State Energy Efficiency in the AEO Electricity Forecasts

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1. EXECUTIVE SUMMARY

The Environmental Protection Agency (EPA) and many U.S. states rely on the Energy Information Administration's (EIA) Annual Energy Outlook (AEO) reference case electricity sales forecast for electric power sector modeling and emissions planning. The EIA's AEO reference case forecast includes some national energy efficiency (EE) and renewable energy (RE) policies, but does not include: 1) existing state EE policies and 2) future state EE policies. However, the EE savings from existing programs appears to be implicitly included through electricity sales forecasts. Planners and policymakers interested in the emissions impacts from reduced electricity sales associated with energy efficiency policies need to quantify embedded state EE policies to avoid double counting EE savings.[1] At the time of this report, which applies to AEO 2011, there is no explicit representation of state energy efficiency programs in the AEO methodology.[2]

In this paper we estimate the implicit effects of state energy efficiency embedded in the AEO forecasts using two calculation methods. Both calculations of ongoing energy efficiency embedded in EIA's electricity sales forecast are a function of:

1) Reported cumulative energy efficiency savings (GWh-years),[3]
2) Reported electricity sales (GWh),[4]
3) Average energy efficiency lifetime (years).

For each of the two calculation methods, we first divide reported cumulative energy efficiency savings by reported electricity sales. This provides the EE savings as a percentage of sales in a given year. We then divide the resulting amount by the average EE lifetime. For this analysis, we assume the average EE savings lifetime is 13 years.[5] The result is a percentage that represents the embedded ongoing effects of state EE efforts in the AEO forecast. The difference between the two calculation methods is the source of data for the starting point of reported cumulative energy efficiency savings. **Exhibit 1** shows the first approach uses sector survey year data based on the survey data. **Exhibit 2** shows the calculation for two recent data years: 2006 energy efficiency data as the starting point, since 2006 was the first year that the EIA incorporated the most recent end-use sector surveys (residential, commercial, and industrial) that were used to develop the AEO baseline sector electricity demand that then determines the AEO

[1] To properly calculate net energy savings, total program energy savings need to be reduced by the embedded EE/RE savings reflected in the AEO forecast. Additional information about EPA's goals can be found at: http://www.epa.gov/statelocalclimate/state/statepolicies.html.

[2] In this report, we will use "AEO" to refer to the EIA's general AEO methodology and results, and "AEO year" to refer to a specific AEO forecast. Thus AEO 2011 refers to the 2011 Annual Energy Outlook.

[3] Energy efficiency savings take from EIA's Electric Power Annual 2010 report available at http://eia.gov/electricity/annual/.

[4] Electricity sales information taken from EIA's Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/.

[5] The average lifetime assumption also assumes that the EE savings will be distributed equally over the 13-year period.

electricity sales forecast. The second calculation uses the most recent year of actual EE data available (2010 data for this report that is incorporated in AEO 2011). The summary calculations for both approaches are shown in the two exhibits below.

Exhibit 1: Summary of Embedded Forecast Based on End Use Sector Survey Year

Sector	Sector Survey Data Year	Cumulative EE Savings for Survey Year (GWh)	Sector Electricity Sales for Survey Year (GWh)	Cumulative Savings as Percentage of Electricity Sales	Embedded Savings Implied by Survey Data Year and Measure Life
		a	b	c=a/b	d=c/13
Residential	2005	19,255	1,359,227	1.42%	0.11%
Commercial	2003	25,089	1,198,727	2.09%	0.16%
Industrial	2006	13,348	1,011,297	1.32%	0.10%
All Sectors	**various**	**57,692**	**3,569,251**	**1.62%**	**0.12%**

Notes: EIA EE savings data from Electric Power Annual 2010 (Table 9.4 and Table 9.5) available at http://www.eia.gov/electricity/annual/. EIA electricity sales data from Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/. Sector savings taken from sector year data and does not sum to 2006 levels.

As noted above, the calculation method shown in **Exhibit 1** incorporates the effects of state EE policies captured in the end-use surveys (residential, commercial, and industrial sectors). However, this method does not incorporate the most recent historical data of actual electricity sales that are reflected in more recent AEOs. A summary of embedded EE forecast that incorporates more recent historical data is presented in **Exhibit 2** below.

