

AVERT Overview and Step-by-Step Instructions

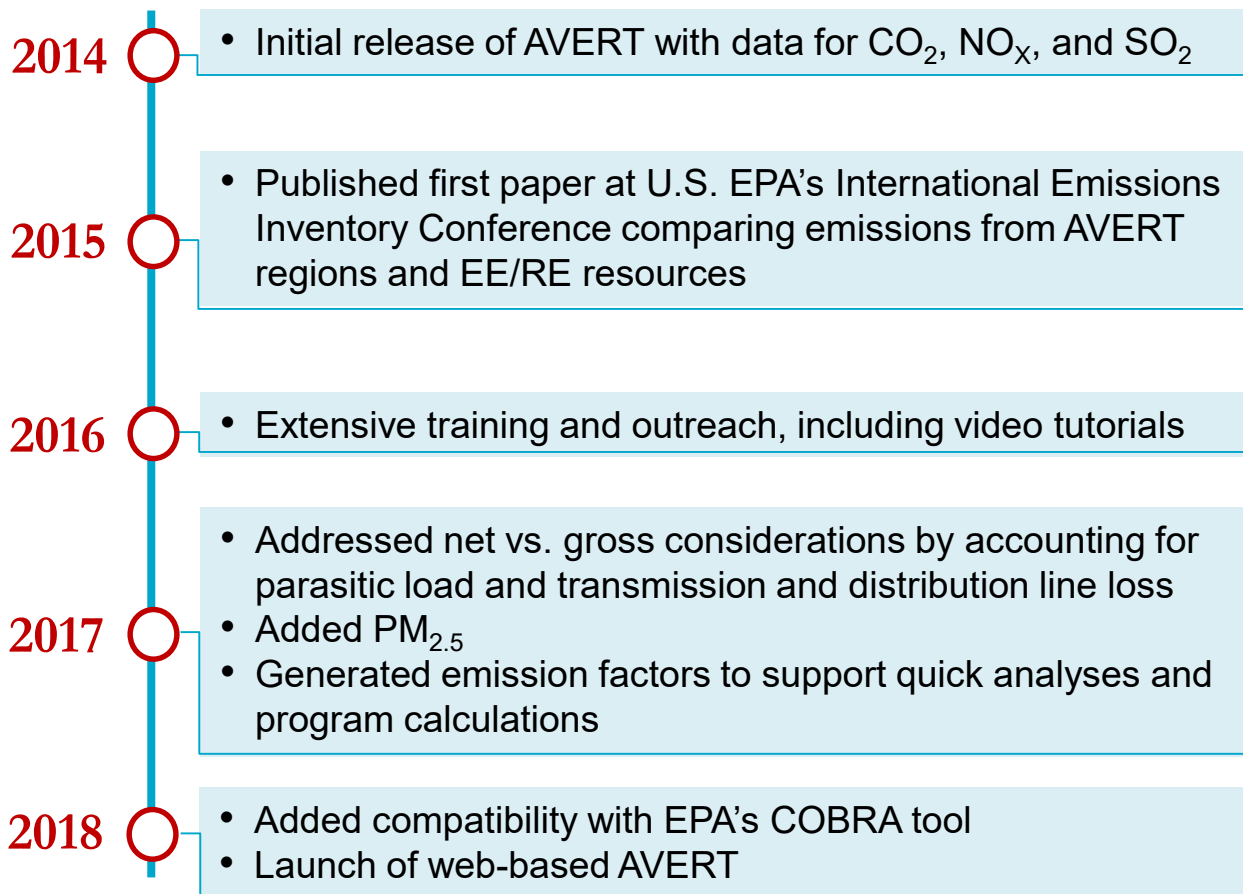
U.S. Environmental Protection Agency
State Energy and Environment Program
Updated May 2018



Overview of AVERT Development for Energy Efficiency and Renewable Energy (EE/RE) Programs

- AVERT (AVoided Emissions and geneRation Tool) translates the energy impacts of EE/RE policies and programs into emission reductions (PM_{2.5}, NO_x, SO₂, and CO₂).
 - It aims to address a key reason states have not implemented previous [EE/RE State Implementation Plan \(SIP\) guidance](#).
- AVERT has been thoroughly reviewed, well documented and tested. EPA has:
 - Conducted external and internal peer reviews.
 - Benchmarked AVERT against industry standard electric power sector model – PROSYM.
 - Worked with states to beta-tested tool for functionality, appropriate uses, and clarity of user manual.
- AVERT was first released in 2014 and is built to be:
 - user friendly
 - transparent
 - credible

AVERT's Evolution



Ongoing activities

- Annual data updates
- Enhancements
- Compatibility updates

Emission Quantification Methods

Basic to Sophisticated

Basic Method

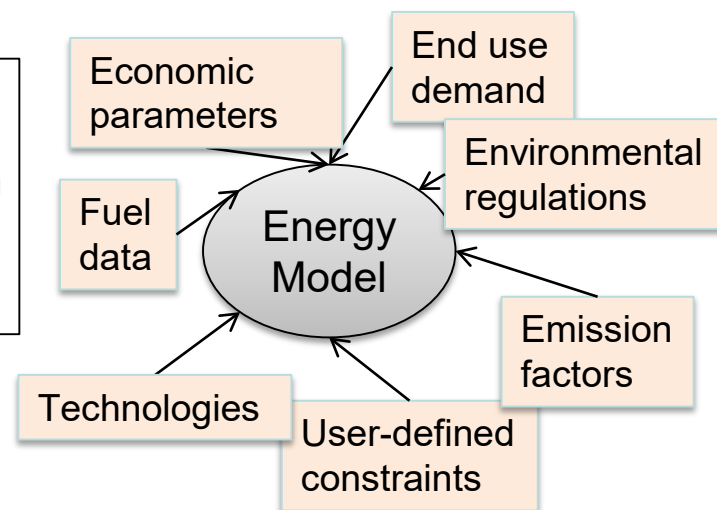
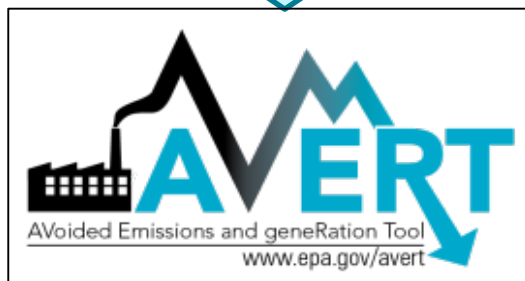
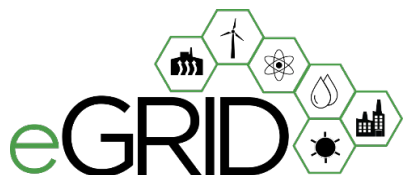
eGRID region non-baseload emission rates

Intermediate Method

Historical hourly emission rates

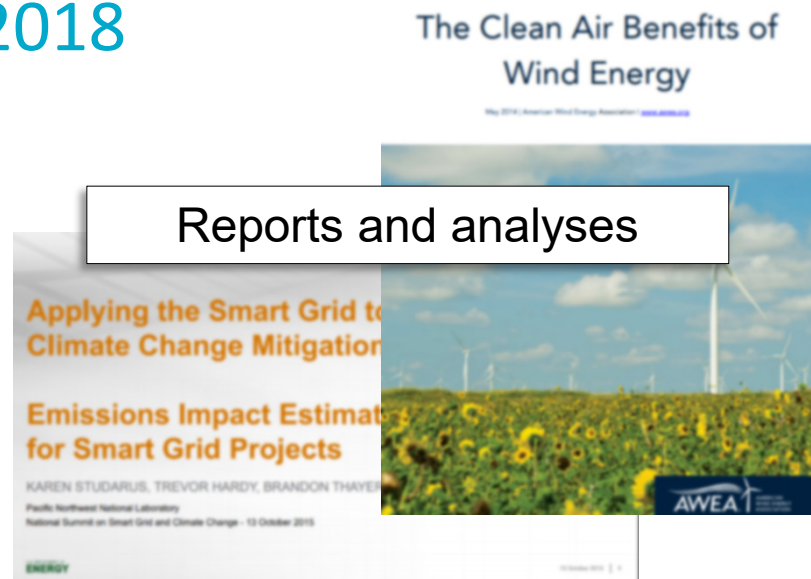
Sophisticated Method

Energy modeling
Dispatch or capacity expansion



Applications for AVERT-Calculated Emissions

- SIP credit in a state's National Ambient Air Quality Standard (NAAQS) Clean Air Act Plan
- Compare emission impacts of varying levels of EE/RE programs, projects, and policies
- Calculate emission reductions in your state or county using AVERT's web-based edition
- Use AVERT-generated emission factors to estimate magnitude of emission reductions without running the tool
 - Four categories include wind, solar, portfolio EE, and uniform EE programs
- This is not a long-term projection tool
 - To conduct analysis more than five years from the baseline, users must use AVERT's statistical module and future year scenario template



Peer-reviewed papers

- Environmental Research Letters
- Environmental Science and Technology
- Nature Energy
- Journal of Industrial Ecology
- Energy Policy
- ...and more

