



United States
Environmental Protection
Agency



State Climate and Energy Program

Estimating Greenhouse Gas Emissions from Electricity Consumption: EPA's New SIT Module

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Overview



- What is the State Inventory Tool?
- How are Electricity Consumption Emissions Estimated?
 - Overview
 - Activity Data
 - Emission and Transmission Loss Factors
- How are Results Displayed?

State Inventory Tool Background

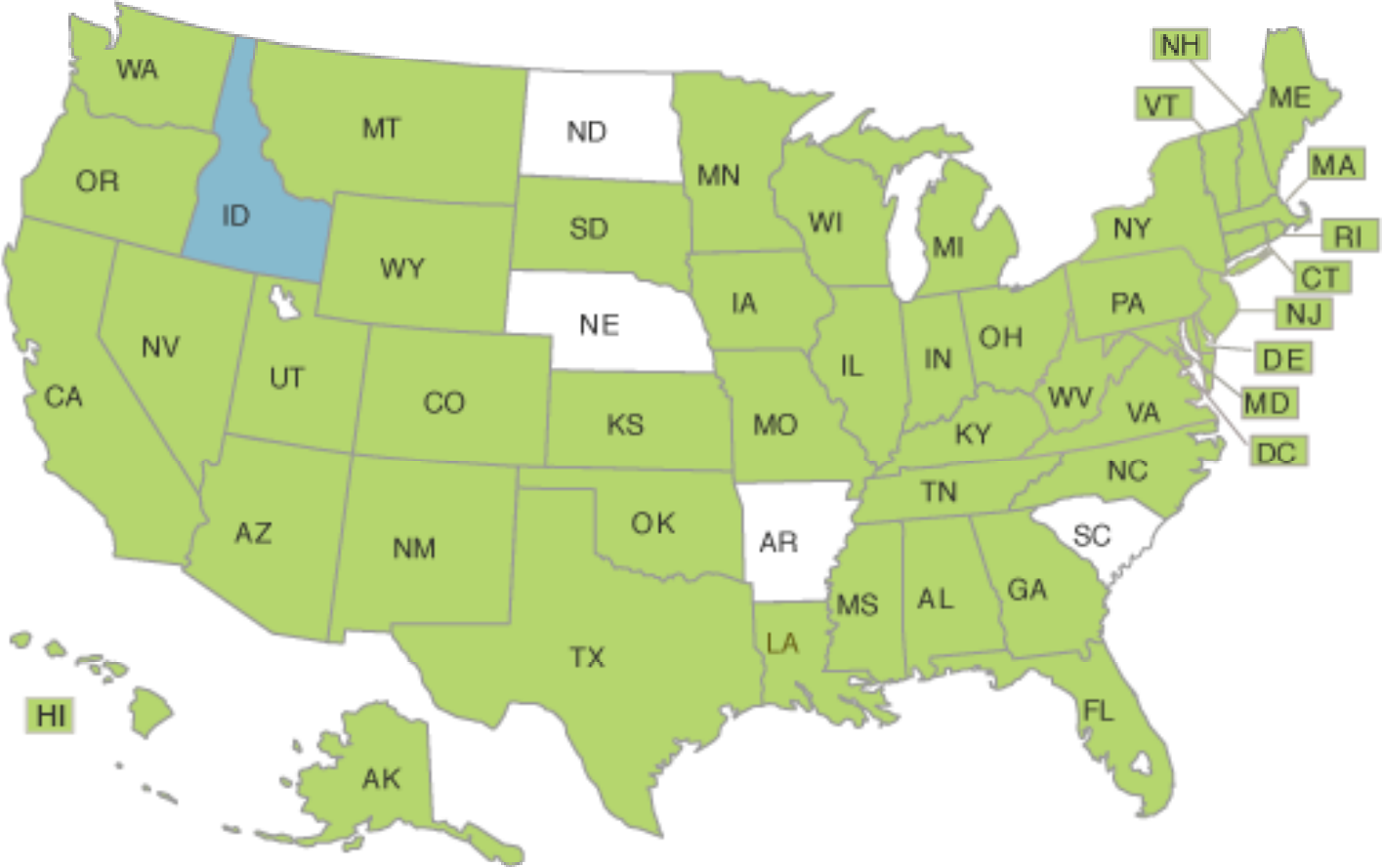


- EPA's State and Local Program began in 1990s
- Developed the *State Workbook* for estimating state GHG emissions; later became Vol. VIII EIIP
- Inventories are time-intensive
 - Collecting the data
 - Identifying the correct emission factors
 - Setting up the infrastructure to calculate emissions
- Inventories for a single year in the 1990s are insufficient for mitigation planning in 2010
- Trends are a necessity: projecting emissions, identifying and prioritizing mitigation activities, setting targets, and creating action plans

