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ENVIRONMENTAL ASSESSMENT FOR PROPOSED ENERGY CONSERVATION STANDARDS FOR DISTRIBUTION TRANSFORMERS

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE or Department) prepared this distribution transformers environmental assessment (EA) pursuant to the National Environmental Policy Act of 1969 (NEPA)(42 U.S.C. 4321 *et seq*.), the regulations of the Council on Environmental Quality (40 CFR parts 1500–1508), and the DOE's regulations for compliance with NEPA (10 CFR part 1021).

Title III of the Energy Policy and Conservation Act (EPCA) (42 U.S.C. 6291 *et seq*.) sets forth a variety of provisions designed to improve energy efficiency. Part C of title III (42 U.S.C. 6311–6317) establishes an energy-conservation program for "Certain Industrial Equipment" and includes distribution transformers, the subject of this EA. EPCA states that the Secretary of Energy shall prescribe testing requirements for those distribution transformers for which the Secretary makes a determination that energy conservation standards would be technologically feasible and economically justified, and would result in significant energy savings. Furthermore, the Secretary shall prescribe, by rule, energy conservation standards for those distribution transformers for which the Secretary prescribed testing requirements under the first statement. (42 U.S.C. 6317) There are no current mandatory national standards for distribution transformers in the United States.

On October 22, 1997, the Secretary of Energy issued a determination that "based on its analysis of the information now available, the Department has determined that energy conservation standards for transformers appear to be technologically feasible and economically justified, and are likely to result in significant savings." 62 FR 54809. The Secretary's determination was based, in part, on analyses conducted by the Department of Energy's Oak Ridge National Laboratory (ORNL). In July 1996, ORNL published a report entitled *Determination Analysis of Energy Conservation Standards for Distribution Transformers*, ORNL-6847,[1] which assessed options for setting energy conservation standards. That report was based on information from annual sales data, average load data, and surveys of existing and potential transformer efficiencies obtained from several organizations.

In September 1997, ORNL published a second report entitled *Supplement to the "Determination Analysis" (ORNL-6847) and Analysis of the NEMA Efficiency Standard for Distribution Transformers*, ORNL-6925.[2] This report assessed the suggested efficiency levels contained in the then-newly published National Electrical Manufacturers Association (NEMA) Standards Publication No. TP 1-1996, *Guide for Determining Energy Efficiency for Distribution Transformers*,[3] along with the efficiency levels previously considered by the Department in the determination study. The latest downloadable version of TP 1 is available at the NEMA website: http://www.nema.org/stds/tp1.cfm#download. In its supplemental assessment, ORNL used a more accurate analytical model and better transformer market and loading data developed following the publication of ORNL-6847. Downloadable versions of both ORNL reports are

available on the DOE website at:
http://www.eere.energy.gov/buildings/appliance_standards/commercial/dist_transformers.html

On July 29, 2004, the Department published the advance notice of proposed rulemaking (ANOPR) and its associated technical support document (TSD).[4] At the ANOPR public meeting on September 28, 2004, as well as during the formal comment period, the Department invited stakeholders to comment on the following issues: definition and coverage, product classes (PCs), engineering analysis inputs, design option combinations, the 0.75 scaling rule, modeling of transformer load profiles, distribution chain markups, discount rate selection and use, baseline determination through purchase evaluation formulae, electricity prices, load growth over time, life-cycle cost (LCC) subgroups, and utility deregulation impacts.

During the ANOPR comment period, which ended on November 9, 2004, stakeholders submitted comments on the 13 issues listed above as well as on other issues. Since then, the Department has updated its ANOPR-phase analyses, performed the notice of proposed rulemaking (NOPR)-phase analyses, selected its proposed standard level, and prepared the NOPR *Federal Register* document and the NOPR TSD[5] to document all of its analyses and the selection of its proposed standard.

The proposed distribution transformer efficiency standard affects customers and manufacturers of distribution transformers.

2.0 PURPOSE

Energy-efficiency standards for distribution transformers are expected to result in savings in electrical energy. The metric used to measure the efficiency of distribution transformers is percent efficiency, which is calculated by taking into account no-load losses (which are constant) and load losses (which vary by the square of the load) at a specified design load. An increase in the percent efficiency as measured above indicates that the distribution transformer is more energy-efficient. Details on the technical analysis of increased efficiency levels are provided in the TSD that accompanies DOE's NOPR for the proposed standard.

To analyze improvements in the efficiency of distribution transformers, DOE created six trial standard levels (TSLs):

TSL 1: The NEMA TP 1 standard level
TSL 2: 1/3 of difference between TP 1 and minimum LCC
TSL 3: 2/3 of difference between TP 1 and minimum LCC
TSL 4: Minimum LCC
TSL 5: Maximum energy savings with no change in LCC
TSL 6: Maximum energy savings

Of these six TSLs, DOE proposes TSL 2 as the standard level for both liquid-immersed and medium-voltage, dry-type transformers.[a] Tables EA.1 and EA.2 summarize the proposed standard levels for the liquid-immersed and medium-voltage, dry-type transformers.

Table EA.1 Proposed Standard Levels for Liquid-Immersed Distribution Transformers

Single-Phase Proposed Efficiency Level TSL2		**Three-Phase Proposed Efficiency Level TSL2**	
kVA	PC 1 Efficiency (%)	kVA	PC 2 Efficiency (%)
10	98.40	15	98.36
15	98.56	30	98.62
25	98.73	45	98.76
37.5	98.85	75	98.91
50	98.90	112.5	99.01
75	99.04	150	99.08
100	99.10	225	99.17
167	99.21	300	99.23
250	99.26	500	99.32
333	99.31	750	99.24
500	99.38	1000	99.29
667	99.42	1500	99.36
833	99.45	2000	99.40
		2500	99.44

Note: All efficiency values are at 50% of nameplate rated load, determined according to the DOE test procedure.

[a] Because the Energy Policy Act of 2005 established energy conservation standards for low-voltage, dry-type distribution transformers, the Department has removed this type of transformer from the NOPR stage of its analysis.

Table EA.2 Proposed Standard Levels for Medium-Voltage, Dry-Type Distribution Transformers

Single-Phase Proposed Efficiency Level TSL2				Three-Phase Proposed Efficiency Level TSL2			
kVA	PC5 20-45kV BIL (%)	PC7 46-95kV BIL (%)	PC9 ≥96kV BIL (%)	kVA	PC6 20-45kV BIL (%)	PC8 46-95kV BIL (%)	PC10 ≥96kV BIL (%)
15	98.10	97.86	-	15	97.50	97.19	-
25	98.33	98.12	-	30	97.90	97.63	-
37.5	98.49	98.30	-	45	98.10	97.86	-
50	98.60	98.42	-	75	98.33	98.12	-
75	98.73	98.57	98.53	112.5	98.49	98.30	-
100	98.82	98.67	98.63	150	98.60	98.42	-
167	98.96	98.83	98.80	225	98.73	98.57	98.53
250	99.07	98.95	98.91	300	98.82	98.67	98.63
333	99.14	99.03	98.99	500	98.96	98.83	98.80
500	99.22	99.12	99.09	750	99.07	98.95	98.91
667	99.27	99.18	99.15	1000	99.14	99.03	98.99
833	99.31	99.23	99.20	1500	99.22	99.12	99.09
				2000	99.27	99.18	99.15
				2500	99.31	99.23	99.20

Note: All efficiency values are at 50% of nameplate rated load, determined according to the DOE test procedure.

3.0 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

The Department analyzed seven alternative standards levels, consisting of the six TSLs identified in the NOPR and a no-action alternative. As discussed above, DOE's proposed action is to propose TSL 2. The seven alternatives are discussed below.

3.1 No-Action Alternative

Under a no-action alternative, DOE would not publish new minimum energy-efficiency standards for distribution transformers. The Department addresses the no-action alternative in the TSD, including the regulatory impact analysis (RIA), along with other non-regulatory policy cases and voluntary incentive programs. The RIA found that the no-action alternative would result in insufficient reductions in energy consumption as compared to other alternatives, including DOE's proposed action.

3.2 Proposed Action

The Department's proposed action is to adopt TSL 2 (as identified in Tables EA.1 and EA.2), which would result in national energy savings, reduced average LCC for consumers, a net national benefit (i.e., monetary savings to the Nation exceed increased equipment costs to the Nation), and air-borne emissions reductions. The proposed action would also result in a reduction in industry net present value, but DOE believes the amount is not significant. In the NOPR, DOE determined that the benefits of the proposed action outweighed its burdens and that the action is economically justified. The Department concluded that the proposed action would save a significant amount of energy and is technologically feasible. The proposed action goes into effect in the year 2010. Additional details on estimated impacts resulting from the proposed action and other TSLs are provided in the TSD.

3.3 Alternative Standards

This EA also presents the results of the environmental impacts from five other distribution transformer TSLs—besides those from DOE's proposed action (TSL 2). Each TSL is an alternative action, which DOE compared with the no-action alternative. (In the no-action alternative, also referred to as the base case, no new amended standards are proposed.) TSL 1 is less stringent than DOE's proposed action (TSL 2), while TSLs 3, 4, 5, and 6 are more stringent than TSL 2. Each TSL has a unique combination of efficiency levels associated with it. Tables EA.3 through EA.10 show each TSL, including DOE's proposed action, by product class.

Some of the critical underlying assumptions of the engineering analysis are the creation of the design lines, the selection of the representative units (shown in the first column in the following tables), and the use of the 0.75 scaling rule to extrapolate findings on the representative unit to other kilovolt-ampere (kVA) ratings within the same design line. The Department created the design lines to better classify the distribution transformer voltage classes (basic impulse insulation level (BIL) groupings) and, explicitly, to minimize the error from scaling. Similarly, the Department subdivided some of the product classes into different design lines, so the kVA rating of the representative unit would not be scaled more than an order of magnitude up or down in a given design line. It took both of these steps to mitigate any error from scaling, and to provide a more robust analytical foundation for the standards. Details regarding the design lines are found in chapter 5 of the TSD.

