CHAPTER 7. IMPACTS OF TRIAL STANDARDS FOR FLUORESCENT LAMP BALLASTS ON ELECTRIC UTILITIES

7.1 SUMMARY

The effects of proposed fluorescent ballast energy-efficiency standards on the electric utility industry were analyzed using a variant of the Energy Information Administration (EIA) National Energy Modeling System (NEMS) called NEMS-BRS, together with some exogenous calculations.[1,2] NEMS was used by the EIA to produce the *1999 Annual Energy Outlook* (AEO99), and NEMS-BRS is used to provide some key equivalent inputs to our standards analysis.[3] Because electric utility restructuring is well under way, we can no longer assume the historical cost recovery regulation of utilities, which was the basis of previous utility impact analyses. Therefore, our electric utility analysis consists of a comparison between model results for a case comparable to the AEO99 Reference Case, as reported in the AEO99, and policy cases incorporating each of the ballast standards scenarios. Because the policy standards effects are small compared to the total size of the power sector, NEMS-BRS is not used directly. Instead, exploratory runs are conducted to estimate marginal effects, which are then used to calculate the small effects on utilities resulting from each standards scenario. The reduced electricity demand from ballast efficiency standards lowers generation from both coal and natural gas, but, because natural gas is more frequently the marginal fuel, it is usually affected to a greater degree.

7.2 PURPOSE OF THE ANALYSIS

The requirement that the effects of proposed standards on electric utilities be analyzed has a long history. Analysis of the effects of proposed standards on the electric utility industry has historically taken the form of estimated fuel savings and capital cost savings relative to the likely reduction in revenues implied by lower electricity sales. In the short term, ratepayers of traditional utilities gained because of reduced energy use at fixed prices, but any imbalance between revenue and costs disappeared in the long run as traditional regulation allowed utilities to recover costs. In a restructured industry, however, only local distribution companies will be permitted to recoup costs, and prices are not rigid in the short run, so the basis of our analysis must change. Using the AEO99 assumptions regarding the spread of restructuring allows us to use NEMS-BRS to estimate the

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[1]For further information about NEMS, please refer to the U.S. Department of Energy, Energy Information Administration. *National Energy Model System: An Overview 1998.* DOE/EIA-0581(98), February 1998.

[2]EIA approves use of the name *NEMS* to describe only an AEO version of the model without any modification to code or data. Because our analysis entails some minor code modifications, and the model is run under various policy scenarios that deviate from AEO assumptions, the name NEMS-BRS refers to the model used here.

[3]U.S. Department of Energy, Energy Information Administration. *Annual Energy Outlook 1999: with Projections Through 2020*. DOE/EIA-0383(99), December 1998.

overall effect of standards on the industry.[4] We assess the impact of standards on utilities by reporting several key industry parameters, notably electricity sales, generation, and capacity.

7.3 ASSUMPTIONS

NEMS-BRS has several advantages that have led to its adoption as the source for basic forecasting appliance energy-efficiency standards analysis. NEMS-BRS relies upon a set of well-known, transparent assumptions. The comprehensiveness of NEMS-BRS permits modeling of interactions among the various energy supply and demand sectors and the economy as a whole, so it produces a sophisticated picture of the effect of standards. Perhaps most importantly, because it explicitly simulates dispatch and capacity expansion of the industry, NEMS-BRS provides accurate estimation of marginal effects, which yield better indicators of actual effects than estimates based on industry wide average values.

The utility analysis uses the assumptions of AEO99 and treats ballast efficiency standards as deviations in policy. Because the analysis reduces demand by only half a percent or less of total U.S. electricity generation in any given year, its effect can not be detected directly by simulations. Therefore, simulation runs are done for larger reductions in demand and results are interpolated between AEO99 and these runs. We assume that the effects measured are linear within the range of interpolation (i.e., close to the origin). This issue is discussed further below.

