwasher use.

To estimate the annual number of cycles for each RECS household in the dishwasher sample, DOE multiplied the specific value derived from RECS by the ratio of 215 cycles to 174 cycles (the RECS average). The resulting range of values used in the LCC analysis is consistent with the average use in the DOE dishwasher test procedure.

Table IV.8 shows the estimated average annual energy and water use for each efficiency level analyzed for standard dishwashers.

[19] Available at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/survey_data.pdf

[20] 68 FR 51887 (August 29, 2003). The 215 value was based on the review's recommendation that the number of average-use cycles per year be reduced into the range of 200 to 233 cycles.

Table IV.8 Standard Dishwashers: Average Annual Energy and Water Use by Efficiency Level

Efficiency Level	Annual Energy Use				Annual Water Use
	Water Heating*	Machine + Drying	Standby†	Total	
	kWh/year	kWh/year	kWh/year	kWh/year	gal/year
Baseline	234.8	120.2	0.0	355	1398
1	209.5	94.8	19.7	324	1247
2	180.6	111.9	14.5	307	1075
3	153.5	127.0	14.5	295	914
4	137.3	82.2	14.5	234	817
5	57.8	107.7	14.5	180	344

* Shown for the case of electrically heated water.

† Standby annual energy use based on a dishwasher cycle length of one hour.
Standby hours = 8760 hours – (215 cycles x 1 hour) = 8545 hours.

Table IV.9 Compact Dishwashers: Average Annual Energy and Water Use by Efficiency Level

Efficiency Level	Annual Energy Use				Annual Water Use
	Water Heating*	Machine + Drying	Standby†	Total	
	kWh/year	kWh/year	kWh/year	kWh/year	gal/year
Baseline	162.5	77.8	19.7	260	968
1	126.4	75.9	19.7	222	753
2	75.9	63.6	14.5	154	452

* Shown for the case of electrically heated water.

† Standby annual energy use based on a dishwasher cycle length of one hour.
Standby hours = 8760 hours – (215 cycles x 1 hour) = 8545 hours.

Chapter 7 of the direct final rule TSD provides details on DOE's energy and water use analysis for dishwashers.

F. Life-Cycle Cost and Payback Period Analysis

DOE conducted LCC and PBP analyses to evaluate the economic impacts on individual consumers of potential energy conservation standards for dishwashers. 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. 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) due to a more stringent standard by the change in average annual operating cost (normally lower) that results from the standard.

For any given efficiency level, DOE measures the PBP and the change in LCC relative to an estimate of the base-case appliance efficiency levels. The base-case estimate reflects the market in the absence of new or amended energy conservation standards, including the market for products that exceed the current energy conservation standards.

For each considered efficiency level in each product class, DOE calculated the LCC and PBP for a nationally representative set of housing units. For the analysis for today's rule, DOE developed household samples from the 2005 RECS. For each sample household, DOE determined the energy consumption for the dishwasher and the appropriate electricity price. By developing a representative sample of households, the analysis captured the variability in energy consumption and energy prices associated with the use of residential dishwashers.

Inputs to the calculation of total installed cost include the cost of the product—which includes manufacturer costs, manufacturer markups, retailer and distributor markups, and sales taxes—and installation costs. Inputs to the calculation of operating expenses include annual energy consumption, energy and water prices and price projections, repair and maintenance costs, product lifetimes, discount rates, and the year that compliance with standards is required. DOE created distributions of values for product lifetime, discount rates, and sales taxes, with probabilities attached to each value, to account for their uncertainty and variability.

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 dishwasher user samples. The model calculated the LCC and PBP for products at each efficiency level for 10,000 housing units per simulation run.

Table IV.10 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations. The subsections that follow provide further discussion. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 and its appendices of the direct final rule TSD (see Table 8.1.1 for a summary of inputs).

Table IV.10 Summary of Inputs and Methods for the LCC and PBP Analysis*

Inputs	Source/Method
Product Cost	Derived by multiplying manufacturer cost by manufacturer and retailer markups and sales tax, as appropriate. Used historical data to derive a price scaling index to forecast product costs.
Installation Costs	Baseline installation cost determined with data from RS Means. Assumed no change with efficiency level.
Annual Energy and Water Use	The sum of the total per-cycle annual energy and water use multiplied by the number of cycles per year and the standby annual energy use. Average number of cycles based on ADL field data. Variability: Based on the 2005 RECS normalized to the average number of cycles.
Energy and Water Prices	Electricity: Based on EIA's Form 861 data for 2010. Variability: Regional energy prices determined for 13 regions. Water: Based on 2010 AWWA/Raftelis Survey. Variability: By census region.
Energy and Water Price Trends	Energy: Forecasted using Annual Energy Outlook 2011 (AEO2011) price forecasts. Water: Forecasted using BLS historic water price index information.
Repair and Maintenance Costs	Assumed no change with efficiency level.
Product Lifetime	Estimated using survey results from RECS (1990, 1993, 1997, 2001, 2005) and the U.S. Census American Housing Survey (2005, 2007), along with historic data on appliance shipments. Variability: Characterized using Weibull probability distributions.
Discount Rates	Approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's SCF** for 1989, 1992, 1995, 1998, 2001, 2004 and 2007.
Compliance Date	2018†

* References for the data sources mentioned in this table are provided in the sections following the table or in chapter 8 of the direct final rule TSD.
** Survey of Consumer Finances.
† For TSL 2, DOE used 2013 as the compliance date.

1. Product Cost

To calculate consumer product costs, DOE multiplied the manufacturer selling prices developed in the engineering analysis by the supply-chain markups described above (along with sales taxes). DOE used different markups for baseline products and higher-efficiency products, because DOE applies an incremental markup to the increase in MSP associated with higher-efficiency products.

Examination of historical price data for a number of appliances that have been subject to energy conservation standards indicates that an assumption of constant real prices and costs may overestimate long-term trends in appliance prices. Economic literature and historical data suggest that the real costs of these products may in fact trend downward over time according to "learning" or "experience" curves. Experience curve analysis focuses on entire industries (often operating globally) and aggregates over many causal factors that may not be well characterized. Experience curve analysis implicitly includes factors such as efficiencies in labor, capital investment, automation, materials prices, distribution, and economies of scale at an industry-wide level.[21] Since market competition is very effective, learning in one plant or firm rapidly diffuses to other firms as well, leading to industry-wide effects.

[21] Newell, R.G., 2000. Incorporation of Technological Learning into NEMS Buildings Modules. U.S. Department of Energy, Energy Information Administration, Washington, DC.

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. In the NODA, DOE proposed that when sufficiently long-term data are available on the cost or price trends for a given product, it would analyze the available data to forecast future trends.

Many commenters were supportive of DOE moving from an assumption-based equipment price trend forecasting method to a data-driven methodology for forecasting price trends. Other commenters were skeptical that DOE could accurately forecast price trends given the many variables and factors that can complicate both the estimation and the interpretation of the numerical price trend results and the relationship between price and cost. DOE evaluated the concerns expressed about its proposed approach for incorporating experience in its forecasts of product prices and determined that retaining an assumption-based approach of a constant real price trend was not consistent with the historical data for residential dishwashers. Therefore, DOE developed a range of potential price trends that was consistent with the available data.

For the default price trend for this final rule, DOE estimated an experience rate for residential dishwashers based on an analysis of long-term historical data. DOE derived a dishwasher price index from 1988 to 2010 using Producer Price Index (PPI) data for miscellaneous household appliances from the Bureau of Labor Statistics' (BLS). (PPI data specific to residential dishwashers were not available.) An inflation-adjusted price index was calculated using the GDP price deflator for the same years. This proxy

for historic price data was then regressed on the quantity of dishwashers produced, based on a corresponding series for total shipments of dishwashers.

To calculate an experience rate, a least-squares power-law fit was performed on the dishwasher price index versus cumulative shipments (including imports). DOE then derived a price factor index, with the price in 2010 equal to 1, to forecast prices in the year of compliance for amended energy conservation standards in the LCC and PBP analysis, and for the NIA, for each subsequent year through 2047. The index value in each year is a function of the experience rate and the cumulative production through that year. To derive the latter, DOE used projected shipments from the base case projections made for the NIA (see section IV.G.1 of this notice). The average annual rate of price decline in the default case is 1.27 percent. By 2047, which is the end date of the forecast period, the price is forecasted to drop 38 percent relative to 2010. For the baseline model, the average price decreases from $630 in 2010 to $392 in 2047 (values given in 2010$). DOE's forecast of product prices for dishwashers is described in further detail in appendix 8-E of the direct final rule TSD.

For the NIA, DOE also considered several alternative price trends as sensitivity cases (see section IV.G.3 for a description). In recognition of the uncertainty regarding estimation of future product price trends, DOE will continue to review the relevant literature and seek to continually improve and refine its methodology through research, enhancements to its models and by seeking public input. DOE will also work to ensure the robustness of its data sets as a means to ensure the reliability of its projections.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the product. DOE used data from the 2010 RS Means Plumbing Cost data book to estimate the baseline installation cost. DOE found no evidence that installation costs would be impacted with increased efficiency levels.

3. Annual Energy Consumption

For each sampled household, DOE determined the energy consumption for a dishwasher at different efficiency levels using the approach described above in section IV.E.

4. Energy Prices

DOE derived average annual energy prices for 13 geographic areas consisting of the nine U.S. Census divisions, with four large states (New York, Florida, Texas, and California) treated separately. For Census divisions containing one of those large states, DOE calculated the regional average excluding the data for the large state.

DOE calculated average residential electricity prices for each of the 13 geographic areas using data from EIA's Form EIA-861 database (based on "Annual Electric Power Industry Report").[22] DOE calculated an average annual regional residential price by: (1) estimating an average residential price for each utility (by dividing the residential revenues by residential sales); and (2) weighting each utility by

[22] Available at: www.eia.doe.gov/cneaf/electricity/page/eia861.html

the number of residential consumers it served in that region. The final rule analysis used the data for 2009, the most recent data available.

DOE calculated average residential natural gas prices for each of the 13 geographic areas using data from EIA's "Natural Gas Monthly."[23] DOE calculated average annual regional residential prices by: (1) estimating an average residential price for each State; and (2) weighting each State by the number of residential consumers. The direct final rule analysis used the data for 2010.

5. Energy Price Projections

To estimate energy prices in future years, DOE multiplied the average regional energy prices discussed in the preceding section by the forecast of annual average residential energy price changes in the Reference case from AEO2011, which has an end year of 2035.[24] To estimate price trends after 2035, DOE used the average annual rate of change in prices from 2020 to 2035.

6. Water and Wastewater Prices

For today's direct final rule, DOE obtained data on water and wastewater prices for 2010 from the Water and Wastewater Rate Survey conducted by Raftelis Financial Consultants and the water utility association, AWWA. The survey, which analyzes each industry separately, covers approximately 308 water utilities and 228 wastewater utilities. The water survey includes, for each utility, the cost to consumers of purchasing a given

[23] Available at: http://www.eia.gov/oil_gas/natural_gas/data_publications/natural_gas_monthly/ngm.html.
[24] U.S. Energy Information Administration. Annual Energy Outlook 2011. Washington, DC. April 2011.

volume of water or treating a given volume of wastewater. The data provide a division of the total consumer cost into fixed and volumetric charges. DOE's calculations use only the volumetric charge to calculate water and wastewater prices, because only this charge is affected by a change in water use. Average water and wastewater prices were estimated for each of four census regions. Each RECS household was assigned a water and wastewater price depending on its census region location.

DOE also used price information for households that use well water and a septic tank from the National Ground Water Association, as well as national cost data on residential septic systems from the National Onsite Wastewater Recycling Association (NOWRA).

Chapter 8 of the direct final rule TSD provides more detail about DOE's approach to developing water and wastewater prices.

7. Maintenance and Repair Costs

Repair costs are associated with repairing or replacing components that have failed in an appliance; maintenance costs are associated with maintaining the operation of the product. Typically, small incremental increases in product efficiency produce no, or only minor, changes in repair and maintenance costs compared to baseline efficiency products.

DOE requested information from manufacturers during interviews as to whether maintenance and repair costs are a function of efficiency level and product class. Manufacturers responded that these costs would not increase with efficiency. Therefore, DOE did not assume that more efficient dishwashers would have greater repair or maintenance costs.

8. Product Lifetime

Because the lifetime of appliances varies depending on utilization and other factors, DOE develops a distribution of lifetimes from which specific values are assigned to the appliances in the samples. DOE conducted an analysis of residential dishwasher lifetimes in the field based on a combination of shipments data and RECS 2005 data on the ages of the dishwashers reported in the household stock. As described in chapter 8 of the direct final rue TSD, the analysis yielded an estimate of mean age for residential dishwashers of approximately 15 years. It also yielded a survival function that DOE incorporated as a probability distribution in its LCC analysis. See chapter 8 of the direct final rule TSD for further details on the method and sources DOE used to develop product lifetimes.

9. Discount Rates

In the calculation of LCC, DOE applies discount rates appropriate to households to estimate the present value of future operating costs. DOE estimated a distribution of residential discount rates for dishwashers based on consumer financing costs and

opportunity cost of any uses of their funds, including investments in more-efficient appliances.