Resource pages and factsheets



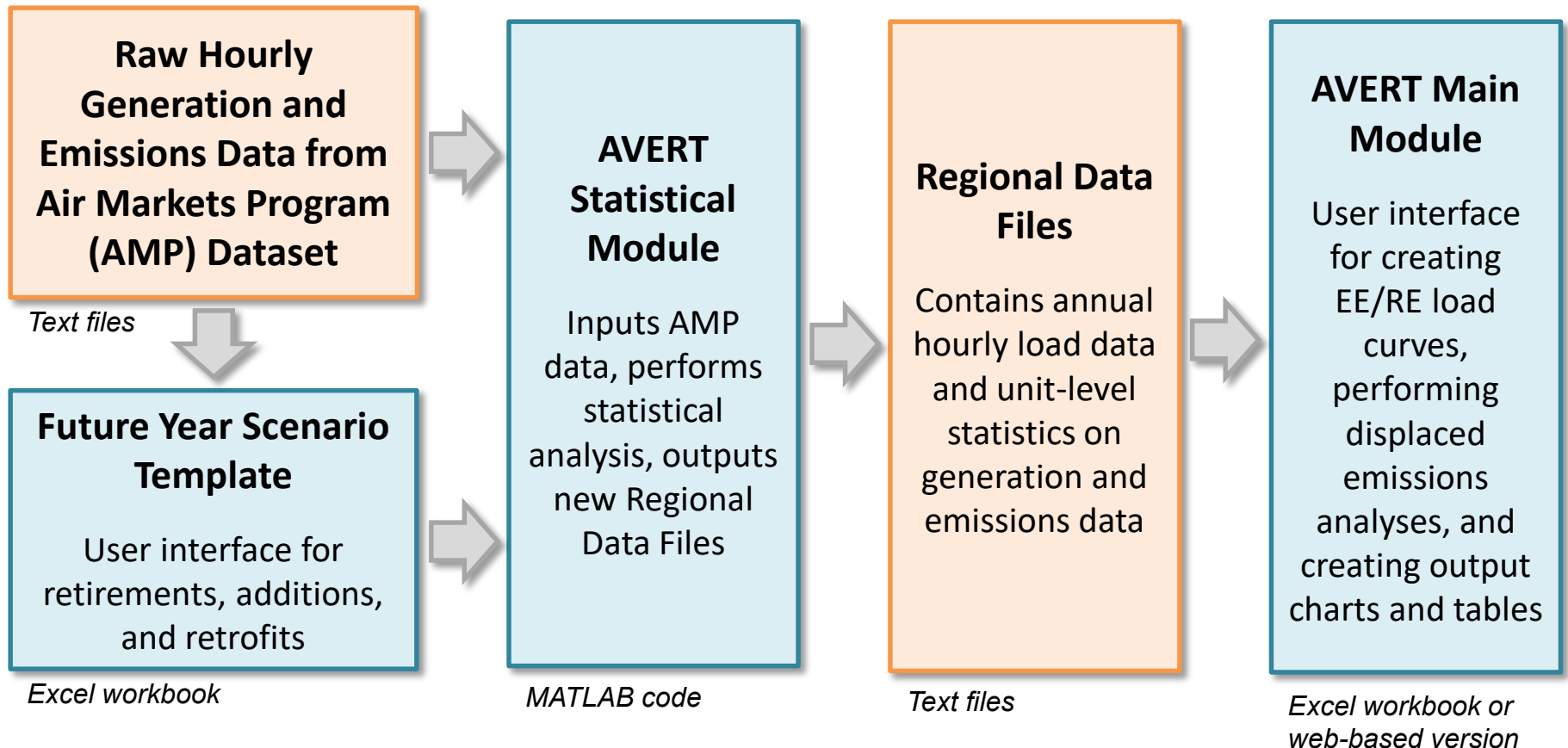
Examples Using AVERT

- The Clean Air Benefits of Wind Energy ([AWEA, May 2014](#))
- Maine Distributed Solar Valuation Study ([Maine PUC, March 2015](#))
- CarbonCount™ Green Bonds Scores ([Alliance to Save Energy, March 2015](#))
- Assessing Emission Benefits of Renewable Energy and Energy Efficiency Programs ([U.S. EPA, April 2015](#))
- U.S. EPA's Ozone Advance Program - [Clark County, NV's](#) Paths Forward
- DOE's Online Smart Grid Calculator ([PNNL, Fall 2015](#))
- Renewable Portfolio Standard (RPS) Benefits Report ([LBNL and NREL, January 2016](#))
- Carbon Reductions and Health Co-benefits from U.S. Residential Energy Efficiency Measures ([Levy et al., 2016](#))
- The Health and Environmental Benefits of Wind and Solar Energy in the United States, 2007-2015 ([LBNL, January 2017](#))

How AVERT Works

- AVERT's Main Module simulates the hourly changes in generation and air emissions ($\text{PM}_{2.5}$, NO_x , SO_2 , and CO_2) at EGU resulting from EE/RE policies and programs.
- User input: MWhs saved from EE programs, or wind and solar generation (MW)
 - Multiple options are built into the tool
 - Users can manually enter hourly data of any EE/RE resource type
- User can retire, add and change emission rates of EGU and re-run simulation using AVERT's Future Year Scenario Template and Statistical Module.

AVERT's Modules and Data Files



Most users will only need to use the Regional Data Files and AVERT Main Module to calculate emissions. The web version of the Main Module provides similar functionality without the need to download any files or software.

AVERT's Data Driven Analysis

- AVERT uses a data-driven analysis to distinguish which EGU respond to marginal changes in load reduction.
 - AVERT analyzes EGU datasets from EPA's Air Markets and Program Data (hourly, unit-by-unit generation & emissions).
 - Dataset includes EGUs with capacity of 25 MWs or greater.
 - Supplemented with PM_{2.5} data from EPA's National Emissions Inventory.
 - AVERT's Statistical Module gathers statistics on EGU operations under specific load conditions, and then replicates changes through a Monte Carlo analysis.
 - AVERT's Regional Data Files contain hourly and unit-level emissions and generation data.

Part I

AVERT Main Module

AVERT's Web-Based Main Module

- Users can choose between AVERT's Excel-based version or the web edition
- In 2018, EPA released AVERT's web-based version
 - The online platform allows users to quickly estimate EE/RE program impacts using current year dataset
 - Users can enter standard EE/RE settings
 - Results are shown in graphical form and savable formats

AVERT Web Edition

Select Region

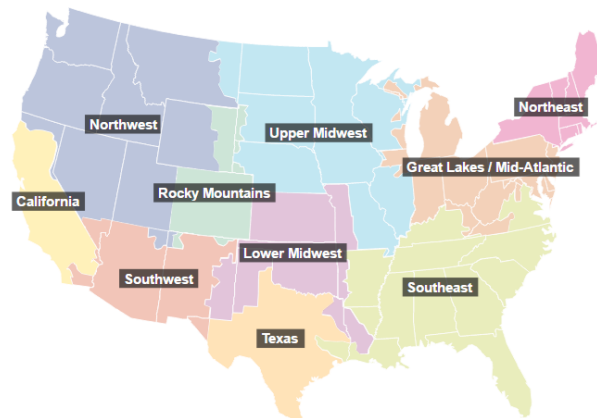
Set EE/RE Impacts

Get Results

Select Region

AVERT splits the contiguous 48 states into 10 regions. AVERT regions are aggregated based on EPA's eGRID subregions. Select a region for analysis by either using the dropdown menu or clicking the map. Selecting a region loads the power plants operating within each region and region-specific wind and solar capacity data.

Select Region



The online version of AVERT can run analyses using 2015 emissions and generation data. The Excel version of AVERT (available for download [here](#)) allows analyses for years 2007–2015 or for a future year scenario.

Set EE/RE Impacts

AVERT's Excel-Based Main Module Step-by-Step Overview

- Enabling Macros
- Using AVERT
- Step 1. Load Regional Data File
- Step 2. Set Energy Efficiency and Renewable Energy Data
- Step 3. Run Displacement
- Step 4. Display Outputs

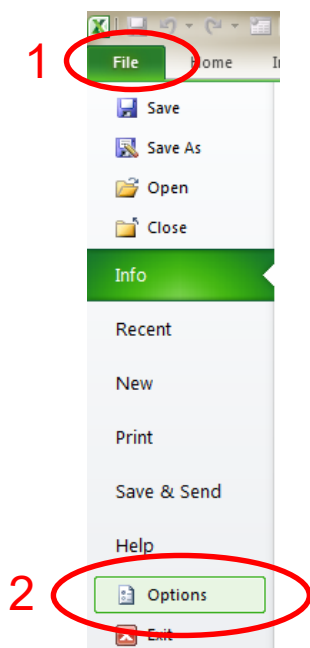
AVERT's Excel-Based Main Module

Enabling Macros

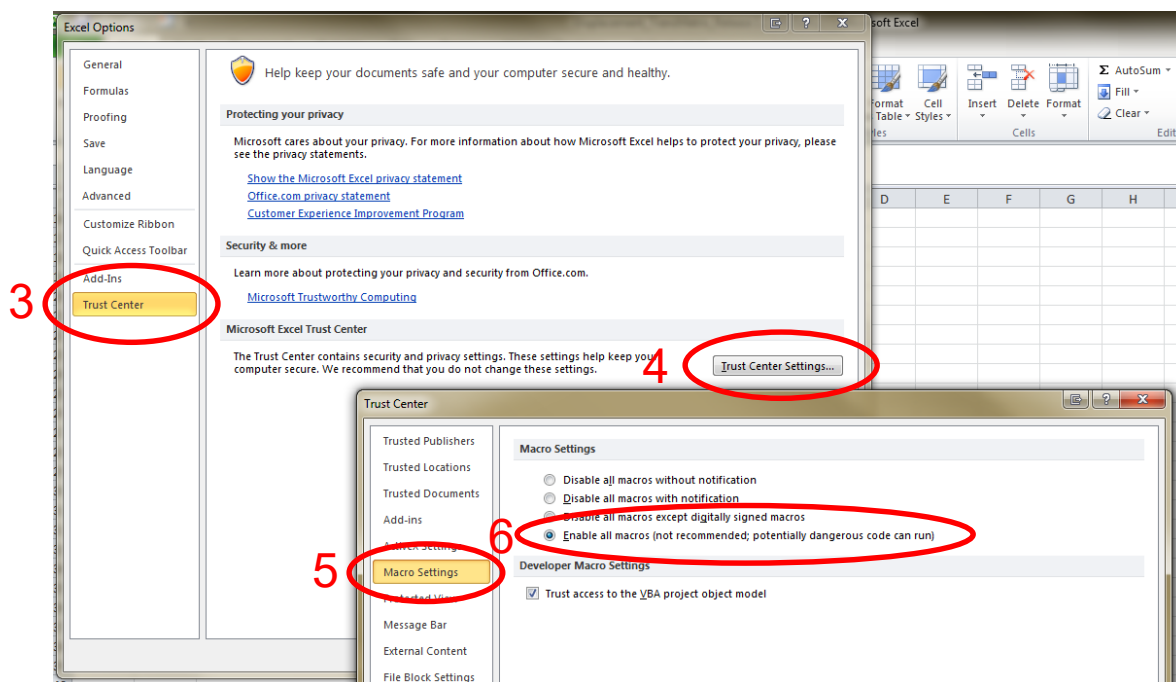
- In Windows, AVERT is compatible with Excel 2007 or newer versions.
- On a Mac, AVERT is compatible with Excel 2011 or newer versions.
 - Only the Main Module has been optimized for Mac. Other components (e.g., the Statistical Module) require Windows.
- You may want to revert to the default macro settings after using the model. Enabling macros in other Excel files may allow potentially dangerous code to run.

AVERT's Excel-Based Main Module Enabling Macros in Windows*

In Excel 2010 or newer, click **File** > **Options**



Next, click **Trust Center** > **Trust Center Settings** > **Macro Settings** > **Enable all macros**



*If using Excel 2007, click the Microsoft Office Button: .

*If using Excel on a Mac, select "Enable macros" in the dialog box that appears when opening the file.

AVERT's Excel-Based Main Module

Using AVERT

- Add details about the user, the date, and the EE/RE program for which displacements are to be estimated.
- Click on the button labeled “Click here to begin”.

Upper Midwest, 2011




AVERT

Welcome to AVERT's Main Module

AVERT is an EPA tool that quantifies the emission impacts of energy efficiency and renewable energy policies and programs within the continental United States. Please refer to the AVERT user manual for details on step-by-step instructions, appropriate uses and assumptions built into the tool.

NOTE

Please ensure macros are enabled on your computer.
AVERT requires Excel 2007 or higher in Windows and Excel 2011 or higher on Mac.

AVERT v.1.6
This version accounts Transmission and Distribution line loss calculations for EE and residential solar projects and can estimate PM_{2.5} emissions impacts.
Developed by Synapse Energy Economics, Inc., July 2017

Use the blue entry to describe each scenario and keep track of multiple versions of AVERT.