Exhibit 2: Summary of Embedded EE Forecast Based on 2006 and 2010 Cumulative Savings

Sectors	Data Year	Cumulative EE Savings (GWh)	Electricity Sales (GWh)	Cumulative Savings as Percentage of Electricity Sales	Embedded Savings Implied by Survey Data Year and Measure Life
		a	b	c=(a/b)	d=c/13
All Sectors	2006	63,817	3,669,919	1.74%	0.13%
All Sectors	2010	87,750	3,746,781	2.34%	0.18%

Notes: EIA EE savings data from Electric Power Annual 2010 (Table 9.4 and Table 9.5) available at http://www.eia.gov/electricity/annual/. EIA electricity sales data from Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/

The advantage of using the most recent historical data is that EIA makes ongoing adjustments to the AEO forecasts to reflect the most recent energy sales data.

Across all sectors, our calculation of the embedded energy efficiency using the two methods ranges from about 0.13 percent to 0.18 percent of national electricity sales.

To determine state-level embedded savings from these national values, we use state-specific data for first-year EE savings reported by the American Council for an Energy-Efficient Economy (ACEEE).[6] We then appropriately scale state savings based on the above national numbers.[7] We apply the two calculations methods shown in **Exhibits 1** and **2** to each state, and in section 6 we present the calculated embedded savings for each state based on these methods.

2. BACKGROUND: EARLIER EFFORTS TO ASSESS EMBEDDED ENERGY EFFICIENCY SAVINGS IN AEO FORECASTS

Other analysts have previously attempted to quantify the amount of energy efficiency embedded in AEO forecasts, and this report builds upon these efforts. In 2009, researchers at the Lawrence Berkeley National Laboratory (LBNL) analyzed energy efficiency policies in the United States and the possible effects on AEO electricity sales forecasts.[8] In their paper, *Shifting Landscape of Ratepayer-Funded Energy Efficiency in the U.S.*, they concluded that the EIA's AEO reference case forecast includes a continuation of ratepayer-funded energy efficiency savings at 50 percent of the level achieved in 2008 based on the lack of precise data.[9]

In the technical appendix to that report, the LBNL researchers described how they came to the 50 percent figure, and how they applied that assumption to 2006 state-level EE savings to estimate embedded EE savings at the national level.[10] The study authors note the following:

> The NEMS model does not explicitly account for ratepayer-funded energy efficiency programs; however, it does model future energy efficiency improvements at the end-use level, which may be partly attributable to future ratepayer-funded energy efficiency programs. Lacking better information, we assumed that the baseline retail sales projections, derived from the AEO2009 forecasted growth rates, implicitly account for a continuation of ratepayer-funded energy efficiency programs with savings equal to 50% of historical levels, as summarized in Table 2. Historical savings at the level of each EMM region were calculated from data on actual savings achieved in each state from

[6] The ACEEE "State Energy Efficiency Scorecard" provides a more comprehensive analysis of all state EE efforts than does the EIA data since ACEEE includes non-utility programs excluded by EIA.

[7] The ACEEE's national first-year EE savings are scaled by the national embedded EE savings percentage to determine an embedded EE ratio. We then multiply the national embedded EE savings by the state first-year EE savings to determine a state-specific embedded EE percentage.

[8] LBNL 2009.

[9] Ibid, page 14.

[10] ACEEE 2008.

ratepayer-funded electric efficiency programs implemented in 2006, as compiled by ACEEE (Eldridge et al. 2008).[11]

Their findings are specific to the Electricity Market Module (EMM) region and range from 0.0 to 0.4 percent.[12]

This paper contains calculations at the state level that were not shown in the LBNL report. Our methodology improves upon the LBNL approach by taking into account 1) reported cumulative energy efficiency savings, 2) reported electricity sales, and 3) average energy efficiency measure lifetime to estimate the embedded EE savings in the AEO forecasts.

3. BACKGROUND: NEMS SECTOR COMPONENT MODULES

Our analysis of embedded energy efficiency stems from our understanding of the EIA's assumptions used to forecast electricity sales in its Annual Energy Outlook. EIA uses the energy-economic modeling systems called the National Energy Modeling System (NEMS). The NEMS model projects "the production, imports, conversion, consumption, and prices of energy" in the United States over a 25-year horizon.[13] According to the EIA, NEMS provides a consistent framework to represent the interactions of the U.S. energy system.[14] At a very high level, the NEMS model contains modules representing macroeconomic assumptions, international effects, supply, demand, electricity market effects, and petroleum market effects. Because the focus of the NEMS model is at the national level, the EIA's model is not granular enough to forecast at the state level. The exact construct and methodology are detailed at length by the EIA.[15]

With regards to energy efficiency policies, the NEMS model is primarily based on federal laws and regulations that have been enacted at the time of the EIA's projection. The EIA provides a summary of federal and state legislation incorporated in the NEMS modeling for each Annual Energy Outlook.[16] State energy efficiency policies are not explicitly included, although their effects are included in the historical sales values.