To establish residential discount rates for the LCC analysis, DOE identified all debt or asset classes that might be used to purchase dishwashers, including household assets that might be affected indirectly. It estimated the average percentage shares of the various debt or asset classes for the average U.S. household using data from the Federal Reserve Board's Survey of Consumer Finances (SCF) for 1989, 1992, 1995, 1998, 2001, 2004, and 2007. Using the SCF and other sources, DOE then developed a distribution of rates for each type of debt and asset to represent the rates that may apply in the year in which amended standards would take effect. DOE assigned each sample household a specific discount rate drawn from one of the distributions. The average rate across all types of household debt and equity, weighted by the shares of each class, is 5.1 percent. DOE used the same approach for today's direct final rule. See chapter 8 in the direct final rule TSD for further details on the development of consumer discount rates.

10. Compliance Date of Amended Standards

In the context of EPCA, the compliance date is the future date when parties subject to the requirements of a new or amended standard must comply. EPCA, as amended by EISA 2007, requires that DOE publish a final rule no later than January 1, 2015, to determine whether to amend the standards in effect for dishwashers manufactured on or after January 1, 2018. (42 U.S.C. 6295(g)(10)(B)) Where appropriate, DOE calculated the LCC and PBP for dishwashers as if consumers would

purchase new products in 2018. As discussed in section II.B.2, TSL 2, which corresponds to the Consensus Agreement level for standard dishwashers, has a compliance date of 2013. Thus, for TSL 2, DOE used 2013 as the compliance year.

11. Base-Case Efficiency Distribution

To accurately estimate the share of consumers that would be affected by a standard at a particular efficiency level, DOE's LCC analysis considered the projected distribution of product efficiencies that consumers purchase under the base case (i.e., the case without new energy efficiency standards). DOE refers to this distribution of product of efficiencies as a base-case efficiency distribution.

To estimate the base-case efficiency distribution of standard-sized dishwashers for 2013 and 2018, DOE relied on data submitted by AHAM for the current rulemaking. These data provide shares of shipments by efficiency level for 2002–2005 and 2008–2010. These data show significant increase in the share of ENERGY STAR products in both periods. To predict the market shares for each efficiency level in 2013 and 2018, DOE considered the shares and market trends present in the AHAM data and assumed these trends would continue in a manner consistent with the decline in average energy use.

For compact dishwashers, AHAM data for efficiency distributions were not available. Thus, DOE first considered 2010 market data from the NPD Group, Inc.[25]

[25] NPD Group, Inc. offers marketing research services, industry tracking, data collection, and analysis. For more information, please visit: http://www.npdgroup.com.

These data show that nearly all shipments for both standard and compact dishwashers are at the baseline efficiency level. For the compact class base-case distribution, however, there were only two types of compact dishwashers in the NPD data set: "countertop" and "portable." DOE is not aware of any portable dishwashers currently on the market in the United States that would be classified as compact size based on the number of place settings. Further, there are no compact dishdrawer platforms included in the NPD dataset, which DOE believes represent a sizeable fraction of compact dishwasher shipments. As a result, DOE estimated compact base-case efficiencies from its research on the number of models available at each efficiency level. Of the eight compact dishwashers listed in the FTC database for manufacturer certifications in 2010, four are dishdrawer models with similar performance. Therefore, DOE allocated half of shipments to the dishdrawer platform that meets candidate standard level (CSL) 2. DOE further estimated, based on the number of countertop models and underlying platforms contained within the CEC and FTC databases, that half of remaining shipments (25 percent of total compact dishwasher shipments) would meet CSL 1, while the remaining 25 percent of compact shipments are at the baseline.

The estimated shares for the base-case efficiency distribution for dishwashers are shown in Table IV.11. See chapter 8 of the direct final rule TSD for further information on the derivation of the base-case efficiency distributions. For standard-sized dishwashers, DOE also considered an alternative base-case efficiency distribution that uses a different set of historical data. This distribution is described in appendix 8-F of the direct final rule TSD.

Table IV.11 Dishwasher Base-Case Efficiency Distribution by Product Class in 2013

CSL	Efficiency Level (kWh)	Standard (% of shipments)	Compact (% of shipments)
Baseline	355	3.8	25.0
1	324	32.3	25.0
2	307	28.0	50.0
3	295	16.4	
4	234	13.8	
5	180	5.6	

12. Inputs to Payback Period Analysis

The payback period is the amount of time it takes the consumer to recover the additional installed cost of more efficient products, compared to baseline products, through energy cost savings. Payback periods are expressed in years. Payback periods that exceed the life of the product mean that the increased total installed cost is not recovered in reduced operating expenses.

The inputs to the PBP calculation are the total installed cost of the product to the customer for each efficiency level and the average annual operating expenditures for each efficiency level. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates are not needed.

13. Rebuttable-Presumption Payback Period

As noted above, EPCA, as amended, 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 (and, as applicable, water) savings during the first year that the consumer will receive as a result of the standard, as calculated under the test procedure in place for that standard. (42 U.S.C. 6295(o)(2)(B)(iii)) For each considered efficiency level, DOE determined the value of the first year's energy and water savings by calculating the quantity of those savings in accordance with the applicable DOE test procedure, and multiplying that amount by the average energy and water price forecast for the year in which compliance with the amended standard would be required. The results of the rebuttable payback period analysis are summarized in section V.B.1.c of this notice.

G. National Impact Analysis–National Energy Savings and Net Present Value Analysis

The national impact analysis (NIA) assesses the national energy savings (NES) and the national net present value (NPV) of total consumer costs and savings that would be expected to result from new or amended standards at specific efficiency levels. ("Consumer" in this context refers to consumers of the product being regulated.) DOE calculates the NES and NPV based on projections of annual appliance shipments, along with the annual energy consumption and total installed cost data from the energy use and LCC analyses.[26] For the present analysis, DOE forecasted the energy savings, operating cost savings, product costs, and NPV of consumer benefits for products sold from 2018 through 2047.[27]

[26] For the NIA, DOE adjusts the installed cost data from the LCC analysis to exclude sales tax, which is a transfer.

[27] For TSL 2, which assumes a compliance date in 2013, DOE forecasted the impacts for products sold from 2013 through 2047.

DOE evaluates the impacts of new and amended standards 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 compares 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. For the base-case forecast, DOE considers historical trends in efficiency and various forces that are likely to affect the mix of efficiencies over time. For the standards cases, DOE also considers how a given standard would likely affect the market shares of efficiencies greater than the standard.

DOE uses an MS Excel spreadsheet model to calculate the energy savings and the national consumer costs and savings from each TSL. The TSD and other documentation that DOE provides during the rulemaking help explain the models and how to use them, and interested parties can review DOE's analyses by changing various input quantities within the spreadsheet. The NIA spreadsheet model uses typical values (as opposed to probability distributions) as inputs.

For the results presented in today's notice, DOE used projections of energy prices and housing starts from the AEO2011 Reference case. As part of the NIA, DOE analyzed scenarios that used inputs from the AEO2011 Low Economic Growth and High Economic Growth cases. Those cases have higher and lower energy price trends compared to the Reference case, as well as higher and lower housing starts, which result

in higher and lower appliance shipments to new homes. NIA results based on these cases are presented in appendix 10-C of the direct final rule TSD.

Table IV.12 summarizes the inputs and methods DOE used for the NIA analysis for the direct final rule. Discussion of these inputs and methods follows the table. See chapter 10 of the direct final rule TSD for further details.

Table IV.12 Summary of Inputs and Methods for the National Impact Analysis

Inputs	Method
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	2018.*
Base-Case Forecasted Efficiencies	Efficiency distributions are forecasted based on historical efficiency data.
Standards-Case Forecasted Efficiencies	Used a "roll-up" scenario.
Annual Energy Consumption per Unit	Annual weighted-average values are a function of energy use at each CSL.
Total Installed Cost per Unit	Annual weighted-average values are a function of cost at each CSL. Incorporates forecast of future product prices based on historical data.
Annual Energy Cost per Unit	Annual weighted-average values as a function of the annual energy consumption per unit and energy prices.
Repair and Maintenance Cost per Unit	Annual values do not change with efficiency level.
Energy Prices	AEO2011 forecasts (to 2035) and extrapolation through 2047.
Energy Site-to-Source Conversion Factor	Varies yearly and is generated by NEMS-BT.
Discount Rate	Three and seven percent real.
Present Year	Future expenses discounted to 2012, when the final rule will be published.

* For TSL 2, the compliance date is 2013.

1. Shipments

Forecasts of product shipments are needed to calculate the national impacts of standards on energy and water use, NPV, and future manufacturer cash flows. DOE develops shipment forecasts based on an analysis of key market drivers for residential dishwashers. In DOE's shipments model, shipments of products are driven by new construction and stock replacements. The shipments model takes an accounting approach, tracking market shares of each product class and the vintage of units in the existing stock. Stock accounting uses product shipments as inputs to estimate the age distribution of in-service product stocks for all years. The age distribution of in-service product stocks is a key input to calculations of both the NES and NPV, because operating costs for any year depend on the age distribution of the stock. DOE also considers the impacts on shipments from changes in product purchase price and operating cost associated with higher energy efficiency levels.

New housing forecasts and market saturation data comprised the two primary inputs for DOE's estimates of new construction shipments. "New housing" includes newly-constructed single-family and multi-family units (referred to as "new housing completions") and mobile home placements. For new housing completions and mobile home placements, DOE used actual data through 2008, and adopted the projections from AEO2011 for later years.

DOE calibrated the shipments model against historical dishwasher shipments. In general, DOE estimated replacements using a product retirement function developed

from product lifetime. DOE based the retirement function on a probability distribution for the product lifetime that was developed in the LCC analysis. The shipments model assumes that no units are retired below a minimum product lifetime and that all units are retired before exceeding a maximum product lifetime.

DOE applied a price elasticity parameter to estimate the effect of standards on dishwasher shipments. DOE estimated the price elasticity parameter from a regression analysis that used purchase price and efficiency data specific to residential clothes washers, refrigerators and dishwashers during 1980–2002. The estimated "relative price elasticity" incorporates the impacts from purchase price, operating cost, and household income. Based on evidence that the price elasticity of demand is significantly different over the short run and long run for other consumer goods (i.e., automobiles),[28] DOE assumed that the relative price elasticity declines over time. DOE estimated shipments in each standards case using the relative price elasticity along with the change in the relative price between a standards case and the base case.

For details on the shipments analysis, see chapter 9 of the direct final rule TSD.

2. Forecasted Efficiency in the Base Case and Standards Cases

A key component of the NIA is the trend in energy efficiency forecasted for the base case (without new or amended standards) and each of the standards cases. Section IV.F.11 describes how DOE developed a base-case energy efficiency distribution (which

[28] S. Hymans. Consumer Durable Spending: Explanation and Prediction, Brookings Papers on Economic Activity, 1971. Vol. 1971, No. 1, pp. 234-239.

yields a shipment-weighted average efficiency) for each of the considered product classes for the first year of the forecast period. To project the trend in efficiency for standard-sized dishwashers over the entire forecast period, DOE utilized the historical trend in shipment-weighted average efficiency from 2002 to 2010 as provided by AHAM and considered the potential effect of programs such as ENERGY STAR. The historical trend demonstrates that the shipment-weighted average annual energy use decreased by almost 90 kWh from 2002 to 2010, reaching 309 kWh. DOE fit an exponential function to the 2002 to 2010 data that indicated that the base-case shipment-weighted average annual energy use will asymptotically approach a value of 290 kWh by 2025 and remain at that level. For standard-sized dishwashers, DOE also considered an alternative base-case efficiency trend that was estimated using a different set of historical data. This trend is described in appendix 10-D of the direct final rule TSD.

The historical record suggests that the likely market response to new or amended standards is that lower efficiency baseline models will roll up to the standard efficiency level, and some products will exceed the minimum requirements. To estimate efficiency trends in the standards cases, DOE has used "roll-up" and/or "shift" scenarios in its standards rulemakings. Under the "roll-up" scenario, DOE assumes: (1) product efficiencies in the base case that do not meet the standard level under consideration would "roll-up" to meet the new standard level; and (2) product efficiencies above the standard level under consideration would not be affected. Under the "shift" scenario, DOE re-orients the distribution above the new minimum energy conservation standard.

DOE determined that a roll-up scenario is most appropriate to establish the distribution of efficiencies for the year that compliance with revised dishwasher standards would be required. For subsequent years, DOE assumed that efficiency would continue to improve in each standards case at the same rate as estimated for the base case, until the max-tech efficiency level is reached. The details of DOE's approach to forecast efficiency trends are described in chapter 10 of the direct final rule TSD.

3. Total Installed Cost per Unit

As discussed in section IV.F.1, DOE developed a dishwasher price trend based on an experience rate for miscellaneous household appliances. It used this trend to forecast the prices of dishwashers sold in each year in the forecast period. DOE applied the same values to forecast prices for each product class at each considered efficiency level.

To evaluate the effect of uncertainty regarding the price trend estimates, DOE investigated the impact of different product price forecasts on the consumer net present value for the considered TSLs for residential dishwashers. In addition to the default price trend, DOE considered two product price sensitivity cases: (1) a high price decline case based on an exponential fit using PPI data for 1991 to 2010; (2) a low price decline case based on an experience rate derived using PPI and shipments data for 1991 to 2000. The derivation of these price trends and the results of these sensitivity cases are described in appendix 10-B of the direct final rule TSD. In the high price decline case, the NPV is significantly higher than in the default case. In the low price decline case, the NPV is

slightly lower than in the default case. The rank order of the TSLs is the same in all of the cases.