Deviations from some of these assumptions have also been explored through two scenarios that represent alternative futures based on the Low and High Economic Growth cases of AEO99. The AEO99 Reference Case assumes a moderate rate of economic growth, 2.1% per year from 1997 to 2020. The growth assumptions for each case are based on macroeconomic forecasts prepared by DRI/McGraw-Hill. These cases demonstrate the effects of alternative growth assumptions on energy markets. The Low Economic Growth case is based on lower growth rates for population, labor force, and productivity, which raises prices and interest rates and lowers growth in industrial output. Economic output in the Low case increases by 1.5% a year from 1997 through 2020.The High case incorporates higher growth rates for population, labor force, and labor productivity, which lowers inflation and interest rates and increases projected economic output to 2.6% a year.[5]

7.4 METHODS

NEMS is a large, multi-sectoral, partial equilibrium model of the U.S. energy sector that has been developed over several years by the EIA, primarily for the purpose of preparing the *Annual Energy Outlook*. NEMS produces a commonly referred to baseline forecast for the U.S. through 2020 and is available in the public domain. The NEMS-BRS model used for appliance standards analysis is based on the AEO99 version of NEMS with minor modifications.

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[4] EIA assumptions on restructuring are explained on pages 14-15 and pages 24-29 of the AEO99.

[5] Please see pages 39 and 45 of the AEO99 for more details on growth assumptions.

NEMS-BRS produces the baseline forecasts for many aspects of this appliance standards analysis, including commercial electricity prices. Because the AEO99 version of NEMS forecasts only to the year 2020, we had to use a method for extrapolating price data to 2030 . The method that we adopted uses the EIA approach to forecast fuel prices for the Federal Energy Management Program (FEMP). Electricity prices are held constant at 2020 levels, from 2020 to 2030.

NEMS-BRS policy runs are executed by reducing electricity consumption in the lighting end use of the NEMS-BRS Commercial Demand Module. The load shape effects of improved lighting efficiency are thereby replicated as well as possible.

As mentioned above, the magnitude of energy reduction that would be required for NEMS-BRS to produce stable results safely out of the range of numerical noise is larger than the most rigorous efficiency standard by at least a factor of two. Therefore, we estimated results in the range of the standard levels effects using interpolation. Energy use in the Commercial Demand Module lighting load is reduced by levels of approximately 2.96, 5.92, 11.83, and 17.75 times the level of the most extreme standard (2b). They were chosen to be roughly equivalent to 50, 100, 200, and 300 TWh, respectively, in the peak savings year for the standard before 2020. This simulation and interpolation process is carried out separately for the a and b cases; the a cases are modeled on standard 2a. Figure 7-1 shows an example of the interpolation approach for gas generation. The size of the energy reduction is plotted on the x-axis against the reduction in gas generation for each reported year. In general, results for the various NEMS-BRS runs are reasonably stable and linear, with the unreliable ("noisy") results appearing below the peak savings of 50 TWh in 2020, or roughly 2 to 3 times the impact of standard 2b. The figure shows simple linear regressions forced through the origin because a zero change must be the case with no standard in place. Figure 7-2 shows a close-up of the interpolated points for standards 2a and 5a. The horizontal lines illustrate the calculated values for the difference in gas generation between the AEO99 prediction for 2015 and the standards level prediction for 2015. These regressions appear stable, so estimating results via interpolation towards zero seems justified. A similar approach was used to find the drop in generation from other fuels and in installed generating capacity in each reported year.

7.5 RESULTS

Table 7-1 shows the results from a NEMS-BRS run comparable to the published AEO99 Reference Case, with results for the 12 trial standard scenarios presented in the parallel Tables 7-2 through 7-13. Although energy savings from the proposed ballast standards continue through 2030, the effects of these savings are reported through 2020 because this is the NEMS-BRS time horizon. Each table shows forecasts using interpolated results as described above for commercial energy sales and total U.S. electric generation and installed capacity. As expected, gas-fired generation is more affected by the standard levels than coal-fired generation. This effect reflects the peaking nature of the ballast end use, and the fact that gas generation, in general, is used to serve this peak. However, effects of standards on installed capacity are small relative to the energy savings.[6]

[6]Capacity factor, a ratio of generation to installed capacity, is an indicator of the robustness of the forecast. The implied capacity factors of the displaced capacity in this forecast are within reasonable limits.