State Inventory Tool Background



State Climate and Energy Program



Sector Modules



- **CO₂ from Fossil Fuel Combustion**
- **CH₄ and N₂O from Stationary Combustion**
- **CH₄ and N₂O from Mobile Combustion**
- **Natural Gas and Oil Systems**
- **Coal Mining**
- **Industrial Processes**
- **Agriculture**
- **Municipal Solid Waste**
- **Wastewater**
- **Land-Use Change and Forestry**
- **Electricity Consumption Module**



Electricity Consumption Module Overview



- Calculates *indirect* GHGs from electricity consumption
- Categorized into 4 main end-use sectors: industrial, transportation, residential, commercial
 - Activity data from publicly available resources
- Uses eGRID emission and transmission loss factors

Indirect Electricity Emissions = Total State Consumption (kWh) × End-Use Equipment Consumption (%) × [Emission Factor (lbs CO₂E/kWh) × (1+ Transmission Loss Factor (%))]

Electricity Consumption Module Overview



- Direct vs. indirect GHG emissions
 - Direct emissions: combustion of fossil fuels at the electricity generating station
 - Indirect emissions: attributed to the point of use (e.g., residential electricity consumption), include transmission and distribution losses
- EPA encourages states to:
 - Include direct emissions in inventory totals
 - Include indirect emissions as a separate line item
 - To inform potential mitigation actions
 - To avoid double counting

Electricity Consumption Module: Activity Data



- Input cells for total electricity consumption
 - Total consumption, by sector (residential, commercial, transportation, industrial)
 - Total consumption disaggregated to end-use equipment
 - Default data from EIA's State Energy Data System

*Indirect Electricity Emissions = **Total State Consumption (kWh)** × End-Use Equipment Consumption (%) × [Emission Factor (lbs CO₂E/kWh) × (1+ Transmission Loss Factor (%))]*

Electricity Consumption Module: Activity Data



- Input cells for end-use equipment type, by sector
- Default data from publicly available resources
 - Residential, commercial, industrial: EIA surveys (RECS, CBECS, and MECS)
 - Transportation: Federal Transit Administration's National Transit Database (NTD)
- Regional consumption percentages for end-use equipment assigned to states

*Indirect Electricity Emissions = Total State Consumption (kWh) × **End-Use Equipment Consumption (%)** × [Emission Factor (lbs CO₂E/kWh) × (1+ Transmission Loss Factor (%))]*

Electricity Consumption Module: Activity Data



Sector	End-Use Equipment	
Residential	<ul style="list-style-type: none"> • Space Heating • Air-conditioning • Water Heating 	<ul style="list-style-type: none"> • Refrigeration • Other Appliances and Lighting
Commercial	<ul style="list-style-type: none"> • Space Heating • Cooling • Ventilation • Water Heating • Lighting 	<ul style="list-style-type: none"> • Cooking • Refrigeration • Office Equipment • Computers • Other
Industrial	<p>Indirect Uses- Boiler Fuel</p> <ul style="list-style-type: none"> • Conventional Boiler Use • CHP and/or Cogeneration Process <p>Direct Uses- Total Process</p> <ul style="list-style-type: none"> • Process Heating • Process Cooling and Refrigeration • Machine Drive • Electro-Chemical Processes 	<ul style="list-style-type: none"> • Other Process Use <p>Direct Uses- Total Nonprocess</p> <ul style="list-style-type: none"> • Facility HVAC • Facility Lighting • Other Facility Support • Onsite Transportation • Other Nonprocess Use
Transportation	<ul style="list-style-type: none"> • Automated Guideway • Bus (charged batteries) • Cable Car • Commuter Rail • Heavy Rail 	<ul style="list-style-type: none"> • Inclined Plane • Light Rail • Trolleybus • Other

Electricity Consumption Module: Activity Data



State Inventory Tool - Indirect CO2 Emissions from Electricity Consumption

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3. Residential Electricity Consumption in Colorado

Click here for information on data sources

Indirect CO₂ emissions from electricity consumption in the residential sector are calculated by multiplying state energy consumption (total kWh consumed in the residential sector) by the percentage of state consumption by residential end-use. The resulting sub-sector consumption values (kWh) are then multiplied by a state-specific emission factor (lbs CO₂E/kWh) and transmission line losses. The resulting emissions values, in pounds of carbon, are converted to short tons of carbon, million metric tons of carbon equivalent (MMTCE), then to million metric tons of carbon dioxide equivalent (MMTCE), and summed.