4. National Energy and Water Savings

For each year in the forecast period, DOE calculates the national energy and water savings for each standard level by multiplying the stock of products affected by the energy conservation standards by the per-unit annual energy savings. Cumulative energy and water savings are the sum of the NES for each year.

To estimate the national energy savings expected from appliance standards, DOE uses a multiplicative factor to convert site energy consumption (at the home) 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. The conversion factors vary over time because of projected changes in generation sources (i.e., the power plant types 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. For today's rule, DOE used annual site-to-source conversion factors based on the version of NEMS that corresponds to AEO2011, which provides energy forecasts through 2035. For 2036–2047, 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 measuring 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. No. 109-58 (August 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 energy consumption as including, in addition to site energy use: 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.

In evaluating the merits of using point-of-use and full-fuel-cycle (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 but, unlike the full-fuel-cycle measure, 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 full-

fuel-cycle measure of energy consumption when assessing national and environmental impacts, especially with respect to the calculation of greenhouse gas (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 website. For those appliances that use multiple fuels (e.g., water heaters), the NAS committee indicated that measuring full-fuel-cycle energy consumption would provide a more complete picture of energy consumed and permit comparisons across many different appliances, as well as an improved assessment of impacts.

In response to the NAS committee recommendations, DOE issued a notice of proposed policy for incorporating a full-fuel cycle analysis into the methods it uses to estimate the likely impacts of energy conservation standards on energy use and emissions. 75 FR 51423 (Aug. 20, 2010). In its final Statement of Policy, DOE stated that it intends to calculate FFC energy and emission impacts by applying conversion factors generated by the GREET model to the NEMS-based results currently used by DOE. 76 FR 51282 (Aug. 18, 2011). Additionally, DOE will review alternative approaches to estimating these factors and may decide to use a model other than GREET to estimate the FFC energy and emission impacts in any particular future appliance efficiency standards rulemaking.

5. Net Present Value of Consumer Benefit

The inputs for determining the net present value (NPV) of the total costs and benefits experienced by consumers of considered appliances are: (1) total annual installed

cost, (2) total annual savings in operating costs, and (3) a discount factor. DOE calculates net savings each year as the difference between the base case and each standards case in total savings in operating costs and total increases in installed costs. DOE calculates operating cost savings over the life of each product shipped during the forecast period.

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. For today's direct final rule, DOE estimated the NPV of appliance consumer benefits using both a 3-percent and a 7-percent real discount rate. DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget (OMB) to Federal agencies on the development of regulatory analysis.[29] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the "social rate of time preference," which is the rate at which society discounts future consumption flows to their present value.

H. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers (e.g., low-income households) that may be disproportionately affected by a national standard. DOE evaluates impacts on particular subgroups of consumers primarily by analyzing the LCC

[29] OMB Circular A-4 (Sept. 17, 2003), section E, "Identifying and Measuring Benefits and Costs. Available at: www.whitehouse.gov/omb/memoranda/m03-21.html.

impacts and PBP for those particular consumers from alternative standard levels. Chapter 11 in the direct final rule TSD describes the consumer subgroup analysis. For this rule, DOE analyzed the impacts of the considered standard levels on low-income households and senior-only households.

I. Manufacturer Impact Analysis

The following sections address the various steps taken to analyze the impacts of the amended standards on manufacturers. These steps include conducting a series of analyses, interviewing manufacturers, and evaluating the information received from interested parties during this rulemaking.

1. Overview

In determining whether an amended energy conservation standard for residential dishwashers subject to this rulemaking is economically justified, DOE is required to consider "the economic impact of the standard on the manufacturers and on the consumers of the products subject to such standard." (42 U.S.C. 6295(o)(2)(B)(i)(I)) The statute also calls for an assessment of the impact of any lessening of competition as determined by the Attorney General that is likely to result from the adoption of a standard. (42 U.S.C. 6295(o)(2)(B)(i)(V)) DOE conducted the MIA to estimate the financial impact of amended energy conservation standards on manufacturers, and to assess the impacts of such standards on employment and manufacturing capacity.

The MIA is both a quantitative and qualitative analysis. The quantitative part of the MIA relies on the Government Regulatory Impact Model (GRIM), an industry cash-flow model customized for the residential dishwashers covered in this rulemaking. See section IV.I.2 below, for details on the GRIM analysis. The qualitative part of the MIA addresses factors such as product characteristics, characteristics of particular firms, and market trends. The complete MIA is discussed in chapter 12 of the direct final rule TSD. DOE conducted the MIA in the three phases described below.

a. Phase 1, Industry Profile

In Phase 1 of the MIA, DOE prepared a profile of the residential dishwasher 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 market structure and characteristics of the industry, tracking trends in market share data, product attributes, product shipments, manufacturer markups, and the cost structure for various manufacturers.

The profile also included an analysis of manufacturers in the industry using Security and Exchange Commission 10–K filings,[30] Standard & Poor's stock reports,[31] and corporate annual reports released by both public and privately held companies. DOE used this and other publicly available information to derive preliminary financial inputs for the GRIM including industry revenues, cost of goods sold, and depreciation, as well

[30] Available online at www.sec.gov.
[31] Available online at www2.standardandpoors.com.

as selling, general, and administrative (SG&A), and research and development (R&D) expenses.

b. Phase 2, Industry Cash Flow Analysis

Phase 2 focused on the financial impacts of potential amended energy conservation standards on the industry as a whole. Amended energy conservation standards can affect manufacturer cash flows 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/or possible changes in sales volumes. DOE used the GRIM to model these effects in a cash-flow analysis of the residential dishwasher industry. In performing this analysis, DOE used the financial values derived during Phase 1 and the shipment assumptions from the NIA.

c. Phase 3, Sub-Group Impact Analysis

Using average cost assumptions to develop an industry-cash-flow estimate may not adequately assess differential impacts of amended energy conservation standards among manufacturer subgroups. For example, small businesses, manufacturers of niche products, or companies exhibiting a cost structure that differs significantly from the industry average could be more negatively affected. During the manufacturer interviews, DOE discussed financial topics specific to each manufacturer and obtained each manufacturer's view of the industry as a whole. DOE reports the MIA impacts of amended energy conservation standards by grouping together the impacts on manufacturers of certain product classes. While DOE did not identify any other subgroup

of manufacturers of residential dishwashers that would warrant a separate analysis, DOE specifically investigated impacts on small business manufacturers. See section VI.B for more information.

The MIA also addresses the direct employment impacts in manufacturing of dishwashers. DOE uses census data and information gained through manufacturer interviews in conjunction with the GRIM to estimate the domestic labor expenditures and number of domestic production workers in the base case and at each TSL from 2012 to 2047.

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 is a standard, annual cash-flow analysis that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs, and models changes in costs, distribution of shipments, investments, and manufacturer margins that could result from 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, 2012 (which accounts for the investments needed to bring products into compliance), and continuing to 2047. DOE uses the industry average weighted average cost of capital (WACC) of 8.5 percent, as this represents the minimum rate of return necessary to cover the debt and equity obligations manufacturers use to finance operations.

DOE used the GRIM to compare INPV in the base case with INPV at various TSLs (the standards cases). The difference in INPV between the base and standards cases represents the financial impact of the amended standard on manufacturers. DOE collected this information from a number of sources, including publicly available data and interviews with a number of manufacturers. Additional details about the GRIM can be found in chapter 12 of the direct final rule TSD.

a. GRIM Key Inputs

Manufacturer Production Costs

Changes in the manufacturer production costs (MPCs) of residential dishwashers can affect revenues, gross margins, and cash flow of the industry, making these product cost data key GRIM inputs for DOE's analysis. DOE created separate cost curves for standard and compact product classes using data from tear-downs to develop both the baseline MPCs and the incremental costs that correspond to the proposed design options. The cost model also disaggregated the MPCs into material, labor, overhead, and depreciation. Later, in Phase 3 of the MIA, manufacturers validated these estimates and assumptions during interviews. DOE used the resulting MPCs and cost breakdowns as described in section IV.C above, and further detailed in chapter 5 of the direct final rule TSD, for each efficiency level analyzed in the GRIM analysis.

Base-Case Shipments Forecast

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of these values by efficiency level and product class.

Changes in the efficiency mix at each standard level affect manufacturer finances. For this analysis, the GRIM uses the NIA shipments forecasts from 2012 to 2047, the end of the analysis period.

To calculate shipments, DOE developed a single shipment model for all dishwashers based on an analysis of key market drivers for residential dishwashers. For greater detail on the shipments analysis, see section IV.G.1 above or chapter 9 of the direct final rule TSD.

Product and Capital Conversion Costs

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 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 focused on making product designs comply with the amended energy conservation standard. Capital conversion costs are investments in property, plant, and equipment to adapt or change existing production facilities so that new product designs can be fabricated and assembled.

DOE based its estimates of both the product and capital conversion costs that would be required to meet each TSL on information obtained from manufacturer interviews, the design pathways considered in the engineering analysis, and market information about the number of platform and product families for each manufacturer.

DOE's estimates of the product and capital conversion costs for the dishwashers addressed in this rulemaking can be found in section V.B.2 of today's final rule and in chapter 12 of the final rule TSD.

b. GRIM Scenarios

Standards-Case Shipment Forecasts

The MIA results presented in section V.B.2 all use shipments from the reference NIA scenario in the GRIM. To determine efficiency distributions in the standards case for the reference NIA scenario, DOE analyzed the roll-up scenario. In this scenario, DOE assumed that base case shipments of products that did not meet the new standard would roll up to meet the standard in the compliance year. See section IV.G.2 for a description of the standards case efficiency distribution. DOE also used a relative price elasticity that considers the possibility of higher first costs lowering total shipments in the standards case.

The reference NIA scenario used historical data to derive a price scaling index to forecast product costs. The MPCs and MSPs in the GRIM use the default price forecast for all scenarios. See section IV.G.4 for a discussion of DOE's price forecasting methodology.

Markup Scenarios

MSP is equal to MPC times a manufacturer markup. The MSP includes 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 baseline manufacturer markup, DOE evaluated publicly available financial information for manufacturers of major household appliances whose product offerings include residential dishwashers. During manufacturer interviews, DOE received feedback supporting the calculated 1.24 baseline manufacturer markup. DOE used the baseline manufacturer markup for all products when modeling the base case in the GRIM.

For the standards-case in the GRIM, DOE modeled two markup scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards. For both GRIM markup scenarios, DOE placed no premium on higher efficiency products. This assumption is informed by a market structure in which over 96 percent of products currently adhere to ENERGY STAR standards, leaving little to no room for differentiation by efficiency level alone, and was further supported by manufacturer interviews. The two standards case markup scenarios are (1) a flat markup scenario, and (2) a preservation of operating profit markup scenario. Modifying these markups from the base case to the standards cases yields different sets of impacts on manufacturers' changing industry revenue and cash flow.

The flat markup scenario assumes that the baseline markup of 1.24 is maintained for all products in the standards case. This scenario represents the upper bound of industry profitability as manufacturers are able to fully pass through additional costs due to standards to their customers under this scenario.

The preservation of operating profit markup scenario is similar to the flat markup scenario with the exception that in the standards case, minimally compliant products lose a fraction of the baseline markup. This scenario is the lower bound profitability scenario and represents a more substantial impact to the dishwasher industry as manufacturers attempt to maintain the lowest possible prices for entry level products while securing the same level of operating profit they saw prior to amended standards.

3. Manufacturer Interviews

DOE interviewed manufacturers representing more than 80 percent of residential dishwasher sales. These interviews were in addition to those DOE conducted as part of the engineering analysis. DOE used these interviews to tailor the GRIM to incorporate unique financial characteristics of the industry. All interviews provided information that DOE used to evaluate the impacts of potential amended energy conservation standards on manufacturer cash flows, manufacturing capacities, and employment levels. See appendix 12-A of the direct final rule TSD for additional information on the MIA interviews. The following sections describe the most significant issues identified by manufacturers.

a. Dishwasher Performance

All manufacturers interviewed expressed concerns about the potential impacts of amended standards on product performance, citing several adverse and possibly severe consequences of standards above those agreed upon in the Joint Petition. For higher efficiency standards, the performance metrics manufacturers expect to be most severely impacted include wash performance, drying performance, cycle time, and the noise levels reached in operation. In considering these metrics, manufacturers anticipate negative reactions ranging from small but meaningful changes in consumer behavior to higher rates of service calls and returns. For efficiency standards well above those proposed in the Joint Petition, manufacturers foresee blanket rejection of poorly performing products in the market. In considering impacts to wash performance, manufacturers cited an increase in unnecessary rinsing or washing of dishes prior to loading the dishwasher, switching to a more aggressive cycle, and running multiple cycles when dishes are not adequately cleaned in a single cycle as the most likely changes in consumer behavior. Manufacturers went on to suggest that any of these changes would result in an increase in both energy and water consumption over that used by a dishwasher of satisfactory performance. To mitigate the impact of future standards on product performance, several manufacturers recommended the adoption of a performance metric into the test procedure and standard.