Table 7-1. Reference Forecast

NEMS-EPCA Results: AEO99 Reference	2000	2005	2010	2015	2020
Commercial-Sector Energy Consumption[1]					
Electricity Sales (TWh)	1,081	1,162	1,248	1,332	1,384
Total U.S. Electric Generation[2]					
Coal (TWh)	1,990	2,037	2,092	2,204	2,348
Gas (TWh)	547	858	1,149	1,441	1,588
Petroleum (TWh)	109	44	35	33	31
Nuclear (TWh)	660	631	554	419	359
Renewables (TWh)	423	433	446	461	483
Total (TWh)[3]	3,729	4,003	4,276	4,558	4,809
Installed Generating Capacity[4]					
Coal (GW)	315.2	315.0	318.9	326.2	343.5
Other Fossil (GW)[5]	301.5	369.7	397.3	470.1	513.5
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9
Renewables (GW)	97.2	98.9	100.3	102.3	105.4
Total (GW)[6]	808.7	871.0	890.7	955.0	1,011.3

[1]Comparable to Table A8 of AEO99: Electricity Sales by Sector

[2]Comparable to Table A8 of AEO99: Electric Generators and Cogenerators

[3]Excludes "Other Gaseous Fuels" cogenerators and "Other" cogenerators

[4]Comparable to Table A9 of AEO99: Electric Generators and Cogenerators Capability

[5]Includes "Other Gaseous Fuels" cogenerators

[6]Excludes Pumped Storage and Fuel Cells

Commercial energy sales fall for each proposed standard compared to the AEO99 Reference Case. The decrease in sales is proportional to the amount of energy that the National Energy Savings (NES) model predicts will be saved by each standard, ranging from just over 0.2% to nearly 1.3% of total commercial electricity sales in the peak savings year reported. Total U.S. generation decreases relative to the AEO99 baseline in each standards case, from just under 0.4% of total U.S. electric generation in the peak savings year of the maximum savings case (standard 2b) to just over 0.06% in the peak year of the smallest savings case (standard 5a). Total installed capacity is also slightly reduced in each standard level scenario, by just under 0.4% in the final year of the maximum savings case. Logically, the reduction in generation should approximately match, or be slightly higher than, the reduction in sales. In some cases, however, for example in 2020 for standard 3a, the change in generation does not match the decrease in sales (plus delivery losses). This apparent inconsistency is a result of either changes in system dispatch or inaccuracy in the interpolation method.

An example of each of the results under the Low and High Economic Growth side cases is presented for the largest effect case of the b pattern (standard 2b) as Tables 7-14 and 7-15. For the Low Growth standards case, savings have a slightly larger impact than in the reference 2b case while the High Growth standards case results in a slightly lower impact for each of the reported industry parameters.