Table EA.3 Trial Standard Levels for PC 1 Distribution Transformers

Product Class 1		Liquid-Immersed, Medium-Voltage, Single-Phase Transformers							
		TSL							
		0		1	2	3	4	5	6
Design Line	kVA	Ave. Base Case Eff.	Min. Base Case Eff.	TP 1	1/3 of Diff between TP 1 and Min LCC	2/3 of Diff between TP 1 and Min LCC	Min LCC	Max Energy Savings with No Change in LCC	Max Energy Savings
	10	98.42	97.77	98.4	98.40	98.44	98.48	98.69	99.32
	15	98.57	97.99	98.6	98.56	98.59	98.63	98.82	99.39
DL2	25	98.74	98.23	98.7	98.73	98.76	98.79	98.96	99.46
	37.5	98.86	98.40	98.8	98.85	98.88	98.91	99.06	99.51
DL1	50	98.97	98.56	98.9	98.90	98.90	99.04	99.19	99.59
	75	99.04	98.66	99.0	99.04	99.06	99.08	99.21	99.59
	100	99.11	98.75	99.0	99.10	99.12	99.14	99.26	99.62
	167	99.22	98.90	99.1	99.21	99.23	99.25	99.35	99.66
	250	99.24	98.89	99.2	99.26	99.36	99.45	99.69	99.70
	333	99.29	98.97	99.2	99.31	99.40	99.49	99.71	99.72
DL3	500	99.36	99.07	99.3	99.38	99.46	99.54	99.74	99.75
	667	99.40	99.13	99.4	99.42	99.50	99.57	99.76	99.77
	833	99.44	99.18	99.4	99.45	99.52	99.60	99.77	99.78

Table EA.4 Trial Standard Levels for PC 2 Distribution Transformers

Product Class 2		Liquid-Immersed, Medium-Voltage, Three-Phase Transformers							
		TSL							
		0		1	2	3	4	5	6
Design Line	kVA	Ave. Base Case Eff.	Min. Base Case Eff,	TP 1	1/3 of Diff between TP 1 and Min LCC	2/3 of Diff between TP 1 and Min LCC	Min LCC	Max Energy Savings with No Change in LCC	Max Energy Savings
	15	98.06	97.19	98.1	98.36	98.68	98.68	99.25	99.31
	30	98.37	97.64	98.4	98.62	98.89	98.89	99.37	99.42
	45	98.53	97.87	98.6	98.76	99.00	99.00	99.43	99.47
	75	98.70	98.12	98.7	98.91	99.12	99.12	99.50	99.54
	112.5	98.83	98.30	98.8	99.01	99.20	99.20	99.55	99.58
DL4	150	98.91	98.42	98.9	99.08	99.26	99.26	99.58	99.61
	225	99.02	98.57	99.0	99.17	99.33	99.33	99.62	99.65
	300	99.08	98.67	99.0	99.23	99.38	99.38	99.65	99.67
	500	99.19	98.83	99.1	99.32	99.45	99.45	99.69	99.71
	750	99.24	98.97	99.2	99.24	99.31	99.37	99.66	99.66
	1000	99.29	99.04	99.2	99.29	99.36	99.41	99.68	99.68
DL5	1500	99.36	99.13	99.3	99.36	99.42	99.47	99.71	99.71
	2000	99.40	99.19	99.4	99.40	99.46	99.51	99.73	99.73
	2500	99.44	99.23	99.4	99.44	99.49	99.53	99.74	99.74

Table EA.5 Trial Standard Levels for PC 5 Distribution Transformers

Product Class 5		Dry-Type, Medium-Voltage, Single-Phase Transformers (20-45 kV BIL)							
		TSL							
		0		1	2	3	4	5	6
Design Line	kVA	Ave. Base Case Eff.	Min. Base Case Eff.	TP 1	1/3 of Diff between TP 1 and Min LCC	2/3 of Diff between TP 1 and Min LCC	Min LCC	Max Energy Savings with No Change in LCC	Max Energy Savings
	15	98.02	97.45	97.6	98.10	98.46	98.81	99.05	99.05
	25	98.26	97.75	97.9	98.33	98.64	98.95	99.17	99.17
	37.5	98.43	97.97	98.1	98.49	98.77	99.05	99.25	99.25
	50	98.54	98.11	98.2	98.60	98.86	99.12	99.30	99.30
	75	98.68	98.29	98.4	98.73	98.97	99.20	99.37	99.37
DL9	100	98.77	98.41	98.5	98.82	99.04	99.26	99.41	99.41
	167	98.92	98.60	98.8	98.96	99.16	99.35	99.48	99.48
	250	99.01	98.56	98.9	99.05	99.17	99.27	99.42	99.42
	333	99.08	98.66	99.0	99.11	99.23	99.32	99.46	99.46
DL10	500	99.17	98.79	99.1	99.20	99.30	99.39	99.51	99.51
	667	99.23	98.87	99.2	99.26	99.35	99.43	99.54	99.54
	833	99.27	98.93	99.2	99.30	99.38	99.46	99.57	99.57

Table EA.6 Trial Standard Levels for PC 6 Distribution Transformers

Product Class 6		Dry-Type, Medium-Voltage, Three-Phase Transformers (20-45 kV BIL)							
		TSL							
		0		1	2	3	4	5	6
Design Line	kVA	Ave. Base Case Eff.	Min. Base Case Eff.	TP 1	1/3 of Diff between TP 1 and Min LCC	2/3 of Diff between TP 1 and Min LCC	Min LCC	Max Energy Savings with No Change in LCC	Max Energy Savings
	15	97.40	96.64	96.8	97.50	97.97	98.44	98.75	98.75
	30	97.81	97.17	97.3	97.90	98.29	98.68	98.95	98.95
	45	98.02	97.45	97.6	98.10	98.46	98.81	99.05	99.05
	75	98.26	97.75	97.9	98.33	98.64	98.95	99.17	99.17
	112.5	98.43	97.97	98.1	98.49	98.77	99.05	99.25	99.25
	150	98.54	98.11	98.2	98.60	98.86	99.12	99.30	99.30
	225	98.68	98.29	98.4	98.73	98.97	99.20	99.37	99.37
DL9	300	98.77	98.41	98.6	98.82	99.04	99.26	99.41	99.41
	500	98.92	98.60	98.8	98.96	99.16	99.35	99.48	99.48
	750	99.01	98.56	98.9	99.05	99.17	99.27	99.42	99.42
	1000	99.08	98.66	99.0	99.11	99.23	99.32	99.46	99.46
DL10	1500	99.17	98.79	99.1	99.20	99.30	99.39	99.51	99.51
	2000	99.23	98.87	99.2	99.26	99.35	99.43	99.54	99.54
	2500	99.27	98.94	99.2	99.30	99.38	99.46	99.57	99.57

Table EA.7 Trial Standard Levels for PC 7 Distribution Transformers

Product Class 7		Dry-Type, Medium-Voltage, Single-Phase Transformers (46-95 kV BIL)							
		TSL							
		0		1	2	3	4	5	6
Design Line	kVA	Ave. Base Case Eff.	Min. Base Case Eff.	TP 1	1/3 of Diff between TP 1 and Min LCC	2/3 of Diff between TP 1 and Min LCC	Min LCC	Max Energy Savings with No Change in LCC	Max Energy Savings
	15	97.46	96.87	97.6	97.86	98.14	98.41	98.54	98.54
	25	97.77	97.24	97.9	98.12	98.36	98.60	98.71	98.71
	37.5	97.98	97.51	98.1	98.30	98.52	98.73	98.84	98.84
	50	98.12	97.68	98.2	98.42	98.62	98.82	98.92	98.92
	75	98.30	97.90	98.4	98.57	98.75	98.94	99.02	99.02
DL11	100	98.42	98.05	98.5	98.67	98.84	99.01	99.09	99.09
	167	98.61	98.28	98.8	98.83	98.98	99.13	99.20	99.20
	250	99.02	98.58	98.9	98.95	99.08	99.23	99.42	99.42
	333	99.09	98.68	99.0	99.03	99.15	99.28	99.46	99.46
DL12	500	99.18	98.81	99.1	99.12	99.23	99.35	99.51	99.51
	667	99.24	98.89	99.2	99.18	99.28	99.40	99.54	99.54
	833	99.28	98.95	99.2	99.23	99.32	99.43	99.57	99.57

Note: Because the representative units for both of the underlying DLs for PC 7 (DL 11 and DL 12) were 95 kV BIL, for kVA ratings from 167 through 833, the value in the “TP 1” column is the NEMA TP 1 value for >60 kV BIL.

Table EA.8 Trial Standard Levels for PC 8 Distribution Transformers

Product Class 8		Dry-Type, Medium-Voltage, Three-Phase Transformers (46-95 kV BIL)							
		TSL							
		0		1	2	3	4	5	6
Design Line	kVA	Ave. Base Case Eff.	Min. Base Case Eff.	TP 1	1/3 of Diff between TP 1 and Min LCC	2/3 of Diff between TP 1 and Min LCC	Min LCC	Max Energy Savings with No Change in LCC	Max Energy Savings
	15	96.66	95.88	96.8	97.19	97.55	97.91	98.08	98.08
	30	97.19	96.53	97.3	97.63	97.94	98.24	98.38	98.38
	45	97.46	96.87	97.6	97.86	98.14	98.41	98.54	98.54
	75	97.77	97.24	97.9	98.12	98.36	98.60	98.71	98.71
	112.5	97.98	97.51	98.1	98.30	98.52	98.73	98.84	98.84
	150	98.12	97.68	98.2	98.42	98.62	98.82	98.92	98.92
	225	98.30	97.90	98.4	98.57	98.75	98.94	99.02	99.02
DL11	300	98.42	98.05	98.5	98.67	98.84	99.01	99.09	99.09
	500	98.61	98.28	98.8	98.83	98.98	99.13	99.20	99.20
	750	99.02	98.58	98.9	98.95	99.08	99.23	99.42	99.42
	1000	99.09	98.68	99.0	99.03	99.15	99.28	99.46	99.46
DL12	1500	99.18	98.81	99.0	99.12	99.23	99.35	99.51	99.51
	2000	99.24	98.89	99.2	99.18	99.28	99.40	99.54	99.54
	2500	99.28	98.95	99.2	99.23	99.32	99.43	99.57	99.57

Note: Because the representative units for both of the underlying DLs for PC 8 (DL 11 and DL 12) were 95 kV BIL, for kVA ratings from 300 through 2500, the value in the “TP 1”column is the NEMA TP 1 value for >60 kV BIL.