While all manufacturers suggested that the efficiency level specified in the Joint Petition would not likely have a substantial negative impact on wash performance, some manufacturers noted that standards above this level would result in a decrease in performance unless substantially higher-cost technology changes were implemented. The

comments did not indicate the specific technology changes that would be required. Even without such technology changes, however, several manufacturers already sell products at efficiency levels above those specified by the Joint Petition, including the max-tech efficiency level. Accordingly, DOE evaluated these efficiency levels as part of this rulemaking.

b. Test Procedures

Manufacturers raised concerns over the current DOE dishwasher test procedure and the multitude of additional dishwasher test procedures in the field today. Several manufacturers suggested that the current DOE test procedure does not accurately capture the energy used by dishwashers in the field. These manufacturers cite the single cycle specification and lack of performance metrics in the test procedure as providing an easy avenue for circumvention of the standards. In the scenario described, manufacturers may optimize a particular cycle to perform well on the DOE test procedure with the implicit understanding that this cycle will not meet customer expectations and thus will not be used in the field as customers opt for a different, more energy-intensive cycle.

In contrast, other manufacturers raised concerns over expanding the test procedure to cover multiple cycles citing the additional testing burden this would generate. Similarly, some manufacturers raised concerns over how DOE would implement a performance test, noting that there already exist numerous performance tests in the industry including those developed by AHAM, IEC, and Consumer Reports and that each performance test procedure favors a different machine cycle algorithm.

As discussed in sections II.A and II.B.4, the DOE test procedure for residential dishwashers is found at Title 10 of the CFR part 430, subpart B, appendix C. DOE is considering amendments to the test procedure to incorporate measures of standby mode and off mode energy consumption in accordance with statutory requirements. DOE will consider concerns regarding active mode testing provisions, including those discussed above, in the test procedure rulemaking.

c. Increased Competition

Manufacturers of both baseline and high efficiency products anticipate an increase in competition in industry stemming from amended standards. Manufacturers whose market share is largely attributed to products currently below amended standards expect to see either the removal of features from higher efficiency units as a means to cut costs to maintain a low-cost minimally-compliant product, or the disappearance of entry level models as they are forced to add other features and cost in line with current higher efficiency products. If the latter approach prevails, manufacturers of higher efficiency products expect to see increased competition as manufacturers which previously focused on low efficiency products move into their target segment of the market. As noted in section III.D.1.d, the Attorney General provides DOE with a determination and analysis of the impact of any lessening of competition that is likely to result from the imposition of the standard. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii))

d. Cumulative Regulatory Burden

Several manufacturers noted that dishwashers are but one of a suite of appliances they produce and that the cumulative burden of research and development to meet standards, capital expenditure and retraining of staff to produce products at the new standards, and product testing to certify compliance of new products represent a significant burden when taken in combination across their various product lines. Manufacturers suggest that the ability to establish standards in a coordinated fashion by such vehicles as a joint petition and receiving adequate notice of DOE's plans for amended standards are both necessary elements in mitigating the cumulative burden and aligning changes in efficiency regulations with the product development cycle. Cumulative regulatory burden is discussed further in section V.B.2.e of today's direct final rule and chapter 12 of the direct final rule TSD.

J. Employment Impact Analysis

DOE considers employment impacts in the domestic economy as one factor in selecting a proposed standard. Employment impacts include direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the products subject to standards, their suppliers, and related service firms. The MIA addresses those impacts. Indirect employment impacts from standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, caused by:

(1) reduced spending by end users on energy;

(2) reduced spending on new energy supply 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.

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sector employment statistics developed by the Labor Department's Bureau of Labor Statistics (BLS).[32] 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. [33] 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. 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 service sectors). Thus, based on the BLS data alone, DOE believes net national employment will increase due to shifts in economic activity resulting from amended standards for dishwashers.

[32] 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. Available at: www.bls.gov/news.release/prin1.nr0.htm.

[33] 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.

For the standard levels considered in today's direct final rule, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 3.1.1 (ImSET).[34] ImSET is a special-purpose version of the "U.S. Benchmark National Input-Output" (I–O) model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model having structural coefficients that characterize economic flows among 187 sectors most relevant to industrial, commercial, and residential building energy use.

DOE notes that ImSET is not a general equilibrium forecasting model, and understands the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run for this rule. Because ImSET predicts small job impacts resulting from this rule, regardless of these uncertainties, the actual job impacts are likely to be negligible in the overall economy. DOE may consider the use of other modeling approaches for examining long run employment impacts. DOE also notes that the employment impacts estimated with ImSET for the entire economy differ from the employment impacts in the dishwasher manufacturing sector estimated using the GRIM in the MIA. The methodologies used and the sectors analyzed in the ImSET and GRIM models are different. For more details on the employment impact analysis, see chapter 13 of the direct final rule TSD.

[34] J. M. Roop, M. J. Scott, and R. W. Schultz, ImSET 3.1: Impact of Sector Energy Technologies, PNNL-18412, Pacific Northwest National Laboratory, 2009. Available at: www.pnl.gov/main/publications/external/technical_reports/PNNL-18412.pdf

K. Utility Impact Analysis

The utility impact analysis estimates several important effects on the utility industry of the adoption of new or amended standards. 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 obtained the energy savings inputs associated with efficiency improvements to considered products from the NIA. DOE conducts the utility impact analysis as a scenario that departs from the latest AEO Reference case. In the analysis for today's rule, the estimated impacts of standards are the differences between values forecasted by NEMS-BT and the values in the AEO2011 Reference case. For more details on the utility impact analysis, see chapter 14 of the direct final rule TSD.

L. Emissions Analysis

In the emissions analysis, DOE estimated the reduction in power sector emissions of CO_2, NO_X, and Hg from amended energy conservation standards for distribution transformers. DOE used the NEMS–BT computer model, which is run similarly to the AEO NEMS, except that distribution transformer 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 is the difference between the forecasted emissions estimated by NEMS–BT at each TSL and the AEO 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 rule, DOE used the version of NEMS-BT based on AEO2011, which incorporated projected effects of all emissions regulations promulgated as of January 31, 2011.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap and trading programs, and DOE has determined that these programs create uncertainty about the 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 (D.C.). SO_2 emissions from 28 eastern States and D.C. are also limited under the Clean Air Interstate Rule (CAIR, 70 Fed. Reg. 25162 (May 12, 2005)), which created an allowance-based trading program that would gradually replaced the Title IV program in those States and D.C. 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 remained in effect temporarily, consistent with the D.C. Circuit's earlier opinion in North Carolina v. EPA, 531 F.3d 896 (D.C. Cir. 2008). On July 6, 2010, EPA issued the Transport Rule proposal, a replacement for CAIR. 75 FR 45210 (Aug. 2, 2010). On July 6, 2011, EPA issued the final Transport Rule, titled the Cross-State Air Pollution Rule. 76 FR 48208 (August 8, 2011). (See http://www.epa.gov/crossstaterule/). On December 30, 2011, however, the D.C. Circuit stayed the new rules while a panel of judges reviews them, and told EPA to continue enforcing CAIR (see EME Homer City Generation v. EPA, No. 11-1302, Order at *2 (D.C. Cir. Dec. 30, 2011)). The AEO 2011 NEMS-BT used for today's direct final rule assumes the implementation of CAIR.

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

As discussed above, the AEO 2011 NEMS used for today's direct final rule assumes the implementation of CAIR, which established a cap on NOx emissions in 28 eastern States and the District of Columbia. With CAIR in effect, energy conservation standards are expected to have little or no physical effect on NOx emissions in the States covered by CAIR, for the same reasons that they may have little effect on SO_2 emissions. However, the standards would be expected to reduce NO_X emissions in the 22 States not

affected by the CAIR. For these 22 states, DOE used NEMS–BT to forecast NOx emission reductions from the standards that are considered in today's direct final rule.

On February 16, 2012, EPA issued national emissions standards for hazardous air pollutants (NESHAPs) for mercury and certain other pollutants emitted from coal and oil-fired EGUs. 77 FR 9304. The NESHAPs do not include emissions caps and, as such, DOE's energy conservation standards would likely reduce Hg emissions. For the emissions analysis for this rulemaking, DOE estimated mercury emissions reductions using NEMS-BT based on AEO2011, which does not incorporate the NESHAPs. DOE expects that future versions of the NEMS-BT model will reflect the implementation of the NESHAPs.

M. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this direct final 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 considered TSLs. 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 benefits estimates considered.

For today's direct final rule, 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 in appendix 15-A of the direct final rule TSD.

1. Social Cost of Carbon

Under 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[35] 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 quoted above, the purpose of the SCC estimates presented here is to make it possible for agencies to incorporate the social benefits from reducing carbon dioxide emissions into cost-benefit analyses of regulatory actions that have small,

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

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 2010$, were $4.9, $22.3, $36.5, and $67.6 per metric ton avoided. For emission 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,[36] 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.[37] 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

[36] 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.

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

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: 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: 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 dollars) 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.

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 used in this direct final 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.[38] 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.

[38] The models are described in appendix 15-A of the direct final rule TSD.

Table IV.13 Social Cost of CO_2, 2010–2050 (in 2007 dollars per metric ton)

	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 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 2010$ using the GDP price deflator. For each of the four cases specified, the values used for emissions in 2010 were $4.9, $22.3, $36.5, and $67.6 per metric ton avoided (values expressed in 2010$).[39] To monetize the CO_2 emissions reductions expected to result from amended standards for dishwashers, 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 direct final rule TSD, appropriately adjusted to 2010$. 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.

2. Valuation of Other Emissions Reductions

DOE investigated the potential monetary benefit of reduced NO_X emissions from the TSLs it considered. As noted above, amended energy conservation standards would reduce NO_X emissions in those 22 States that are not affected by the CAIR, in addition to the reduction in site NO_X emissions nationwide. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for today's direct

[39] 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.

final rule based on environmental damage estimates from the 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 $450 to $4,623 per ton in 2010$).[40] 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.[41]

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 monetizes Hg in its rulemakings.

V. Analytical Results

The following section addresses the results from DOE's analyses with respect to potential energy conservation standards for residential dishwashers. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for dishwashers, and the standards levels that DOE sets forth in today's direct final rule. Additional details regarding DOE's analyses are contained in the publicly available direct final rule TSD supporting this notice.

[40] 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. 2006. Washington, DC.

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

A. Trial Standard Levels

DOE analyzed the benefits and burdens of four TSLs for residential dishwashers. These TSLs were developed using combinations of efficiency levels for the standard and compact product classes analyzed by DOE. DOE presents the results for those TSLs in today's final rule. DOE presents the results for all efficiency levels that it analyzed in the direct final rule TSD. Table V.1 presents the TSLs and the corresponding efficiency levels for dishwashers. TSL 4 represents the maximum technologically feasible ("max-tech") improvements in energy efficiency for residential dishwashers. TSL 3 consists of the next efficiency level below the max-tech level for standard dishwashers, and the max-tech level for compacts. The efficiency levels in TSL 2 correspond to the recommended levels in the Joint Petition. TSL 1 consists of the first efficiency levels considered above the baseline.

Table V.1 Trial Standard Levels for Residential Dishwashers

TSL	Standard		Compact	
	CSL	Annual Energy Use (kWh)	CSL	Annual Energy Use (kWh)
1	1	324	1	222
2	2	307	1	222
3	4	234	2	154
4	5	180	2	154

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, the impacts on individual

consumers are best captured by changes in LCC and by the PBP. Therefore, DOE calculated the LCC and PBP analyses for the potential standard levels considered in this rulemaking. DOE's LCC and PBP analyses provided key outputs for each TSL, which are reported by dishwasher product class in Table V.2 and Table V.3. The LCC and its components refer to the average values at each efficiency level. The average LCC savings (averaged over all sample consumers), as well as the fraction of product consumers for which the LCC will decrease (net benefit), increase (net cost), or exhibit no change (no impact), are relative to the base-case efficiency distribution. The last column in the tables is the median PBP for the consumer purchasing a design that complies with the TSL. DOE presents the median PBP because it is the most statistically robust measure of the PBP. The results for each potential standard level are relative to the efficiency distribution in the base case (no amended standards). DOE based the LCC and PBP analyses on the range of energy consumption under conditions of actual product use.

Table V.2 LCC and PBP Results for Standard Dishwashers

TSL	Efficiency Level (kWh/yr)	Life-Cycle Cost (2010$)			LCC Savings				Payback Period (years)
		Installed Cost	Discounted Operating Cost	LCC	Average Savings (2010$)	Percent of households that experience			Median
						Net Cost	No Impact	Net Benefit	
1	324	$656	$445	$1,101	$1	2%	96%	2%	5.9
2	307	$674	$411	$1,086	$3	19%	64%	17%	11.8
3	234	$734	$318	$1,052	$41	30%	20%	50%	6.6
4	180	$745	$232	$977	$108	23%	9%	68%	4.5

Table V.3 LCC and PBP Results for Compact Dishwashers

TSL	Efficiency Level (kWh/yr)	Life-Cycle Cost (2010$)			LCC Savings				Payback Period (years)
		Installed Cost	Discounted Operating Cost	LCC	Average Savings 2010$	Percent of households that experience			Median
						Net Cost	No Impact	Net Benefit	
1, 2	222	$623	$297	$920	$12	7%	76%	18%	0.3
3, 4	154	$638	$206	$844	$52	5%	50%	44%	2.1

For standard-sized dishwashers, DOE also considered an alternative base-case efficiency distribution that uses a different set of historical data. LCC and PBP results using this distribution are described in appendix 8-F of the direct final rule TSD.

b. Consumer Subgroup Analysis

As described in section IV.H, DOE determined the impact of the considered TSLs on low-income households and senior-only households.[42] Table V.4 compares the average LCC savings at each efficiency level for the two consumer subgroups, along with the average LCC savings for the entire sample for each product class for dishwashers. For today's standards, the average LCC savings for low-income households and senior-only households at the considered efficiency levels are not substantially different from the average for all households. At higher efficiency levels the average LCC savings for these subgroups are somewhat lower than the average for all households. Chapter 11 of the direct final rule TSD presents the complete LCC and PBP results for the two subgroups.