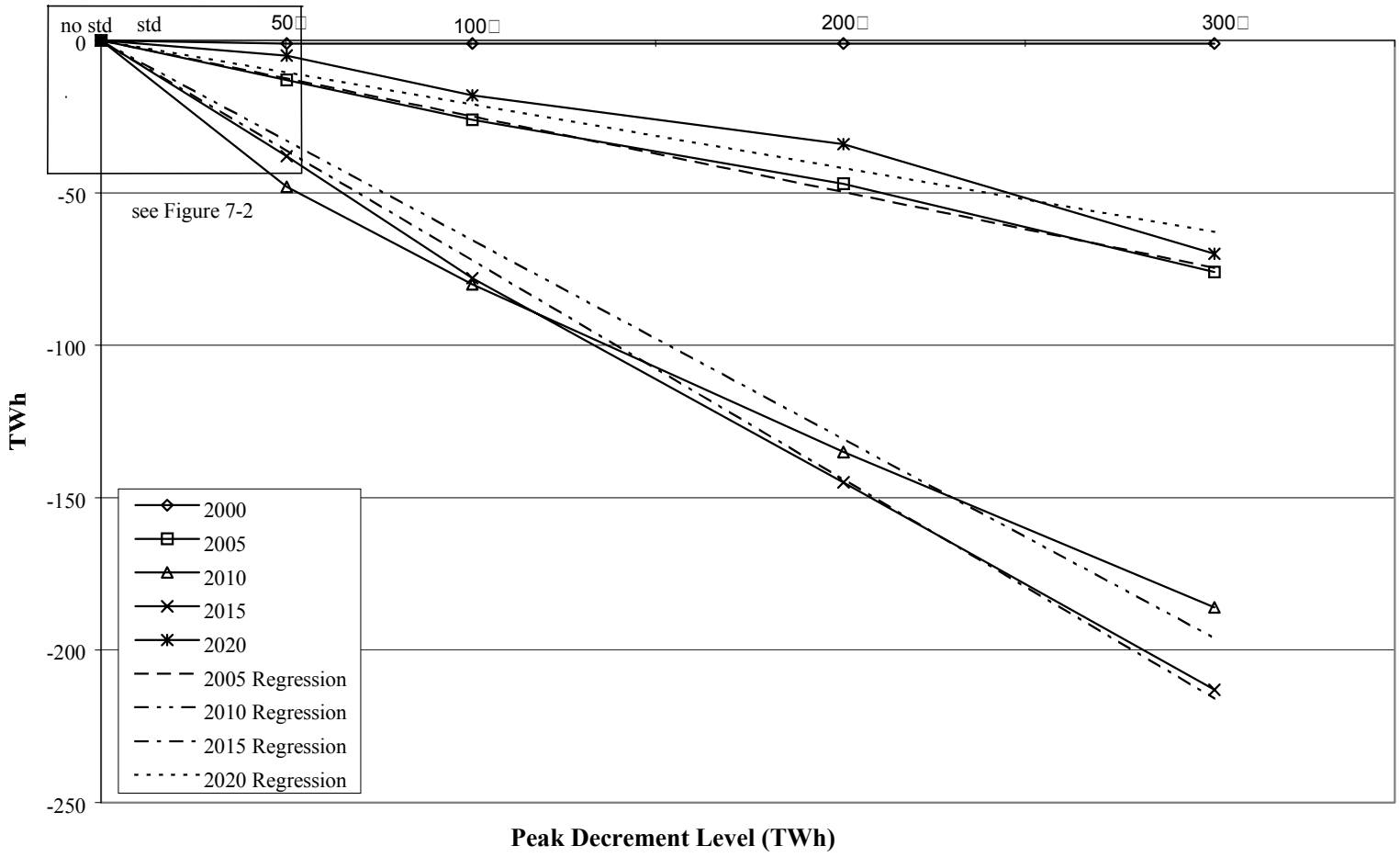

Figure 7-1. Standards Level 2a Difference in Gas Generation

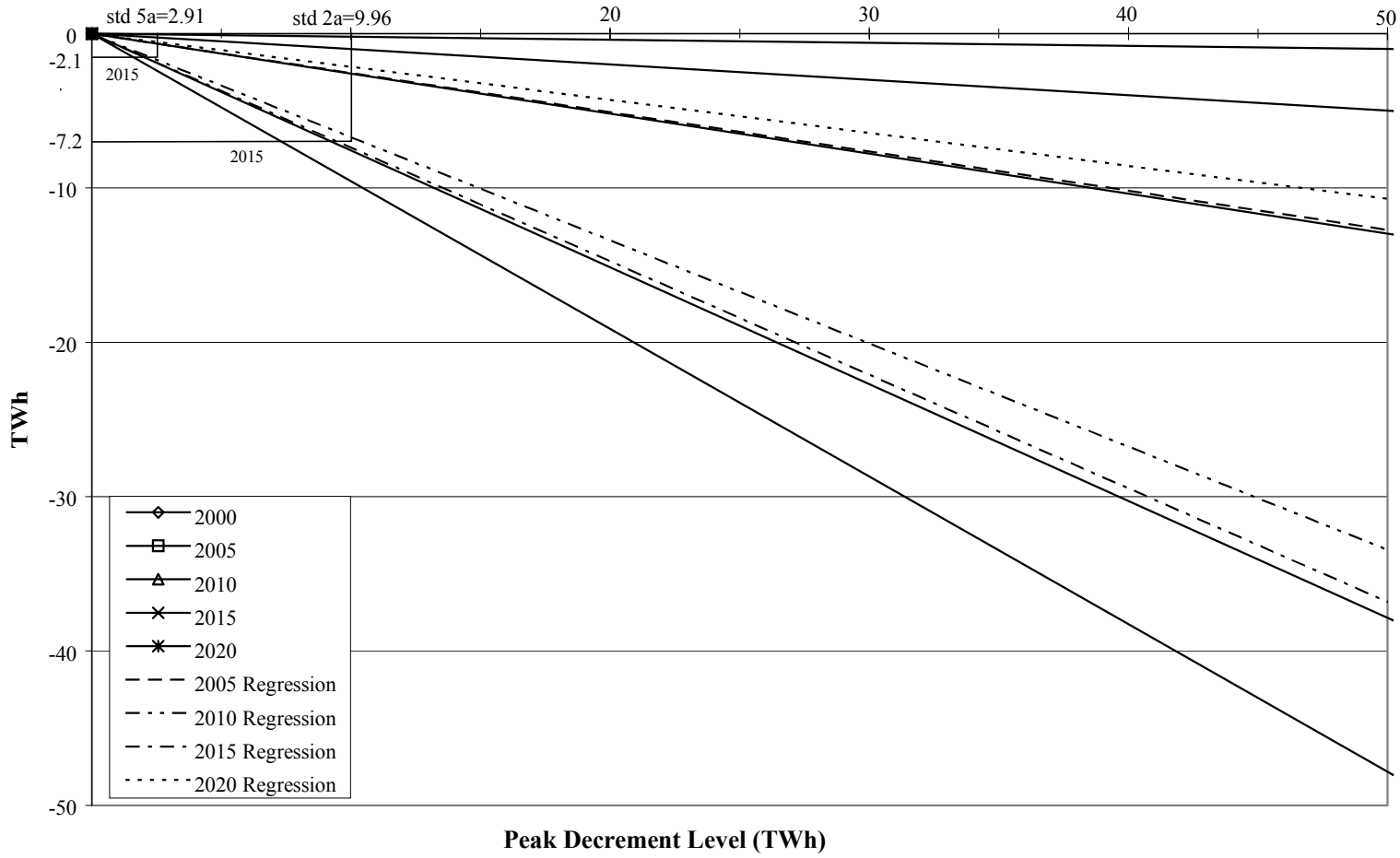

Figure 7-2. An Example of the Interpolation of Standards Levels 2a and 5a

Table 7-2. Standards Level 1a Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,160	1,243	1,326	1,380	Electricity Sales (TWh)	0.0	-2.2	-4.9	-6.0	-4.2
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,091	2,202	2,345	Coal (TWh)	0.0	-0.7	-1.1	-1.8	-3.0
Gas (TWh)	547	856	1,145	1,437	1,587	Gas (TWh)	0.0	-1.5	-4.0	-4.4	-1.3
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	4,001	4,271	4,552	4,805	Total (TWh)	0.0	-2.2	-5.1	-6.1	-4.3
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.8	326.0	343.1	Coal (GW)	0.0	0.0	-0.1	-0.2	-0.4
Other Fossil (GW)	301.5	369.7	396.5	469.1	512.9	Other Fossil (GW)	0.0	0.0	-0.8	-1.0	-0.6
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	889.7	953.7	1,010.3	Total (GW)	0.0	0.0	-1.0	-1.3	-1.0

Table 7-3. Standards Level 1b Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,159	1,241	1,322	1,375	Electricity Sales (TWh)	0.0	-2.7	-6.6	-9.6	-8.9
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,091	2,201	2,343	Coal (TWh)	0.0	-0.9	-0.9	-2.5	-5.0