Go to the Control Sheet

Go to the MMTCE Summary Sheet

Check All Boxes

Clear All Data

Residential 2000 Default Consumption Data? Default Percent Data?

Sub-sector	Total State Consumption (kWh)	Sub-sector % of State Consumption (%)	Sub-sector Consumption (kWh)	Emission Factor (lbs CO ₂ E/kWh)	Transmission loss Factor (%)	Emission Factor Including losses (lbs CO ₂ E/kWh)	Emissions (lbs carbon)	Emissions (short tons carbon)
Space Heating		12.9%	1,807,954,557	1.88	5.3%	1.98	974,320,825	487,160
Air-conditioning		7.7%	1,084,772,734	1.88	5.3%	1.98	584,592,495	292,296
Water Heating		9.3%	1,301,727,281	1.88	5.3%	1.98	701,510,994	350,755
Refrigeration		14.4%	2,024,909,104	1.88	5.3%	1.98	1,091,239,324	545,620
Other Appliances and Lighting		55.7%	7,810,363,688	1.88	5.3%	1.98	4,209,065,964	2,104,533
TOTAL	14,029,727,365	100.0%	14,029,727,365	1.88	5.3%	1.98	7,560,729,601	3,780,365

Residential 2001 Default Consumption Data? Default Percent Data?

Sub-sector	Total State Consumption (kWh)	Sub-sector % of State Consumption (%)	Sub-sector Consumption (kWh)	Emission Factor (lbs CO ₂ E/kWh)	Transmission loss Factor (%)	Emission Factor Including losses (lbs CO ₂ E/kWh)	Emissions (lbs carbon)	Emissions (short tons carbon)
Space Heating			-	1.88	5.3%	1.98	-	-
Air-conditioning			-	1.88	5.3%	1.98	-	-
Water Heating			-	1.88	5.3%	1.98	-	-
Refrigeration			-	1.88	5.3%	1.98	-	-
Other Appliances and Lighting			-	1.88	5.3%	1.98	-	-
TOTAL				1.88	5.3%	1.98		

Residential 2002 Default Consumption Data? Default Percent Data?

Sub-sector	Total State Consumption (kWh)	Sub-sector % of State Consumption (%)	Sub-sector Consumption (kWh)	Emission Factor (lbs CO ₂ E/kWh)	Transmission loss Factor (%)	Emission Factor Including losses (lbs CO ₂ E/kWh)	Emissions (lbs carbon)	Emissions (short tons carbon)
Space Heating				1.88	5.3%	1.98		
Air-conditioning				1.88	5.3%	1.98		
Water Heating				1.88	5.3%	1.98		
Refrigeration				1.88	5.3%	1.98		
Other Appliances and Lighting				1.88	5.3%	1.98		
TOTAL				1.88	5.3%	1.98		

Navigation: Control / EF Selection / Residential C / Commercial C / Transportation C / Industrial C / Summary-MMTCE / Data Sources / Transport Breakout

Electricity Consumption Module: Electricity and Transmission Loss Factors



- Input cells for emission and transmission loss factors
 - Default state emission and transmission loss factors from EPA's Emissions & Generation Resource Integrated Database (eGRID)
 - Emission factor: plant-specific factors for U.S. electricity generating plants providing power to the electric grid
 - Transmission loss factor: accounts for transmission and distribution losses between the point of generation and the point of consumption