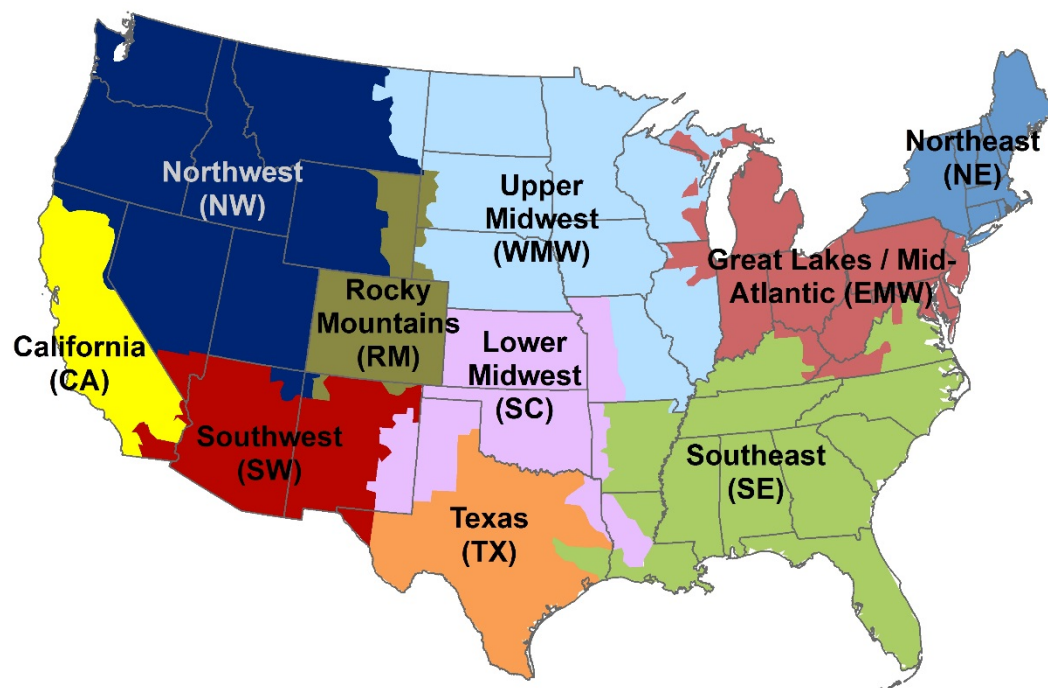
Editor:
Date edited:
Edition name:
Edition description:

Click here to begin

Click here to restore default Excel functionality

AVERT's Excel-Based Main Module

Step 1. Load Regional Data File



Regions represent relatively autonomous electricity production zones, and are based on electricity market module regions.

Regions include

- California
- Great Lakes/Mid-Atlantic
- Lower Midwest
- Northeast
- Northwest
- Rocky Mountains
- Southeast
- Southwest
- Texas
- Upper Midwest


AVERT's Excel-Based Main Module

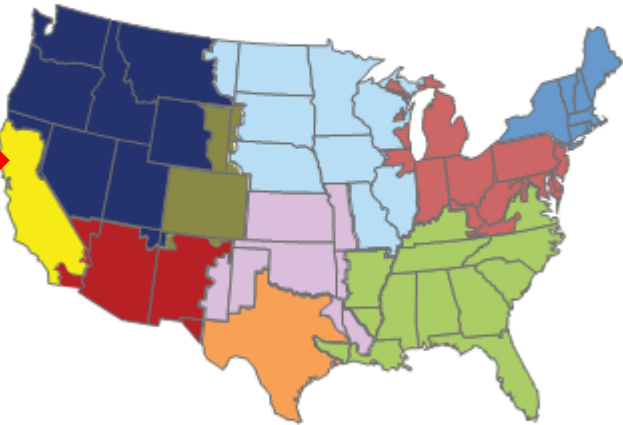
Step 1. Load Regional Data File

- Select a region for analysis by either using the dropdown or clicking the map.

Select region

Select a region for analysis by using the dropdown or by clicking the map.





[If you haven't yet downloaded a Regional Data File, click here.](#)

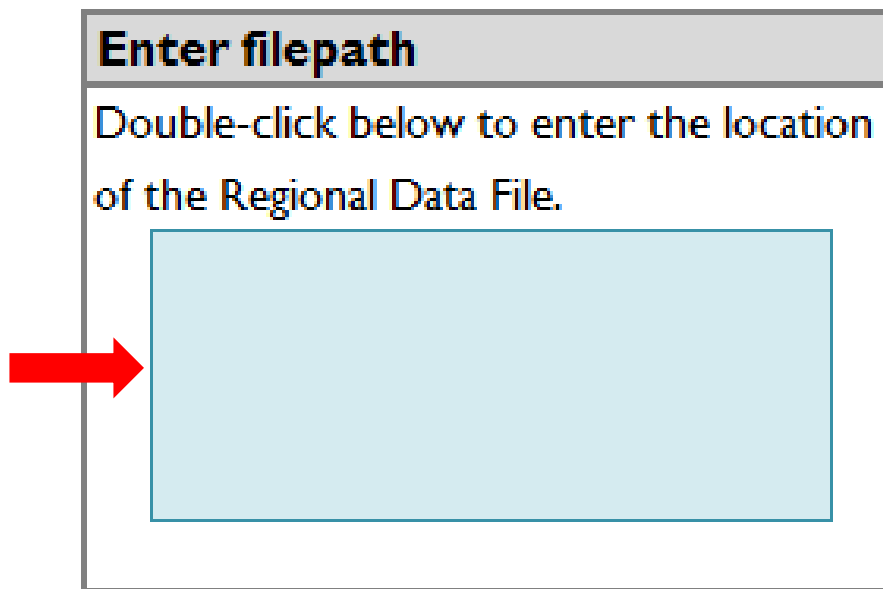
– Selecting a region loads region-specific data for wind and solar capacity factors, and dynamically creates a hyperlink to that region's data on EPA's website.

- After selecting a region, click the link under the map to download it from EPA's website.

AVERT's Excel-Based Main Module

Step 1. Load Regional Data File

- In the box labeled “Enter filepath,” double-click the blue area to navigate to the location of the downloaded regional data file.



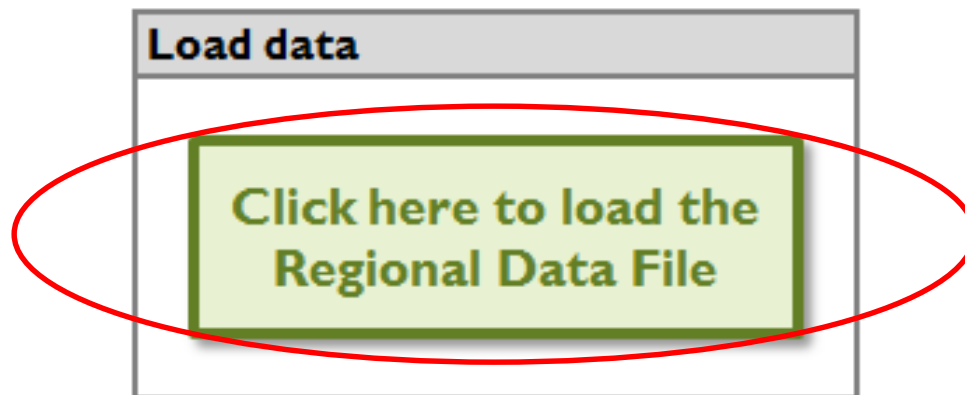
Enter filepath

Double-click below to enter the location of the Regional Data File.

AVERT's Excel-Based Main Module

Step 1. Load Regional Data File

- Click the button under “Load data” entitled:



Clicking this button loads the following information from the regional data file:

- Hourly fossil load
- EGU information (e.g., location, fuel type)
- Typical EGU performance for generation and emissions at a given regional load

AVERT's Excel-Based Main Module

Step 1. Load Regional Data File

- A popup will indicate when the file has finished loading and remind you how to handle states that are split across multiple AVERT regions.

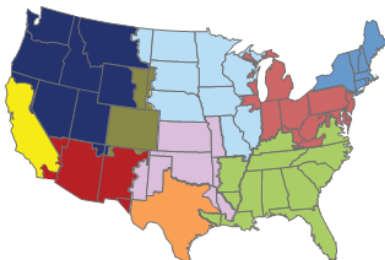
AVERT

Step 1: Import Regional Data File

Select region

Select a region for analysis by using the dropdown or by clicking the map.

Southeast



If you haven't yet downloaded a Regional Data File, click [here](#).

Enter filepath

Double-click below to enter the filepath of the Regional Data File.

K:\AVERT\CLLEX\AVERT and data files\regional files\AVERT RDF 2015 (Southeast).xlsx

Load data

Click here to download Regional Data File

X

AVERT

Import complete.

You have loaded the 2015 Southeast (SE) Regional Data File. This region contains 1003 fossil units.

Generation from the following states is fully represented in this AVERT region:

- Alabama
- Florida
- Georgia
- North Carolina
- South Carolina
- Tennessee

Generation from the following states is only partially represented in this AVERT region:

- Arkansas (89%)
- Kentucky (91%)
- Louisiana (76%)
- Missouri (21%)
- Mississippi (99%)
- Oklahoma (4%)
- Texas (6%)
- Virginia (95%)
- West Virginia (12%)

Appendix G of the User Manual describes a rule of thumb that users analyzing partially represented states should consider for assessing the impact of EE/RE over multiple AVERT regions. The Southeast (SE) region may include generation from units in states with a representation too small to be considered significant for this analysis.

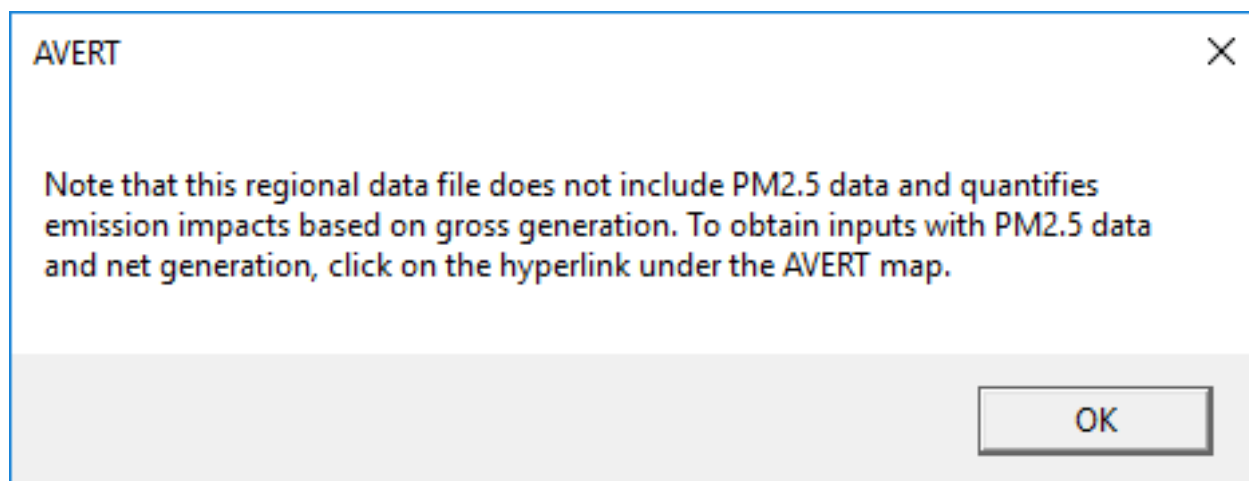
Click the red "Next" button to continue.

OK

Step 1. Load Regional Data File

Regional Data File import pop-up

- Regional Data Files (RDFs) 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 RDF, another pop-up box will alert you and suggest that you download a newer RDF from EPA's website.



AVERT's Excel-Based Main Module

Step 2. Set EE and RE Data

- This page leads you through the process of creating a load impact profile depicting the load reductions expected from an EE/RE program.