Table EA.9 Trial Standard Levels for PC 9 Distribution Transformers

Product Class 9		Dry-Type, Medium-Voltage, Single-Phase Transformers (≥96 kV BIL)							
		TSL							
		0		1	2	3	4	5	6
Design Line	kVA	Ave. Base Case Eff.	Min. Base Case Eff.	TP 1	1/3 of Diff between TP 1 and Min LCC	2/3 of Diff between TP 1 and Min LCC	Min LCC	Max Energy Savings with No Change in LCC	Max Energy Savings
	75	98.72	98.22	98.4	98.53	98.79	99.05	99.22	99.22
	100	98.81	98.34	98.5	98.63	98.88	99.12	99.28	99.28
	167	98.95	98.54	98.7	98.80	99.01	99.22	99.36	99.36
	250	99.05	98.68	98.8	98.91	99.11	99.30	99.42	99.42
	333	99.12	98.77	98.9	98.99	99.17	99.35	99.46	99.46
	500	99.20	98.89	99.0	99.09	99.25	99.41	99.52	99.52
DL13	667	99.26	98.97	99.0	99.15	99.30	99.45	99.55	99.55
	833	99.30	99.03	99.1	99.20	99.34	99.48	99.57	99.57

Table EA.10 Trial Standard Levels for PC 10 Distribution Transformers

Product Class 10		Dry-Type, Medium-Voltage, Three-Phase Transformers (≥96 kV BIL)							
		TSL							
		0		1	2	3	4	5	6
Design Line	kVA	Ave. Base Case Eff.	Min. Base Case Eff.	TP 1	1/3 of Diff between TP 1 and Min LCC	2/3 of Diff between TP 1 and Min LCC	Min LCC	Max Energy Savings with No Change in LCC	Max Energy Savings
	225	98.72	98.22	98.4	98.53	98.79	99.05	99.22	99.22
	300	98.81	98.34	98.5	98.63	98.88	99.12	99.28	99.28
	500	98.95	98.54	98.7	98.80	99.01	99.22	99.36	99.36
	750	99.05	98.68	98.8	98.91	99.11	99.30	99.42	99.42
	1000	99.12	98.78	98.9	98.99	99.17	99.35	99.46	99.46
	1500	99.20	98.89	99.0	99.09	99.25	99.41	99.52	99.52
DL13	2000	99.26	98.97	99.0	99.15	99.30	99.45	99.55	99.55
	2500	99.30	99.03	99.1	99.20	99.34	99.48	99.57	99.57

4.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 Geography

The distribution transformer standard that DOE has proposed (TSL 2) would apply to all 50 States and United States territories.

4.2 Air Resources

The primary focus of the EA is the effect of proposed efficiency standards on air resources. For this analysis, the EA used a variant of the DOE Energy Information Administration (EIA)'s National Energy Modeling System (NEMS), called NEMS-BT (BT is DOE's Building Technologies Program).[a] As described in section 4.2.1 below, the environmental analysis is similar to the utility impact analysis described in Chapter 13 of the

[a] The EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data. Because this analysis entails some minor code modifications and the model is run under various policy scenarios that are variations on DOE/EIA assumptions, DOE refers to it as NEMS-BT. NEMS-BT was previously called NEMS-BRS.

TSD.[5] Outputs of the environmental analysis are in a format similar to the results of the EIA's *Annual Energy Outlook 2005 (AEO2005)*.[6]

For each of the energy-efficiency standard levels, DOE calculated total power-sector emissions based on output from NEMS-BT. The EA considers three pollutants, nitrogen oxides (NO_x), mercury (Hg), and sulfur dioxide (SO_2), and one emission, carbon dioxide (CO_2). An air pollutant is any substance in the air that can cause harm to humans or the environment. Pollutants may be natural or man-made and may take the form of solid particles, liquid droplets, or gases. The Clean Air Act Amendments of 1990 list 188 toxic air pollutants that the U.S. Environmental Protection Agency (EPA) is required to control. The EPA has set national air-quality standards for six common pollutants (also referred to as "criteria" pollutants), two of which are SO_2 and NO_x. Also, the Clean Air Act Amendments of 1990 gave authority to EPA to control acidification and to require operators of electric power plants to reduce emissions of SO_2 and NO_x. In addressing SO_2 emissions, the Clean Air Act Amendments of 1990 set an SO_2 emissions cap on all power generation, but permitted flexibility among generators through the use of emissions allowances and tradable permits. This SO_2 trading implies that physical emissions effects of a standard will be zero because emissions will always be at, or near, the allowed ceiling. Consequently, there is no direct SO_2 environmental benefit from electricity conservation, as long as there is enforcement of the emissions ceiling. But to the extent reduced power generation demand decreases the demand for and price of emissions allowance permits, there is an environmentally related economic benefit from standards reducing SO_2 emissions allowance demand.

Carbon dioxide is of interest because of its classification as a greenhouse gas and its impact on global climate change. Greenhouse gases—which trap the sun's radiation inside the Earth's atmosphere—either occur naturally in the atmosphere or result from human activities. Naturally occuring greenhouse gases include water vapor, CO_2, methane (CH_4), nitrous oxide, and ozone. Human activities, however, add to the levels of most of these naturally occurring gases. For example, CO_2 is emitted to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), wood, and wood products are burned. During the past 20 years, about three-quarters of anthropogenic (i.e., human-made) CO_2 emissions resulted from burning fossil fuels. Concentrations of CO_2 in the atmosphere are naturally regulated by numerous processes, collectively known as the "carbon cycle." The movement of carbon between the atmosphere and the land and oceans is dominated by natural processes, such as plant photosynthesis. While these natural processes can absorb some of the anthropogenic CO_2 emissions produced each year, billions of metric tons are added to the atmosphere annually. The Earth's positive imbalance between emissions and absorption results in the continuing growth in greenhouse gases in the atmosphere, thereby causing surface air temperatures and sub-surface ocean temperatures to rise. The U.S. CO_2 emissions from both energy consumption and industrial processes account for 84.6 percent of total U.S. greenhouse gas emissions.[7]

4.2.1 Assumptions

The Department conducted the EA as a policy deviation from the typical meteorological year (TMY) System Load Reference Case, a modified *AEO2005 Reference Case,* using the same basic set of assumptions. The emissions characteristics of all electricity-generating plants are exactly as those used in *AEO2005*. The TMY System Load Reference Case and alternative growth scenarios are as described in the utility impact analysis of the TSD (Chapter 13). The Department derived the environmental impacts of the proposed standard using the same higher decrement, double-decrement approach described in the utility impact analysis.

As in the utility impact analysis, the Department substituted the default NEMS system load with a system load that represents weather conditions for a TMY—here referred to as the TMY system load. As a result, the reference case used to judge the impacts from a proposed distribution transformer standard is no longer an exact replication of the *AEO2005* Reference Case and is therefore referred to as the TMY System Load Reference Case.

The EA also includes a sensitivity analysis for the proposed standard level, using the High and Low Economic Growth scenarios of NEMS-BT. As described in Chapter 13 of the TSD, these scenarios cover a range of macro-economic growth assumptions.

4.2.2 Methods

***CO_2*.** The NEMS-BT tracks CO_2 emissions using a detailed CO_2 module that features broad coverage of all sectors and includes interactive effects. Past experience with NEMS-generated CO_2 emissions suggests estimates are somewhat lower than estimates based on simple average factors. One of the reasons for this divergence is that NEMS tends to predict that conservation displaces more-efficient generating capacity in the later years of its forecast.

***Power Sector NO_x and Hg*.** The NEMS-BT reports the two airborne pollutant emissions that the Department has considered in past analyses, SO_2 and NO_x and now also reports Hg emissions. The NEMS-BT estimates NO_x and Hg emissions from power generation by assuming that the power sector conforms to all pre-2005 legislation and regulations with respect to monitoring power facility development, retrofitting, and dispatch, including potential installations of emissions-reducing equipment (i.e., scrubbers). Three recent regulatory actions proposed by the EPA—regarding (1) regulations and guidelines for best-available retrofit technology determinations, (2) the reduction of interstate transport of fine particulate matter and ozone—are tending toward further NO_x reductions and has lead to an emissions cap on NO_x for the Eastern United States. 69 FR 25184 (May 5, 2004), 69 FR 32684 (June 10, 2004), and 70 FR 25162 (May 12, 2005), and (3) the recent promulgation of the mercury emissions rule has resulted in a cap on Hg emissions 70 FR 28606 (May 18, 2005). As with SO_2 emissions, a cap on NO_x and Hg emissions will possibly result in no physical emissions effects from equipment efficiency standards, but reduced power generation demand will have the benefit of generating net emissions allowance credits relative to a base case of no energy conservation standard. The Department reports NO_x and Hg emissions reductions in a future scenario without emissions caps. The Department assumes that under emissions cap regulation, the reduction in power generation demand results in the creation of an equivalent amount of net emissions allowance credits.