[42] DOE did not analyze subgroup impacts for compact dishwashers because the saturation of these products is extremely small.

Table V.4 Standard Dishwashers: Comparison of Average LCC Savings for Consumer Subgroups and All Households

TSL	Low-income households	Senior-only households	All Households
	2010$		
1	$0	$0	$1
2	$3	$2	$3
3	$26	$24	$41
4	$84	$78	$108

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. In calculating a rebuttable presumption payback period for the considered standard levels, DOE used discrete values rather than distributions for input values, and, as required by EPCA, based the energy use calculation on the DOE test procedures for residential dishwashers. As a result, DOE calculated a single rebuttable presumption payback value, and not a distribution of payback periods, for each efficiency level.

Table V.5 presents the average rebuttable presumption payback periods for the considered TSLs. 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 those levels pursuant to 42 U.S.C. 6295(o)(2)(B)(i). The results of that analysis serve as the basis for DOE to evaluate the economic justification for a potential standard level (thereby

supporting or rebutting the results of any preliminary determination of economic justification).

Table V.5 Dishwashers: Rebuttable PBPs

	Trial Standard Level			
	1	**2**	**3**	**4**
Standard (years)	5.40	5.51	5.57	4.00
Compact (years)	0.23	0.23	1.02	1.02

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of residential dishwashers. The section below describes the expected impacts on manufacturers at each TSL. Chapter 12 of the direct final rule TSD explains the analysis in further detail.

a. Industry Cash Flow Analysis Results

DOE modeled two scenarios using different markup assumptions. Each scenario results in a unique set of cash flows and corresponding industry value at each TSL. These assumptions correspond to the bounds of a range of market responses that DOE anticipates could occur in the standards case. The tables below depict the financial impacts on manufacturers (represented by changes in INPV) and the conversion costs DOE estimates manufacturers would incur at each TSL. The first table corresponds to the flat markup scenario and reflects the lower (less severe) bound of impacts whereas the second table corresponds to the preservation of operating profit scenario and reflects the upper bound of impacts.

The INPV results refer to the difference in industry value between the base case and the standards case, which DOE calculated by summing the discounted industry cash flows from the base year (2012) through the end of the analysis period. The discussion also notes the difference in cash flow between the base case and the standards case in the year before the compliance date of potential amended energy conservation standards. This figure provides an estimate of the required conversion costs relative to the cash flow generated by the industry in the base case.

Table V.6 Manufacturer Impact Analysis for Residential Dishwashers – Flat Markup Scenario

	Units	Base Case	Trial Standard Level			
			1	2	3	4
INPV	(2010$ millions)	637.5	593.2	563.6	508.6	491.9
Change in INPV	(2010$ millions)	-	(44.3)	(73.9)	(128.9)	(145.6)
	(%)	-	-7.0%	-11.6%	-20.2%	-22.8%
Product Conversion Costs	(2010$ millions)	-	27.8	34.9	66.5	76.7
Capital Conversion Costs	(2010$ millions)	-	45.5	59.1	195.4	226.3
Total Conversion Costs	(2010$ millions)	-	73.2	94.0	261.9	303.0

Table V.7 Manufacturer Impact Analysis for Residential Dishwashers – Tiered Markup Scenario

	Units	Base Case	Trial Standard Level			
			1	2	3	4
INPV	(2010$ millions)	637.5	592.2	552.9	463.1	434.8
Change in INPV	(2010$ millions)	-	(45.3)	(84.6)	(174.4)	(202.7)
	(%)	-	-7.1%	-13.3%	-27.4%	-31.8%
Product Conversion Costs	(2010$ millions)	-	27.8	34.9	66.5	76.7
Capital Conversion Costs	(2010$ millions)	-	45.5	59.1	195.4	226.3
Total Conversion Costs	(2010$ millions)	-	73.2	94.0	261.9	303.0

Because standard dishwashers represent over 99 percent of shipments in the year leading up to amended standards, changes to this product class contribute the majority of impacts to INPV across all TSLs analyzed in this rulemaking.

At TSL 1, DOE estimates impacts on INPV to range from -$44.3 million to -$45.3 million, or a change in INPV of -7.0 percent to -7.1 percent. At this level, industry free cash flow is estimated to decrease by approximately 56.5 percent to $21.9 million, compared to the base-case value of $50.5 million in the year leading up to the amended energy conservation standards. As TSL 1 corresponds to current ENERGY STAR standards, and these products represent over 96 percent of shipments in the year leading up to amended standards, only a very small fraction of the market is affected at this efficiency level. In either markup scenario, the impact to INPV at TSL 1 stems from the conversion costs required to switch production lines from manufacturing baseline units to those meeting the standards set at EL 1 for both product classes.

As a large fraction of the energy used in dishwashing is associated with heating the wash water, the design options proposed to meet this efficiency level relate primarily to minimizing the amount of wash water through spray-arm optimization and enabling greater control over the wash water temperature. Both of these practices are in common use in higher efficiency platforms across the industry and contribute to an MPC of $209.25 for standard dishwashers. Because the industry already produces a substantial number of products at this efficiency level, product and capital conversion costs are limited to 73.2 million, which accounts for switching production lines from baseline products to existing higher efficiency platforms.

TSL 2 represents the efficiency level set forth in the Joint Petition, and establishes a compliance date of 2013 as compared the 2018 compliance date for the other TSLs. At TSL 2, DOE estimates impacts on INPV to range from -$73.9 million to -$84.6 million, or a change in INPV of -11.6 percent to -13.3 percent. At this level, industry free cash flow is estimated to decrease by approximately 192.2 percent to -$39.2 million, compared to the base-case value of $42.5 million in the year leading up to the amended energy conservation standards. As with TSL 1, the impact to INPV at TSL 2 stems from the conversion costs required to switch production lines from manufacturing baseline units to those meeting the standards set at EL 2 for both product classes. At TSL 2, these impacts grow as the number of products requiring changes grows from 3.8 percent of shipments in the year leading up to amended standards to 36.1 percent.

As a large fraction of the energy used in dishwashing is associated with heating wash water, the design options proposed to meet this efficiency level relate primarily to minimizing the amount of wash water through additional optimization of the water lines as well as upgrades to higher efficiency pumps and electronic controls. Incorporating these design options leads to an estimated MPC of $222.80 for standard products. While a significant fraction of dishwashers currently employ these energy and water saving measures, the product and capital conversion costs rise to $94.0 million (as compared to $73.2 million for TSL 1), to account for the additional switching of production lines to higher efficiency platforms.

At TSL 3, DOE estimates impacts on INPV to range from -$128.9 million to -$174.4 million, or a change in INPV of -20.2 percent to -27.4 percent. At this level, industry free cash flow is estimated to decrease by approximately 212.6 percent to -$56.8 million, compared to the base-case value of $50.5 million in the year leading up to the amended energy conservation standards. While TSL 3 returns the compliance date to 2018 (5 years after the compliance date for TSL 2) the impact to INPV is more severe as less than 20 percent of shipments in the year leading up to amended standards meet or exceed this efficiency level. As such, the capital and product conversion costs required to bring these products into compliance rise significantly to a total of $261.9 million, $167.9 million more than at TSL 2. These conversion costs stem from both the research programs needed to develop such optimized products and the capital investment required to change over the majority of production lines to produce these high efficiency products.

The design options proposed to meet efficiency standards at TSL 3 include exchanging a heated drying system for a condensation drying system, further optimizing the hydraulic system (extending to a redesign of both the sump and water lines), and incorporating a flow meter, temperature control, and a humidity sensor to finely tune water consumption, temperature, and the drying cycle. Beyond component exchanges alone, the design options proposed at TSL 3 extend to include control strategies that would reduce the wash and rinse water temperatures. The component changes required to enable these improvements contribute to an MPC of $266.16 for standard dishwashers, $43.37 above that at TSL 2.

At TSL 4, DOE estimates impacts on INPV to range from -$145.6 million to -$202.7 million, or a change in INPV of -22.8 percent to -31.8 percent. At this level, industry free cash flow is estimated to decrease by approximately -246.0 percent to -$73.7 million, compared to the base-case value of $50.5 million in the year leading up to the amended energy conservation standards. TSL 4 represents the max-tech efficiency level for all dishwashers. The effects on INPV result from similar sources as TSL 3, but the fraction of products in the market that currently meet this standard is reduced to less than 9 percent in the year leading up to amended standards. As such, standards at TSL 4 would affect nearly all platforms and will result in substantial capital conversion costs associated with improvements to nearly all production facilities. Because so few products exist at this level today, nearly all manufacturers would face complete redesigns for products to meet this standard. Accordingly, the product conversion costs increase to reflect this substantial research effort. The total conversion cost required to meet

standards at TSL 5 is approximately $303.0 million—a $41.1 million increase from TSL 4.

The design options proposed to meet the efficiency levels specified at TSL 4 start with those at TSL 3, but replace the in-line flow-through water heater with one that is integrated with the pump and eliminate the fan used to circulate air during drying. Where these design options have little impact on the product MPC, contributing to only a $7.77 increase over that at TSL 3, they significantly impact INPV because of the large conversion costs associated with developing and producing these highly optimized products.

b. Impacts on Employment

DOE used the GRIM to estimate the domestic labor expenditures and number of domestic production workers in the base case and at each TSL from 2012 to 2047. DOE used the labor content of each product and the manufacturing production costs from the engineering analysis to estimate the total annual labor expenditures associated with residential dishwashers sold in the United States. Using statistical data from the most recent U.S. Census Bureau's 2009 "Annual Survey of Manufactures" and interviews with manufacturers, DOE estimates that 95 percent of residential dishwashers sold in the United States are manufactured domestically and hence that portion of total labor expenditures is attributable to domestic labor. Labor expenditures for the manufacture of a product are a function of the labor intensity of the product, the sales volume, and an assumption that wages in real terms remain constant.

Using the GRIM, DOE forecasts the domestic labor expenditure for residential dishwasher production labor in 2018 will be approximately $248.7 million. Using the $27.03 hourly wage rate including fringe benefits and 2,003 production hours per year per employee found in the 2009 *ASM*, DOE estimates there will be approximately 4,593 domestic production workers involved in manufacturing residential dishwashers in 2018, the year in which amended standards would go into effect for TSL 1, TSL 3, and TSL 4. In addition, DOE estimates that 1,120 non-production employees in the United States will support residential dishwasher production.[43] The employment spreadsheet of the residential dishwasher GRIM shows the annual domestic employment impacts in further detail.

The production worker estimates in this section cover workers only up to the line-supervisor level who are directly involved in fabricating and assembling dishwashers within an Original Equipment Manufacturer (OEM) facility. Workers performing services that are closely associated with production operations, such as material handling with a forklift, are also included as production labor. Additionally, the employment impacts shown are independent of the employment impacts from the broader U.S. economy, which are documented in chapter 13 of the direct final rule TSD.

Table V.8 depicts the potential levels of production employment that could result following amended energy conservation standards as calculated by the GRIM. The employment levels shown reflect the scenario in which manufacturers continue to produce the same scope of covered products in domestic facilities and domestic production is not shifted to lower-labor-cost countries. If all existing production were moved outside of the United States, the expected impact to domestic manufacturing employment would be a loss of 4,593 jobs, the equivalent of the total base case employment. Because there is a risk of manufacturers evaluating sourcing decisions in response to amended energy conservation standards, the expected impact to domestic production employment falls between the potential increases as shown in Table V.8, and the levels of job loss associated with all domestic dishwasher manufacturing moving outside of the United States. The discussion below includes a qualitative evaluation of the likelihood of negative domestic production employment impacts at the various TSLs.

Table V.8 Total Number of Domestic Residential Dishwasher Production Workers in 2018*

		Trial Standard Level			
	Base Case	**1**	**2**	**3**	**4**
Total Number of Domestic Production Workers in 2018 (without changes in production locations)	4,593	4,601	4,679	4,658	4,799

*The compliance date for residential dishwashers at TSL 1, TSL 3, and TSL 4 is 2018. At TSL 2, the compliance date is 2013 as specified by the Joint Petition.

All examined TSLs show relatively minor impacts on domestic employment levels relative to total industry employment. At all TSLs, most of the design options analyzed by DOE do not greatly alter the labor content of the final product. For example,

longer or more complex wash cycles or improved sump designs involve one-time changes to the final product but do not significantly change the number of steps required for the final assembly of the dishwasher (which would add labor). Because many manufacturers have recently introduced high efficiency products in the United States that meet or exceed the standards in today's final rule, it is unlikely today's direct final rule would greatly impact the sourcing decisions of these manufacturers. However, at higher TSLs, some of the design options analyzed greatly impact the ability of manufacturers to make product changes within existing platforms. The very large upfront capital costs at these levels could influence the decision of some manufacturers to relocate some or all of their domestic production of dishwashers to lower labor cost countries.

c. Impacts on Manufacturing Capacity

Nearly 64 percent of shipments of residential dishwashers already comply with the amended energy conservation standards as agreed upon in the Joint Petition and established in this rulemaking. Every manufacturer that ships standard dishwashers offers products that meet these amended energy conservation standards. Because manufacturers would need to make only minor platform changes and/or increase the production of existing products by the 2013 compliance date, the experience of multiple manufacturers that already produce standards-compliant dishwashers would allow the industry to meet the amended energy conservation standards proposed in the Joint Petition without any significant impact to manufacturing capacity in the interim.

d. Impacts on Sub-Groups of Manufacturers

Using average cost assumptions to develop an industry cash-flow estimate may not be adequate for assessing differential impacts among manufacturer subgroups. Small manufacturers, niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. DOE analyzed the impacts to small business, as discussed in section VI.B. DOE did not identify any other subgroups for residential dishwashers for this rulemaking.

e. Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of several 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 can 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.