Upper Midwest, 2012

AVERT

Step 2: Set Energy Efficiency and Renewable Energy Impacts

DIRECTIONS: Enter the EERE load for one or a group of EERE policies and programs.

To include the impacts of hourly data manually, click the green button on the right.

Each entry is additive and will create a portfolio of EE/RE impacts.

For further instructions consult Section 4 of the AVERT user manual.

Enter hourly data manually

Enter EE impacts based on the % reduction of regional fossil load

Reduce generation by a percent in some or all hours

Apply reduction to top X% hours: % of top hours

Reduction % in top X% of hours: % reduction

And/or enter EE impacts distributed evenly throughout the year

Reduce generation by annual GWh: GWh

OR

Reduce each hour by constant MW: MW

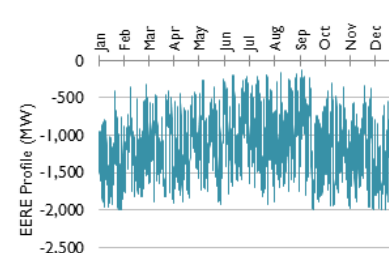
And/or enter annual capacity of RE resources

Wind Capacity: MW

Utility Solar PV Capacity: MW

Rooftop Solar PV Capacity: MW

Selected EERE Profile Portfolio:



The currently entered reduction profile equals 10,159 GWh, or 4.1% of regional fossil load.

Welcome

1. Regional Data File

2. Set EERE Profile

3. Run Displacement

4. Display Outputs

Next →

← Back

BaseEPA

AVERT's Excel-Based Main Module

Step 2. Set EE and RE Data

- If you enter an EE/RE program that exceeds 15% of regional fossil load in any given hour, you will be shown an alert highlighting the hours of exceedance, but you can still proceed with the calculations.

Upper Midwest, 2011

AVERT

Step 2: Set Energy Efficiency and Renewable Energy Impacts

DIRECTIONS: Enter the EERE load for one or a group of EERE policies and programs.

To include the impacts of hourly data manually, click the green button on the right.

Each entry is additive and will create a portfolio of EE/RE impacts.

For further instructions consult Section 4 of the AVERT user manual.

Enter hourly data manually

Enter EE impacts based on the % reduction of regional fossil load

Reduce generation by a percent in some or all hours

Apply reduction to top X% hours: 0% % of top hours

Reduction % in top X% of hours: 0.0% % reduction

And/or enter EE impacts distributed evenly throughout the year

Reduce generation by annual GWh: 0 GWh

OR

Reduce each hour by constant MW: 0.0 MW

And/or enter annual capacity of RE resources

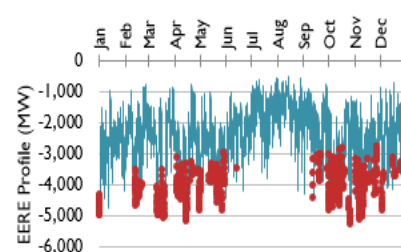
Wind Capacity: 6000 MW

Utility Solar PV Capacity: 0 MW

Rooftop Solar PV Capacity: 0 MW

Caution! EERE profile exceeds 15% of fossil load in one or more hours (see below).

Selected EERE Profile Portfolio:



The currently entered reduction profile equals 21,667 GWh, or 8.1% of regional fossil load.

Welcome

1. Regional Data File

2. Set EERE Profile

3. Run Displacement

4. Display Outputs

Next →

← Back

AVERT's Excel-Based Main Module

Step 2. Set EE and RE Data

- If the hourly load reductions expected from a particular EE/RE policy, program, or measure are known, a manual stream of load reduction values can be entered for every hour of the year by clicking the “Enter hourly data manually” button.

Enter hourly data manually

Northeast, 2012

AVERT

Manual EERE Data Entry

When complete, click here to return to
Step 2: Enter Energy Efficiency and Renewable Energy Data

Date	Hour	Day of Week	Regional Fossil Load (MW)	Manual EE RE Profile (MW)	Total Change (MW)
1/1/2012	1	Sunday	9,182		0
1/1/2012	2	Sunday	8,084		0
1/1/2012	3	Sunday	7,072		0
1/1/2012	4	Sunday	6,666		0
1/1/2012	5	Sunday	6,726		0
1/1/2012	6	Sunday	6,986		0
1/1/2012	7	Sunday	7,330		0
1/1/2012	8	Sunday	7,051		0
1/1/2012	9	Sunday	7,401		0
1/1/2012	10	Sunday	7,841		0
1/1/2012	11	Sunday	8,135		0
1/1/2012	12	Sunday	8,445		0
1/1/2012	13	Sunday	8,581		0
1/1/2012	14	Sunday	8,615		0

AVERT's Excel-Based Main Module

Step 2. Set EE and RE Data

This page 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
- Reduce each hour by a constant MW
- Renewable energy proxy
- Combination of EE/RE programs including combining pre-set options with manual entry

Enter EE impacts based on the % reduction of regional fossil load

Reduce generation by a percent in some or all hours		
Apply reduction to top X% hours:	0%	% of top hours
Reduction % in top X% of hours:	0.0%	% reduction

And/or enter EE impacts distributed evenly throughout the year

Reduce generation by annual GWh:	0	GWh
OR		
Reduce each hour by constant MW:	0.0	MW

And/or enter annual capacity of RE resources

Wind Capacity:	2000	MW
Utility Solar PV Capacity:	0	MW
Rooftop Solar PV Capacity:	0	MW

AVERT's Excel-Based Main Module

Step 3. Run Displacement

- Run displacement by selecting the button entitled "Click here to calculate displaced generation and emissions."

Upper Midwest, 2012

AVERT

Step 3: Run Displacement

Click below to calculate displaced generation and emissions.

NOTE
Please be patient.
This calculation may take up to ten minutes to run on older machines.
During this time your screen may go blank or a "not responding" error may occur - please disregard and allow the calculation to continue.

Click here to calculate displaced generation and emissions

Welcome

1. Regional Data File


2. Set EERE Profile

3. Run Displacement

4. Display Outputs

Next →

← Back



BaseEPA

AVERT's Excel-Based Main Module

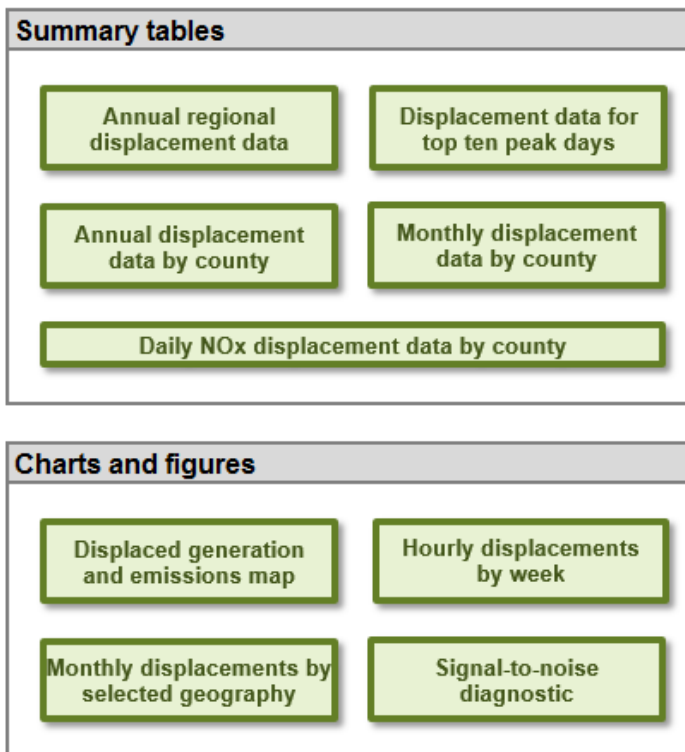
Step 3. Run Displacement

- This step calculates hourly displaced generation and emissions ($\text{PM}_{2.5}$, SO_2 , NO_x , CO_2) for each fossil EGU within the selected region.
- Note that this is a processor-intensive step. When using an older computer, or when analyzing regions with many fossil EGU, this step may take up to ten minutes.

AVERT's Excel-Based Main Module

Step 4. Display Outputs

- The data generated in Step 3 are aggregated in two groups of charts and tables in Step 4.



AVERT's Excel-Based Main Module

Step 4. Display Outputs

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.

AVERT's Excel-Based Main Module

Step 4. Display Outputs

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 EGU is displayed.

Upper Midwest, 2012

Output: Annual Displacement Data by County

[Click here to return to Step 4: Display Outputs](#)

State	County	Peak Gross	Annual Gross	Annual Displaced	Annual Displaced
		Generation, Post- EERE (MW)	Generation, Post- EERE (MWh)		
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

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}/SO₂/NO_x/CO₂
- Ozone Season Change in
SO₂/NO_x
- Ozone Season, 10 Peak Days
Change in SO₂/NO_x

AVERT's Excel-Based Main Module

Step 4. Display Outputs

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.

Upper Midwest, 2011

AVERT

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.

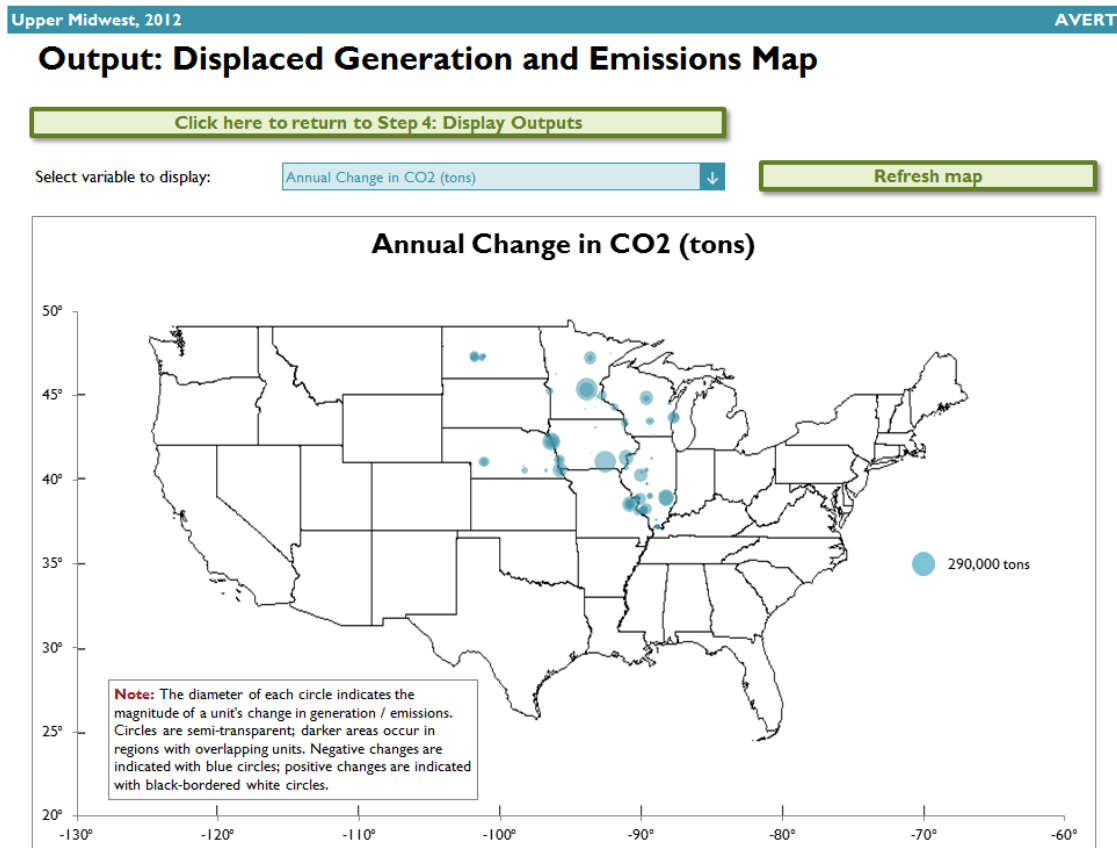
All results are rounded to the nearest ten. A dash ("—") indicates a result greater than zero, but lower than the level of reportable significance.