Power Sector SO_2. As explained above, accurate simulation of SO_2 trading tends to imply that physical emissions effects will be zero, as long as emissions are at the allowed ceiling. Because SO_2 has been regulated with emissions caps for more than a decade, and no emissions reductions are reported from the NEMS-BT forecast model, DOE does not report SO_2 results here.

Fuel-Cycle Emissions. Fuel-cycle emissions refer to the emissions associated with the amount of energy used in the upstream production and downstream consumption of electricity, including energy used at the power plant. Upstream processes include the mining of coal or extraction of natural gas, physical preparatory and cleaning processes, and transportation to the power plant. The NEMS-BT does a thorough accounting of emissions at the power plant due to downstream energy consumption, but does not account for upstream emissions (i.e., emissions from energy losses during coal and natural gas production). Thus, this EA reports only power plant emissions.

Interpolation. Because the energy savings from distribution transformer standards are too small to produce stable power sector results in NEMS-BT, the Department estimated results for the TSLs using interpolation. To run a simulation in NEMS-BT, the system electricity load and commercial demand use are reduced annually according to the energy savings estimated by the national energy savings (NES) Spreadsheet Model (see Chapter 10 of the TSD) for each TSL. These energy savings increase over time. The magnitude of the energy decrement that would be required for NEMS-BT to produce stable results out of the range of numerical noise is greater than the highest standard level under consideration. Therefore, to estimate results for the TSLs considered here, DOE carried out a series of NEMS-BT runs using higher values for the input energy savings. These runs established the relationship between the NEMS-BT outputs (e.g., installed capacity reductions, emissions reductions) and the energy savings inputs. The Department then obtained results for energy savings corresponding to the TSLs using linear interpolation.

The Department then used the estimated reduction in total fuel generation at each TSL, as determined by interpolation, to determine emissions savings. First, it calculated annual marginal emissions rates for each of the simulations in each standard level, based on the actual output from NEMS-BT. Marginal emissions rates incorporate both effects of the standards—the emissions saved by the reduction in total generation, and the slight change in the emissions characteristics of the whole power sector that result from the slight change in dispatch and capacity expansion plan. The net effect on the entire system is very small and, typically, the overall effect on emissions can be fully attributed to the reduced generation capacity. The Department could then determine annual marginal emissions rates at the trial standard level from these rates (at multipliers of the TSL savings), by taking a simple average.

Extrapolation. The current time horizon of NEMS-BT is 2025 (modeling a 15-year period, 2010–2025); however, other parts of the distribution transformer rulemaking analysis extend to 2038. To address this disparity, the Department developed an adjunct version of the NEMS model called NEMS-BT2 that is capable, although in limited form, of modeling out to year 2050. As with the *AEO2005* Reference Case in general, the implicit assumption is that the regulatory environment does not change from the current, known situation during the extrapolation period. Only changes that have been announced with date-certain introduction are included in NEMS-BT. The NEMS-BT2 2050 extension model, based on the 2004 version of NEMS-BT, was developed by OnLocation, Inc., under a subcontract to the Department. Extensive code and input file changes were required to allow NEMS-BT2 to run to 2050, unfortunately rendering it impossible to extend the 2005 version. Therefore, the Department used the 2005 version of NEMS-BT to conduct the analysis through 2025 and the 2004 NEMS-BT2 2050 extension to conduct the analysis from 2026 to 2038. Some assumptions and adjustments were required to ease the transition from year 2025 to 2026, thereby removing the inherent differences between these two versions of the model (see Appendix 13A for a detailed discussion). To emphasize the extrapolated results in tables where they appear, DOE has shaded them in grey to distinguish them from the TMY System Load Reference Case 2010–2025 NEMS-BT results.

4.3 Socioeconomics

As part of the rulemaking process, DOE evaluated the socioeconomic effect on small businesses, especially small manufacturers, a subgroup that DOE identified as possibly being disproportionately affected by a national standard level. Converting from a company's current basic product line involves designing, prototyping, testing, and manufacturing a new product. These tasks have associated capital investments and product conversion expenses. Small businesses, because of their limited access to capital and their need to spread product conversion expenses over smaller production volumes, may be affected more negatively than major manufacturers by an energy-conservation standard. For these reasons, the Department specifically evaluated the impacts on small businesses from an energy-conservation standard. Chapter 12 of the TSD provides more details on the manufacturer subgroup analysis.

4.4 Environmental Justice

The Department considered environmental justice, pursuant to the Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The Executive Order requires Federal agencies to assess whether a proposed Federal action causes any disproportionately high and adverse human health or environmental effects on low-income or minority populations.

4.5 Energy Consumption

The Department used a detailed shipments and NES Spreadsheet Model to determine national energy savings as a result of increases in the minimum efficiency standard. This spreadsheet model forecasts the national shipments and energy use of distribution transformers with and without new standards. The shipments and NES analyses are described in detail in TSD Chapters 9 and 10, respectively.

4.6 Noise and Aesthetics

The Department considered how new energy conservation standards for distribution transformers may affect the noise and aesthetics of the equipment. To improve the efficiency of distribution transformers, increased amounts of heavier materials (e.g., steel) may be used that can enlarge the size of the equipment. The Department reviewed these components and determined if noise and aesthetics were impacted.

5.0 ENVIRONMENTAL IMPACTS

5.1 Air Quality/Emissions Impacts

5.1.1 Power Sector Emissions

The results for the environmental analysis are similar to a complete NEMS run as published in the *AEO2005*, and include power sector emissions for NO_x, Hg and CO_2 in five-year forecast increments, extrapolated to the year 2038 for a regulatory scenario where none of the three emissions are subject to regulatory caps. The Department reports the outcome of the analysis for each TSL as a deviation from the TMY System Load Reference Case. This is also referred to as the base case.

As discussed in section 4.2, the Clean Air Act Amendments of 1990 set an SO_2 emissions cap on all power generation, but permitted flexibility among generators through the use of emissions allowances and tradable permits. Moreover, SO_2 trading implies that physical emissions effects of a standard will be zero because emissions will always be at, or near, the ceiling. Consequently, there is virtually no physical SO_2 environmental benefit from electricity conservation as long as there is enforcement of the emissions ceiling. Even though there is no physical environmental benefit from proposed standards, there are potential environmental economic benefits. Given reduced demand for coal generation, there is reduced demand for SO_2 emission allowances and this lowers the allowance price and traded allowance volume..

NEMS-BT in its forecast implements the SO_2 emissions caps, but is not able to estimate changes in emissions allowance prices or volumes, nor can it calculate emissions cap compliance investments and expenses. Thus, the Department did not report these quantities.

For power sector CO_2, Hg and NO_x emissions, NEMS-BT calculated emissions impacts under an un-capped scenario. Since Hg and NOx emissions shall comply with emissions caps in the future, these emissions estimates correspond to emissions allowances that power producers will not have to generate in future cap and trade emissions allowance markets.

Tables EA.11 through EA.15 show annual total power sector CO_2, Hg and NO_x emissions for the various distribution transformer TSLs for each superclass. The liquid-immersed and dry-type, medium-voltage classes consider six TSLs, while the dry-type, low-voltage superclass focuses only on TSL 1.[a] Annual CO_2, Hg and NO_x emissions reductions are the highest for liquid-immersed TSL 6 and are the lowest for dry-type, medium-voltage TSL 1. The annual CO_2 emissions reductions are 22.5 million metric tons per annum (Mt/a) in 2025 for liquid-immersed TSL 6, the strictest standard under consideration. In the same year, NO_x emissions reductions are 5.6 kilo metric tons per annum (kt/a) for the same TSL and Hg emissions are 0.5 metric tons per annum (t/a). Tables EA.16 through EA.18 show the results for the cumulative emissions reductions through 2025 and 2038 for CO_2, Hg and NO_x.

The results for the Low and High Economic Growth cases for the proposed standard of each product class are also shown in Tables EA.16 through EA.18. The differences between the reference and sensitivity cases are due to changes in the macroeconomic assumptions of NEMS-BT.

[a] The Energy Policy Act of 2005 set energy conservation standards for low-voltage, dry-type distribution transformers at TP 1, which is equivalent to TSL 1.

Table EA.11 Power Sector Emissions for Liquid-Immersed Transformer Trial Standard Levels