Gas (TWh)	547	856	1,143	1,434	1,584	Gas (TWh)	0.0	-1.9	-6.0	-7.2	-4.0
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	4,000	4,269	4,548	4,800	Total (TWh)	0.0	-2.8	-6.9	-9.8	-9.1
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.8	325.9	342.8	Coal (GW)	0.0	0.0	-0.1	-0.3	-0.7
Other Fossil (GW)	301.5	369.7	396.2	468.5	512.2	Other Fossil (GW)	0.0	0.0	-1.1	-1.6	-1.3
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	889.5	953.1	1,009.3	Total (GW)	0.0	0.0	-1.2	-1.9	-2.0

Table 7-4. Standards Level 2a Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,158	1,240	1,322	1,377	Electricity Sales (TWh)	0.0	-3.7	-7.9	-9.8	-6.8
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,090	2,201	2,343	Coal (TWh)	0.0	-1.2	-1.8	-2.9	-4.9
Gas (TWh)	547	856	1,142	1,434	1,586	Gas (TWh)	0.0	-2.5	-6.5	-7.2	-2.1
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	3,999	4,268	4,548	4,802	Total (TWh)	0.0	-3.7	-8.3	-10.1	-7.0
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.7	325.9	342.8	Coal (GW)	0.0	0.0	-0.2	-0.3	-0.7
Other Fossil (GW)	301.5	369.7	395.9	468.4	512.5	Other Fossil (GW)	0.0	0.0	-1.4	-1.7	-1.0
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	889.1	952.9	1,009.6	Total (GW)	0.0	0.0	-1.6	-2.1	-1.7

