AVERT Main Module Quick Start Guide

AVoided Emissions and geneRation Tool (AVERT) is a free tool with a simple user interface designed to meet the needs of state air quality planners and other interested stakeholders. Non-experts can use AVERT to evaluate county-level emissions displaced at electric power plants by energy efficiency (EE) and renewable energy (RE) policies and programs.

Download Instructions

AVERT's Main Module requires Excel 2007 or newer to run in Windows. The Main Module can also be used in Excel 2011 for Mac. To download AVERT's Main Module, go to www.epa.gov/avert and save the following files to the same folder on a local computer or drive:

1. AVERT's Main Module workbook.
2. The Regional Data File for the region under analysis.

Step-by-Step Instructions

To begin using AVERT's Main Module, open the **AVERT Main Module.xlsm** file.

Enable Macros

Before making any selections or beginning calculations, macros must be enabled on your computer.

To enable macros in Excel 2007 for Windows:

- Click the Microsoft Office Button , and then click "Excel Options."
- Click "Trust Center," click "Trust Center Settings," and then click "Macro Settings."
- Click on "Enable all Macros."

To enable macros in Excel 2010 or later for Windows:

- Click the "File" menu (Office Backstage), and then click "Options" in the left sidebar.
- Click "Trust Center" on the left, and then click the "Trust Center Settings" button in the main window.
- Click "Macro Settings" in the left sidebar, then choose the "Enable All Macros" option and hit OK.

To enable macros in Excel 2011 or later for Mac, select "Enable macros" in the dialog box that appears when opening the file.

> Installation of AVERT's Statistical Module and AVERT's Future Year Scenario Template is not necessary to use AVERT's Main Module to estimate displaced emissions for EE/RE programs modeled in a historical base year. However, modeling displaced emissions with reference to user-created future years requires all three AVERT modules. Refer to the AVERT User Manual for additional installation instructions.

Begin Using AVERT

When launched in Excel, AVERT's Main Module opens to its "Welcome" page.

1. Personalize the welcome page with details about the user, the date of use, and the EE/RE program for which displacements are to be estimated.

2. Click on the button labeled "Click here to begin" to move on to AVERT's first step.

Note: The tabs that drive the calculations for AVERT are hidden to enhance the usability and appearance of the tool. For users that prefer full Excel functionality, there is a button at the lower right-hand side of the welcome page that reads "Click here to restore default Excel functionality". Users may complete the steps required to estimate displaced emissions regardless of whether full Excel functionality is visible.

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Step 1: Import Regional Data File

AVERT regions represent relatively autonomous electricity production zones, and are based on electricity market module regions. For more detailed information on the specific boundaries of each region, consult the AVERT User Manual.

1. Select a region for analysis by either using the dropdown menu or by clicking the map. Selecting a region loads region-specific data for wind and solar capacity factors.

2. If you have not already, click the link under the map to download the corresponding Regional Data File from EPA's website.

3. Once you have downloaded your Regional Data File, in the box labeled "Enter filepath," double-click the blue area to navigate to its location.

4. Click the button under "Load data" that reads, "Click here to load the Regional Data File." Clicking this button loads hourly fossil load, unit information, and typical unit performance for generation and emissions. This step may take several minutes to complete.

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Once the Regional Data File has loaded, a pop-up box will appear. This pop-up confirms the region and data year and indicates the number of reporting fossil units. The pop-up lists the states that are fully represented in the selected region as well as those that are partially represented, as some states are divided between multiple AVERT regions. For example, parts of Illinois are considered to be in the Upper Midwest region, while other parts are in the Great Lakes / Mid-Atlantic Region. Consult Appendix G of the AVERT User Manual for guidance on determining the impact of EE/RE programs in states that are split across multiple AVERT regions.

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Regional Data Files released before July 2017 do not have $PM_{2.5}$ emissions and they include net generation values to account for parasitic losses. If you are using an earlier Regional Data File, another pop-up box will alert you and suggest that you download a newer file from EPA's website.