AVERT's Excel-Based Main Module

Step 4. Display Outputs

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}, SO₂, NO_x, and CO₂.



AVERT's Excel-Based Main Module

Step 4. Display Outputs

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.

Upper Midwest, 2011

AVERT

Output: Monthly Displacements by Selected Geography

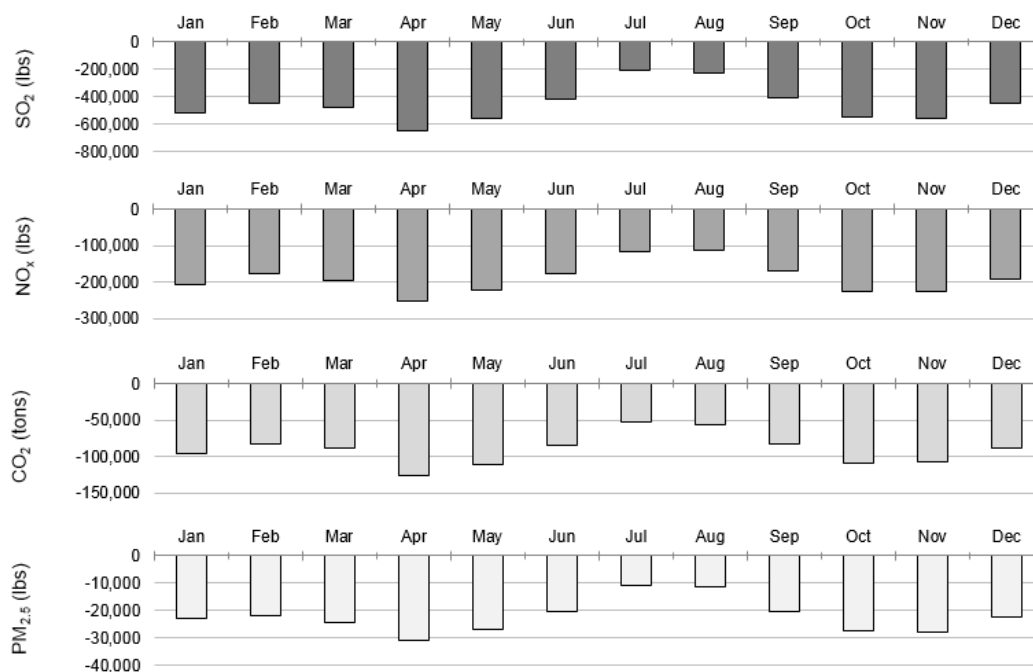
[Click here to return to Step 4: Display Outputs](#)

Select level of aggregation:
Select state:

State

IA

Monthly Emission Changes, Upper Midwest (IA)

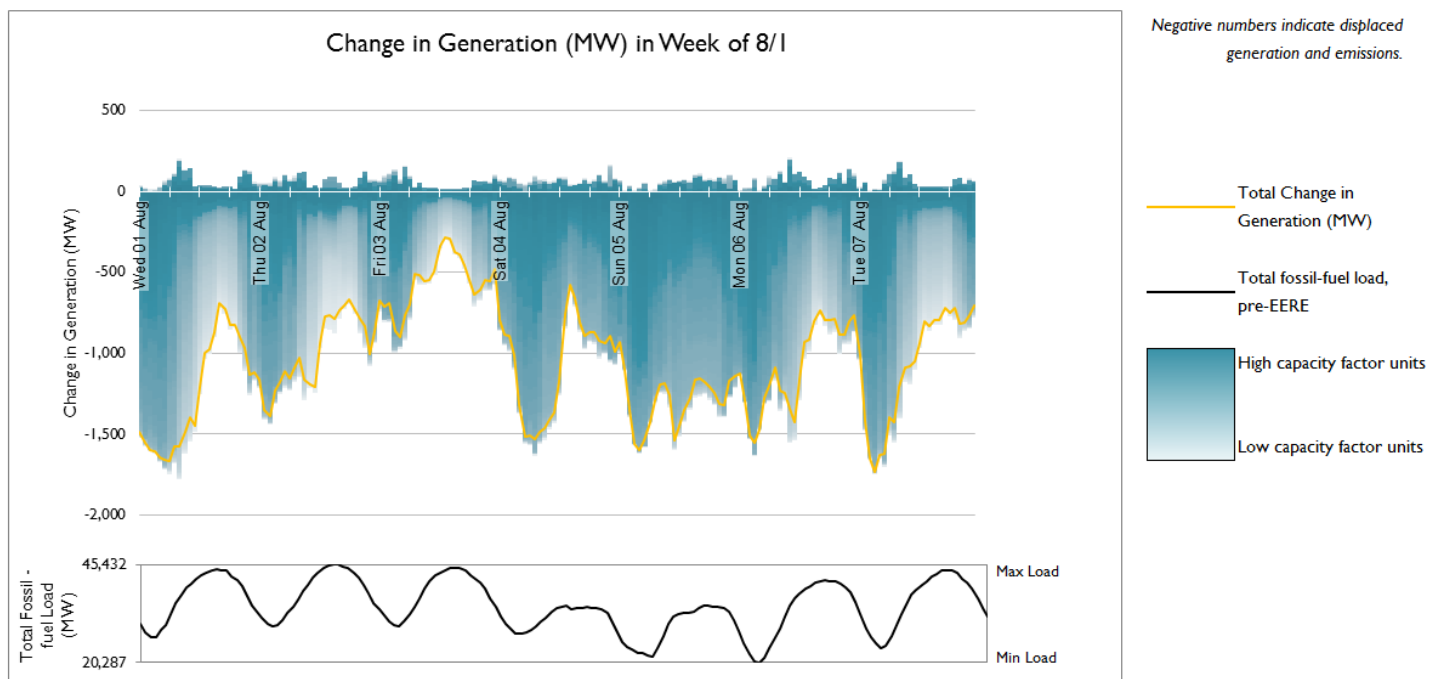


AVERT's Excel-Based Main Module

Step 4. Display Outputs

Hourly displacements by week

- This graph displays a dynamic representation of hourly displacement from each EGU in a region. Individual plants are stacked as gradated bar plots.

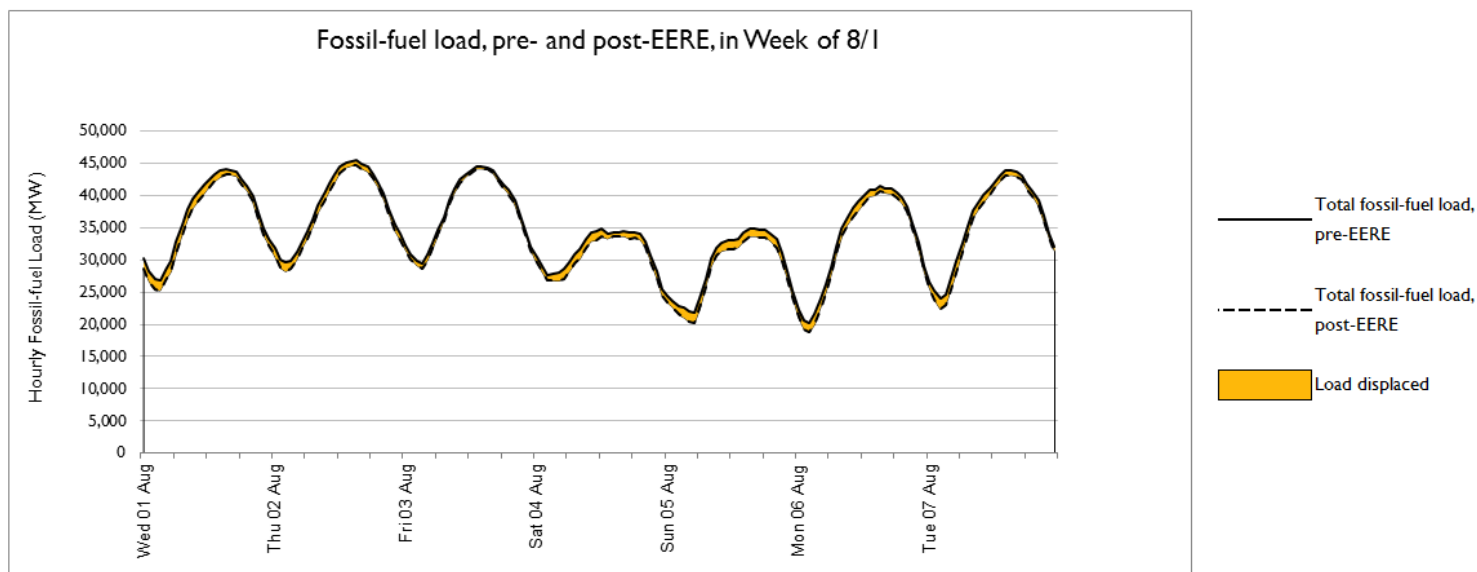


AVERT's Excel-Based Main Module

Step 4. Display Outputs

Hourly displacements by week

- 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.