NEMS-BT Results										Difference from AEO2005 Reference with TMY System Load									
	2000	2005	2010	2015	2020	2025	2030	2035	2038		2000	2005	2010	2015	2020	2025	2030	2035	2038
AEO2005 Reference Case with TMY System Load																	Extrapolation		
CO_2 (Mt/a)[1,3]	2,283.0	2,372.0	2,624.0	2,800.0	3,024.0	3,312.0	3,493.0	3,684.0	3,812.0										
NOx (kt/a)[2,3]	4,681.1	3,338.4	3,637.8	3,737.6	3,810.2	3,900.9	3,338.6	3,356.8	3,393.1										
Hg (t/a)[2,3]	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.8	57.8										
Trial Standard Level 1 Liquid																			
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,798.1	3,021.0	3,307.9	3,487.6	3,677.1	3,804.3	CO_2 (Mt/a)	0.0	0.0	0.0	-1.9	-3.0	-4.1	-5.4	-6.9	-7.7
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,736.6	3,809.4	3,899.9	3,337.3	3,355.0	3,391.1	NOx (kt/a)	0.0	0.0	0.0	-1.0	-0.8	-1.0	-1.4	-1.7	-1.9
Hg (t/a)	50.7	52.7	53.7	54.6	54.2	55.5	54.9	55.6	57.5	Hg (t/a)	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.3
Trial Standard Level 2 Liquid																			
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,797.4	3,020.0	3,306.5	3,485.7	3,674.6	3,801.6	CO_2 (Mt/a)	0.0	0.0	0.0	-2.6	-4.0	-5.5	-7.3	-9.4	-10.4
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,736.3	3,809.1	3,899.5	3,336.8	3,354.4	3,390.5	NOx (kt/a)	0.0	0.0	0.0	-1.3	-1.0	-1.4	-1.8	-2.4	-2.6
Hg (t/a)	50.7	52.7	53.7	54.6	54.1	55.5	54.9	55.5	57.5	Hg (t/a)	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.3
Trial Standard Level 3 Liquid																			
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,796.6	3,018.7	3,304.8	3,483.5	3,671.9	3,798.6	CO_2 (Mt/a)	0.0	0.0	0.0	-3.4	-5.3	-7.2	-9.5	-12.1	-13.4
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,735.8	3,808.8	3,899.1	3,336.2	3,353.7	3,389.7	NOx (kt/a)	0.0	0.0	0.0	-1.8	-1.4	-1.8	-2.4	-3.0	-3.4
Hg (t/a)	50.7	52.7	53.7	54.6	54.1	55.4	54.8	55.5	57.5	Hg (t/a)	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.3	-0.3
Trial Standard Level 4 Liquid																			
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,796.1	3,018.0	3,303.9	3,482.2	3,670.3	3,796.8	CO_2 (Mt/a)	0.0	0.0	0.0	-3.9	-6.0	-8.1	-10.8	-13.7	-15.2
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,735.6	3,808.6	3,898.9	3,335.9	3,353.3	3,389.2	NOx (kt/a)	0.0	0.0	0.0	-2.0	-1.5	-2.0	-2.7	-3.4	-3.8
Hg (t/a)	50.7	52.7	53.7	54.6	54.1	55.4	54.8	55.5	57.4	Hg (t/a)	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.3	-0.4
Trial Standard Level 5 Liquid																			
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,792.6	3,012.5	3,296.3	3,472.1	3,657.2	3,782.3	CO_2 (Mt/a)	0.0	0.0	0.0	-7.4	-11.5	-15.7	-20.9	-26.8	-29.7
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,733.8	3,807.2	3,897.0	3,333.4	3,350.1	3,385.6	NOx (kt/a)	0.0	0.0	0.0	-3.8	-3.0	-3.9	-5.2	-6.7	-7.4
Hg (t/a)	50.7	52.7	53.7	54.6	54.0	55.2	54.8	55.5	57.4	Hg (t/a)	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.2	-0.3	-0.4
Trial Standard Level 6 Liquid																			
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,789.3	3,007.4	3,289.5	3,463.0	3,645.7	3,769.6	CO_2 (Mt/a)	0.0	0.0	0.0	-10.7	-16.6	-22.5	-30.0	-38.3	-42.4
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,732.1	3,805.9	3,895.2	3,331.1	3,347.2	3,382.4	NOx (kt/a)	0.0	0.0	0.0	-5.5	-4.3	-5.6	-7.5	-9.6	-10.6
Hg (t/a)	50.7	52.7	53.6	54.5	53.9	55.1	54.9	55.6	57.6	Hg (t/a)	0.0	0.0	0.0	-0.1	-0.3	-0.5	-0.1	-0.2	-0.2

[1] Comparable to Table A17 of AEO2005: Electric Generators
[2] Comparable to Table A8 of AEO2005: Emissions
[3] All results in metric tons (t), equivalent to 1.1 short tons

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Table EA.12 Power Sector Emissions for Liquid-Immersed Transformer Trial Standard Levels (continued)

NEMS-BT Results

	2000	2005	2010	2015	2020	2025	2030	2035	2038
AEO2005 High Reference Case with TMY System Load									
CO_2 (Mt/a)[1,3]	2,283.0	2,385.0	2,673.0	2,884.0	3,169.0	3,554.0	3,748.2	3,953.2	4,090.5
NOx (kt/a)[2,3]	4,681.1	3,356.6	3,674.1	3,773.9	3,864.6	3,973.5	3,400.6	3,419.0	3,456.0
Hg (t/a)[2,3]	50.7	52.1	54.7	54.4	55.3	56.6	59.0	59.8	62.0
Liquid Immersed Trial Standard Level 2 High Growth									
CO_2 (Mt/a)	2,283.0	2,385.0	2,673.0	2,884.0	3,161.8	3,543.9	3,748.2	3,953.2	4,090.5
NOx (kt/a)	4,681.1	3,356.6	3,674.1	3,773.9	3,862.5	3,970.3	3,400.6	3,419.0	3,456.0
Hg (t/a)	50.7	52.1	54.7	54.2	54.8	56.0	58.7	59.3	61.4
AEO2005 Low Reference Case with TMY System Load									
CO_2 (Mt/a)[1,3]	2,283.0	2,359.0	2,573.0	2,719.0	2,887.0	3,088.0	3,256.8	3,434.8	3,554.2
NOx (kt/a)[2,3]	4,681.1	3,320.3	3,583.4	3,683.2	3,755.7	3,828.3	3,276.3	3,294.1	3,329.7
Hg (t/a)[2,3]	50.7	52.5	53.2	54.4	55.6	55.9	51.3	52.0	53.9
Liquid Immersed Trial Standard Level 2 Low Growth									
CO_2 (Mt/a)	2,283.0	2,359.0	2,573.0	2,716.5	2,883.1	3,082.9	3,256.8	3,434.8	3,554.2
NOx (kt/a)	4,681.1	3,320.3	3,583.4	3,681.1	3,753.7	3,825.2	3,276.3	3,294.1	3,329.7
Hg (t/a)	50.7	52.5	53.2	54.3	55.6	55.8	51.2	51.8	53.6

Difference from AEO2005 Reference with TMY System Load

	2000	2005	2010	2015	2020	2025	2030	2035	2038
Liquid Immersed Trial Standard Level 2 High Growth									
CO_2 (Mt/a)	0.0	0.0	0.0	0.0	-7.2	-10.1	0.0	0.0	0.0
NOx (kt/a)	0.0	0.0	0.0	0.0	-2.1	-3.2	0.0	0.0	0.0
Hg (t/a)	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.1	-0.2	-0.3
Liquid Immersed Trial Standard Level 2 Low Growth									
CO_2 (Mt/a)	0.0	0.0	0.0	-2.5	-3.9	-5.1	0.0	0.0	0.0
NOx (kt/a)	0.0	0.0	0.0	-2.0	-2.1	-3.1	0.0	0.0	0.0
Hg (t/a)	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.3

[1] Comparable to Table A17 of AEO2005: Electric Generators

[2] Comparable to Table A8 of AEO2005: Emissions

[3] All results in metric tons (t), equivalent to 1.1 short tons

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Table EA.13 Power Sector Emissions for Dry-Type, Medium-Voltage Transformer Trial Standard Levels

NEMS-BT Results

	2000	2005	2010	2015	2020	2025	2030	2035	2038
AEO2005 Reference Case with TMY System Load									
CO_2 (Mt/a)[1,3]	2,283.0	2,372.0	2,624.0	2,800.0	3,024.0	3,312.0	3,493.0	3,684.0	3,812.0
NOx (kt/a)[2,3]	4,681.1	3,338.4	3,637.8	3,737.6	3,810.2	3,900.9	3,338.6	3,356.8	3,393.1
Hg (t/a)[2,3]	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.8	57.8
Trial Standard Level 1 MvDry									
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,799.9	3,023.9	3,311.8	3,492.7	3,683.7	3,811.6
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,737.5	3,810.1	3,900.8	3,338.5	3,356.6	3,392.9
Hg (t/a)	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.7	57.8
Trial Standard Level 2 MvDry									
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,799.9	3,023.8	3,311.7	3,492.6	3,683.5	3,811.4
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,737.5	3,810.1	3,900.8	3,338.5	3,356.6	3,392.8
Hg (t/a)	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.7	57.8
Trial Standard Level 3 MvDry									
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,799.8	3,023.7	3,311.5	3,492.4	3,683.2	3,811.2
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,737.4	3,810.1	3,900.7	3,338.4	3,356.5	3,392.7
Hg (t/a)	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.7	57.8
Trial Standard Level 4 MvDry									
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,799.7	3,023.5	3,311.3	3,492.1	3,682.9	3,810.7
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,737.4	3,810.0	3,900.6	3,338.3	3,356.3	3,392.5
Hg (t/a)	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.7	57.8
Trial Standard Level 5 MvDry									
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,799.5	3,023.2	3,310.9	3,491.5	3,682.2	3,810.0
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,737.2	3,810.0	3,900.4	3,338.0	3,356.0	3,392.2
Hg (t/a)	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.7	57.8
Trial Standard Level 6 MvDry									
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,799.5	3,023.2	3,310.9	3,491.5	3,682.2	3,810.0
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,737.2	3,810.0	3,900.4	3,338.0	3,356.0	3,392.2
Hg (t/a)	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.7	57.8

Difference from AEO2005 Reference with TMY System Load

	2000	2005	2010	2015	2020	2025	2030	2035	2038
							Extrapolation		
Trial Standard Level 1 MvDry									
CO_2 (Mt/a)	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.3	-0.3	-0.4
NOx (kt/a)	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.1
Hg (t/a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trial Standard Level 2 MvDry									
CO_2 (Mt/a)	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6
NOx (kt/a)	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2
Hg (t/a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trial Standard Level 3 MvDry									
CO_2 (Mt/a)	0.0	0.0	0.0	-0.2	-0.3	-0.5	-0.6	-0.8	-0.8
NOx (kt/a)	0.0	0.0	0.0	-0.2	-0.1	-0.2	-0.2	-0.3	-0.3
Hg (t/a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trial Standard Level 4 MvDry									
CO_2 (Mt/a)	0.0	0.0	0.0	-0.3	-0.5	-0.7	-0.9	-1.1	-1.3
NOx (kt/a)	0.0	0.0	0.0	-0.2	-0.1	-0.3	-0.4	-0.5	-0.5
Hg (t/a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trial Standard Level 5 MvDry									
CO_2 (Mt/a)	0.0	0.0	0.0	-0.5	-0.8	-1.1	-1.5	-1.8	-2.0
NOx (kt/a)	0.0	0.0	0.0	-0.4	-0.2	-0.5	-0.6	-0.8	-0.8
Hg (t/a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trial Standard Level 6 MvDry									
CO_2 (Mt/a)	0.0	0.0	0.0	-0.5	-0.8	-1.1	-1.5	-1.8	-2.0
NOx (kt/a)	0.0	0.0	0.0	-0.4	-0.2	-0.5	-0.6	-0.8	-0.8
Hg (t/a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[1] Comparable to Table A17 of AEO2005: Electric Generators
[2] Comparable to Table A8 of AEO2005: Emissions
[3] All results in metric tons (t), equivalent to 1.1 short tons