AVERT ✕

Note that this regional data file does not include PM2.5 data and quantifies emission impacts based on gross generation. To obtain inputs with PM2.5 data and net generation, click on the hyperlink under the AVERT map.

OK
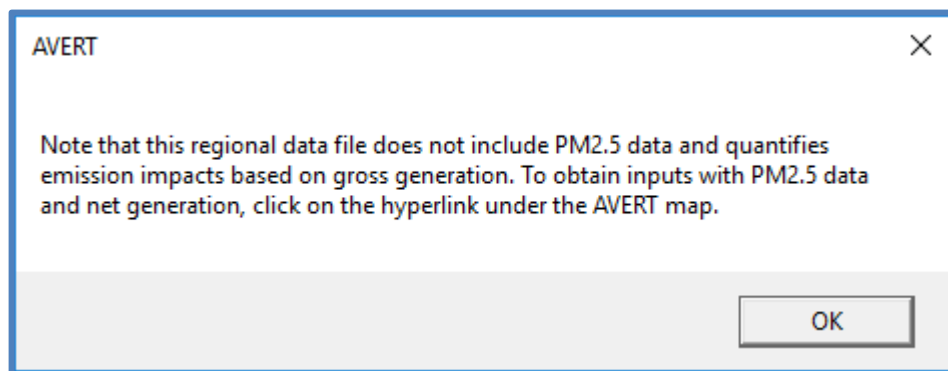
Step 2: Set Energy Efficiency (EE) and Renewable Energy (RE) Impacts

This page leads you through the process of creating a load impact profile depicting the load reductions expected from an EE/RE program. It also allows you to estimate a load reduction from basic characteristics:

- Reduce fossil-fuel generation by a percent in some or all hours
- Reduce fossil-fuel generation by total GWh (flat)
- Reduce each hour by a constant MW each hour
- Renewable energy proxy
- Combination of EE/RE programs including combining pre-set options with manual entry

Each option is described in more detail in the AVERT User Manual. If more than one option (including manual entry) is chosen, the selected options will be combined into a portfolio of programs.

For hourly load reductions expected from a particular EE/RE policy, program, or measure, values can be input manually. Click the "Enter hourly data manually" button, which will allow you to enter a manual stream of load reduction values for every hour of the year.

Step 3: Run Displacement

This step calculates hourly displaced generation and emissions ($PM_{2.5}$, SO_2, NO_X, CO_2) for each fossil unit within the selected region.

Run displacement by selecting the button entitled "Click here to calculate displaced generation and emissions." Note that this is a processor-intensive step. When using an older computer, or when analyzing regions with many fossil units, this step may take up to ten minutes.

A pop-up box that reads "Calculation complete" will appear once the calculations are complete.

Step 4: Display Outputs

The data generated in Step 3 are aggregated in two major groups of charts and tables in this step: "Summary tables" and "Charts and figures". There are eight total display output options. Each output is described in more detail in the AVERT User Manual.

Annual regional displacements

This table displays the total annual generation and emissions as reported for the region in the base year ("Original") and as calculated by AVERT's Main Module after the EE/RE reduction ("Post-EERE").

Upper Midwest, 2011 — **AVERT**

Output: Annual Regional Displacements

Click here to return to Step 4: Display Outputs

	Original	Post-EERE		Impacts
Generation (MWh)	267,436,050	260,240,200		-7,195,850
Total Emissions from Fossil Generation Fleet				
SO$_2$ (lbs)	1,301,793,140	1,268,694,580		-33,098,570
NO$_x$ (lbs)	540,761,980	527,072,950		-13,689,030
CO$_2$ (tons)	300,935,610	293,707,130		-7,228,480
PM$_{2.5}$ (lbs)	43,319,100	42,280,340		-1,038,760
Fossil Generation Fleet Emission Rates				
SO$_2$ (lbs/MWh)	4.868	4.875		
NO$_x$ (lbs/MWh)	2.022	2.025		
CO$_2$ (tons/MWh)	1.125	1.129		
PM$_{2.5}$ (lbs/MWh)	0.162	0.162		

Negative numbers indicate displaced generation and emissions.