AVERT's Excel-Based Main Module

Step 4. Display Outputs

Signal-to-noise diagnostic

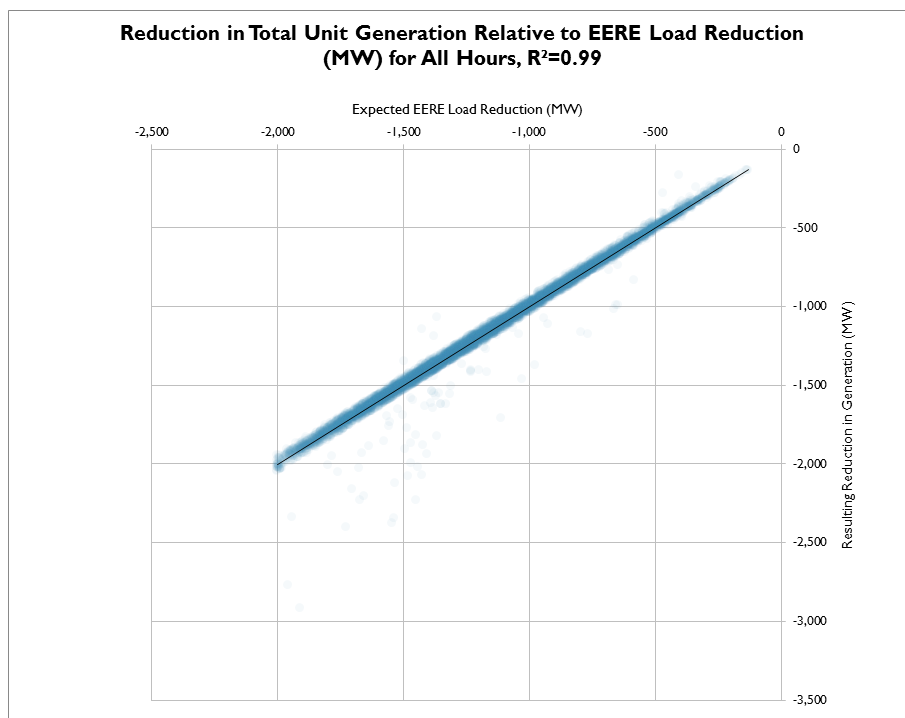
- This chart is a scatterplot of every hour of the year, showing calculated total generation reduction in each hour (y-axis) against the user-input EE/RE load reduction in each hour (x-axis).
- Ideally, AVERT perfectly matches unit generation reductions to the amount of EE/RE load reduction requested by the user.
- This graphic 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](#)



AVERT's Excel-Based Main Module

Step 4. Display Outputs

COBRA Output

- AVERT outputs may be used as inputs to EPA's CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool to assess EE/RE public health implications
- To download a COBRA-formatted file, double-click the blue box to enter a filepath and hit the green button to save a CSV file (example below)
- The file will contain county-level emission impacts for PM_{2.5}, SO₂, and NO_x, and will be ready for upload into COBRA

	FIPS	STATE	COUNTY	TIER1NAME	NOx_REDUCTIONS_TONS	SO2_REDUCTIONS_TONS	PM25_REDUCTIONS_TONS
1	01001	Alabama	Autauga County	FUEL COMB. ELEC. UTIL.	-1.13	-0.05	-0.765
2	01015	Alabama	Calhoun County	FUEL COMB. ELEC. UTIL.	-0.315	-0.005	-0.06
3	01033	Alabama	Colbert County	FUEL COMB. ELEC. UTIL.	-3.23	-11.365	-0.13
4	01039	Alabama	Covington County	FUEL COMB. ELEC. UTIL.	-0.5	-0.005	-0.09
5	01047	Alabama	Dallas County	FUEL COMB. ELEC. UTIL.	-0.11	0	-0.01
6	01063	Alabama	Greene County	FUEL COMB. ELEC. UTIL.	-3.32	-12.685	-0.735
7	01073	Alabama	Jefferson County	FUEL COMB. ELEC. UTIL.	-5.835	-8.575	-0.07
8	01081	Alabama	Lee County	FUEL COMB. ELEC. UTIL.	-0.455	-0.01	-0.225
9	01085	Alabama	Lowndes County	FUEL COMB. ELEC. UTIL.	-0.05	0	-0.025
10	01097	Alabama	Mobile County	FUEL COMB. ELEC. UTIL.	-5.89	-9.695	-0.265
11	01103	Alabama	Morgan County	FUEL COMB. ELEC. UTIL.	-0.395	-0.025	-0.15
12	01113	Alabama	Russell County	FUEL COMB. ELEC. UTIL.	-3.465	0	-0.195
13	01117	Alabama	Shelby County	FUEL COMB. ELEC. UTIL.	-3.57	-15.625	-0.22
14	01121	Alabama	Talladega County	FUEL COMB. ELEC. UTIL.	-0.13	0	-0.01
15	01123	Alabama	Tallapoosa County	FUEL COMB. ELEC. UTIL.	-0.12	-0.01	-0.08
16	01127	Alabama	Walker County	FUEL COMB. ELEC. UTIL.	-17.395	-15.505	-0.11
17	01129	Alabama	Washington County	FUEL COMB. ELEC. UTIL.	-7.16	-1.605	-0.415
18	05031	Arkansas	Craighead County	FUEL COMB. ELEC. UTIL.	-0.105	0	-0.005
19	05059	Arkansas	Hot Spring County	FUEL COMB. ELEC. UTIL.	-2.365	-0.015	-0.28
20	05063	Arkansas	Independence County	FUEL COMB. ELEC. UTIL.	-15.845	-39.095	-0.46
21	05069	Arkansas	Jefferson County	FUEL COMB. ELEC. UTIL.	-19.94	-42.335	-0.415
22	05093	Arkansas	Mississippi County	FUEL COMB. ELEC. UTIL.	-0.755	-1.515	-0.035
23							

COBRA text file generation

Enter a filepath, then click the button to save a COBRA text file.

NOTE

Please be patient.

This calculation may take up to twenty minutes to run on older machines.

Generate COBRA text files

Part II

AVERT Statistical Module Operation

AVERT Statistical Module

Overview

- Purpose
 - Basis of AVERT analysis
 - Processes raw CAMD data to determine behavioral characteristics of fossil-fired EGU
 - Returns expected generation and emissions behavior to AVERT Main Module
 - Allows users to alter EGU characteristics, retire and add EGU with Future Year Template
- Advanced use of AVERT
 - Most users will not require the Statistical Module
 - Based in MATLAB
 - Executable version available for public use
 - Requires MATLAB Compiler Runtime (MCR) to be installed (free from Mathworks) **R2012b (8.0)**.
 - Requires Windows
- Output file can be used directly in Main Module

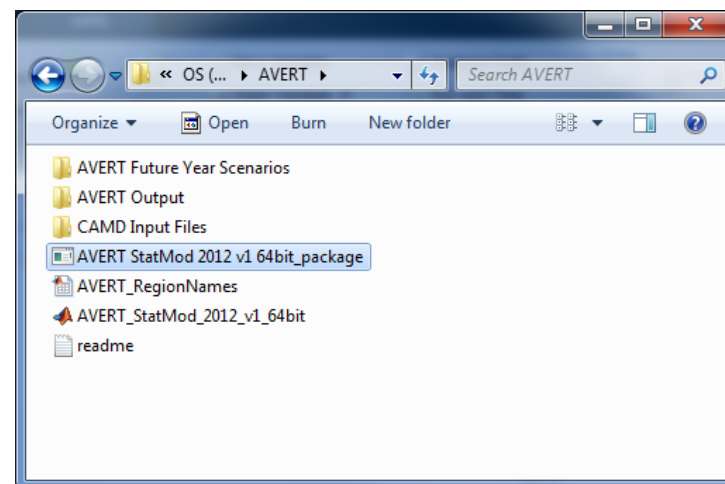
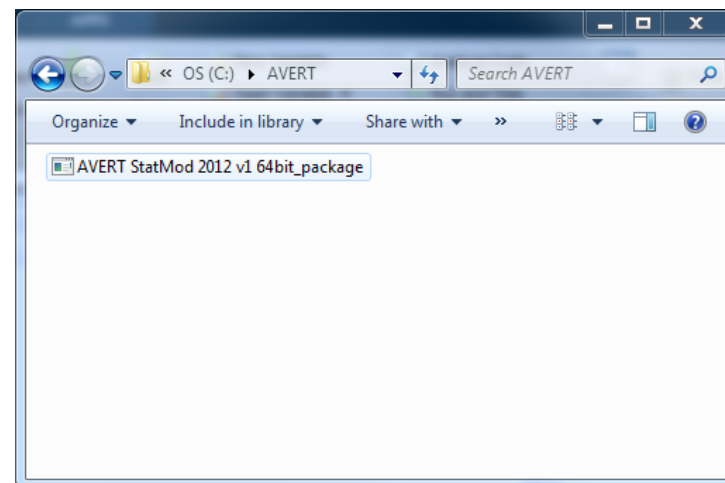
AVERT Statistical Module

Obtain Correct Version

- AVERT Statistical Module requires is sensitive to PC specifications.
- 32-bit and 64-bit operating system versions available.
- Obtain correct version of AVERT Statistical Module.
- Obtain correct version of MCR from Mathworks: **R2012b (8.0)**.
 - **Use the exact version noted on the AVERT website and in the user guide. An older or newer version will give you an error when you try to run the analysis.**
- Determine if your Windows system operates in a 32-bit or 64-bit environment.
 - Find this information in “properties” of “My Computer” in Windows XP, or “Computer” in Windows Vista, Windows 7, or Windows 8.
 - Follow these instructions: <https://support.microsoft.com/en-us/help/15056/windows-7-32-64-bit-faq>.

AVERT Statistical Module Unpacking and Startup

- Download the AVERT Statistical Module package.
- Run the executable to decompress the package to three files and three subfolders.



AVERT Statistical Module

File Structure

- **AVERT Future Year Scenarios**

- Excel-based input files for altering EGU

- **AVERT Output**

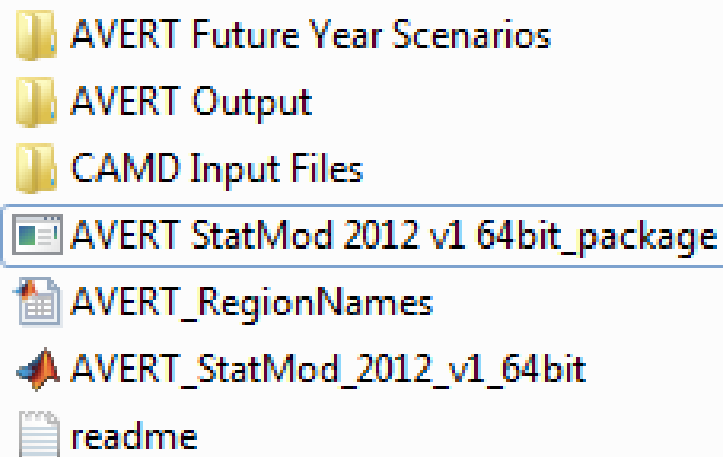
- Statistical Module output files
- These become Main Module input files

- **CAMD Input Files**

- Processed CAMD data files
- New versions expected 2nd quarter annually

- **AVERT_StatMod_2012_v1_64bit**

- Executable

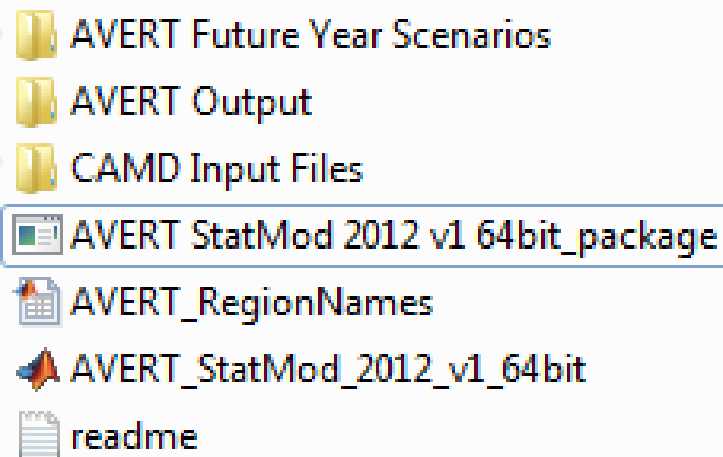


Obtaining Other Base Years

To obtain additional historical base year data, visit:

<https://www.epa.gov/statelocalenergy/download-avert>.