As a result, we approach this question by first investigating electricity sales forecast at the residential, commercial, and industrial sector modules that comprise the demand components of the NEMS

[11] LBNL 2009, page 25.

[12] The authors do not provide a national number in their discussion.

[13] http://www.eia.gov/oiaf/aeo/overview/.

[14] Ibid.

[15] http://www.eia.gov/oiaf/aeo/assumption/introduction.html.

[16] State legislation generally includes renewable portfolio standards detailed in Table 2 of "Annual Energy Outlook 2011 with Projections to 2035," EIA-0383(2011), April 2011. Page 8. Available at http://www.eia.gov/forecasts/archive/aeo11/pdf/0383(2011).pdf.

model.[17] These modules account for equipment and technology improvements, building and equipment stock turnover, and building shell improvements.

The data in end-use surveys include energy intensity (e.g., energy per household). EIA incorporates those intensity factors in its NEMS model and thus in its forecasting.[18] All other things being equal, the intensity factors would increase as energy efficiency measures expired, but EIA does not include that adjustment in its modeling. Thus, EIA assumes that new EE policies continue to maintain the end-use survey energy intensities.[19]

The following sections summarize the three end-use sector surveys that we analyzed.

3.1. Residential Sector

The EIA's residential electricity sales forecast incorporates the Residential Energy Consumption Survey (RECS) that was conducted in 2005.

The following passage from the AEO assumption documentation describes the residential sector demand module.[20]

> The NEMS Residential Demand Module projects future residential sector energy requirements based on projections of the number of households and the stock, efficiency, and intensity of energy-consuming equipment. (p.27)

The AEO assumptions document states the following about efficiency in the residential modeling:

> One of the implicit assumptions embodied in the Residential Demand Module is that, through 2035, there will be no radical changes in technology or consumer behavior. With the exception of efficiency levels described in consensus agreements among equipment manufacturers and efficiency advocates, no new regulations of efficiency beyond those currently embodied in law or new government programs fostering efficiency improvements are assumed. Technologies which have not gained widespread acceptance today will generally not achieve significant penetration by 2035. Currently available technologies will evolve in both efficiency and cost. In general, at the same efficiency level, future technologies will be less expensive, in real dollar terms, than those available today. When choosing new or replacement technologies, consumers will behave similarly to the way they now behave. The intensity of end-uses will change moderately in response to price changes. Electric end uses will continue to expand, but at a decreasing rate. (p30)

[17] The transportation sector is the other demand component, but not the subject of this analysis.

[18] EIA will incorporate future end-use surveys in future AEOs. However, we do not have specific knowledge of the exact timing.

[19] EIA does incorporate improvements in future federal appliance efficiency standards in its forecast.

[20] Available at http://www.eia.gov/forecasts/aeo/assumptions/pdf/residential.pdf

Two key statements from this passage are:

1. "There will be no radical changes in technology or consumer behavior."

2. "With the exception of efficiency levels described in consensus agreements among equipment manufacturers and efficiency advocates, no new regulations of efficiency beyond those currently embodied in law or new government policies fostering efficiency improvements are assumed."

Thus, there is no explicit representation of state energy efficiency programs in the AEO methodology. However, there are some possible ways that existing state energy efficiency policies might be affecting the AEO forecast implicitly. The implicit impacts of existing state EE policies are captured in the sector survey data. This affects the intensity of the end-use model coefficients in NEMS, which in turn drives the growth rates in the AEO demand forecast.

Additionally, our review of the historical AEO forecasts indicates that the model parameters are adjusted to reflect recent sales levels. However, these appear to be very specific adjustments.[21]

3.2. Commercial Sector

The commercial forecast is based on data from a 2003 Commercial Buildings Energy Consumption Survey (CBECS).

The EIA summarizes its methodology in its AEO assumptions document (emphasis added):

> Energy demands are projected for **ten end-use services** for **eleven building categories** in each of the **nine Census divisions**. The model begins by developing projections of **floorspace** for the 99 building category and Census division combinations. Next, the ten end-use service demands required for the projected floor space are developed. The electricity generation and water and space heating supplied by distributed generation and combined heat and power technologies are projected. **Technologies** are then chosen to meet the projected service demands for the seven major end uses. Once technologies are chosen, the energy consumed by the equipment stock (both existing and purchased equipment) is developed to **meet the projected end-use service demands**.