Table 7-5. Standards Level 2b Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,158	1,237	1,316	1,370	Electricity Sales (TWh)	0.0	-4.4	-10.8	-15.7	-14.5
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,091	2,200	2,340	Coal (TWh)	0.0	-1.5	-1.4	-4.2	-8.2
Gas (TWh)	547	855	1,139	1,429	1,581	Gas (TWh)	0.0	-3.0	-9.9	-11.8	-6.6
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	3,998	4,265	4,542	4,794	Total (TWh)	0.0	-4.5	-11.3	-16.0	-14.9
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.7	325.8	342.4	Coal (GW)	0.0	0.0	-0.2	-0.4	-1.1
Other Fossil (GW)	301.5	369.6	395.5	467.4	511.3	Other Fossil (GW)	0.0	-0.1	-1.8	-2.7	-2.2
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	870.9	888.7	951.9	1,008.0	Total (GW)	0.0	-0.1	-2.0	-3.1	-3.3

Table 7-6. Standards Level 3a Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,159	1,242	1,324	1,378	Electricity Sales (TWh)	0.0	-2.6	-6.4	-8.3	-6.4
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,090	2,202	2,344	Coal (TWh)	0.0	-1.0	-1.5	-2.4	-4.1
Gas (TWh)	547	856	1,143	1,435	1,586	Gas (TWh)	0.0	-2.1	-5.5	-6.1	-1.8
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	4,000	4,269	4,549	4,803	Total (TWh)	0.0	-3.1	-7.0	-8.5	-5.9
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.7	325.9	342.9	Coal (GW)	0.0	0.0	-0.2	-0.3	-0.6
Other Fossil (GW)	301.5	369.7	396.1	468.6	512.7	Other Fossil (GW)	0.0	0.0	-1.2	-1.5	-0.8
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	889.4	953.2	1,009.9	Total (GW)	0.0	0.0	-1.3	-1.8	-1.4

Table 7-7. Standards Level 3b Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,159	1,239	1,318	1,370	Electricity Sales (TWh)	0.0	-3.2	-8.8	-13.8	-14.0
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,091	2,200	2,341	Coal (TWh)	0.0	-1.3	-1.3	-3.7	-7.4
Gas (TWh)	547	855	1,140	1,430	1,582	Gas (TWh)	0.0	-2.7	-8.8	-10.6	-5.9
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	3,999	4,266	4,544	4,796	Total (TWh)	0.0	-4.0	-10.1	-14.3	-13.3
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.7	325.8	342.5	Coal (GW)	0.0	0.0	-0.2	-0.4	-1.0
Other Fossil (GW)	301.5	369.7	395.6	467.7	511.5	Other Fossil (GW)	0.0	0.0	-1.7	-2.4	-2.0
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	888.9	952.2	1,008.3	Total (GW)	0.0	0.0	-1.8	-2.8	-3.0

Table 7-8. Standards Level 4a Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,159	1,241	1,323	1,377	Electricity Sales (TWh)	0.0	-2.9	-7.3	-9.2	-6.9
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,090	2,201	2,343	Coal (TWh)	0.0	-1.1	-1.7	-2.7	-4.6
Gas (TWh)	547	856	1,143	1,434	1,586	Gas (TWh)	0.0	-2.3	-6.1	-6.7	-2.0
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	4,000	4,268	4,549	4,802	Total (TWh)	0.0	-3.5	-7.8	-9.4	-6.6
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.7	325.9	342.8	Coal (GW)	0.0	0.0	-0.2	-0.3	-0.7
Other Fossil (GW)	301.5	369.7	396.0	468.5	512.6	Other Fossil (GW)	0.0	0.0	-1.3	-1.6	-0.9
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	889.2	953.1	1,009.7	Total (GW)	0.0	0.0	-1.5	-1.9	-1.6