All results are rounded to the nearest ten. A dash ("—") indicates a result greater than zero, but lower than the level of reportable significance.

State and Local Energy and Environment Program

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Annual displacement data by county

This table presents a summary of the displaced generation and emissions for each of the counties from each of the states contained within the region. A line for each county containing an electric generating unit (EGU) is displayed.

For each county, annual output statistics are given for:

- Peak gross generation post-EE/RE
- Annual gross generation post-EE/RE
- Capacity factor
- Annual change in generation
- Annual change in heat input, $PM_{2.5}$, SO_2, NO_X, and CO_2
- Ozone season change in SO_2 and NO_X
- Ozone season, 10 peak days change in SO_2 and NO_X

Upper Midwest, 2012

Output: Annual Displacement Data by County

Click here to return to Step 4: Display Outputs

State	County	Peak Gross Generation, Post-EERE (MW)	Annual Gross Generation, Post-EERE (MWh)	Annual Displaced Generation (MWh)	Annual Displaced SO₂ (lbs)
IA	Allamakee	250	1,152,800	-91,800	-639,700
IA	Appanoose	17	2,700	-600	-5,300
IA	Audubon	125	39,100	-8,800	–
IA	Black Hawk	109	42,300	-8,900	-30,700
IA	Cerro Gordo	522	772,800	-154,400	-600
IA	Clay	30	11,000	-2,300	-21,000
IA	Clinton	143	583,900	-30,500	-195,700
IA	Des Moines	210	1,195,400	-58,200	-438,500
IA	Dubuque	42	91,300	-1,600	-500
IA	Louisa	770	5,304,300	-197,800	-642,500
IA	Marshall	57	32,500	-1,700	-200
IA	Muscatine	262	960,200	-79,200	-353,300
IA	Polk	481	343,100	-59,900	-2,100

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Monthly displacement data by county

This table shows a summary of the displaced generation and emissions for each of the counties from each of the states contained within the region, broken out by month and with an annual total.

Output: Monthly Displacement Data by County

Click here to return to Step 4: Display Outputs

Negative numbers indicate displaced generation and emissions. All results are rounded to the nearest ten. A dash ("—") indicates a result greater than zero, but lower than the level of reportable significance.

State	County	Month	Displaced Generation (MWh)	Displaced SO$_2$ (lbs)	Displaced NO$_x$ (lbs)	Displaced CO$_2$ (Tons)	Displaced PM$_{2.5}$ (lbs)
IA	Allamakee	3	-6,990	-53,440	4,080	-8,120	-2,350
IA	Allamakee	4	-7,640	-57,470	6,140	-8,660	-2,490
IA	Allamakee	5	-6,030	-44,440	-1,270	-6,840	-1,970
IA	Allamakee	6	-3,290	-24,500	-80	-3,780	-1,090
IA	Allamakee	7	-1,830	-13,710	-530	-2,130	-610
IA	Allamakee	8	-2,050	-15,390	-430	-2,380	-690
IA	Allamakee	9	-4,970	-37,160	-2,130	-5,740	-1,650
IA	Allamakee	10	-6,880	-52,320	3,830	-7,890	-2,280
IA	Allamakee	11	-6,400	-48,680	3,010	-7,410	-2,130
IA	Allamakee	12	-5,230	-39,850	2,760	-6,070	-1,750
IA	Allamakee	Annual	-60,810	-461,920	20,200	-70,380	-20,280
IA	Appanoose	1	-20	-10	-80	-10	—
IA	Appanoose	2	-20	-10	-40	-10	—
IA	Appanoose	3	-40	-30	-310	-30	-10

Displacement data for top ten peak days

This table displays a summary of the ten days in the region featuring the highest level of fossil fuel load.