Thus, state program energy savings as of 2003 are likely reflected in the CBECs base data. Our review of the usage-related drivers in the commercial model suggests that there is no apparent connection with the effects of state EE efforts. As noted, the CBECs drivers are based on floorspace, equipment, building standards, technology improvements, and economic factors.

[21] For example, in AEO 2011 the EIA changed future coefficients for clothes dryers, refrigerators, and freezers.

3.3. Industrial Sector

The baseline data for the industrial model is the 2006 Unit Energy Consumption (UEC), based on the Manufacturing Energy Consumption Survey (MECS) of 2006. The following passage from the AEO assumptions documentation report describes the industrial sector demand module.

> The NEMS Industrial Demand Module estimates energy consumption by energy source (fuels and feedstocks) for 15 manufacturing and 6 non-manufacturing industries. The manufacturing industries are further subdivided into the energy-intensive manufacturing industries and non-energy-intensive manufacturing industries (Table 6.1). The manufacturing industries are modeled through the use of a detailed process-flow or end-use accounting procedure, whereas the non-manufacturing industries are modeled with substantially less detail. The petroleum refining industry is not included in the Industrial Module, as it is simulated separately in the Petroleum Market Module of NEMS. (p.51)

The industrial sector is even more disparate than the other sectors and is based on 15 manufacturing and nonmanufacturing industries. The EIA models energy-intensive industries in some detail, as indicated below:

> The energy-intensive industries (food products, paper and allied products, bulk chemicals, glass and glass products, cement, iron and steel, and aluminum) are modeled in considerable detail. Each industry is modeled as three separate but interrelated components: the Process and Assembly (PA) Component, the Buildings (BLD) Component, and the Boiler, Steam, and Cogeneration (BSC) Component. The BSC Component satisfies the steam demand from the PA and BLD Components. In some industries, the PA Component produces byproducts that are consumed in the BSC Component. For the manufacturing industries, the PA Component is separated into the major production processes or end uses.[22]

We note that industrial electricity use has been declining since 1990, as many industrial activities have moved offshore. However, AEO 2011 is forecasting a slight increase to 2013 and level usage thereafter.

4. CALCULATION METHODOLOGY 1: SECTOR-SPECIFIC SURVEY YEAR

Based on the end-use survey methodology described above, we calculate the embedded EE savings for each sector based on the year of the most recent completed end-use sector survey in the NEMS model.

[22] *Assumptions to the Annual Energy Outlook 2010.* Available at http://www.eia.gov/oiaf/aeo/assumption/industrial.html.

For the residential sector this is 2005, for the commercial sector this is 2003, and for the industrial sector this is 2006.

4.1. Residential Sector

The most recent residential sector survey year data is from the 2005 RECS. For 2005, EIA reported residential cumulative EE savings of 19,255 GWh, or 1.42 percent of the residential sector electricity sales as shown in **Exhibit 3**.

Exhibit 3: Residential Calculations Based on 2005 Survey Year

AEO Survey Data Year	Survey Year Cumulative EE Savings (GWh)	Survey-Year Commercial Sector Sales (GWh)	Cumulative Savings Percentage of Survey Year Sector Sales	Embedded Savings Implied by Survey Data Year and Measure Life
	a	b	c=(a/b)	d=c/13
2005	19,255	1,359,227	1.42%	0.11%

Notes: Column a from EIA Electric Power Annual 2010 (Table 9.4) available at http://www.eia.gov/electricity/annual/. Column b from EIA Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/. Column e from EIA Electric Power Annual 2010 (Table 9.5).

We calculate the residential embedded EE savings based on cumulative EE saving as a percentage of electricity sales of 1.42 percent divided by our assumed 13-year EE measure life. The resulting calculation shown in column d of **Exhibit 3** indicates that the embedded EE savings for the residential sector is 0.11 percent based on 2005 data.

4.2. Commercial Sector

In reviewing the commercial sector forecasting methodology, there are no obvious linkages to state energy efficiency policies. However, there are two possible ways that existing energy efficiency might be affecting the AEO forecast: 1) effects on the sector survey year levels and 2) changes in efficiency and intensity trends.

The most recent commercial sector survey year data are from the 2003 Commercial Building Energy Consumption Survey (CBECS). For 2003, EIA reported commercial cumulative EE savings of 25,089 GWh, or 2.09 percent of the commercial sector electricity sales as shown in **Exhibit 4**.