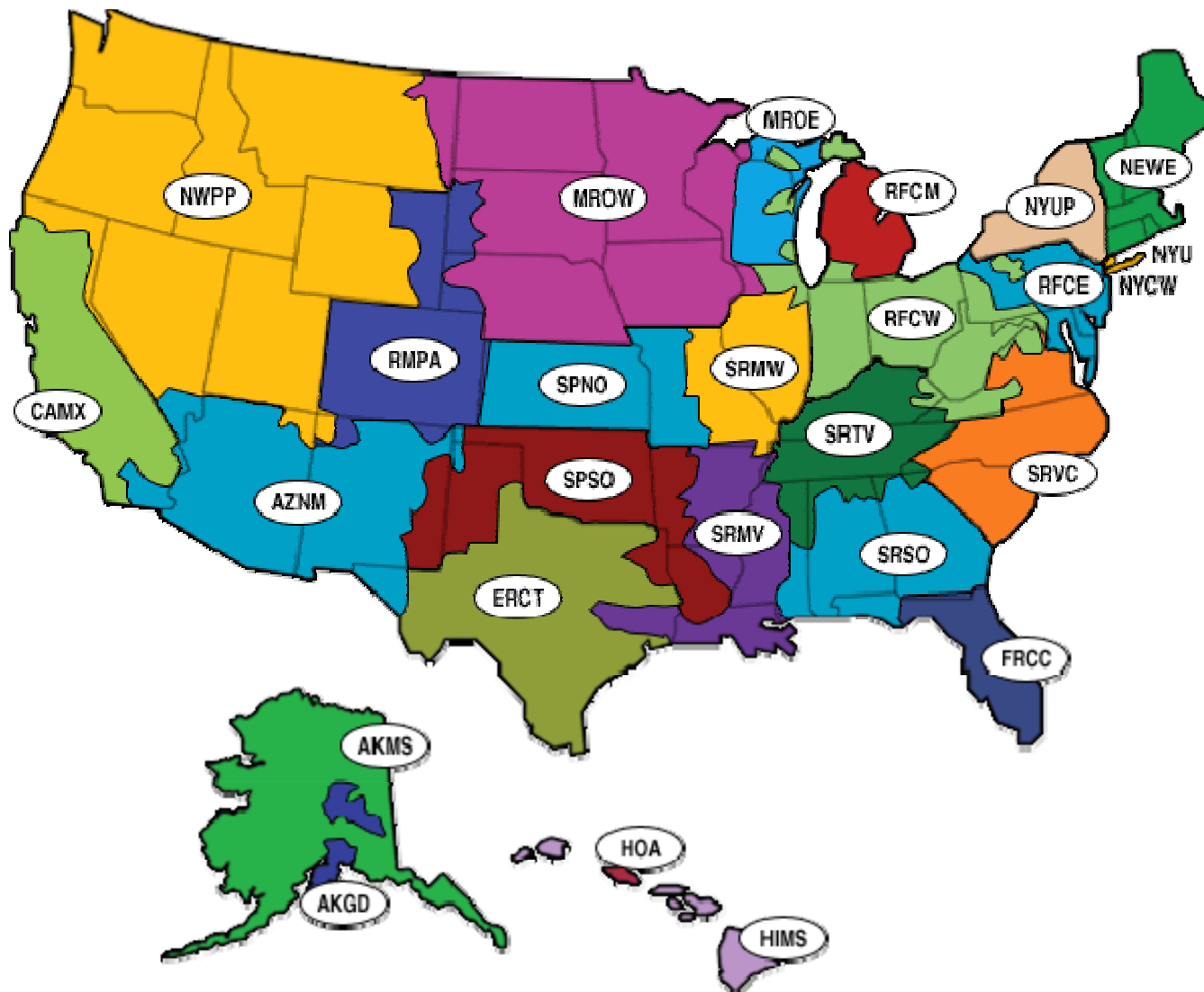
Indirect Electricity Emissions = Total State Consumption (kWh) × End-Use Equipment Consumption (%) × [Emission Factor (lbs CO₂E/kWh) × (1+ Transmission Loss Factor (%))]

Electricity Consumption Module: Electricity and Transmission Loss Factors



- Electricity emission factors (lbs CO₂E/kWh)
- Derived from 2005 eGRID subregion values
- Weighted by the number of households in each eGRID subregion in each state
 - To reflect emissions related to electricity consumption in a state
 - To account for the flow of electricity across state boundaries

Electricity Consumption Module: Electricity and Transmission Loss Factors



Electricity Consumption Module: Electricity and Transmission Loss Factors



State Inventory Tool - Indirect CO2 Emissions from Electricity Consumption

File Edit Module Options

Type a question for help

2. Electricity Emission Factors and Transmission Loss Factors in Colorado

Default emission factors for electricity consumption (lbs CO₂E/kWh) are provided below. Values are derived from Year 2005 Emissions & Generation Resource Integrated Database (eGRID) subregion values, weighted by the number of households in each eGRID subregion in each state. This weighted emission factor is intended to better reflect emissions related to electricity consumption within a state, and take into account the flow of electricity across state boundaries. Since these emission factors do not account for any transmission and distribution losses between the points of generation and the points of consumption, a transmission loss factor must be applied. The transmission loss factor takes into account electric energy lost due to the transmission and distribution of electricity. Additional information on the emission factors is provided in the Electricity Consumption User's Guide.