Manufacturers provided comment on some of these regulations during interviews. DOE summarizes and addresses these comments in section IV.I.3. For the cumulative

regulatory burden, DOE attempts to quantify or describe the impacts of other Federal regulations that have a compliance date within approximately 3 years of the compliance date of this rulemaking. Most of the major regulations identified by DOE that meet this criterion are other energy conservation standards for products and equipment made by manufacturers of residential dishwashers. See chapter 12 of the direct final rule TSD for the results of DOE's analysis of the cumulative regulatory burden.

3. National Impact Analysis

a. Significance of Energy Savings

To estimate the energy savings attributable to potential standards for dishwashers, DOE compared the energy consumption of those products under the base case to their anticipated energy consumption under each TSL. Table V.9 presents DOE's projections of the national energy savings and national water savings for each TSL considered for dishwashers.[44] The savings were calculated using the approach described in section IV.G.[45] For standard-sized dishwashers, DOE also considered an alternative base-case efficiency trend that was estimated using a different set of historical data. Results calculated using this trend are described in appendix 10-D of the direct final rule TSD.

[44] National energy and water savings are cumulative over a 30-year period. Any savings for products entering the housing stock in this 30-year period which occur beyond the 30-year time limit are not reported in the national totals.

[45] Chapter 10 of the direct final rule TSD presents tables that also show the magnitude of the energy savings if the savings are discounted at rates of 7 percent and 3 percent. Discounted energy savings represent a policy perspective in which energy savings realized farther in the future are less significant than energy savings realized in the nearer term.

Table V.9 Dishwashers: Cumulative National Energy and Water Savings (2018-2047)*

	Trial Standard Level			
	1	**2**	**3**	**4**
Energy (quads)	0.02	0.07	0.94	1.59
Water (trillion gallons)	0.01	0.14	0.56	1.71

* For TSL 2, the impacts are counted for 2013–2047.

b. 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 dishwashers. 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, since 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.

Table V.10 shows the consumer NPV results for each TSL DOE considered for dishwashers, using a 3-percent and a 7-percent discount rate. The impacts are counted over the lifetime of products purchased in 2018–2047 for TSLs 1, 3 and 4, and in 2013–2047 for TSL 2.

Table V.10 Dishwashers: Cumulative Net Present Value of Consumer Benefits for Products Shipped in 2018–2047*

Discount rate	Trial Standard Level			
	1	2	3	4
	Billion 2010$			
3 percent	0.12	0.46	6.51	17.45
7 percent	0.03	0.08	1.96	5.88

* For TSL 2, the impacts are counted over the lifetime of products shipped in 2013–2047.

The NPV results presented in Table V.10 are based on the default product price trend. As discussed in section IV.G.3, DOE developed several sensitivity cases with alternative forecasts of future prices of dishwashers. The impact of these alternative forecasts on the NPV results is presented in appendix 10-C of the direct final rule TSD.

For standard-sized dishwashers, DOE also considered an alternative base-case efficiency trend that was estimated using a different set of historical data. NPV results calculated using this trend are described in appendix 10-D of the direct final rule TSD.

Circular A-4 requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A-4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. DOE believes its standard 30-year

analysis is fully compliant with Circular A-4. For this rulemaking, DOE undertook an additional sensitivity analysis of its standard 30-year analysis, in compliance with Circular A-4, using a 9-year analytical period. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of the energy conservation standard established in this direct final rule and potential revision of and compliance with a new standard for dishwashers.[46] The timeframe established in EPCA may not be statistically relevant with regard to the product lifetime, product manufacturing cycles or other factors specific to dishwashers. DOE notes that the review timeframe established in EPCA generally does not overlap with the product lifetime, product manufacturing cycles or other factors specific to dishwashers. Thus, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology.

The sensitivity analysis results based on a 9-year analytical period are presented below. Table IV.11 presents DOE's forecasts of the national energy savings and national water savings for each TSL for dishwashers.[47] Table IV.12 shows the consumer NPV results for each TSL DOE considered for dishwashers, using a 3-percent and a 7-percent discount rate. For determination of the NPV, the impacts are counted over the lifetime of products purchased in 2018–2026 for TSLs 1, 3 and 4, and in 2013–2021 for TSL 2 (note

[46] EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products including dishwashers, a 3 year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the standards established in this direct final rule. While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6 year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year analysis period does not reflect the variability that may occur in the timing of standards reviews and the fact that for some consumer products, the compliance period is 5 years rather than 3 years.

[47] National energy and water savings are cumulative over the 9-year period. Any savings for products entering the housing stock in this 9-year period which occur beyond the 9-year time limit are not reported in the national totals. In contrast, the social benefit and cost estimates include the benefits and costs that are incurred over the lifetime of the dishwashers irrespective of when they are purchased.

that the NPV estimate incorporates all of the operating cost savings of dishwashers purchased in the 9 year analytical period).

Table V.11 Dishwashers: Cumulative National Energy and Water Savings, Nine-Year Analysis Period (2018-2026)*

	Trial Standard Level			
	1	2	3	4
Energy (quads)	0.00	0.01	0.13	0.22
Water (trillion gallons)	0.00	0.02	0.08	0.24

* For TSL 2, the impacts are counted for 2013–2021.

Table V.12 Dishwashers: Cumulative Net Present Value of Consumer Benefits for Products Shipped in 2018–2026, Nine-Year Analysis Period*

Discount rate	Trial Standard Level			
	1	2	3	4
	Billion 2010$			
3 percent	0.04	0.07	2.15	6.01
7 percent	0.02	0.00	0.93	2.89

* For TSL 2, the impacts are counted over the lifetime of products shipped in 2013–2021.

c. 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 dishwashers to reduce energy bills for consumers of those products, and the resulting net savings to be redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.J, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered in this rulemaking. DOE understands that there are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term timeframes, where these uncertainties are reduced.

The results suggest that today's standards are likely to have negligible impact on the net demand for labor in the economy. The net change in jobs is so small that it would be imperceptible in national labor statistics and might be offset by other, unanticipated effects on employment. Chapter 13 of the direct final rule TSD presents detailed results.

4. Impact on Utility or Performance of Products

As presented in section III.D.1.d of this notice, DOE concluded that the TSL adopted in this direct final rule would not reduce the utility or performance of the dishwashers under consideration in this rulemaking. Manufacturers of these products currently offer units that meet or exceed today's standards. (42 U.S.C. 6295(o)(2)(B)(i)(IV))

5. Impact of Any Lessening of Competition

DOE has also considered any lessening of competition that is likely to result from 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 DOE, 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 published a NOPR containing energy conservation standards identical to those set forth in today's direct final rule and transmitted a copy of today's direct final rule and the accompanying TSD to the Attorney General, requesting that the DOJ provide

its determination on this issue. DOE will consider DOJ's comments on the rule in determining whether to proceed with the direct final rule. DOE will also publish and respond to DOJ's comments in the Federal Register in a separate notice.

6. 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.

Energy savings from amended standards for residential dishwashers are expected to produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table V.13 provides DOE's estimate of cumulative CO_2, NO_X, and Hg emissions reductions that would be expected to result from the TSLs considered in this rulemaking. In the environmental assessment (chapter 15 of the direct final rule TSD), DOE reports annual CO_2, NO_X, and Hg emissions reductions for each TSL.

As discussed in section IV.L, DOE has not reported SO_2 emissions reductions from power plants because 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. DOE also did not include NO_X emissions reduction from power plants in States subject to emissions caps because in such a case an energy

conservation standard would likely not affect the overall level of NO_X emissions in those States.[48]

Table V.13 Emissions Reduction Estimated for Dishwasher Trial Standard Levels (cumulative in 2018–2047)*

	TSL 1	TSL 2	TSL 3	TSL 4
CO_2 (million metric tons)	1.15	4.06	65.02	98.62
NO_X (thousand tons)	0.96	3.54	54.27	83.31
Hg (tons)	0.004	0.000	0.274	0.304

* For TSL 2, the impacts are counted for 2013–2047.

DOE also 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 for dishwashers. As discussed in section IV.M, DOE used values for the SCC developed by an interagency process. The four values for CO_2 emissions reductions in 2010 resulting from that process (expressed in 2010$) are $4.9/ton (the average value from a distribution that uses a 5-percent discount rate), $22.3/ton (the average value from a distribution that uses a 3-percent discount rate), $36.5/ton (the average value from a distribution that uses a 2.5-percent discount rate), and $67.6/ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). The values for later years are higher due to increasing damages as the magnitude of climate change increases. For each of the four cases, DOE calculated a present value of the stream of annual values using the same discount rate as used in the studies upon which the dollar-per-ton values are based. Table V.14 presents the global values of CO_2 emissions reductions at each TSL. DOE calculated domestic

[48] EPA issued the final Cross-State Air Pollution Rule on July 6, 2011 (www.epa.gov/crossstaterule/). The Cross-State Air Pollution Rule will replace CAIR. In the emissions analysis for today's amended energy conservation standards, DOE's discussion and conclusions about NOx emissions assume the implementation of CAIR. In future rulemakings, DOE will adjust its relevant models to assume the implementation of the Cross-State Air Pollution Rule.

values as a range from 7 percent to 23 percent of the global values. Those results are presented in Table V.15.

Table V.14 Estimates of Global Present Value of CO_2 Emissions Reductions Under Dishwasher Trial Standard Levels

TSL	Million 2010$			
	5% discount rate, average*	**3% discount rate, average***	**2.5% discount rate, average***	**3% discount rate, 95th percentile***
1	4.88	25.9	44.2	78.9
2	16.1	79.5	133	242
3	278	1484	2534	4515
4	427	2284	3904	6951

***** Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution.

Table V.15 Estimates of Domestic Present Value of CO_2 Emissions Reductions Under Dishwasher Trial Standard Levels

TSL	Million 2010$			
	5% discount rate, average*	**3% discount rate, average***	**2.5% discount rate, average***	**3% discount rate, 95th percentile***
1	0 to 1	2 to 6	3 to 10	6 to 18
2	1 to 4	6 to 18	9 to 31	17 to 56
3	19 to 64	104 to 341	177 to 583	316 to 1039
4	30 to 98	160 to 525	273 to 898	487 to 1599

***** Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution.

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 social 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 final rule 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 emissions reductions anticipated to result from amended standards for residential dishwashers. The dollar-per-ton values that DOE used are discussed in section IV.M. Table V.16 presents the cumulative present values for each TSL calculated using 3-percent and 7-percent discount rates.

Table V.16 Estimates of Present Value of NO_X Emissions Reductions Under Dishwasher Trial Standard Levels

TSL	3% discount rate (million 2010$)	7% discount rate (million 2010$)
1	0 to 3	0 to 1
2	1 to 10	0 to 5
3	14 to 148	6 to 59
4	22 to 230	9 to 91

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 V.17 and Table V.18 present 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 a 3-percent discount rate. The CO_2 values used in the columns of each table correspond to the four scenarios for the valuation of CO_2 emission reductions presented in section IV.M.

Table V.17 Results of Adding Net Present Value of Consumer Savings (at 7-Percent Discount Rate) to Net Present Value of Monetized Benefits from CO_2 and NO_X Emissions Reductions Under Dishwasher Trial Standard Levels

TSL	Consumer NPV at 7% Discount Rate added with:			
	SCC Value of $4.9/metric ton CO_2* and Low Value for NO_X** (billion 2010$)	SCC Value of $22.3/metric ton CO_2* and Medium Value for NO_X** (billion 2010$)	SCC Value of $36.5/metric ton CO_2* and Medium Value for NO_X** (billion 2010$)	SCC Value of $67.6/metric ton CO_2* and High Value for NO_X** (billion 2010$)
1	0.04	0.06	0.08	0.11
2	0.10	0.16	0.21	0.33
3	2.24	3.48	4.53	6.53
4	6.31	8.21	9.83	12.92

* These label values represent the global SCC of CO_2 in 2010, in 2010$. Their present values have been calculated with scenario-consistent discount rates.
** Low Value corresponds to $450 per ton of NO_X emissions. Medium Value corresponds to $2,537 per ton of NO_X emissions. High Value corresponds to $4,623 per ton of NO_X emissions.

Table V.18 Results of Adding Net Present Value of Consumer Savings (at 3-Percent Discount Rate) to Net Present Value of Monetized Benefits from CO_2 and NO_X Emissions Reductions Under Dishwasher Trial Standard Levels

TSL	Consumer NPV at 3% Discount Rate added with:			
	SCC Value of \$4.9/metric ton CO_2* and Low Value for NO_X** (billion 2010\$)	SCC Value of \$22.3/metric ton CO_2* and Medium Value for NO_X** (billion 2010\$)	SCC Value of \$36.5/metric ton CO_2* and Medium Value for NO_X** (billion 2010\$)	SCC Value of \$67.6/metric ton CO_2* and High Value for NO_X** (billion 2010\$)
1	0.13	0.15	0.17	0.20
2	0.48	0.54	0.60	0.71
3	6.80	8.07	9.12	11.17
4	17.90	19.86	21.48	24.63

* These label values represent the global SCC of CO_2 in 2010, in 2010\$. Their present values have been calculated with scenario-consistent discount rates.
** Low Value corresponds to \$450 per ton of NO_X emissions. Medium Value corresponds to \$2,537 per ton of NO_X emissions. High Value corresponds to \$4,623 per ton of NO_X emissions.