Exhibit 4: Commercial Sector Calculations Based on 2003 Survey Year

AEO Survey Data Year	Survey Year Cumulative EE Savings (GWh)	Survey-Year Commercial Sector Sales (GWh)	Cumulative Savings Percentage of Survey Year Sector Sales	Embedded Savings Implied by Survey Data Year and Measure Life
	a	b	c=(a/b)	d=c/13
2003	25,089	1,198,727	2.09%	0.16%

Notes: Column a from EIA Electric Power Annual 2010 (Table 9.4) available at http://www.eia.gov/electricity/annual/. Column b from EIA Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/. Column e from EIA Electric Power Annual 2010 (Table 9.5).

We calculate the commercial embedded EE savings based on cumulative EE saving as a percentage of electricity sales of 2.09 percent divided by our assumed 13-year EE measure life. The resulting calculation, shown in column d of **Exhibit 4**, indicates that the embedded EE savings for the residential sector is 0.16 percent based on 2003 data.

4.3. Industrial Sector

The most recent industrial survey sector year data are from the 2006 Industrial Building Energy Consumption Survey (IBECS). For 2006, EIA reported cumulative industrial EE savings of 13,348 GWh, or 2.09 percent of the industrial sector electricity sales as shown in **Exhibit 5**.

Exhibit 5: Industrial Sector Calculations Based on 2006 Survey Year

AEO Survey Data Year	Survey Year Cumulative EE Savings (GWh)	Survey-Year Commercial Sector Sales (GWh)	Cumulative Savings Percentage of Survey Year Sector Sales	Embedded Savings Implied by Survey Data Year and Measure Life
	a	b	c=(a/b)	d=c/13
2006	13,348	1,011,297	1.31%	0.10%

Notes: Column a from EIA Electric Power Annual 2010 (Table 9.4) available at http://www.eia.gov/electricity/annual/. Column b from EIA Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/. Column e from EIA Electric Power Annual 2010 (Table 9.5).

We calculate the industrial embedded EE savings based on cumulative EE saving as a percentage of electricity sales of 1.31 percent divided by our assumed 13-year EE measure life. The resulting calculation shown in column d of **Exhibit 5** indicates that the embedded EE savings for the residential sector is 0.10 percent based on 2006 data.

Exhibit 6 summarizes the embedded EE savings based on the sector survey year data for the three end-use sectors.

Exhibit 6: Embedded EE Savings Based on Sector Survey Year Data

Sector	Survey Data Year	Survey Year Cumulative EE Savings (GWh)	Sector Electricity Sales for Survey Year (GWh)	Survey Year Cumulative Savings as Fraction of Electricity Sales	Embedded Savings Implied by Survey Data Year and Measure Life
		a	b	c=a/b	d=c/13
Residential	2005	19,255	1,359,227	1.42%	0.11%
Commercial	2003	25,089	1,198,727	2.09%	0.16%
Industrial	2006	13,348	1,011,297	1.31%	0.10%
All Sectors (total)	various	57,692	3,569,251	1.61%	0.12%

Notes: EIA EE savings data from Electric Power Annual 2010 (Table 9.4 and Table 9.5) available at http://www.eia.gov/electricity/annual/. EIA electricity sales data from Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/. Sector savings taken from survey year data and does not sum to 2006 levels.

Exhibit 6 indicates that the national overall embedded EE savings based on end-use survey data years is 0.12 percent. The next section describes our calculations based on data from AEO.

5. CALCULATION METHODOLOGY 2: RECENT YEAR

In each Annual Energy Outlook, we presume that the EIA makes adjustments in its electricity sales forecast to account for recent historical data. While we do not have knowledge of the exact magnitude and mechanism of those adjustments, the most recent sales figures do reflect the most recent EE savings effects. This section shows the calculations for two years: 2006 and 2010. The 2006 data year reflects the first year that the most recent residential, commercial, and industrial surveys were incorporated in an AEO forecast. The 2010 data year reflects the most recent year that we have energy efficiency data from EIA.

Exhibit 7 summarizes the embedded EE savings at the sector and national level based on 2006 AEO data.

Exhibit 7: Implied National Savings Required to Maintain Base Energy Intensity Levels for 2006

Sector	Cumulative EE Savings (GWh)	Electricity Sales (GWh)	Cumulative Savings as Fraction of Electricity Sales	Embedded Savings Implied by Survey Data Year and Measure Life
	a	b	c=a/b	d=c/13
Residential	21,437	1,351,520	1.59%	0.12%
Commercial	28,982	1,299,744	2.23%	0.17%
Industrial	13,348	1,011,298	1.32%	0.10%
Transportation	50	7,358	0.68%	0.05%
All Sectors	63,817	3,669,919	1.74%	0.13%
All Sectors Excluding Transportation	63,767	3,662,562	1.74%	0.13%

Notes: We include transportation to sum to reported savings and sales. EIA EE savings data from Electric Power Annual 2010 (Table 9.4 and Table 9.5) available at http://www.eia.gov/electricity/annual/. EIA electricity sales data from Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/.