Output: Displacement Data for Top Ten Peak Days

Click here to return to Step 4: Display Outputs

Day Rank	Date	Total Fossil Generation (MWh)	Expected Displaced Generation (MWh)	Displaced Generation (MWh)	Displaced NO$_x$ (lbs)	Displaced SO$_2$ (lbs)	Displaced CO$_2$ (Tons)	Displaced PM$_{2.5}$ (lbs)
1	Jul 18	1,048,930	-13,490	-13,860	-39,530	-17,890	-8,730	-1,770
2	Jul 19	1,039,940	-17,190	-17,270	-61,370	-25,000	-13,150	-2,440
3	Jul 21	1,024,750	-15,770	-15,820	-58,630	-23,210	-13,000	-2,350
4	Jul 20	1,018,680	-16,810	-16,810	-57,920	-22,360	-13,410	-2,590
5	Jul 22	1,003,160	-12,930	-13,030	-44,900	-17,970	-10,620	-1,960
6	Aug 02	993,440	-12,690	-12,700	-46,380	-18,640	-10,370	-1,860
7	Aug 01	988,190	-12,610	-12,650	-46,790	-19,670	-10,530	-1,880
8	Aug 03	983,760	-12,070	-12,110	-34,960	-14,660	-9,550	-1,830
9	Jul 28	979,210	-10,310	-10,290	-36,970	-15,170	-8,330	-1,440
10	Jul 29	975,520	-8,010	-8,130	-25,300	-10,340	-6,580	-1,210

Negative numbers indicate displaced generation and emissions.
All results are rounded to the nearest ten. A dash ("—") indicates a result greater than zero, but lower than the level of reportable significance.

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Daily NOₓ displacement data by county

Daily NO$_x$ displacement data by county

This table displays displaced NO$_x$ emissions for each county in the region, broken out by day along with a daily average, for up to 10 days specified by the user.

Upper Midwest, 2012

Output: Daily NOx Displacements (lbs)

Click here to return to Step 4: Display Outputs

Negative numbers indicate displaced generation and emissions. All results are rounded to the nearest hundred. A dash ("–") indicates a result greater than zero, but lower than the level of reportable significance.

Enter up to ten dates in the header column. This page will calculate the NOx displacement associated with each day in each county, as well as the average for each county. Use the filters to select individual states or counties.

State	County	8-Aug	7-Jul	6-Jun	5-May	8-Sep	8-Jul	6-Sep	5-Jun	19-Aug	20-Aug	Average
IA	Allamakee	-460	-372	-912	-670	-585	-666	-691	-781	-1,072	-982	-719
IA	Appanoose	-298	-280	-28	18	-28	-255	-201	-80	-61	-48	-126
IA	Audubon	-443	-467	-46	-3	-4	-321	-201	-23	2	-128	-164
IA	Black Hawk	-1,960	-1,905	-331	-114	-40	-1,409	-868	-357	-215	-388	-759
IA	Cerro Gordo	-95	-98	-260	-55	-31	-109	-168	-263	-122	-229	-143
IA	Clay	-294	-321	-91	-15	-3	-199	-124	-82	-35	-130	-129
IA	Clinton	-93	-97	-304	-189	-183	-9	-84	-451	-326	-65	-180
IA	Dubuque	-531	-550	-53	56	69	-467	-295	-31	101	-140	-184
IA	Louisa	-3,108	-2,467	-4,242	-6,246	-6,124	-3,672	-4,554	-5,216	-4,414	-4,284	-4,433
IA	Marshall	136	257	-57	-95	-207	83	-57	-81	21	-103	-10
IA	Muscatine	-5,832	-6,263	-3,071	-1,466	-1,097	-5,273	-4,084	-3,030	-2,766	-3,525	-3,641
IA	Polk	-1,358	-1,319	-76	-22	-15	-681	-295	-92	-33	-111	-400
IA	Pottawattamie	-5,357	-4,944	-4,663	-7,363	-6,087	-5,108	-3,950	-4,741	-6,325	-3,749	-5,229
IA	Poweshiek	-103	-92	-4	0	0	-43	-20	0	-1	-13	-35
IA	Scott	-450	-506	-996	-732	-916	-412	-536	-1,259	-1,125	-810	-774
IA	Union	-1,621	-1,676	-211	-17	-4	-1,109	-692	-158	-91	-305	-589
IA	Wapello	-4,713	-5,491	-4,939	-2,336	-1,839	-5,144	-4,716	-4,764	-3,997	-5,334	-4,327
IA	Woodbury	-19,145	-20,484	-20,410	-13,567	-11,454	-20,738	-20,200	-20,989	-20,255	-21,545	-18,879
IL	Clay	-10	-1	-20	0	0	6	-2	-25	-4	-16	-8
IL	Fayette	-24	-22	-6	0	0	-1	1	-7	-4	-2	-6
IL	Ford	-251	-253	-22	-10	2	-136	-63	-54	-15	2	-80