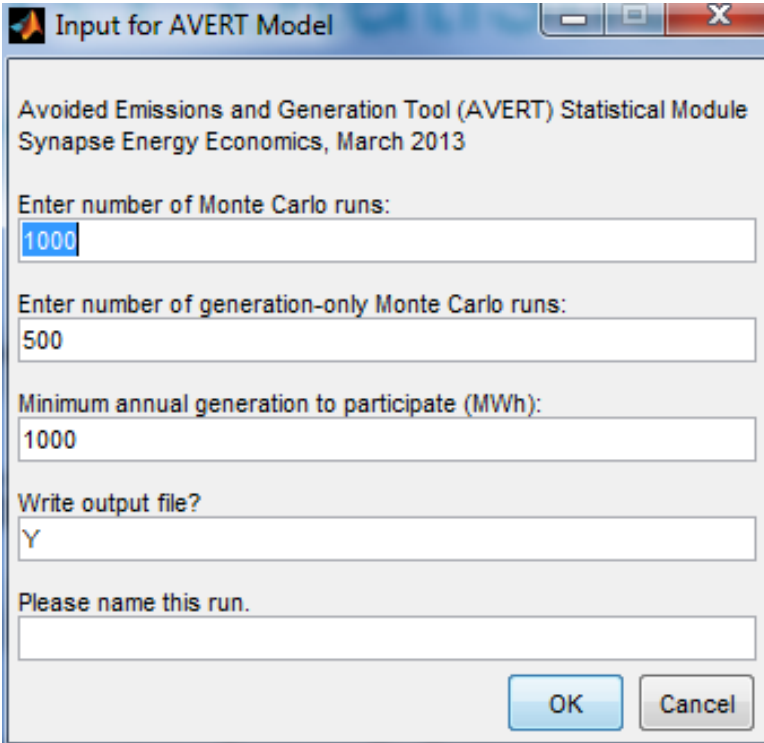
- Download AVERT Future Year Scenario for the same historical base year.
 - Place the file in “AVERT Future Year Scenarios”
- Download the CAMD input file for the historical base year.
 - Place the file in “CAMD Input Files”



AVERT Statistical Module

Input Parameters

- Higher number of Monte Carlo (MC) runs reduces noise.
 - For test runs, use a low number of MC runs (10) and generation-only MC runs (5).
 - For final runs, use a high number of MC runs (1,000) and generation-only MC runs (500).
- Select “Y” to write output and save runs.



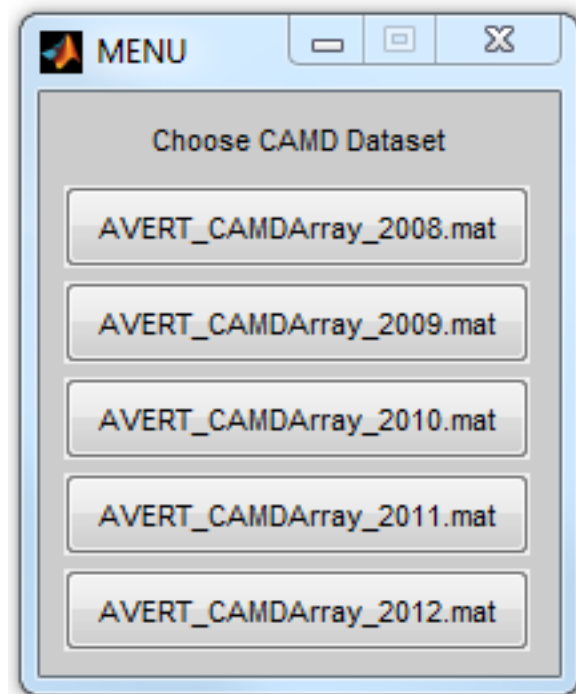
The screenshot shows a Windows-style dialog box titled "Input for AVERT Model". The text inside reads: "Avoided Emissions and Generation Tool (AVERT) Statistical Module Synapse Energy Economics, March 2013". There are four input fields: "Enter number of Monte Carlo runs:" with the value "1000" entered; "Enter number of generation-only Monte Carlo runs:" with the value "500" entered; "Minimum annual generation to participate (MWh):" with the value "1000" entered; and "Write output file?" with the value "Y" entered. Below these fields is a label "Please name this run." followed by an empty text box. At the bottom right are "OK" and "Cancel" buttons.

*Use letters and numbers only.
No special characters and no spaces.*

AVERT Statistical Module

Choose Data File

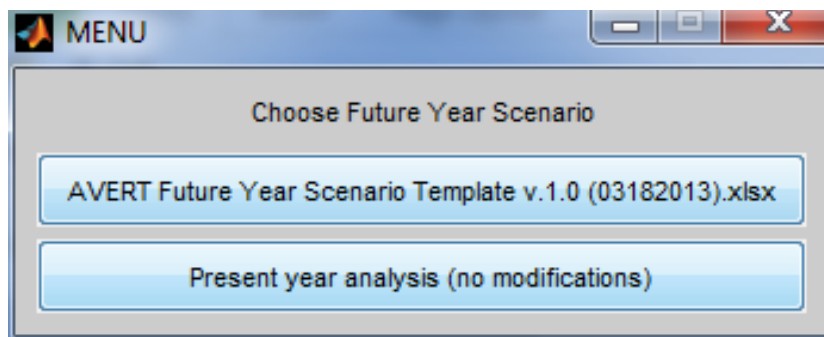
- Choose base year for analysis.
 - Data from 2007 through 2017 are available.
 - New data will be ready by the second quarter of the next year.
 - Requires data to be vetted by EPA and post-processed.



AVERT Statistical Module

Choose Future Year Scenario

- Select either
 - Saved future year scenario
 - Present year analysis

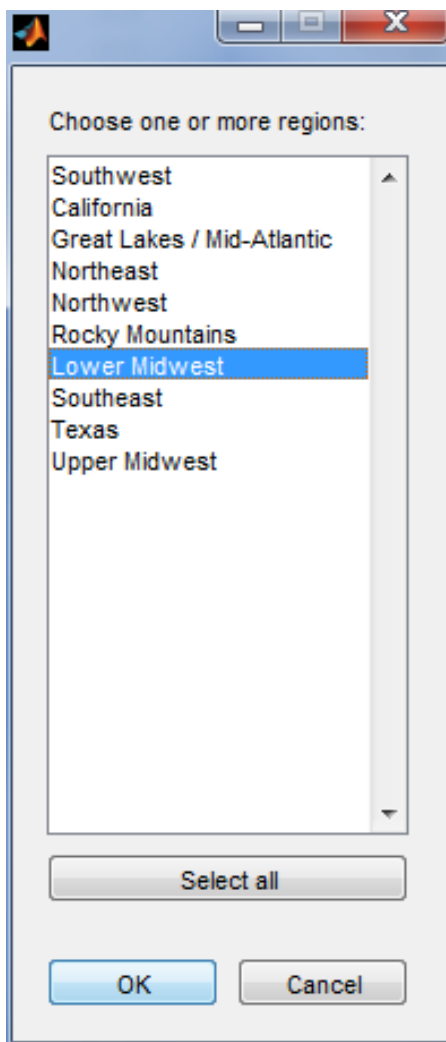


Present year analysis makes no modifications to the AVERT dataset.

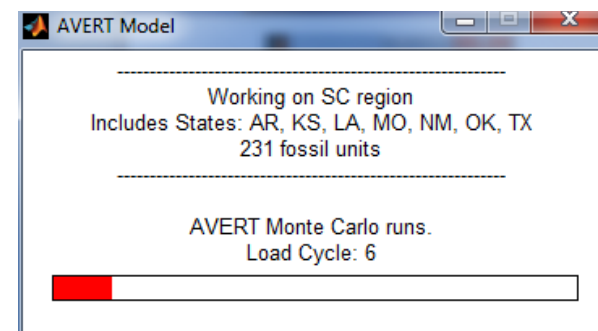
- Uses EGU that exist in data year
- No changes in emissions rates

AVERT Statistical Module

Choose Region(s) of Interest



- Choose region (or multiple regions) of interest.
- Same regions as in AVERT Main Module
- Once you hit “OK”, the program will run uninterrupted until completion.
 - Program returns updated run status on a regular basis.
 - Output graphic and file indicate successful completion.



Part III

AVERT Future Year Scenario Template

AVERT Future Year Scenario Overview

- Purpose
 - AVERT is not forward-looking: cannot predict EGU retirements, new additions, or emissions modifications.
 - Future Year Scenarios allow users to
 - Remove EGU from analysis.
 - Include additional proxy EGU.
 - Modify emissions characteristics.
- Advanced use of AVERT
 - Excel spreadsheet
 - Read into AVERT Statistical Module
- Each spreadsheet becomes a scenario.
 - Spreadsheet becomes input file for AVERT Statistical Module.
 - Each future year scenario template is specifically designed to match the same historical base year.

Use AVERT Future Year Scenario in Statistical Module

- Obtain Future Year Scenario Template (slides 41-44).
- Modify Future Year Scenario Template (slides 52-54).
- Save Future Year Scenario Template with a meaningful name.
- Run Statistical Module (slides 45-48).
 - Provide a unique name for the statistical module run (slide 45).
 - Choose saved future year scenario (slide 47).

AVERT Future Year Scenario Retires and Modifications

Retiring Units / Emission Modifications													
Enter an option manually in blue cells													
Facility Name	ORSPL UnitID	Retire?	Retire (binary)	Revise Emissions Rates?	Revise (binary)	Revised SO2 Rate (lbs/MWh)	Revised NOx Rate (lbs/MWh)	Revised CO2 Rate (Tons/MWh)	Revised PM2.5 Rate (Tons/MMBTU)	AVERT Region	capacity	unit type	CF
Healy Power Plant	6288	1	No	0	No	0	0.000	0.000	0.000	0	0	Coal	0%
Healy Power Plant	6288	2	No	0	No	0	0.000	0.000	0.000	0	0	Other	0%
AMEA Sylacauga Plant	56018	1	No	0	No	0	0.000	0.000	0.000	Southeast	49	Gas	6%
AMEA Sylacauga Plant	56018	2	No	0	No	0	0.000	0.000	0.000	Southeast	49	Gas	5%
Ascend (Decatur Plant)	880041	X015	No	0	No	0	0.000	0.000	0.000	Southeast	0	Coal	0%
Ascend (Decatur Plant)	880041	Z005	No	0	No	0	0.000	0.000	0.000	Southeast	0	Coal	0%
Ascend (Decatur Plant)	880041	Z006	No	0	No	0	0.000	0.000	0.000	Southeast	0	Coal	0%
Barry	3	1	No	0	No	0	0.000	0.000	0.000	Southeast	58	Gas	2%
Barry	3	2	No	0	No	0	0.000	0.000	0.000	Southeast	56	Gas	2%
Barry	3	4	No	0	No	0	0.000	0.000	0.000	Southeast	354	Coal	36%
Barry	3	5	No	0	No	0	0.000	0.000	0.000	Southeast	791	Coal	46%
Barry	3	6A	No	0	No	0	0.000	0.000	0.000	Southeast	291	Gas	83%
Barry	3	6B	No	0	No	0	0.000	0.000	0.000	Southeast	288	Gas	78%
Barry	3	7A	No	0	No	0	0.000	0.000	0.000	Southeast	288	Gas	82%
Barry	3	7B	No	0	No	0	0.000	0.000	0.000	Southeast	288	Gas	83%
Calhoun Energy Center	55409	CT1	Yes	1	No	0	0.000	0.000	0.000	Southeast	163	Gas	4%
Calhoun Energy Center	55409	CT2	Yes	1	No	0	0.000	0.000	0.000	Southeast	164	Gas	2%
Calhoun Energy Center	55409	CT3	No	0	No	0	0.000	0.000	0.000	Southeast	165	Gas	3%
Calhoun Energy Center	55409	CT4	No	0	No	0	0.000	0.000	0.000	Southeast	161	Gas	5%
Charles R Lowman	56	1	No	0	Yes	1	1.000	1.000	1.000	Southeast	80	Coal	3%
Charles R Lowman	56	2	No	0	Yes	1	1.000	1.000	1.000	Southeast	239	Coal	30%
Charles R Lowman	56	3	No	0	Yes	1	1.000	1.000	1.000	Southeast	241	Coal	43%
Colbert	47	1	No	0	No	0	0.000	0.000	0.000	Southeast	170	Coal	16%
Colbert	47	2	No	0	No	0	0.000	0.000	0.000	Southeast	156	Coal	17%
Colbert	47	3	No	0	No	0	0.000	0.000	0.000	Southeast	164	Coal	11%
Colbert	47	4	No	0	No	0	0.000	0.000	0.000	Southeast	163	Coal	9%

- Find EGU of interest, or filter by state or region.
- To retire, select "Yes" in the "Retire?" column.
- To change emissions rate, select "Yes" in the "Revise Emissions Rates?" column and enter new rate(s) in columns I, J, K, or L.