Table 7-9. Standards Level 4b Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,158	1,238	1,317	1,369	Electricity Sales (TWh)	0.0	-3.6	-10.1	-15.1	-14.7
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,091	2,200	2,340	Coal (TWh)	0.0	-1.4	-1.4	-4.0	-8.0
Gas (TWh)	547	855	1,139	1,430	1,582	Gas (TWh)	0.0	-2.9	-9.5	-11.5	-6.4
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	3,999	4,265	4,543	4,795	Total (TWh)	0.0	-4.4	-10.9	-15.5	-14.4
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.7	325.8	342.4	Coal (GW)	0.0	0.0	-0.2	-0.4	-1.1
Other Fossil (GW)	301.5	369.6	395.5	467.5	511.4	Other Fossil (GW)	0.0	-0.1	-1.8	-2.6	-2.1
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	870.9	888.7	952.0	1,008.1	Total (GW)	0.0	-0.1	-2.0	-3.0	-3.2

Table 7-10. Standards Level 5a Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,161	1,246	1,329	1,382	Electricity Sales (TWh)	0.0	-1.1	-2.3	-2.9	-2.0
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,037	2,091	2,203	2,347	Coal (TWh)	0.0	-0.4	-0.5	-0.8	-1.4
Gas (TWh)	547	857	1,147	1,439	1,587	Gas (TWh)	0.0	-0.7	-1.9	-2.1	-0.6
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	4,002	4,274	4,555	4,807	Total (TWh)	0.0	-1.1	-2.4	-2.9	-2.0
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.8	326.1	343.3	Coal (GW)	0.0	0.0	-0.1	-0.1	-0.2
Other Fossil (GW)	301.5	369.7	396.9	469.6	513.2	Other Fossil (GW)	0.0	0.0	-0.4	-0.5	-0.3
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	890.2	954.4	1,010.8	Total (GW)	0.0	0.0	-0.5	-0.6	-0.5

Table 7-11. Standards Level 5b Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,161	1,245	1,327	1,380	Electricity Sales (TWh)	0.0	-1.3	-3.2	-4.6	-4.2
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,037	2,092	2,203	2,346	Coal (TWh)	0.0	-0.4	-0.4	-1.2	-2.4
Gas (TWh)	547	857	1,146	1,438	1,586	Gas (TWh)	0.0	-0.9	-2.9	-3.4	-1.9
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	4,002	4,273	4,553	4,805	Total (TWh)	0.0	-1.3	-3.3	-4.6	-4.3
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.8	326.1	343.2	Coal (GW)	0.0	0.0	-0.1	-0.1	-0.3
Other Fossil (GW)	301.5	369.7	396.8	469.3	512.9	Other Fossil (GW)	0.0	0.0	-0.5	-0.8	-0.6
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	890.1	954.1	1,010.3	Total (GW)	0.0	0.0	-0.6	-0.9	-1.0

Table 7-12. Standards Level 6a Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,160	1,243	1,325	1,379	Electricity Sales (TWh)	0.0	-2.5	-5.4	-6.6	-4.6
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,091	2,202	2,345	Coal (TWh)	0.0	-0.8	-1.2	-2.0	-3.3
Gas (TWh)	547	856	1,145	1,436	1,587	Gas (TWh)	0.0	-1.7	-4.4	-4.9	-1.4
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	4,000	4,270	4,551	4,804	Total (TWh)	0.0	-2.5	-5.6	-6.8	-4.7
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.8	326.0	343.0	Coal (GW)	0.0	0.0	-0.1	-0.2	-0.5
Other Fossil (GW)	301.5	369.7	396.4	468.9	512.8	Other Fossil (GW)	0.0	0.0	-0.9	-1.2	-0.7
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	889.6	953.6	1,010.1	Total (GW)	0.0	0.0	-1.1	-1.4	-1.2