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Displaced generation and emissions map

This dynamic map allows the user to view where emissions have been displaced within the selected region. Users can view changes in generation, heat input, $PM_{2.5}$, SO_2, NO_X, and CO_2.

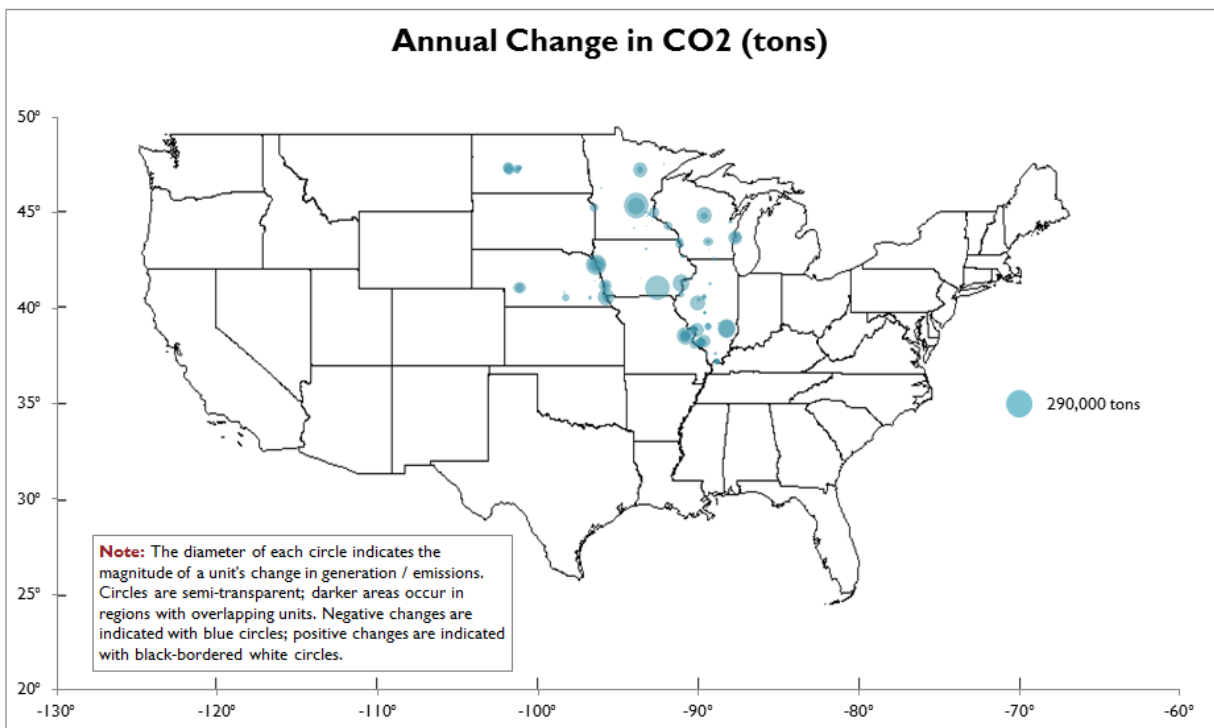**Upper Midwest, 2012**   AVERT

Output: Displaced Generation and Emissions Map

Click here to return to Step 4: Display Outputs

Select variable to display: Annual Change in CO2 (tons) ↓   Refresh map

Annual Change in CO2 (tons)

290,000 tons

Note: The diameter of each circle indicates the magnitude of a unit's change in generation / emissions. Circles are semi-transparent; darker areas occur in regions with overlapping units. Negative changes are indicated with blue circles; positive changes are indicated with black-bordered white circles.