Note that default emission factors are identical throughout the time series. While these emission and transmission loss factors were developed for 2005, emission factor and household data were not available for the remaining years in the time series. To facilitate emission calculations for other years, the tool utilizes the 2005 emission factors as proxies. Emission factors will be updated as soon as new data become available. For further detail on this method, refer to the Electricity Consumption Chapter in the User's Guide.

Click here for information on data sources

Go to the Control Sheet

Check All Boxes

Clear All Data

Year	Electricity Emission Factor (lbs CO ₂ E/kWh)	Transmission Loss Factor (%)
2000	1.88	5.33%
2001	1.88	5.33%
2002	1.88	5.33%
2003	1.88	5.33%
2004	1.88	5.33%
2005	1.88	5.33%

Electricity Consumption Module: Estimating Emissions



State Inventory Tool - Indirect CO2 Emissions from Electricity Consumption

File Edit Module Options Type a question for help

3. Residential Electricity Consumption in Colorado

Indirect CO₂ emissions from electricity consumption in the residential sector are calculated by multiplying state energy consumption (total kWh consumed in the residential sector) by the percentage of state consumption by residential end-use. The resulting sub-sector consumption values (kWh) are then multiplied by a state-specific emission factor (lbs CO₂E/kWh) and transmission line losses. The resulting emissions values, in pounds of carbon, are converted to short tons of carbon, million metric tons of carbon equivalent (MMTCE), then to million metric tons of carbon dioxide equivalent (MMTCO₂E), and summed.

Click here for information on data sources

Go to the Control Sheet

Go to the MMTCO₂E Summary Sheet

Check All Boxes

Clear All Data

Residential		2000		<input checked="" type="checkbox"/> Default Consumption Data?	<input checked="" type="checkbox"/> Default Percent Data?						
	Total State Consumption (kWh)	Sub-sector % of State Consumption (%)	Sub-sector Consumption (kWh)	Emission Factor (lbs CO ₂ E/kWh)	Transmission loss Factor (%)	Emission Factor Including losses (lbs CO ₂ E/kWh)	Emissions (lbs carbon)	Emissions (short tons carbon)	Emissions (MMTCE)		
Sub-sector											
Space Heating		12.9%	1,807,954,557	1.88	5.3%	1.98	974,320,825	487,160	0.44		
Air-conditioning		7.7%	1,084,772,734	1.88	5.3%	1.98	584,592,495	292,296	0.27		
Water Heating		9.3%	1,301,727,281	1.88	5.3%	1.98	701,510,994	350,755	0.32		
Refrigeration		14.4%	2,024,909,104	1.88	5.3%	1.98	1,091,239,324	545,620	0.49		
Other Appliances and Lighting		55.7%	7,810,363,688	1.88	5.3%	1.98	4,209,065,964	2,104,533	1.91		
TOTAL	14,029,727,365	100.0%	14,029,727,365	1.88	5.3%	1.98	7,560,729,601	3,780,365	3.43		

Residential		2001		<input type="checkbox"/> Default Consumption Data?	<input type="checkbox"/> Default Percent Data?						
	Total State Consumption (kWh)	Sub-sector % of State Consumption (%)	Sub-sector Consumption (kWh)	Emission Factor (lbs CO ₂ E/kWh)	Transmission loss Factor (%)	Emission Factor Including losses (lbs CO ₂ E/kWh)	Emissions (lbs carbon)	Emissions (short tons carbon)	Emissions (MMTCE)		
Sub-sector											
Space Heating			-	1.88		1.98	-	-	0.00		
Air-conditioning			-	1.88		1.98	-	-	0.00		
Water Heating			-	1.88		1.98	-	-	0.00		
Refrigeration			-	1.88		1.98	-	-	0.00		
Other Appliances and Lighting			-	1.88		1.98	-	-	0.00		
TOTAL				1.88	5.3%	1.98			0.00		