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Table EA.14 Power Sector Emissions for Dry-Type, Medium-Voltage Transformer Trial Standard Levels (continued)

NEMS-BT Results										Difference from AEO2005 Reference with TMY System Load									
	2000	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2038**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2038**
AEO2005 High Reference Case with TMY System Load																			
CO_2 (Mt/a)[1,3]	2,283.0	2,385.0	2,673.0	2,884.0	3,169.0	3,554.0	3,748.2	3,953.2	4,090.5										
NOx (kt/a)[2,3]	4,681.1	3,356.6	3,674.1	3,773.9	3,864.6	3,973.5	3,400.6	3,419.0	3,456.0										
Hg (t/a)[2,3]	50.7	52.1	54.7	54.4	55.3	56.6	59.0	59.8	62.0										
Dry-Type, Medium-Voltage Trial Standard Level 2 High Growth																			
CO_2 (Mt/a)	2,283.0	2,385.0	2,673.0	2,884.0	3,168.7	3,553.5	3,747.8	3,952.6	4,089.9	CO_2 (Mt/a)	0.0	0.0	0.0	0.0	-0.3	-0.5	-0.4	-0.5	-0.6
NOx (kt/a)	4,681.1	3,356.6	3,674.1	3,773.9	3,864.5	3,973.3	3,400.4	3,418.8	3,455.7	NOx (kt/a)	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.2
Hg (t/a)	50.7	52.1	54.7	54.4	55.3	56.6	59.0	59.8	62.0	Hg (t/a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AEO2005 Low Reference Case with TMY System Load																			
CO_2 (Mt/a)[1,3]	2,283.0	2,359.0	2,573.0	2,719.0	2,887.0	3,088.0	3,256.8	3,434.8	3,554.2										
NOx (kt/a)[2,3]	4,681.1	3,320.3	3,583.4	3,683.2	3,755.7	3,828.3	3,276.3	3,294.1	3,329.7										
Hg (t/a)[2,3]	50.7	52.5	53.2	54.4	55.6	55.9	51.3	52.0	53.9										
Dry-Type, Medium-Voltage Trial Standard Level 2 Low Growth																			
CO_2 (Mt/a)	2,283.0	2,359.0	2,573.0	2,718.9	2,886.8	3,087.8	3,256.4	3,434.3	3,553.6	CO_2 (Mt/a)	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.4	-0.5	-0.5
NOx (kt/a)	4,681.1	3,320.3	3,583.4	3,683.1	3,755.6	3,828.2	3,276.2	3,293.9	3,329.5	NOx (kt/a)	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Hg (t/a)	50.7	52.5	53.2	54.4	55.6	55.9	51.3	52.0	53.9	Hg (t/a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[1] Comparable to Table A17 of AEO2005: Electric Generators

[2] Comparable to Table A8 of AEO2005: Emissions

[3] All results in metric tons (t), equivalent to 1.1 short tons

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Table EA.15 Power Sector Emissions for Dry-Type, Low-Voltage Transformer Trial Standard Levels

NEMS-BT Results

	2000	2005	2010	2015	2020	2025	2030	2035	2038
AEO2005 Reference Case with TMY System Load									
CO_2 (Mt/a)[1,3]	2,283.0	2,372.0	2,624.0	2,800.0	3,024.0	3,312.0	3,493.0	3,684.0	3,812.0
NOx (kt/a)[2,3]	4,681.1	3,338.4	3,637.8	3,737.6	3,810.2	3,900.9	3,338.6	3,356.8	3,393.1
Hg (t/a)[2,3]	50.7	52.7	53.7	54.7	54.2	55.6	55.0	55.8	57.8
Trial Standard Level 1 LvDry									
CO_2 (Mt/a)	2,283.0	2,372.0	2,624.0	2,791.9	3,010.9	3,293.2	3,468.4	3,653.6	3,778.5
NOx (kt/a)	4,681.1	3,338.4	3,637.8	3,731.4	3,806.8	3,893.2	3,328.5	3,344.3	3,379.3
Hg (t/a)	50.7	52.7	53.7	54.6	53.9	55.1	54.6	55.2	57.1
AEO2005 High Reference Case with TMY System Load									
CO_2 (Mt/a)[1,3]	2,283.0	2,385.0	2,673.0	2,884.0	3,169.0	3,554.0	3,748.2	3,953.2	4,090.5
NOx (kt/a)[2,3]	4,681.1	3,356.6	3,674.1	3,773.9	3,864.6	3,973.5	3,400.6	3,419.0	3,456.0
Hg (t/a)[2,3]	50.7	52.1	54.7	54.4	55.3	56.6	59.0	59.8	62.0
Dry-Type, Low-Voltage Trial Standard Level 1 High Growth									
CO_2 (Mt/a)	2,283.0	2,385.0	2,673.0	2,884.0	3,148.9	3,527.1	3,722.4	3,921.2	4,055.3
NOx (kt/a)	4,681.1	3,356.6	3,674.1	3,773.9	3,859.6	3,964.4	3,389.9	3,405.9	3,441.5
Hg (t/a)	50.7	52.1	54.7	54.2	54.8	56.0	58.7	59.3	61.3
AEO2005 Low Reference Case with TMY System Load									
CO_2 (Mt/a)[1,3]	2,283.0	2,359.0	2,573.0	2,719.0	2,887.0	3,088.0	3,256.8	3,434.8	3,554.2
NOx (kt/a)[2,3]	4,681.1	3,320.3	3,583.4	3,683.2	3,755.7	3,828.3	3,276.3	3,294.1	3,329.7
Hg (t/a)[2,3]	50.7	52.5	53.2	54.4	55.6	55.9	51.3	52.0	53.9
Dry-Type, Low-Voltage Trial Standard Level 1 Low Growth									
CO_2 (Mt/a)	2,283.0	2,359.0	2,573.0	2,711.2	2,875.8	3,073.4	3,233.4	3,405.9	3,522.3
NOx (kt/a)	4,681.1	3,320.3	3,583.4	3,676.9	3,748.8	3,818.5	3,266.7	3,282.2	3,316.6
Hg (t/a)	50.7	52.5	53.2	54.3	55.5	55.7	50.9	51.5	53.1

Difference from AEO2005 Reference with TMY System Load

	2000	2005	2010	2015	2020	2025	2030	2035	2038
							Extrapolation		
Trial Standard Level 1 LvDry									
CO_2 (Mt/a)	0.0	0.0	0.0	-8.1	-13.1	-18.8	-24.6	-30.4	-33.5
NOx (kt/a)	0.0	0.0	0.0	-6.2	-3.4	-7.7	-10.1	-12.5	-13.8
Hg (t/a)	0.0	0.0	0.0	-0.1	-0.3	-0.4	-0.4	-0.5	-0.7
Dry-Type, Low-Voltage Trial Standard Level 1 High Growth									
CO_2 (Mt/a)	0.0	0.0	0.0	0.0	-20.1	-26.9	-25.8	-32.0	-35.2
NOx (kt/a)	0.0	0.0	0.0	0.0	-5.1	-9.1	-10.6	-13.1	-14.5
Hg (t/a)	0.0	0.0	0.0	-0.2	-0.5	-0.6	-0.3	-0.5	-0.7
Dry-Type, Low-Voltage Trial Standard Level 1 Low Growth									
CO_2 (Mt/a)	0.0	0.0	0.0	-7.8	-11.2	-14.6	-23.4	-28.9	-31.9
NOx (kt/a)	0.0	0.0	0.0	-6.3	-6.9	-9.8	-9.6	-11.9	-13.1
Hg (t/a)	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.4	-0.5	-0.8

[1]Comparable to Table A17 of AEO2005: Electric Generators

[2]Comparable to Table A8 of AEO2005: Emissions

[3]All results in metric tons (t), equivalent to 1.1 short tons

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Table EA.16 Cumulative Power Sector Emissions Impacts for Liquid-Immersed Transformers

NEMS-BT Results		
	2000-2025	**2000-2038**
Trial Standard Level 1 Liquid		
CO_2 (Mt/a)	-37.9	-117.4
NOx (kt/a)	-11.7	-31.7
Hg (t/a)	-0.7	-2.9
Trial Standard Level 2 Liquid		
CO_2 (Mt/a)	-50.7	-158.2
NOx (kt/a)	-15.7	-42.7
Hg (t/a)	-1.0	-3.5
Trial Standard Level 3 Liquid		
CO_2 (Mt/a)	-66.5	-205.4
NOx (kt/a)	-20.6	-55.5
Hg (t/a)	-1.3	-4.1
Trial Standard Level 4 Liquid		
CO_2 (Mt/a)	-75.2	-232.8
NOx (kt/a)	-23.3	-62.8
Hg (t/a)	-1.4	-4.5
Trial Standard Level 5 Liquid		
CO_2 (Mt/a)	-144.8	-451.2
NOx (kt/a)	-44.9	-121.7
Hg (t/a)	-2.7	-5.8
Trial Standard Level 6 Liquid		
CO_2 (Mt/a)	-208.7	-647.6
NOx (kt/a)	-64.7	-174.8
Hg (t/a)	-4.0	-5.9
Liquid Immersed Trial Standard Level 2 High Growth		
CO_2 (Mt/a)	-56.8	-56.8
NOx (kt/a)	-20.4	-20.4
Hg (t/a)	-1.9	-4.3
Liquid Immersed Trial Standard Level 2 Low Growth		
CO_2 (Mt/a)	-48.7	-48.7
NOx (kt/a)	-35.2	-35.2
Hg (t/a)	-0.8	-3.0