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Displacement data by month

Monthly output can be viewed over the entire region, or a specific state or county within the region. First select region, state, or county in the top dropdown menu.
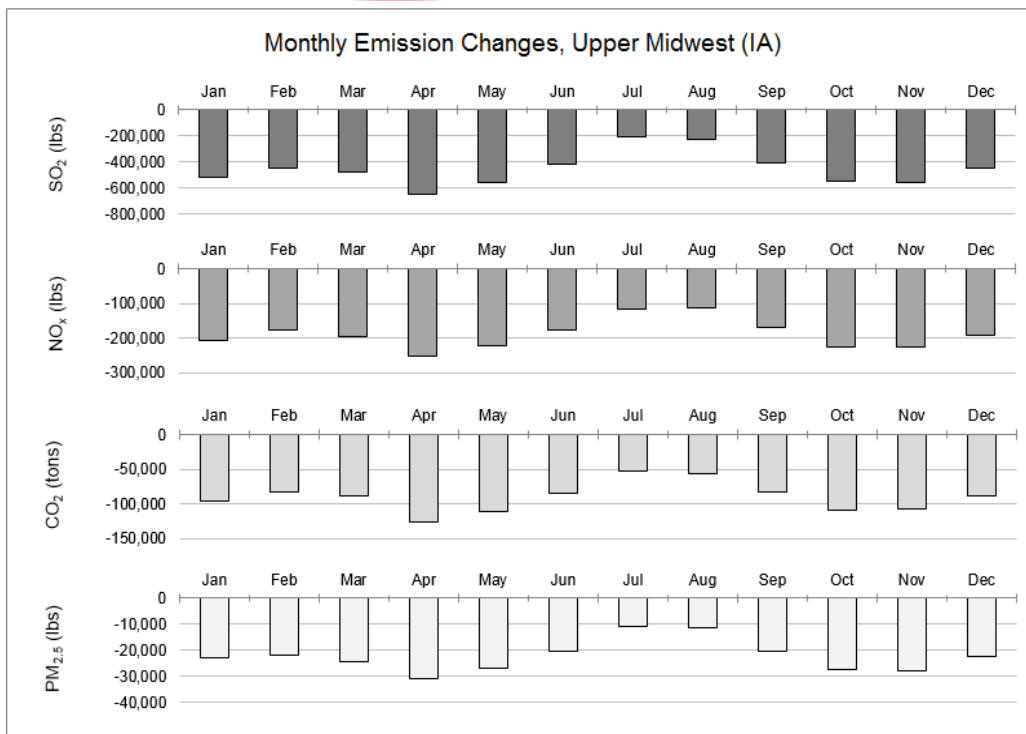
- If selecting a state, choose the state in the next dropdown menu.