Residential		2002		<input type="checkbox"/> Default Consumption Data?	<input type="checkbox"/> Default Percent Data?						
	Total State Consumption (kWh)	Sub-sector % of State Consumption (%)	Sub-sector Consumption (kWh)	Emission Factor (lbs CO ₂ E/kWh)	Transmission loss Factor (%)	Emission Factor Including losses (lbs CO ₂ E/kWh)	Emissions (lbs carbon)	Emissions (short tons carbon)	Emissions (MMTCE)		
Sub-sector											
Space Heating			-	1.88		1.98	-	-	0.00		
Air-conditioning			-	1.88		1.98	-	-	0.00		
Water Heating			-	1.88		1.98	-	-	0.00		
Refrigeration			-	1.88		1.98	-	-	0.00		
Other Appliances and Lighting			-	1.88		1.98	-	-	0.00		
TOTAL				1.88	5.3%	1.98			0.00		

Control / EF Selection / Residential C / Commercial C / Transportation C / Industrial C / Summary-MMTCO₂E / Data Sources / Transport Breakout

Electricity Consumption Module: Applications



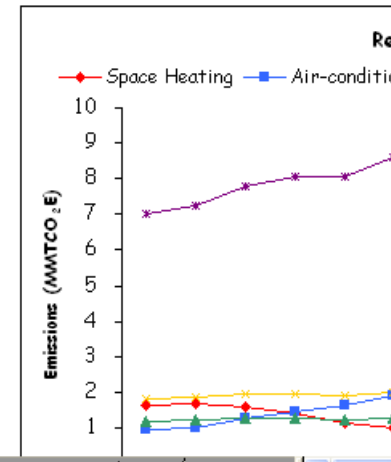
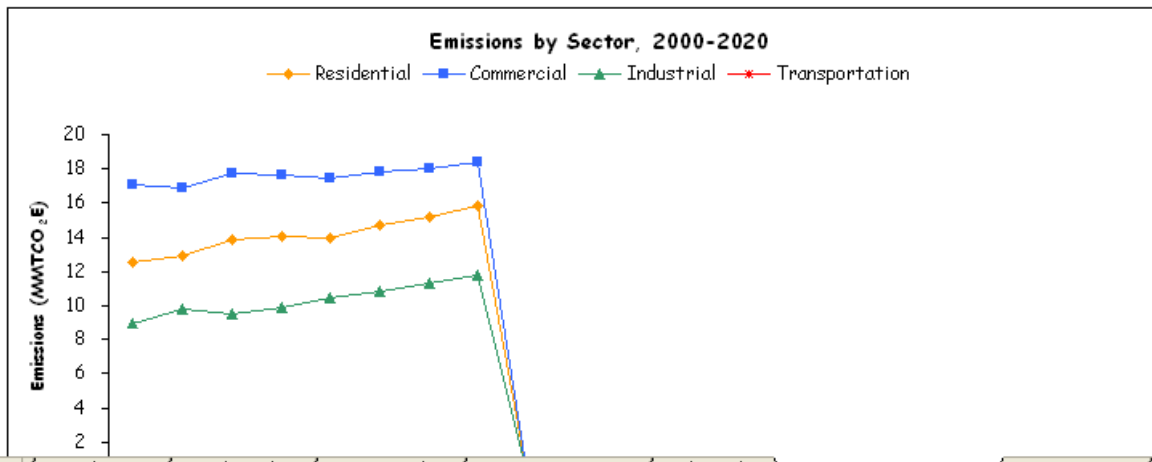
- Increases in EE funding
 - Total budgets for EE programs: \$3.4 billion in 2009
 - States need to develop innovative program designs
- Analyze the GHG impact of EE efforts using the Electricity Consumption Module
 - To track decreased electricity consumption from EE programs and improved building codes
 - To illustrate the relationship between GHG emissions and EE funding

Electricity Consumption Module: Summary Worksheet



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	7. Colorado Emissions Summary (MMTCO₂E)															
2																
3																
4																
5		MMTCO₂E	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
6	+	Residential	12.57	12.97	13.83	14.09	13.92	14.73	15.19	15.81	-	-	-	-	-	-
12	+	Commercial	17.06	16.88	17.75	17.62	17.48	17.79	18.06	18.38	-	-	-	-	-	-
23	+	Industrial	8.92	9.79	9.57	9.93	10.47	10.80	11.30	11.75	-	-	-	-	-	-
40	+	Transportation	0.01	0.01	0.03	0.03	0.02	0.02	0.02	0.04	-	-	-	-	-	-
50		TOTAL	38.56	39.65	41.18	41.68	41.88	43.34	44.58	45.98	-	-	-	-	-	-
51		Residential	12.57	12.97	13.83	14.09	13.92	14.73	15.19	15.81	-	-	-	-	-	-
52		Commercial	17.06	16.88	17.75	17.62	17.48	17.79	18.06	18.38	-	-	-	-	-	-
53		Industrial	8.92	9.79	9.57	9.93	10.47	10.80	11.30	11.75	-	-	-	-	-	-
54		Transportation	0.01	0.01	0.03	0.03	0.02	0.02	0.02	0.04	-	-	-	-	-	-