[1] Comparable to Table A17 of AEO2005: Electric Generators
[2] Comparable to Table A8 of AEO2005: Emissions
[3] All results in metric tons (t), equivalent to 1.1 short tons

Table EA.17 Cumulative Power Sector Emissions Impacts for Dry-Type, Low-Voltage Transformers

NEMS-BT Results		
Trial Standard Level 1 LvDry		
CO_2 (Mt/a)	-166.6	-519.6
NOx (kt/a)	-69.4	-214.5
Hg (t/a)	-3.5	-9.7
Dry-Type, Low-Voltage Trial Standard Level 1 High Growth		
CO_2 (Mt/a)	-158.9	-529.5
NOx (kt/a)	-56.1	-208.5
Hg (t/a)	-5.1	-11.0
Dry-Type, Low-Voltage Trial Standard Level 1 Low Growth		
CO_2 (Mt/a)	-143.5	-478.8
NOx (kt/a)	-106.7	-244.6
Hg (t/a)	-2.2	-8.6

[1]Comparable to Table A17 of AEO2005: Electric Generators
[2]Comparable to Table A8 of AEO2005: Emissions
[3]All results in metric tons (t), equivalent to 1.1 short tons

Table EA.18 Cumulative Power Sector Emissions Impacts for Dry-Type, Medium-Voltage Transformers

NEMS-BT Results	2000-2025	2000-2038
Trial Standard Level 1 MvDry		
CO_2 (Mt/a)	-1.8	-5.6
NOx (kt/a)	-0.7	-2.3
Hg (t/a)	0.0	-0.1
Trial Standard Level 2 MvDry		
CO_2 (Mt/a)	-2.8	-8.9
NOx (kt/a)	-1.2	-3.7
Hg (t/a)	-0.1	-0.2
Trial Standard Level 3 MvDry		
CO_2 (Mt/a)	-4.1	-12.8
NOx (kt/a)	-1.7	-5.3
Hg (t/a)	-0.1	-0.2
Trial Standard Level 4 MvDry		
CO_2 (Mt/a)	-6.3	-19.5
NOx (kt/a)	-2.6	-8.1
Hg (t/a)	-0.1	-0.4
Trial Standard Level 5 MvDry		
CO_2 (Mt/a)	-10.0	-31.2
NOx (kt/a)	-4.2	-12.9
Hg (t/a)	-0.2	-0.6
Trial Standard Level 6 MvDry		
CO_2 (Mt/a)	-10.0	-31.2
NOx (kt/a)	-4.2	-12.9
Hg (t/a)	-0.2	-0.6
Dry-Type, Medium-Voltage Trial Standard Level 2 High Growth		
CO_2 (Mt/a)	-2.7	-9.0
NOx (kt/a)	-1.0	-3.6
Hg (t/a)	-0.1	-0.2
Dry-Type, Medium-Voltage Trial Standard Level 2 Low Growth		
CO_2 (Mt/a)	-2.5	-8.2
NOx (kt/a)	-1.8	-4.2
Hg (t/a)	0.0	-0.1

[1]Comparable to Table A17 of AEO2005: Electric Generators
[2]Comparable to Table A8 of AEO2005: Emissions
[3]All results in metric tons (t), equivalent to 1.1 short tons

5.1.2 Discounted Emissions

In the ANOPR, the Department stated that, for its NOPR analysis, it would calculate discounted values for future emissions (or reduced emissions allowance demand in a cap and trade emissions scenario). 69 FR 45376. Accordingly, the Department here presents its results for discounted emissions of CO_2, Hg and NO_x. The Department used the same discount rates that it used in calculating the net present value (NPV)—seven percent and three percent real—to calculate discounted cumulative emission reductions. As described in Chapter 10, DOE used the seven-percent and three-percent real discount rates in accordance with the Office of Management and Budget (OMB) guidelines on regulatory analysis.[8] Table EA.19 shows the discounted cumulative emissions impacts for both liquid-immersed and dry-type, medium-voltage transformers.

The seven-percent and three-percent real discount rate values are meant to capture the present value of costs and benefits associated with projects facing an average degree of risk. Other discount rates may be more applicable to discount costs and benefits associated with projects facing different risks and uncertainties. (For example, see Lind *et. al* 1982.[9])

Table EA.19 Discounted Cumulative Emissions Impacts, Liquid-Immersed and Dry-Type, Medium-Voltage Transformers

		Liquid-Immersed		Dry-Type, Medium-Voltage	
		Cumulative 2000-2038 3% discount	Cumulative 2000-2038 7% discount	Cumulative 2000-2038 3% discount	Cumulative 2000-2038 7% discount
TSL 1	CO_2 (Mt)	-58.2	-25.3	-2.8	-1.2
	NO_x (kt)	-16.3	-7.5	-1.2	-0.5
	Hg (t)	-1.37	-0.56	-0.05	-0.02
TSL 2	CO_2 (Mt)	-78.4	-34.0	-4.4	-1.9
	NO_x (kt)	-21.9	-10.1	-1.8	-0.8
	Hg (t)	-1.67	-0.69	-0.08	-0.04
TSL 3	CO_2 (Mt)	-101.9	-44.3	-6.4	-2.8
	NO_x (kt)	-28.6	-13.2	-2.7	-1.2
	Hg (t)	-2.00	-0.84	-0.12	-0.05
TSL 4	CO_2 (Mt)	-115.5	-50.1	-9.7	-4.2
	NO_x (kt)	-32.4	-15.0	-4.0	-1.8
	Hg (t)	-2.20	-0.93	-0.18	-0.08
TSL 5	CO_2 (Mt)	-223.5	-96.9	-15.5	-6.7
	NO_x (kt)	-62.6	-28.9	-6.5	-2.9
	Hg (t)	-3.01	-1.38	-0.29	-0.12
TSL 6	CO_2 (Mt)	-321.1	-139.4	-15.5	-6.7
	NO_x (kt)	-90.0	-41.6	-6.5	-2.9
	Hg (t)	-3.26	-1.62	-0.29	-0.12

5.1.3 Fuel-Cycle Emissions

As discussed earlier, fuel-cycle emissions refer to the emissions associated with the amount of fuel used in the upstream production of electricity and downstream consumption of electricity, including energy used at the power plant. The amount of energy used to perform the upstream processes, such as natural gas production, is not linked to the downstream consumption of electricity attributed to natural gas. For this reason, changes in upstream emissions due to proposed standards are not counted in NEMS-BT. Although the Department does not report actual estimates of the effects of standards on upstream emissions, the emissions factors described here provide the reader with a sense of the possible magnitude of the effects.

Estimates of upstream emissions for CO_2 and NO_x are taken from a study in 1993 by Mark A. DeLuchi (sometimes spelled DeLucci), Ph. D., at Argonne National Laboratory. Dr. DeLuchi provides estimates of full fuel-cycle emissions factors for CO_2, CH_4, carbon monoxide (CO), non-methane organic compounds (NMOC), and NO_x from coal and natural gas production.[10] The emission factor for SO_2 is taken from the EPA Report AP-42, *Compilation of Air Pollutant Emission Factors*.[11] The EPA AP-42 report notes that coal-cleaning is the primary source for upstream SO_2 emissions from coal production, so the emission factor for SO_2 reflects only the coal-cleaning process. Transportation of coal is not addressed in EPA's study.

Emission factor estimates and corresponding percentages of contributions of upstream emissions from coal and natural gas production, relative to power plant emissions, are shown in Table EA.20 for CO_2, SO_2, and NO_x. The percentage relative to power plant emissions provides a means to estimate upstream emission savings based on the savings from the power plant. The values shown in Table EA.20 represent emissions from upstream processes as mass (g) per deliverable energy to end-use consumers, in gigajoules (GJ).

Table EA.20 Estimated Upstream Emission Factors and Corresponding Percentages of Direct Power Plant Combustion Emissions

	Coal		**Natural Gas**	
	Emission Factor *(g/GJ)*	**% of Combustion Emissions**	**Emission Factor *(g/GJ)***	**% of Combustion Emissions**
CO_2	8,147	2.7	20,000	11.9
SO_2	29.2	0.9	0	0
NO_x	41.7	5.8	153	40

Relative to the entire fuel cycle, Dr. DeLuchi estimates that approximately eight percent, by mass, of emissions from coal production are due to mining, preparation that includes cleaning the coal, and transportation from the mine to the power plant. Transportation emissions include emissions from the fuel used by the mode of transportation that moves the coal from the mine to the power plant. Also, Dr. DeLuchi estimates that approximately 14 percent of emissions from natural gas production result from upstream processes. In view of Table EA.20, this higher loss factor in natural gas production, compared to the emissions factor for coal, is likely due to the higher NO_x contribution. In sum, emissions factors relative to power plant emissions are a relatively small proportion of the energy losses attributable to upstream processes. With the exception of NO_x emissions from natural gas production, upstream emissions are less than 12 percent of power plant emissions.

5.2 Wetlands / Endangered and Threatened Species / Cultural Resources

The Department's proposed action is not site-specific, nor would it impact land disturbance or use due to distribution transformer placement. Therefore, this action is not expected to affect the quality of wetlands, or threatened or endangered species. Further, this action is not expected to impact cultural resources such as historical or archaeological sites.