Table 7-13. Standards Level 6b Forecast

NEMS-NAECA Results: Standards Level						Difference from AEO99 Reference					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial-Sector Energy Consumption						*Commercial-Sector Energy Consumption*					
Electricity Sales (TWh)	1,081	1,159	1,241	1,321	1,374	Electricity Sales (TWh)	0.0	-3.0	-7.4	-10.7	-9.8
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1,990	2,036	2,091	2,201	2,342	Coal (TWh)	0.0	-1.0	-0.9	-2.8	-5.6
Gas (TWh)	547	856	1,142	1,433	1,584	Gas (TWh)	0.0	-2.1	-6.7	-8.0	-4.5
Petroleum (TWh)	109	44	35	33	31	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	359	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	433	446	461	483	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3,729	4,000	4,268	4,547	4,799	Total (TWh)	0.0	-3.1	-7.6	-10.8	-10.1
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.0	318.8	325.9	342.7	Coal (GW)	0.0	0.0	-0.1	-0.3	-0.8
Other Fossil (GW)	301.5	369.7	396.0	468.3	512.0	Other Fossil (GW)	0.0	0.0	-1.3	-1.8	-1.5
Nuclear (GW)	94.8	87.4	74.2	56.4	48.9	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.2	98.9	100.3	102.3	105.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	808.7	871.0	889.3	952.9	1,009.1	Total (GW)	0.0	0.0	-1.4	-2.1	-2.2

Table 7-14. Standard Level 2b Low Economic Growth Utility Forecast

NEMS-EPCA Results: Standard Level						Difference from AEO99 Low Economic Growth					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial Sector Energy Consumption						*Commercial Sector Energy Consumption*					
Electricity Sales (TWh)	1080	1149	1217	1277	1313	Electricity Sales (TWh)	0.0	-4.4	-10.8	-15.7	-14.5
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1982	1999	2056	2125	2189	Coal (TWh)	0.0	-1.3	-3.7	-4.8	-6.4
Gas (TWh)	541	796	1015	1266	1407	Gas (TWh)	0.0	-3.2	-8.3	-11.5	-7.5
Petroleum (TWh)	110	43	33	30	28	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	627	551	411	343	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	423	432	440	449	460	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3716	3896	4095	4281	4427	Total (TWh)	0.0	-4.5	-12.0	-16.3	-13.9
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.1	314.6	315.3	319.3	326.6	Coal (GW)	0.0	0.0	-0.4	-0.6	-0.9
Other Fossil (GW)	300.8	355.4	368.2	430.6	464.3	Other Fossil (GW)	0.0	0.0	-1.5	-2.6	-2.4
Nuclear (GW)	94.8	86.6	73.4	55.3	47.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.1	98.7	99.7	100.9	102.6	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	807.8	855.3	856.6	906.1	940.5	Total (GW)	0.0	0.0	-1.9	-3.2	-3.3

Table 7-15. Standard Level 2b High Economic Growth Utility Forecast

NEMS-EPCA Results: Standard Level						Difference from AEO99 High Economic Growth					
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**
Commercial Sector Energy Consumption						*Commercial Sector Energy Consumption*					
Electricity Sales (TWh)	1081	1167	1259	1351	1422	Electricity Sales (TWh)	0.0	-4.4	-10.8	-15.7	-14.5
Total U.S. Electric Generation						*Total U.S. Electric Generation*					
Coal (TWh)	1993	2064	2146	2301	2545	Coal (TWh)	0.0	-1.4	-2.5	-4.6	-11.3
Gas (TWh)	557	927	1251	1576	1705	Gas (TWh)	0.0	-3.1	-8.8	-11.5	-3.5
Petroleum (TWh)	108	44	35	34	32	Petroleum (TWh)	0.0	0.0	0.0	0.0	0.0
Nuclear (TWh)	660	631	554	419	373	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	424	437	454	480	517	Renewables (TWh)	0.0	0.0	0.0	0.0	0.0
Total (TWh)	3742	4103	4441	4811	5171	Total (TWh)	0.0	-4.5	-11.3	-16.1	-14.8
Installed Generating Capacity						*Installed Generating Capacity*					
Coal (GW)	315.2	315.3	321.9	335.0	365.7	Coal (GW)	0.0	0.0	-0.1	-0.5	-1.5
Other Fossil (GW)	303.4	385.4	426.0	506.9	554.0	Other Fossil (GW)	0.0	0.0	-1.9	-2.5	-2.0
Nuclear (GW)	94.8	87.4	74.2	56.4	50.8	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	97.3	99.2	101.4	104.8	109.9	Renewables (GW)	0.0	0.0	0.0	0.0	0.0
Total (GW)	810.7	887.3	923.5	1003.1	1080.3	Total (GW)	0.0	0.0	-2.0	-3.0	-3.6