Although adding the value of consumer savings to the values of emission reductions provides a valuable perspective, two issues should be considered. First, the national operating cost 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 products shipped in 2013–2047. 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 carbon dioxide in each year. These impacts continue well beyond 2100.

7. Other Factors

The Secretary of Energy, in determining whether a standard is economically justified, may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VI))) In developing the direct final rule, DOE has also considered the Joint Petition submitted to DOE. DOE recognizes the value of consensus agreements submitted by parties in accordance with 42 U.S.C. 6295(p)(4) and has weighed the value of such consensus in establishing the standards set forth in today's final rule. DOE has encouraged the submission of consensus agreements as a way to get diverse interested parties together, to develop an independent and probative analysis useful in DOE standard setting, and to expedite the rulemaking process. DOE also believes that standard levels recommended in the consensus agreement may increase the likelihood for regulatory compliance, while decreasing the risk of litigation.

C. Conclusion

When considering proposed standards, the new or amended energy conservation standard that DOE adopts for any type (or class) of covered product shall 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, considering to the greatest extent practicable the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i)) The new or amended standard must also "result in significant conservation of energy." (42 U.S.C. 6295(o)(3)(B))

The Department considered the impacts of standards at each TSL, beginning with maximum technologically feasible level, to determine whether that level was economically justified. Where 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.

To aid the reader as DOE discusses the benefits and/or burdens of each trial standard level, tables 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. Those include the impacts on identifiable subgroups of consumers, such as low-income households and seniors, who may be disproportionately affected by a national standard. Section V.B.1 presents the estimated impacts of each TSL for these subgroups.

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 salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases (for example, an inefficient ventilation fan in a new building or the delayed replacement of a water pump); (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments; (5) computational or other difficulties associated with the evaluation of relevant tradeoffs; and (6) a divergence in incentives (that is, renter versus owner; builder versus 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 DOE's current regulatory analysis, potential changes in the benefits and costs of a regulation due to changes in consumer purchase decisions are included in two ways: First, if consumers forego a purchase of a product in the standards case, this decreases sales for product manufacturers and the cost to manufacturers is included in the MIA. Second, DOE accounts for energy savings attributable only to products actually used by consumers in the standards case; if a regulatory option decreases the number of products used by consumers, this decreases the potential energy savings from an energy conservation standard. DOE provides detailed estimates of shipments and changes in the volume of product purchases in chapter 9 of the direct final rule TSD. However, DOE's current analysis does not explicitly control for heterogeneity in consumer preferences,

preferences across subcategories of products or specific features, or consumer price sensitivity variation according to household income (Reiss and White, 2005).[49]

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an energy conservation standard, DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance energy efficiency standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[50] DOE welcomes comments on how to more fully assess the potential impact of energy conservation standards on consumer choice and how to quantify this impact in its regulatory analysis in future rulemakings.

1. Benefits and Burdens of TSLs Considered for Residential Dishwashers

Table V.19 and Table V.20 summarize the quantitative impacts estimated for each TSL for residential dishwashers. The efficiency levels contained in each TSL are described in section V.A.

[49] P.C. Reiss and M.W. White. Household Electricity Demand, Revisited. Review of Economic Studies (2005) 72, 853–883.
[50] Alan Sanstad, Notes on the Economics of Household Energy Consumption and Technology Choice. Lawrence Berkeley National Laboratory. 2010. Available online at: http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf.

Table V.19 Summary of Results for Residential Dishwasher Trial Standard Levels: National Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4
National Energy Savings (quads)	0.02	0.07	0.94	1.59
National Water Savings (trillion gal.)	0.01	0.14	0.56	1.71
Net Present Value (2010$ billion)				
3% discount rate	0.12	0.46	6.51	17.45
7% discount rate	0.03	0.08	1.96	5.88
Cumulative Emissions Reduction				
CO_2 (million metric tons)	1.15	4.06	65.02	98.62
NO_X (thousand tons)	0.96	3.54	54.27	83.31
Hg (tons)	0.004	0.000	0.274	0.304
Value of Emissions Reduction				
CO_2 (2010$ million)*	5 to 79	16 to 242	278 to 4515	427 to 6951
NO_X – 3% discount rate (2010$ million)	0 to 3	1 to 10	14 to 148	22 to 230
NO_X – 7% discount rate (2010$ million)	0 to 1	0 to 5	6 to 59	9 to 91

Parentheses indicate negative (-) values.
* Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
** Values are for 2047.

Table V.20 Summary of Results for Residential Dishwasher Trial Standard Levels: Consumer and Manufacturer Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4
Manufacturer Impacts				
Impact to Industry NPV (2010$ million, 8.5% discount rate)	(44.3) – (45.3)	(73.9) – (84.6)	(128.9) – (174.4)	(145.6) – (202.7)
Industry NPV (% change)	(7.0) – (7.1)	(11.6) – (13.3)	(20.2) – (27.4)	(22.8) – (31.8)
Consumer Mean LCC Savings (2010$)				
Standard Dishwasher	1	3	41	108
Compact Dishwasher	13	12	52	52
Consumer Median PBP (years)				
Standard Dishwasher	5.9	11.8	6.6	4.5
Compact Dishwasher	0.3	0.3	2.1	2.1
Distribution of Consumer LCC Impacts				
Standard Dishwasher				
Net Cost (%)	1.9	18.7	29.7	22.9
No Impact (%)	96.3	64.1	20.0	9.0
Net Benefit (%)	1.7	17.2	50.4	68.1
Compact Dishwasher				
Net Cost (%)	6.4	6.5	5.4	5.4
No Impact (%)	75.6	75.6	50.2	50.2
Net Benefit (%)	18.0	17.9	44.4	44.4

Parentheses indicate negative (-) values.

DOE first considered TSL 4, which represents the max-tech efficiency levels. TSL 4 would save 1.59 quads of energy and 1.71 trillion gallons of water, amounts DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $5.88 billion, using a discount rate of 7 percent, and $17.45 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 99 Mt of CO_2, 83 thousand tons of NO_X, and 0.304 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 4 ranges from $427 million to $6,951 million.

At TSL 4, the average LCC impact is a savings of $108 for standard dishwashers and a savings of $52 for compact dishwashers. The median payback period is 4.5 years for standard dishwashers and 2.1 years for compact dishwashers. The fraction of consumers experiencing an LCC benefit is 68.1 percent for standard dishwashers and 44.4 percent for compact dishwashers. However, 22.9 percent of standard dishwasher consumers and 5.4 percent of compact dishwasher consumers experience an LCC net cost. In addition, DOE is concerned that reducing energy and water use at TSL 4 without implementing significantly higher-cost technologies could result in the loss of certain consumer utility. Specifically, a substantially longer cycle time could be required to maintain cleaning performance. Therefore, DOE is concerned that TSL 4 may result in a loss of consumer utility.

At TSL 4, the projected change in INPV ranges from a decrease of $145.6 million to a decrease of $202.7 million, equivalent to 22.8 percent and 31.8 percent, respectively. Products that meet the efficiency standards specified by this TSL are forecast to represent less than 9 percent of shipments in the year leading up to amended standards. As such, manufacturers would have to redesign nearly all products by the 2018 compliance date to meet demand. Redesigning all units to meet the current max-tech efficiency levels would require considerable capital and product conversion expenditures. At TSL 4, the capital conversion costs total $226.3 million, 2.2 times the industry annual capital expenditure in the year leading up to amended standards. DOE estimates that complete platform redesigns would cost the industry $76.7 million in product conversion costs. These conversion costs largely relate to the research programs required to develop new products

that meet the efficiency standards set forth by TSL 4. These costs are equivalent to 1.6 times the industry annual budget for research and development. As such, the conversion costs associated with the changes in products and manufacturing facilities required at TSL 4 would require significant use of manufacturers' financial reserves (manufacturer capital pools), impacting other areas of business that compete for these resources and significantly reducing INPV. In addition, manufacturers could face a substantial impact on profitability at TSL 4. Because manufacturers are more likely to reduce their margins to maintain a price-competitive product at higher TSLs, DOE expects that TSL 4 would yield impacts closer to the high end of the range of INPV impacts. If the high end of the range of impacts is reached, as DOE expects, TSL 4 could result in a net loss of 31.8 percent in INPV to dishwasher manufacturers.

The Secretary concludes that at TSL 4 for residential dishwashers, the benefits of energy savings, water savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the economic burden on some consumers, the potential burden on all consumers from loss of product utility, and the impacts on manufacturers, including the conversion costs and profit margin impacts that could result in a large reduction in INPV. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3. TSL 3 would save 0.94 quads of energy and 0.56 trillion gallons of water, amounts DOE considers significant. Under TSL 3, the NPV of

consumer benefit would be $1.96 billion, using a discount rate of 7 percent, and $6.51 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 65 Mt of CO_2, 54 thousand tons of NO_X, and 0.274 ton of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 3 ranges from $278 million to $4,515 million.

At TSL 3, the average LCC impact is a savings of $41 for standard dishwashers and a savings of $52 for compact dishwashers. The median payback period is 6.6 years for standard dishwashers and 2.1 years for compact dishwashers. The fraction of consumers experiencing an LCC benefit is 50.4 percent for standard dishwashers and 44.4 percent for compact dishwashers. However, 29.7 percent of standard dishwasher consumers and 5.4 percent of compact dishwasher consumers experience an LCC net cost. In addition, DOE is concerned that reducing energy and water use at TSL 3 without implementing significantly higher-cost technologies could result in the loss of certain consumer utility. Specifically, a substantially longer cycle time could be required to maintain cleaning performance. Therefore, DOE is concerned that TSL 3 may result in significant loss of consumer utility.

At TSL 3, the projected change in INPV ranges from a decrease of $128.9 million to a decrease of $174.4 million, decreases of 20.2 percent and 27.4 percent, respectively. Products that meet the efficiency standards specified by this TSL represent less than 20 percent of shipments in the year leading up to amended standards. As such,

manufacturers would have to overhaul a significant fraction of products by the 2018 compliance date to meet demand. Redesigning significant component systems or developing entirely new platforms to meet the efficiency levels specified by this TSL would require considerable capital and product conversion expenditures. At TSL 3, the estimated capital conversion costs total $195.4 million, which is 1.9 times the industry annual capital expenditure in the year leading up to amended standards. DOE estimates that the redesigns necessary to meet these standards would cost the industry $66.5 million in product conversion costs. These conversion costs largely relate to the research programs required to develop products that meet the efficiency standards set forth by TSL 3, and are 1.4 times the industry annual budget for research and development in the year leading up to amended standards. As such, the conversion costs associated with the changes in products and manufacturing facilities required at TSL 3 would require significant use of manufacturers' financial reserves (manufacturer capital pools), impacting other areas of business that compete for these resources and significantly reducing INPV. Because manufacturers are more likely to reduce their margins to maintain a price-competitive product at higher TSLs, DOE expects that TSL 3 would yield impacts closer to the high end of the range of INPV impacts as indicated by the preservation of operating profit markup scenario. If the high end of the range of impacts is reached, as DOE expects, TSL 3 could result in a net loss of 27.4 percent in INPV to dishwasher manufacturers.

The Secretary concludes that at TSL 3 for residential dishwashers, the benefits of energy savings, water savings, positive NPV of consumer benefits, emission reductions,

and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the economic burden on some consumers, the potential burden on all consumers from loss of product utility, and the impacts on manufacturers, including the conversion costs and profit margin impacts that could result in a large reduction in INPV. Consequently, the Secretary has concluded that TSL 3 is not economically justified.

DOE then considered TSL 2. TSL 2 would save 0.07 quads of energy and 0.14 trillion gallons of water, amounts DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $0.08 billion, using a discount rate of 7 percent, and $0.46 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 4.06 Mt of CO_2, 3.54 thousand tons of NO_X, and 0.000 ton of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 2 ranges from $16 million to $242 million.

At TSL 2, the average LCC impact is a savings of $3 for standard dishwashers and a savings of $12 for compact dishwashers. The median payback period is 11.8 years for standard dishwashers and 0.3 years for compact dishwashers. While some consumers experience an LCC increase, this increase is very small in most cases.

At TSL 2, the projected change in INPV ranges from a decrease of $73.9 million to a decrease of $84.6 million, decreases of 11.6 percent and 13.3 percent, respectively. All dishwasher manufacturers currently produce products that meet the efficiency levels

specified at TSL 2. As such, this level corresponds more to incremental product conversions rather than the platform redesigns expected for TSL 3 and TSL 4. Products at or above the efficiency levels of TSL 2 represent nearly 64 percent of shipments in the year leading up to amended standards. As such, DOE believes that the scope of the redesigns necessary to meet TSL 2 by the 2013 compliance date greatly mitigates concerns over manufacturers' ability to redesign products and switch over the bulk of production in time to meet the amended standards by the compliance date (operational risk). DOE estimates that the improvements to manufacturing facilities necessary to meet these standards would cost the industry $59.1 million in capital conversion costs, over $130 million less than those incurred at TSL 3, and only 56 percent of the industry budget for capital expenditure in the year leading up to amended standards. TSL 2 will require an estimated 34.9 million in product conversion costs primarily relating to the research and development programs needed to improve upon existing platforms to meet the specified efficiency levels. This represents 72 percent of the industry budget for research and development in the year leading up to amended standards. The substantial reduction in conversion costs over those incurred at higher TSLs, coupled with the fact that many products currently meet the efficiency standards set forth by TSL 2, greatly mitigate the operational risk and impact on INPV.