The 2006 data indicate that embedded EE savings are 0.13 percent at the national level based on reported cumulative EE savings, electricity sales, and a 13-year average EE measure life. This value compares to the 0.12 percent from **Exhibit 6** embedded EE savings aggregated from the sector survey year data.

Exhibit 8 summarizes the embedded EE savings at the sector and national level based on 2010 AEO data.

Exhibit 8: Implied National Savings Required to Maintain Base Energy Intensity Levels for 2010

Sector	Cumulative EE Savings (GWh)	Electricity Sales (GWh)	Cumulative Savings as Fraction of Electricity Sales	Embedded Savings Implied by Survey Data Year and Measure Life
	a	b	c=a/b	d=c/13
Residential	32,436	1,445,708	2.24%	0.17%
Commercial	37,659	1,330,199	2.83%	0.22%
Industrial	17,655	970,873	1.82%	0.14%
Transportation	89	7,712	1.16%	0.10%
All Sectors	87,839	3,754,493	2.34%	0.18%
All Sectors Excluding Transportation	87,750	3,746,780	2.34%	0.18%

Notes: We include transportation to sum to reported savings and sales. EIA EE savings data from Electric Power Annual 2010 (Table 9.4 and Table 9.5) available at http://www.eia.gov/electricity/annual/. EIA electricity sales data from Retail Sales of Electricity by State by Sector by Provider (EIA-861) available at http://www.eia.gov/electricity/data/state/.

The 2010 data indicate that embedded EE savings are 0.18 percent at the national level based on reported cumulative EE savings, electricity sales, and a 13-year average EE measure life.

Using this calculation methodology, we find the embedded EE savings to range from 0.13 to 0.18 percent based on the vintage of the data. More recent EIA data and AEO vintages will reflect more recent EE policies that may not be captured in earlier data.

6. CALCULATION OF STATE ENERGY EFFICIENCY SAVINGS USING 2006 AND 2010 DATA

In order to calculate state-specific embedded EE savings, we need to obtain state-specific EE savings and electricity sales data. Since AEO does not perform state-level analysis and the EIA savings data does not adequately reflect non-utility policies in a number of states, we use the State Energy Efficiency Scorecard that the ACEEE (American Center for an Energy-Efficient Economy) publishes annually, which reflects all EE efforts within a state.[23]

The ACEEE data only reports first-year savings. For this analysis, we assume that the cumulative state savings within each state are generally proportional to the first-year savings. Thus, if we adjust our embedded EE savings at the national level to national first-year EE savings, we can calculate state-level embedded EE savings with state-specific EE savings and electricity sales.[24]

Since we conduct this calculation using the national embedded EE savings for 2006 and 2010 data, we reviewed the first-year EE savings estimates from ACEEE and EIA in 2006 and 2010. The 2006 ACEEE data indicates that the national first-year EE savings is 0.21 percent. EIA reports first-year EE savings of 0.15 percent for 2006.[25] Because 2010 ACEEE data was not available at the time of this analysis, we use 2009 state data for the 2010 analysis. The 2009 ACEEE data indicates that national first-year EE savings are 0.37 percent compared to EIA's reported first-year EE savings of 0.36 percent for 2009 and 2010.[26]

Exhibit 9 and **Exhibit 10** present our calculations of state-level embedded energy efficiency savings for 2006 and 2010. In **Exhibit 9**, Column a presents the reported first-year EE savings by state for 2006. Column b presents the embedded savings percentage based on column a multiplied by the calibration value of 0.63. The calibration value is the national embedded EE savings level of 0.13 percent from **Exhibit 7** divided by the ACEEE national first-year average of 0.21 percent (0.63 = 0.13/0.21). Columns c

[23] ACEEE incorporates non-utility energy efficiency policies, such as those in Vermont and Maine.

[24] The ACEEE analysis includes non-utility energy efficiency programs that are not captured in the EIA data.

[25] EE savings taken from Tables 9.4 and 9.5 from EIA's "Electric Power Annual 2010." Electricity sales taken from EIA's "Retail Sales of Electricity by State by Sector by Provider (EIA-861)."

[26] EE savings taken from Tables 9.4 and 9.5 from EIA's "Electric Power Annual 2010." Electricity sales taken from EIA's "Retail Sales of Electricity by State by Sector by Provider (EIA-861)."

and d show the reported electricity sales and the amount of embedded savings based on the calculations shown in columns a and b.