Go to the Control Sheet



Electricity Consumption Module: Summary Worksheet



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	7. Colorado Emissions Summary (MMTCO₂E)													
2	Go to the Control Sheet													
3														
4														
5		MMTCO₂E	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
6	-	Residential	12.57	12.97	13.83	14.09	13.92	14.73	15.19	15.81	-	-	-	-
7		Space Heating	1.62	1.67	1.57	1.38	1.15	0.99	1.02	1.06	-	-	-	-
8		Air-conditioning	0.97	1.00	1.25	1.46	1.62	1.91	1.97	2.05	-	-	-	-
9		Water Heating	1.17	1.20	1.26	1.25	1.21	1.25	1.29	1.34	-	-	-	-
10		Refrigeration	1.81	1.87	1.96	1.96	1.90	1.97	2.03	2.12	-	-	-	-
11		Other Appliances and Lighting	7.00	7.22	7.79	8.04	8.04	8.62	8.89	9.24	-	-	-	-
12	-	Commercial	17.06	16.88	17.75	17.62	17.48	17.79	18.06	18.38	-	-	-	-
13		Space Heating	0.83	0.82	0.86	0.85	0.85	0.86	0.87	0.89	-	-	-	-
14		Cooling	2.20	2.18	2.29	2.27	2.26	2.30	2.33	2.37	-	-	-	-
15		Ventilation	1.93	1.91	2.00	1.99	1.97	2.01	2.04	2.08	-	-	-	-
16		Water Heating	0.37	0.36	0.38	0.38	0.38	0.38	0.39	0.40	-	-	-	-
17		Lighting	6.60	6.54	6.87	6.82	6.77	6.89	6.99	7.12	-	-	-	-
18		Cooking	0.09	0.09	0.10	0.09	0.09	0.10	0.10	0.10	-	-	-	-
19		Refrigeration	1.56	1.54	1.62	1.61	1.60	1.63	1.65	1.68	-	-	-	-
20		Office Equipment	0.55	0.54	0.57	0.57	0.56	0.57	0.58	0.59	-	-	-	-
21		Computers	0.83	0.82	0.86	0.85	0.85	0.86	0.87	0.89	-	-	-	-
22		Other	2.11	2.09	2.19	2.18	2.16	2.20	2.23	2.27	-	-	-	-
23	-	Industrial	8.92	9.79	9.57	9.93	10.47	10.80	11.30	11.75	-	-	-	-
24		<i>Indirect Uses-Boiler Fuel</i>	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-
25		Conventional Boiler Use	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-
26		CHP and/or Cogeneration Process	-	-	-	-	-	-	-	-	-	-	-	-
27		<i>Direct Uses-Total Process</i>	6.73	7.38	7.22	7.49	7.89	8.15	8.52	8.87	-	-	-	-
28		Process Heating	0.80	0.88	0.86	0.89	0.94	0.97	1.02	1.06	-	-	-	-
29		Process Cooling and Refrigeration	0.59	0.65	0.63	0.66	0.69	0.71	0.75	0.78	-	-	-	-
30		Machine Drive	4.49	4.92	4.81	4.99	5.26	5.43	5.68	5.91	-	-	-	-
31		Electro-Chemical Processes	0.80	0.88	0.86	0.89	0.94	0.97	1.02	1.06	-	-	-	-
32		Other Process Use	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	-	-	-	-
33		<i>Direct Uses-Total Nonprocess</i>	1.75	1.92	1.87	1.95	2.05	2.12	2.21	2.30	-	-	-	-
34		Facility HVAC	0.90	0.99	0.97	1.00	1.06	1.09	1.14	1.19	-	-	-	-
35		Facility Lighting	0.62	0.68	0.67	0.69	0.73	0.75	0.79	0.82	-	-	-	-

For More Information



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For More Information



Questions???