The Secretary concludes that at TSL 2 for residential dishwashers, the benefits of energy savings, water savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would outweigh the

impacts on manufacturers, including the conversion costs that could result in a reduction in INPV for manufacturers.

In addition, the efficiency levels in TSL 2 correspond to the recommended levels in the Joint Petition, which DOE believes sets forth a statement by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered products, States, and efficiency advocates) and contains recommendations with respect to an energy conservation standard that are in accordance with 42 U.S.C. 6295(o). Moreover, DOE has encouraged the submission of consensus agreements as a way for diverse interested parties to develop an independent and probative analysis useful in DOE standard setting and to expedite the rulemaking process. DOE also believes that the standard levels recommended in the consensus agreement may increase the likelihood for regulatory compliance, while decreasing the risk of litigation.

After considering the analysis and the benefits and burdens of TSL 2, the Secretary concludes that this TSL will offer the maximum improvement in efficiency that is technologically feasible and economically justified, and will result in the significant conservation of energy. Therefore, DOE today adopts TSL 2 for residential dishwashers. The amended energy conservation standards for residential dishwashers, which are a maximum allowable annual energy use and maximum allowable per-cycle water consumption, are shown in Table V.21.

Table V.21 Amended Energy Conservation Standards for Residential Dishwashers

Product Class	Compliance Date: [INSERT DATE 1 YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]	
	Maximum Annual Energy Use*	Maximum Per-Cycle Water Consumption
1. Standard (≥8 place settings plus 6 serving pieces)	307 kWh/year	5.0 gallons/cycle
2. Compact (<8 place settings plus 6 serving pieces)	222 kWh/year	3.5 gallons/cycle

*Annual energy use, expressed in kilowatt-hours (kWh) per year, is calculated as: the sum of the annual standby electrical energy in kWh and the product of (1) the representative average dishwasher use cycles per year and (2) the sum of machine electrical energy consumption per cycle in kWh, the total water energy consumption per cycle in kWh, and, for dishwashers having a truncated normal cycle, the drying energy consumption divided by 2 in kWh. A truncated normal cycle is defined as the normal cycle interrupted to eliminate the power-dry feature after the termination of the last rinse option,

2. Summary of Benefits and Costs (Annualized) of the Standards

The benefits and costs of today's standards can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic value, expressed in 2010$, of the benefits from operating products that meet the proposed standards (consisting primarily of operating cost savings from using less energy and water, minus increases in product purchase costs, which is another way of representing consumer NPV), and (2) the monetary value of the benefits of emission reductions, including CO_2 emission reductions.[51] The value of the CO_2 reductions,

[51] 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 2012, the year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of 3 and 7 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 V.22. From the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in 2013, that yields the same present value. This payment includes benefits to consumers which accrue after 2047 from the dishwashers purchased from 2013 to 2047. Costs incurred by manufacturers, some of which may be incurred prior to 2013 in preparation for the rule, are indirectly included as part of incremental equipment costs. The extent of these costs and benefits depends on the projected price trends of dishwashers because consumer demand of dishwashers is a function of dishwasher prices. The fixed annual payment is the annualized value. Although DOE calculated annualized

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.

Although combining the values of operating savings and CO_2 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 SCC are performed with different methods that use quite different time frames for analysis. The national operating cost savings is measured for the lifetime of products shipped in 2013–2047. 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 carbon dioxide in each year. These impacts continue well beyond 2100.

Table V.22 shows the annualized values for residential dishwashers under TSL 2, expressed in 2010$. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reductions, for which DOE used a 3-percent discount rate along with the SCC series corresponding to a value of $22.3/ton in 2010 (in 2010$), the cost of the standards for dishwashers in today's rule is $46 million per year in increased equipment costs, while the annualized benefits are $53 million per year in reduced equipment operating costs, $3.9 million in CO_2 reductions, and $0.24 million in reduced NO_X emissions. In this case, the net benefit amounts to $11

values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

million per year. Using a 3-percent discount rate for all benefits and costs and the SCC series corresponding to a value of $22.3/ton in 2010 (in 2010$), the cost of the standards for dishwashers in today's rule is $44 million per year in increased equipment costs, while the benefits are $66 million per year in reduced operating costs, $3.9 million in CO_2 reductions, and $0.26 million in reduced NO_X emissions. In this case, the net benefit amounts to $27 million per year.

Table V.22 Annualized Benefits and Costs of Amended Standards (TSL 2) for Residential Dishwashers Sold in 2013–2047

	Discount Rate	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		Monetized (million 2010$/year)		
Benefits				
Operating Cost Savings	7%	53	48	59
	3%	66	59	75
CO_2 Reduction at $4.9/t**	5%	1.1	1.0	1.3
CO_2 Reduction at $22.3/t**	3%	3.9	3.5	4.7
CO_2 Reduction at $36.5/t**	2.5%	6.1	5.4	7.2
CO_2 Reduction at $67.6/t**	3%	12.0	10.8	14.2
NO_X Reduction at $2,537/t**	7%	0.24	0.23	0.27
	3%	0.26	0.24	0.30
Total†	7% plus CO_2 range	54 to 65	49 to 59	60 to 73
	7%	57	52	64
	3% plus CO_2 range	68 to 78	60 to 70	76 to 89
	3%	70	63	80
Costs				
Incremental Product Costs	7%	46	44	43
	3%	44	41	40
Total Net Benefits				
Total†	7% plus CO_2 range	8 to 19	6 to 16	17 to 30
	7%	11	8	20
	3% plus CO_2 range	24 to 35	19 to 29	37 to 49
	3%	27	22	40

* The results include benefits to consumers which accrue after 2047 from the dishwashers purchased from 2013 through 2047. Costs incurred by manufacturers, some of which may be incurred prior to 2013 in preparation for the rule, are not directly included, but are indirectly included as part of incremental equipment costs. The extent of the costs and benefits will depend on the projected price trends of dishwashers, as the consumer demand for dishwashers is a function of dishwasher prices. The Primary, Low Benefits, and High Benefits Estimates utilize forecasts of energy prices and housing starts from the AEO2011 Reference case, Low Estimate, and High Estimate, respectively. In addition, incremental product costs reflect a medium decline rate for projected product price trends in the Primary Estimate, a low decline rate for projected product price trends in the Low Benefits Estimate, and a high decline rate for projected product price trends in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.G.3.

** The CO_2 values represent global values (in 2010$) of the social cost of CO_2 emissions in 2010 under several scenarios. The values of $4.9, $22.3, and $36.5 per ton are the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The value of $67.6 per ton represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The value for NO_X (in 2010$) is the average of the low and high values used in DOE's analysis.

† Total Benefits for both the 3% and 7% cases are derived using the SCC value calculated at a 3% discount rate, which is $22.3/ton in 2010 (in 2010$). 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.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866 and Executive Order 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 home appliance 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 residential dishwashers 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 included these documents in the rulemaking record. The assessments prepared pursuant to Executive Order 12866 can be found in the technical support document for this rulemaking at http://www1.eere.energy.gov/buildings/appliance_standards/residential/dishwashers.html

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 explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (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.

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that today's direct final rule is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA, 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 website (www.gc.doe.gov).

DOE reviewed today's direct final rule and corresponding NOPR pursuant to the RFA and the policies and procedures discussed above. DOE certifies that the standards established in today's direct final rule and proposed in the NOPR, published elsewhere in today's Federal Register, will not have a significant impact on a substantial number of small entities. The factual basis for this certification is set forth below. DOE will consider any comments on the certification or economic impacts of the rule in determining whether to proceed with the direct final rule.

For manufacturers of residential dishwashers, 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, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (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: www.sba.gov/sites/default/files/Size_Standards_Table.pdf. Residential dishwasher manufacturing is classified under NAICS 335228, "Other Major Household Appliance Manufacturing." The SBA sets a threshold of 500 employees or less for an entity to be considered as a small business for this category.

To estimate the number of small businesses which could be impacted by the amended energy conservation standards, DOE conducted a market survey using all available public information to identify potential small manufacturers. DOE's research included the AHAM membership directory, product databases (CEE, CEC, and ENERGY STAR databases) and individual company websites to find potential small business manufacturers. DOE also asked interested parties and industry representatives if they were aware of any other small business manufacturers during manufacturer interviews and at previous DOE public meetings. DOE reviewed all publicly available data and contacted various companies, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered residential dishwashers. 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.

Almost half of residential dishwashers are currently manufactured in the United States by one corporation that accounts for approximately 49 percent of the total market. Together, this manufacturer and 3 other manufacturers that do not meet the definition of a small business manufacturer comprise 99 percent of the residential dishwasher market. The small portion of the remaining residential dishwasher market (approximately 57,000 shipments) is supplied by a combination of approximately 15 international and domestic companies, all of which have small market shares. These companies are either foreign owned and operated or exceed the SBA's employment threshold for consideration as a

small business under the appropriate NAICS code. Therefore, DOE did not identify any small business manufacturers of dishwashers.

Based on the discussion above, DOE certifies that the standards for residential dishwashers set forth in today's rule would not have a significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE will transmit this certification to the SBA as required by 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act

Manufacturers of residential dishwashers must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for dishwashers, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including residential dishwashers. (76 FR 12422 (March 7, 2011). 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 approved by OMB under OMB control number 1910-1400. 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.

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.

D. Review Under the National Environmental Policy Act of 1969

Pursuant to the National Environmental Policy Act (NEPA) of 1969, DOE has determined that today's rule fits within the category of actions included in Categorical Exclusion (CX) B5.1 and otherwise meets the requirements for application of a CX. *See* 10 CFR Part 1021, App. B, B5.1(b); 1021.410(b) and Appendix B, B(1)-(5). The rule fits within the category of actions because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, and for which none of the exceptions identified in CX B5.1(b) apply. Therefore, DOE has made a CX determination for this rulemaking, and DOE does not need to prepare an Environmental Assessment or Environmental Impact Statement for this rule. DOE's CX determination for this direct final rule is available at http://cxnepa.energy.gov.

E. Review Under Executive Order 13132

Executive Order 13132, "Federalism." 64 FR 43255 (Aug. 10, 1999) imposes certain requirements on Federal 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 direct final 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.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, "Civil Justice Reform," 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 direct final rule meets the relevant standards of Executive Order 12988.

G. 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. Pub. L. 104-4, sec. 201 (codified at 2 U.S.C. 1531). For an amended 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 "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. DOE's policy statement is also available at www.gc.doe.gov.

DOE has concluded that this direct final rule would likely require expenditures of $100 million or more on the private sector. Such expenditures may include: (1) investment in research and development and in capital expenditures by dishwasher manufacturers in the years between the direct final rule and the compliance date for the new standards, and (2) incremental additional expenditures by consumers to purchase higher-efficiency residential dishwashers, starting at the compliance date for the applicable standard.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the final 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 direct final rulemaking and the "Regulatory Impact Analysis" section of the TSD for this direct final 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(g)(1) and (10), and (o), today's direct final rule would establish energy conservation standards for residential dishwashers 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 direct final rule.

H. 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.

I. 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.

J. 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 Federal 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 direct final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any 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 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 concluded that today's regulatory action, which sets forth energy conservation standards for residential dishwashers, is not a significant energy action because the amended 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 direct final rule.

L. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy (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: www1.eere.energy.gov/buildings/appliance_standards/peer_review.html.

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule prior to its effective date. The report will state that it has been determined that the rule is not a "major rule" as defined by 5 U.S.C. 804(2).

VII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's direct final rule.

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, and Reporting and recordkeeping requirements.

10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Intergovernmental relations, and Small businesses.

Issued in Washington, DC, on May 11, 2012.

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Dr. David Danielson
Assistant Secretary of Energy
Energy Efficiency and Renewable Energy

For the reasons set forth in the preamble, DOE amends parts 429 and 430, of title 10 of the Code of Federal Regulations, to read as set forth below:

PART 429 - CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

2. In § 429.19 revise paragraph (b)(2) to read as follows:

§ 429.19 Dishwashers.

* * * * *

(b) * * *

(2) Pursuant to §429.12(b)(13), a certification report shall include the following public product-specific information: The estimated annual energy use in kilowatt hours per year (kWh/yr) and the water consumption in gallons per cycle.

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PART 430 - ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

3. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291-6309; 28 U.S.C. 2461 note.

4. In §430.32 add paragraph (f)(3) to read as follows:

§430.32 Energy and water conservation standards and their effective dates.

* * * * *

(f) * * *

(3) All dishwashers manufactured on or after **[INSERT DATE 1 YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, shall meet the following standard—

(i) Standard size dishwashers shall not exceed 307 kwh/year and 5.0 gallons per cycle.

(ii) Compact size dishwashers shall not exceed 222 kwh/year and 3.5 gallons per cycle.

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