5.3 Socioeconomic Impacts

The Department's analysis has shown that the increase in the first cost of purchasing a more efficient distribution transformer at the proposed and alternative standard levels is offset by a reduction in the LCC of owning a more efficient piece of equipment. Although the proposed and alternative standards increase the first cost, the standard levels result in a decrease in LCC (due to reduced energy costs) for many consumers. The precise change in LCC varies by standard level, size, class of transformer, and type of customer. At the proposed standard level, at least 83.2 percent of consumers realize LCC savings. For a complete discussion of the LCC impacts on consumers, see Chapter 8 of the TSD

5.4 Environmental Justice Impacts

According to Executive Order 12898 of February 11, 1994, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," DOE is required to examine the effect of more stringent energy-efficiency standards on (1) small businesses that either manufacture or use distribution transformers, (2) manufacturers of niche products related to distribution transformers, and (3) small businesses operated by disadvantaged or minority populations.

Regarding users of distribution transformers, small businesses are included as part of the overall population examined by the Department in the LCC analysis. The results of that analysis estimated that between 26 and 61 percent of distribution transformer customers would experience positive economic impacts from the proposed standard.

Small distribution transformer manufacturing enterprises, as defined by the Small Business Administration, are those with no more than 750 employees.[a] The Department identified and interviewed six small manufacturers of distribution transformers, five of which produce medium-voltage, dry-type transformers and one of which produces liquid-immersed transformers. Because the liquid-immersed distribution transformer industry largely produces customized transformers, small businesses can compete because each unique design is produced in relatively small volumes for a given order. Implementation of an energy conservation standard would have a relatively minor differential impact on small manufacturers of liquid-immersed distribution transformers.

[a] Small Business Administration -http://www.sba.gov/gopher/Financial-Assistance/Defin/defi4.txt (06/24/05)

Because of the potential impacts of a standard on manufacturers of the medium-voltage, dry-type superclass, DOE determined that it cannot certify that the proposed rule (TSL2), if promulgated, would have no significant economic impact on a substantial number of small entities. Because DOE cannot certify this, due to the potential impacts on medium-voltage, dry-type manufacturers, it prepared an initial regulatory flexibility analysis (IRFA) for this rulemaking, which can be found in section VI.B of the NOPR. For additional information on this subject, see also section V.B.2.b of the NOPR and the manufacturer impact analysis (MIA) in Chapter 12 of the TSD.

The Department did not conduct a separate analysis to assess the impacts of a new standard on niche product manufacturers because it found no niche products for which the adoption of a new standard would raise special considerations.

The Department's LCC subgroup analysis (TSD Chapter 11) did not include small or disadvantaged businesses or populations as a subgroup. However, the Department believes that there are no disproportionately high and adverse human health or environmental effects on small businesses, minority populations, and low-income populations resulting from more stringent energy-efficiency standards. Positive impacts, such as decreased air emissions, would be equally shared among all populations.

The MIA (TSD Chapter 12), and the regulatory impact analysis (published with the TSD) examined impacts on various business populations. However, the Department received no data concerning differential impacts on businesses owned by minority or disadvantaged populations. The Department requests comment on this issue.

5.5 Energy Consumption Impacts

The proposed standard levels for distribution transformers (TSL 2 for liquid-immersed and TSL 2 for medium-voltage, dry-type) would result in the national energy savings shown in Table EA.21. Energy savings for the other five TSLs (TSLs 1, 3, 4, 5, and 6) are also provided.

Table EA.21 Cumulative Energy Savings from Standards

	TSL 1 ***quads***	**TSL 2** ***quads***	**TSL 3** ***quads***	**TSL 4** ***quads***	**TSL 5** ***quads***	**TSL 6** ***quads***
From 2010 to 2038	1.77	2.39	3.15	3.63	6.90	9.77

5.6 Noise and Aesthetics

The proposed action is not likely to affect the sound power levels or sound quality levels associated with distribution transformers. Transformers have no moving parts but do often emit a buzz associated with 60-Hz alternating current. The Department’s proposed standard is not expected to materially affect the noise of transformers. Higher-efficiency transformers tend to be larger; however, the efficiencies selected by the Department will not result in significant changes in transformer size nor in any other aesthetic feature. In sum, the noise and aesthetics of the more efficient distribution transformers covered under this EA would be virtually no different from equipment being installed today.

5.7 Summary of Environmental Impacts

Tables EA.22 to EA.24 provide a summary of the analysis results by superclass to aid the reader in the discussion of the benefits and burdens for the different TSLs as well as the no-action alternative.

Table EA.22 Summary of the Analysis Results for Liquid-Immersed Transformers

	No Action	Trial Standard Level					
		1	2 (Proposed Action)	3	4	5	6
Cumulative Emission Reductions*							
CO_2 Equivalent (Mt)	0.0	117.4	158.2	205.4	232.8	451.2	647.6
NO_x (kt)	0.0	31.7	42.7	55.5	62.8	121.7	174.8
Hg (t)	0.0	2.9	3.5	4.1	4.5	5.8	5.9
Cumulative Primary Energy Saved (Quads)*	0.0	1.70	2.28	2.99	3.38	6.51	9.38
Socioeconomic Impacts – All Consumers							
Transformers with positive LCC (%) based on underlying DLs	NA	95.1 to 99.8	83.2 to 98.6	47.2 to 94.8	60.1 to 91.4	33.7 to 56.1	1.1 to 42.8
Payback periods (years), based on underlying DLs	NA	1.4 to 11.4	4.3 to 21.9	8.8 to 36.0	12.0 to 19.8	24.4 to 31.7	26.1 to 66.6
Environmental Justice Impacts	None	None	None	None	None	None	None
Wetlands/Endangered and Threatened Species/Cultural Resources Impacts	None	None	None	None	None	None	None
Fuel-Cycle (Upstream) Emissions Impacts	None	**	**	**	**	**	**
Noise and Aesthetics Impacts	None	None	None	None	None	None	None

* Cumulative total is over a time period starting in 2010 and ending in 2038.

** DOE does not report actual estimates of the effects of standards on upstream emissions, but section 5.1.2 above provides a sense of the possible magnitude of effects.

Table EA.23 Summary of the Analysis Results for Dry-Type, Low-Voltage Transformers

	No Action	Trial Standard Level
		1
Cumulative Emission Reductions*		
CO_2 Equivalent (Mt)	0.0	519.6
NO_x (kt)	0.0	214.5
Hg (t)	0.0	9.7
Cumulative Primary Energy Saved (Quads)*	0.0	6.76
Socioeconomic Impacts – All Consumers		
Transformers with positive LCC (%) based on underlying DLs	NA	99.1 to 99.6
Payback periods (years), based on underlying DLs	NA	0.8 to 1.8
Environmental Justice Impacts	None	None
Wetlands/Endangered and Threatened Species/Cultural Resources Impacts	None	None
Fuel-Cycle (Upstream) Emissions Impacts	None	**
Noise and Aesthetics Impacts	None	None

* Cumulative total is over a time period starting in 2010 and ending in 2038.

** DOE does not report actual estimates of the effects of standards on upstream emissions, but section 5.1.2 above provides a sense of the possible magnitude of effects.

Table EA.24 Summary of the Analysis Results for Dry-Type, Medium-Voltage Transformers

	No Action	Trial Standard Level					
		1	2 (Proposed Action)	3	4	5	6
Cumulative Emission Reductions*							
CO_2 Equivalent (Mt)	0.0	5.7	9.1	13.1	19.9	31.9	31.9
NO_x (kt)	0.0	2.4	3.7	5.4	8.2	13.2	13.2
Hg (t)	0.0	0.1	0.2	0.2	0.4	0.6	0.6
Cumulative Primary Energy Saved (Quads)*	0.0	0.07	0.11	0.16	0.25	0.39	0.39
Socioeconomic Impacts – All Consumers							
Transformers with positive LCC (%) based on underlying DLs	NA	96.2 to 99.7	94.7 to 98.9	94.2 to 95.6	57.4 to 81.8	24.2 to 65.8	24.3 to 66.8
Payback periods (years), based on underlying DLs	NA	1.5 to 9.7	2.4 to 8.3	5.4 to 10.0	11.8 to 19.5	15.1 to 32.5	14.8 to 32.4
Environmental Justice Impacts	None	None	None	None	None	None	None
Wetlands/Endangered and Threatened Species/Cultural Resources Impacts	None	None	None	None	None	None	None
Fuel-Cycle (Upstream) Emissions Impacts	None	**	**	**	**	**	**
Noise and Aesthetics Impacts	None	None	None	None	None	None	None

* Cumulative total is over a time period starting in 2010 and ending in 2038.

** DOE does not report actual estimates of the effects of standards on upstream emissions, but section 5.1.2 above provides a sense of the possible magnitude of effects.

The Department has proposed energy-efficiency standards for distribution transformers at TSL 2. The proposed standards would apply to all covered products offered for sale in the United States and its Territories, with a compliance date of January 1, 2010. The justification for selecting the proposed action, adopting TSL 2 over the other TSLs considered, is fully explained in the NOPR. The NOPR is available on the internet at: http://www.eere.energy.gov/buildings/appliance_standards/commercial/distribution_transformers.html under "NOPR."

In addition to reducing the secondary energy lost in the distribution transformers themselves, the proposed standards would save even more energy at the electric power plant source, where less primary energy (e.g., oil, coal, or natural gas) directly attributable to the losses from distribution transformers would be burned. Burning less oil, coal, or natural gas reduces greenhouse gas emissions and pollutants, creating a cleaner environment.

In the 28-year period after the new standards become effective, the Nation will save about 2.39 quadrillion British thermal units (quads) of primary energy. The 2.39 quads are equivalent to saving twice the combined primary electrical energy consumption in 2001 by all households in both New York and California. Additionally, these energy savings would significantly reduce emissions of air pollutants and greenhouse gases associated with electricity production, by 158.2 Mt of CO_2, 42.7 kt of NO_x and 3.5 t of Hg from liquid-immersed TSL 2. With cap and trade emissions controls on NO_x and Hg, these emissions reductions will manifest as a reduction of demand for emissions allowances in the corresponding cap and trade emissions markets. Furthermore, the proposed standards would eliminate the need for construction of roughly 11 new 400-megawatt (MW) power plants by 2038.

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