AVERT Future Year Scenario Additions

AVERT Future Year Scenario Template v.1.0 (03182013) - Microsoft Excel

FileHomeInsertPage LayoutFormulasDataReviewViewPDFAcrobat

J7250

#	Region	Fuel Type	Unit Type	Unit	ORSPL	UNIT ID	Description (Note that "0 MW" units did not run in 2011.)	Capacity (MW)	State	County	Lat - County	Lon - County	Region Ref 1	Region Ref 2	Fuel Select Range	Fuel Ref 1	Fuel Ref 2
1	SC	Gas	CC	Redbud Power Plant CT-01	55463	CT-01	This is a 332 MW unit. It is located in Oklahoma County, OK. In 2011, it ran for 1155 GWh at a capacity factor of 40%.	250	OK	Oklahoma	35.510	-97.497	2599	282	Dropdowns!G2 599:G2880	2665	2878
2	SC	Gas	CC	Redbud Power Plant CT-02	55463	CT-02	This is a 328 MW unit. It is located in Oklahoma County, OK. In 2011, it ran for 1267 GWh at a capacity factor of 44%.	250	OK	Oklahoma	35.510	-97.497	2599	282	Dropdowns!G2 599:G2880	2665	2878
3	SC	Gas	CC	Mustang Station 1	55065	1	This is a 243 MW unit. It is located in Yoakum County, TX. In 2011, it ran for 1297 GWh at a capacity factor of 61%.	250	TX	Potter	35.257	-101.842	2599	282	Dropdowns!G2 599:G2880	2665	2878
4	SC	Gas	CT	John Twitty Energy Center CT2A	6195	CT2A	This is a 28 MW unit. It is located in Greene County, MO. In 2011, it ran for 1 GWh at a capacity factor of 0%.	35	OK	Tulsa	36.125	-95.939	2599	282	Dropdowns!G2 599:G2880	2665	2878
5	SC	Gas	CT	John Twitty Energy Center CT1B	6195	CT1B	This is a 24 MW unit. It is located in Greene County, MO. In 2011, it ran for 1 GWh at a capacity factor of 0%.	35	OK	Tulsa	36.125	-95.939	2599	282	Dropdowns!G2 599:G2880	2665	2878
6	SC	Gas	CT	West Gardner Generating Station 1	7929	1	This is a 81 MW unit. It is located in Johnson County, KS. In 2011, it ran for 15 GWh at a capacity factor of 2%.	75	KS	Labette	37.216	-95.259	2599	282	Dropdowns!G2 599:G2880	2665	2878
7	SC	Gas	CT	West Gardner Generating Station 2	7929	2	This is a 71 MW unit. It is located in Johnson County, KS. In 2011, it ran for 14 GWh at a capacity factor of 2%.	75	KS	Labette	37.216	-95.259	2599	282	Dropdowns!G2 599:G2880	2665	2878
8					0	#N/A	#N/A				#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A

Retires_ModificationsAdditionsEPA_FacilitiesEPA_AMEGRID PLNT09CapacityGen

Ready85%

In order

1. Select region
2. Select fuel type
3. Select generator type

4. Select specific EGU (unit)

Description will appear about EGU type automatically.

AVERT Future Year Scenario Additions

AVERT Future Year Scenario Template v1.0 (03182013) - Microsoft Excel

FileHomeInsertPage LayoutFormulasDataReviewViewPDFAcrobat

J7250

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Additions														Dropdown builder (fill down this section with e				
2																			
3															Either select a county from the dropdown, or enter manually				
4	#	Region	Fuel Type	Unit Type	Unit	ORSPL	UNIT ID	Description (Note that "0 MW" units did not run in 2011.)	Capacity (MW)	State	County	Lat - County	Lon - County	Region Ref 1	Region Ref 2	Fuel Select Range	Fuel Ref 1	Fuel Ref 2	
5	1	SC	Gas	CC	Redbud Power Plant CT-01	55463	CT-01	This is a 332 MW unit. It is located in Oklahoma County, OK. In 2011, it ran for 1155 GWh at a capacity factor of 40%.	250	OK	Oklahoma	35.510	-97.497	2599	282	Dropdowns\G2 599:G2880	2665	2878	
6	2	SC	Gas	CC	Redbud Power Plant CT-02	55463	CT-02	This is a 328 MW unit. It is located in Oklahoma County, OK. In 2011, it ran for 1267 GWh at a capacity factor of 44%.	250	OK	Oklahoma	35.510	-97.497	2599	282	Dropdowns\G2 599:G2880	2665	2878	
7	3	SC	Gas	CC	Mustang Station 1	55065	1	This is a 243 MW unit. It is located in Yoakum County, TX. In 2011, it ran for 1297 GWh at a capacity factor of 61%.	250	TX	Potter	35.257	-101.842	2599	282	Dropdowns\G2 599:G2880	2665	2878	
8	4	SC	Gas	CT	John Twitty Energy Center CT2A	6195	CT2A	This is a 28 MW unit. It is located in Greene County, MO. In 2011, it ran for 1 GWh at a capacity factor of 0%.	35	OK	Tulsa	36.125	-95.939	2599	282	Dropdowns\G2 599:G2880	2665	2878	
9	5	SC	Gas	CT	John Twitty Energy Center CT1B	6195	CT1B	This is a 24 MW unit. It is located in Greene County, MO. In 2011, it ran for 1 GWh at a capacity factor of 0%.	35	OK	Tulsa	36.125	-95.939	2599	282	Dropdowns\G2 599:G2880	2665	2878	
10	6	SC	Gas	CT	West Gardner Generating Station 1	7929	1	This is a 81 MW unit. It is located in Johnson County, KS. In 2011, it ran for 15 GWh at a capacity factor of 2%.	75	KS	Labette	37.216	-95.259	2599	282	Dropdowns\G2 599:G2880	2665	2878	
11	7	SC	Gas	CT	West Gardner Generating Station 2	7929	2	This is a 71 MW unit. It is located in Johnson County, KS. In 2011, it ran for 14 GWh at a capacity factor of 2%.	75	KS	Labette	37.216	-95.259	2599	282	Dropdowns\G2 599:G2880	2665	2878	
12	8					0	#N/A	#N/A				#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	

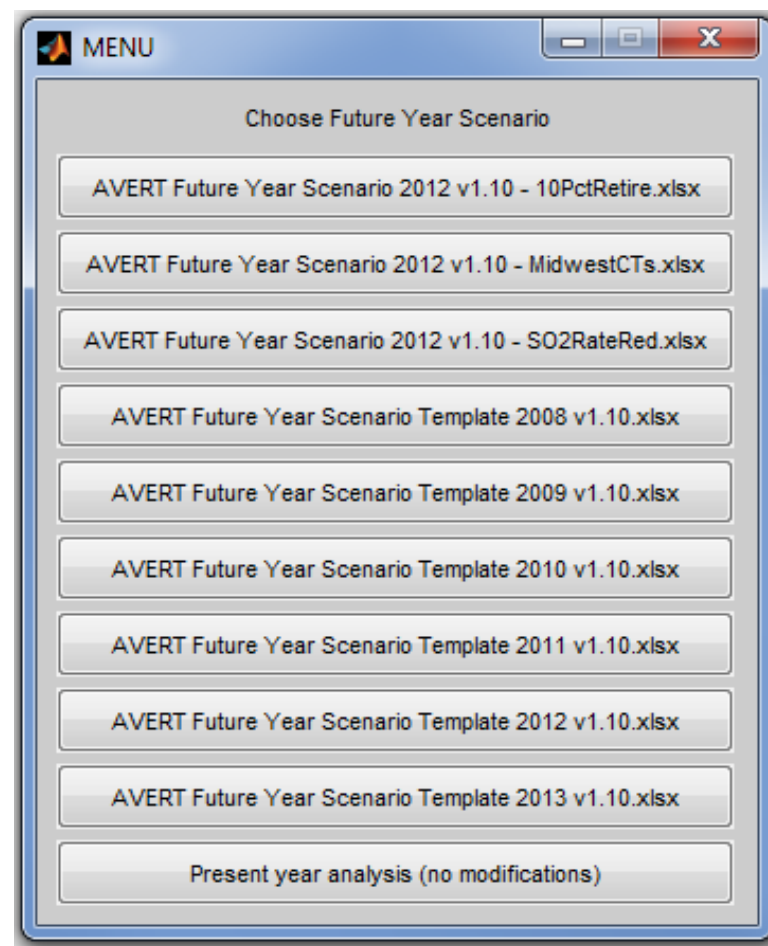
Retires_ModificationsAdditionsEPA_FacilitiesEPA_AMEGRID PLNT09CapacityGen

Ready85%

- Choose proxy unit capacity (will scale all other factors)
- Choose state (within region)
- Choose county (within region)
- Save file

Use AVERT Future Year Scenario in Statistical Module

- Run Statistical Module (slides 45-48).
- Provide a unique name for the statistical module run (slide 45).
- Choose saved future year scenario (slide 47).



For More Information

- Visit the AVERT website at www.epa.gov/avert.
- Contact EPA at avert@epa.gov.

AVoided Emissions and geneRation Tool (AVERT)

A tool that estimates the
emissions benefits of energy
efficiency and renewable
energy policies and programs



- [Cost-effective ways to reduce air pollution and include emission benefits in Clean Air Act Plans](#)
- [What is AVERT?](#)
- [Why use AVERT?](#)
- [When should AVERT not be used?](#)
- [Who should use AVERT?](#)
- [How does AVERT work?](#)
- [How to run scenarios in AVERT](#)
- [Download AVERT](#)

Cost-effective ways to reduce
air pollution and include
emission benefits in Clean Air
Act Plans

Helpful Links

- [AVERT Training Module](#)
- [AVERT Main Module Quick Start Guide](#)
- [AVERT User Manual](#)
- [The AVERT Overview and Step-by-Step instructions](#)
- [Fact Sheet for Decision Makers](#)
- [Contact AVERT](#)