Exhibit 9: State Embedded Savings Based on 2006 Data

2006 Electricity Embedded Savings by State based on ACEEE				
State	First-Year Savings	Embedded Savings Level	2006 Sales (GWh)	Embedded Savings (GWh)
	A	b=a*(0.13/0.21)	c	d=b*c
AK	0.02%	0.01%	6,182	0.7
AL	0.01%	0.01%	90,678	5.3
AR	0.00%	0.00%	46,636	0.0
AZ	0.17%	0.11%	73,253	77.5
CA	0.73%	0.46%	262,959	1,200.8
CO	0.12%	0.08%	49,734	37.7
CT	1.04%	0.65%	31,677	206.0
DC	0.00%	0.00%	11,396	0.0
DE	0.00%	0.00%	11,555	0.0
FL	0.13%	0.08%	228,220	189.1
GA	0.00%	0.00%	134,834	1.6
HI	0.64%	0.40%	10,568	42.7
IA	0.73%	0.46%	43,337	197.4
ID	0.66%	0.42%	22,762	94.8
IL	0.00%	0.00%	142,448	0.1
IN	0.01%	0.01%	105,664	7.9
KS	0.00%	0.00%	39,751	0.0
KY	0.13%	0.08%	88,743	74.1
LA	0.00%	0.00%	77,468	0.0
MA	0.81%	0.51%	55,850	285.8
MD	0.00%	0.00%	63,173	0.1
ME	0.61%	0.38%	12,285	47.0
MI	0.00%	0.00%	108,018	0.0
MN	0.55%	0.35%	66,770	232.6
MO	0.00%	0.00%	82,015	2.4
MS	0.01%	0.01%	46,936	3.4
MT	0.47%	0.29%	13,815	40.6
NC	0.00%	0.00%	126,699	1.9
ND	0.00%	0.00%	11,245	0.2
NE	0.02%	0.01%	27,276	3.4
NH	0.67%	0.42%	11,094	46.4
NJ	0.29%	0.18%	79,681	143.0
NM	0.00%	0.00%	21,435	0.1
NV	0.62%	0.39%	34,586	135.7
NY	0.57%	0.36%	142,238	511.4
OH	0.00%	0.00%	153,429	0.2
OK	0.00%	0.00%	54,905	0.0
OR	0.77%	0.48%	48,069	232.3
PA	0.00%	0.00%	146,150	1.4
RI	1.23%	0.77%	7,799	60.3
SC	0.02%	0.01%	80,877	9.2

2006 Electricity Embedded Savings by State based on ACEEE				
State	First-Year Savings	Embedded Savings Level	2006 Sales (GWh)	Embedded Savings (GWh)
	A	b=a*(0.13/0.21)	c	d=b*c
SD	0.00%	0.00%	10,056	0.0
TN	0.06%	0.04%	103,932	38.5
TX	0.12%	0.07%	342,724	249.5
UT	0.46%	0.29%	26,366	76.0
VA	0.00%	0.00%	106,721	0.0
VT	1.08%	0.68%	5,795	39.5
WA	0.74%	0.47%	85,033	396.1
WI	0.49%	0.31%	69,821	216.2
WV	0.00%	0.00%	32,312	0.0
WY	0.00%	0.00%	14,947	0.0
US	**0.21%**	**0.13%**	**3,669,919**	**4,909**

Exhibit 10 presents the state-level embedded savings for 2010 based on first-year savings reported by ACEEE for 2009 and applied to 2010 electricity sales.[27] Column a presents the reported first-year EE savings by state. Column b presents the embedded savings percentage based on Column a multiplied by the calibration value of 0.49. The calibration value is the national embedded EE savings level of 0.18 percent from **Exhibit 8** divided by the ACEEE national first-year average of 0.37 percent (0.49 = 0.18/0.37). The embedded savings is the first-year savings multiplied by the calibration value of 0.49. Columns c and d show the reported electricity sales and the amount of embedded savings based on the calculations shown in columns a and b.

Exhibit 10: State Embedded Savings Based on 2010 Data

2010 State Electricity Embedded Savings based on ACEEE				
State	First-Year Savings	Embedded Savings Level	2010 Sales (GWh)	Embedded Savings (GWh)
	A	b=a*(0.18/0.37)	c	d=b*c
AK	0.02%	0.01%	6,247	0.6
AL	0.08%	0.04%	90,863	35.4
AR	0.14%	0.07%	48,194	32.9
AZ	0.78%	0.38%	72,833	277.0
CA	0.88%	0.43%	258,531	1,109.2
CO	0.50%	0.24%	52,918	129.0
CT	0.84%	0.41%	30,392	124.5
DC	0.46%	0.22%	11,877	26.6
DE	0.00%	0.00%	11,606	0.0
FL	0.16%	0.08%	231,210	180.4
GA	0.04%	0.02%	140,672	27.4
HI	1.12%	0.55%	10,017	54.7
IA	0.94%	0.46%	45,445	208.3

[27] From the ACEEEE 2011 Scorecard.