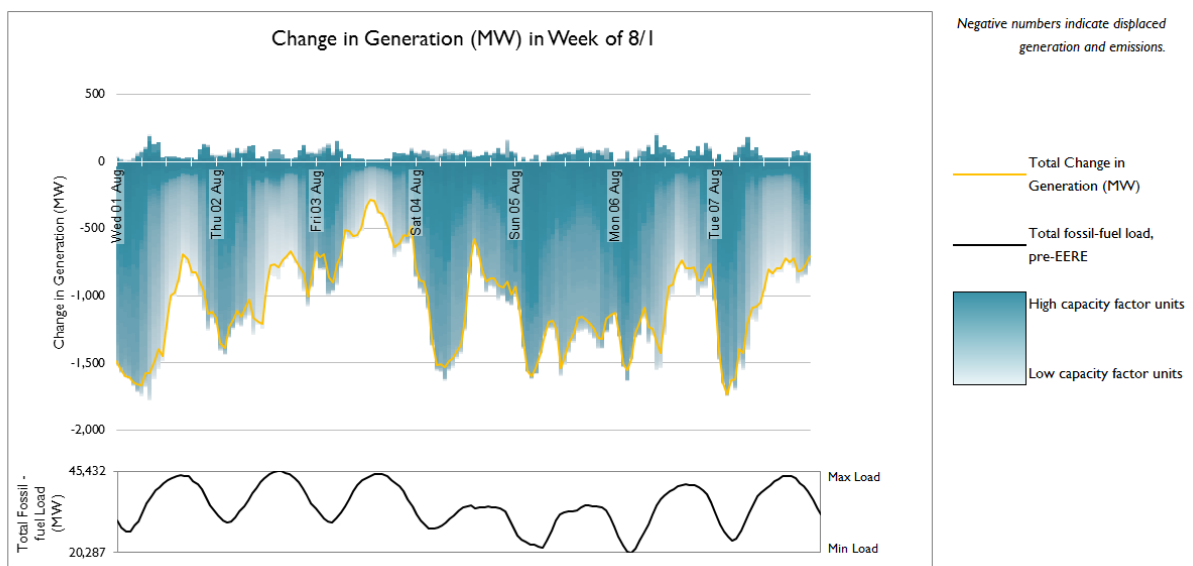- If selecting a county, choose both the state and the county in the next two dropdown menus.

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Hourly displacements by week

This option includes two figures. The first displays a dynamic representation of hourly displacement from each EGU in a region. Individual plants are stacked as gradated bar plots.

The second figure shows the same week-long load impact profile, but presents the displaced load in reference to the total fossil-fuel load to illustrate the degree of change represented by the EE/RE program relative to the baseline.
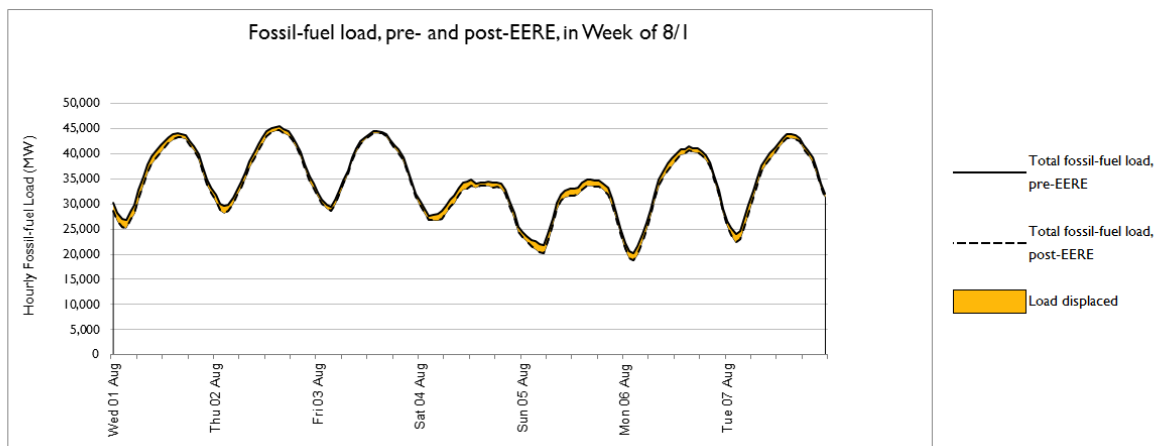
Signal-to-noise diagnostic

This chart is a scatterplot of every hour of the year, showing calculated total generation reduction in each hour (y-axis) against the user-input EE/RE load reduction in each hour (x-axis).

Ideally, AVERT perfectly matches unit generation reductions to the amount of EE/RE load reduction requested by the user. The signal-to-noise diagnostic chart shows where that assumption holds, where it does not hold, and to what extent.

Upper Midwest, 2012   AVERT

Output: Signal-to-noise diagnostic

Click here to return to Step 4: Display Outputs

Reduction in Total Unit Generation Relative to EERE Load Reduction (MW) for All Hours, R²=0.99

Expected EERE Load Reduction (MW)

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