2010 State Electricity Embedded Savings based on ACEEE				
State	**First-Year Savings**	**Embedded Savings Level**	**2010 Sales (GWh)**	**Embedded Savings (GWh)**
	A	b=a*(0.18/0.37)	c	d=b*c
ID	0.82%	0.40%	22,798	91.1
IL	0.40%	0.20%	144,761	282.3
IN	0.04%	0.02%	105,994	20.7
KS	0.00%	0.00%	40,421	0.0
KY	0.07%	0.03%	93,569	31.9
LA	0.00%	0.00%	85,080	0.0
MA	0.84%	0.41%	57,123	234.0
MD	0.44%	0.21%	65,335	140.2
ME	0.83%	0.40%	11,532	46.7
MI	0.38%	0.19%	103,649	192.0
MN	1.00%	0.49%	67,800	330.6
MO	0.11%	0.05%	86,085	46.2
MS	0.07%	0.03%	49,687	17.0
MT	0.40%	0.20%	13,423	26.2
NC	0.04%	0.02%	136,415	26.6
ND	0.02%	0.01%	12,956	1.3
NE	0.23%	0.11%	29,849	33.5
NH	0.64%	0.31%	10,890	34.0
NJ	0.66%	0.32%	79,179	254.8
NM	0.27%	0.13%	22,428	29.5
NV	1.28%	0.62%	33,773	210.8
NY	0.68%	0.33%	144,624	479.5
OH	0.36%	0.18%	154,145	270.6
OK	0.04%	0.02%	57,846	11.3
OR	0.61%	0.30%	46,026	136.9
PA	0.19%	0.09%	148,964	138.0
RI	1.07%	0.52%	7,799	40.7
SC	0.06%	0.03%	82,479	24.1
SD	0.20%	0.10%	11,356	11.1
TN	0.13%	0.06%	103,522	65.6
TX	0.22%	0.11%	358,458	384.5
UT	0.64%	0.31%	28,044	87.5
VA	0.00%	0.00%	113,806	0.0
VT	1.64%	0.80%	5,595	44.7
WA	0.74%	0.36%	90,380	326.1
WI	0.88%	0.43%	68,752	295.0
WV	0.00%	0.00%	32,032	0.0
WY	0.04%	0.02%	17,113	3.3
US	**0.37%**	**0.18%**	**3,754,493**	**6,574**

7. CONCLUSIONS AND FINDINGS

State energy efficiency policies are not explicitly included in the AEO modeling, yet state policies have impacted the end usage and intensity levels incorporated in the EIA's modeling. This paper shows calculations based on two approaches: survey year and recent year data (shown for two recent years).

The first approach uses 2006 energy efficiency data as the starting point to reflect the first year that incorporates the EIA's most recent end-use sector surveys (residential, commercial, and industrial) that were used to develop the AEO baseline sector electricity demand that then determines the AEO electricity sales forecast. The first approach results in mixing survey year data depending on the end-use sector surveys. The second approach uses the recent year of actual EE data available (2006 and 2010 for this report). We show calculations for this approach using two data years: 2006, the first year that all three end use-sector surveys were incorporated by the EIA; and 2010, currently available data at the time of this study. Our calculations for the two methodologies represent a reasonable range of national embedded energy efficiency in the AEO electricity sales forecast.

Our calculations of the embedded EE savings levels range from 0.13 to 0.18 percent of electricity sales per year based on 2006 and 2010 data. The 2006 embedded EE savings of 0.13 percent reflect the first year incorporating end-use sector surveys. The 2010 embedded EE savings of 0.18 percent reflect the most recent historical data. These values represent the ongoing energy efficiency efforts embedded throughout the AEO forecast period. Therefore, we recommend using the most recent AEO forecast when calculating embedded EE savings, since the forecast will include the most recent electricity sales that are implicitly accounting for state level EE policies.

We determine state-level embedded savings from these national values by using state-specific data for first-year EE savings reported by the ACEEE. We appropriately scale state savings based on the national embedded EE savings percentages. Our two calculation methods suggest that state-specific embedded EE savings range from 0 to 0.8 percent.

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