AVERT Overview and Step-by-Step Instructions

U.S. Environmental Protection Agency
State Energy and Environment Program
Updated April 2024

AVoided Emissions and geneRation Tool
www.epa.gov/avert

United States Environmental Protection Agency

Overview of AVERT Development for Energy Efficiency (EE), Renewable Energy (RE), and Electric Vehicle (EV) Programs

- AVERT (AVoided Emissions and geneRation Tool) translates the impacts of EE, RE, EVs, energy storage, and other energy policies and programs into emission impacts ($PM_{2.5}$, NO_x, SO_2, CO_2, VOCs, and NH_3).
  - 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 multiple 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

For more information on EPA's EE/RE SIP Roadmap visit: https://www.epa.gov/energy-efficiency-and-renewable-energy-sips-and-tips/energy-efficiencyrenewable-energy-roadmap.

AVERT's Evolution

2014
- Initial release of AVERT with data for CO_2, NO_X, and SO_2.

2015
- Published first paper comparing emissions from AVERT regions and EE/RE resources.

2016
- Extensive training and outreach, including video tutorials.

2017
- Addressed net vs. gross considerations by accounting for parasitic load and transmission and distribution line loss.
- Added $PM_{2.5}$.
- Generated emission rates to support quick analyses.

2018
- Added compatibility with EPA's COBRA tool.
- Launch of web-based AVERT.

2019
- Updated AVERT to provide year-specific transmission and distribution loss factors from EIA generation and sales data.

2020
- Revised AVERT regions to reflect the modern electric grid.
- Added offshore wind and scaleable RE capacity factors.
- Added statewide analysis function (web AVERT only).

2021
- Annual data updates, including newer source data and capacity factors.
- Added VOCs and NH_3.

2022
- Annual data updates, including newer source data and capacity factors.

2023
- Added capability to model the impact of electric vehicles.
- Added new summary outputs, including vehicle emission changes and references to long-run marginal emission rates.

2024
- Added energy storage and solar PV-plus-storage as new resources to model.

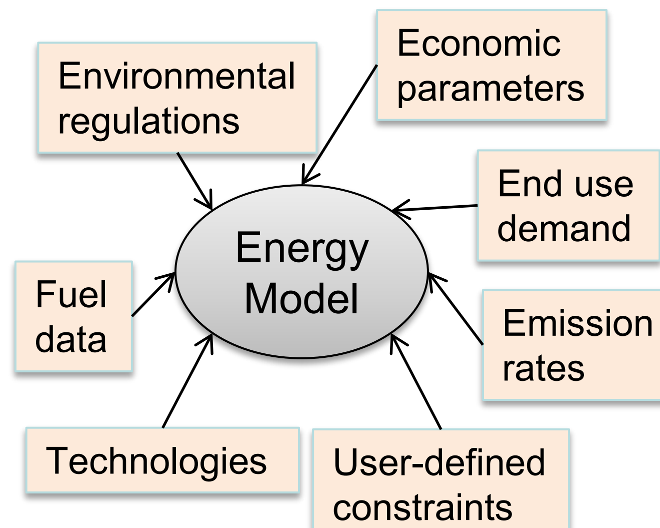
Ongoing activities
- Annual data updates
- Enhancements
- Compatibility updates

Emission Quantification Methods
Basic to Sophisticated

Basic Method	**Intermediate Method**	**Sophisticated Method**
eGRID region non-baseload emission rates	Historical hourly emission rates	Energy modeling Dispatch or capacity expansion

eGRID

AVERT
AVoided Emissions and geneRation Tool
www.epa.gov/avert



Applications for AVERT-Calculated Emissions

- SIP credit in a state's National Ambient Air Quality Standard (NAAQS) Clean Air Act Plan
  - EE and RE only, not suitable for vehicles
- Compare emission impacts of varying levels of energy programs, projects, and policies
- Calculate emission reductions in your state or county using AVERT's web-based edition
- Use AVERT-generated emission rates to estimate magnitude of emission reductions without running the tool
  - Eight categories include offshore and onshore wind, rooftop- and utility-scale solar, rooftop PV-plus-storage (2023 only) and utility-scale PV-plus-storage (2023 only), 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

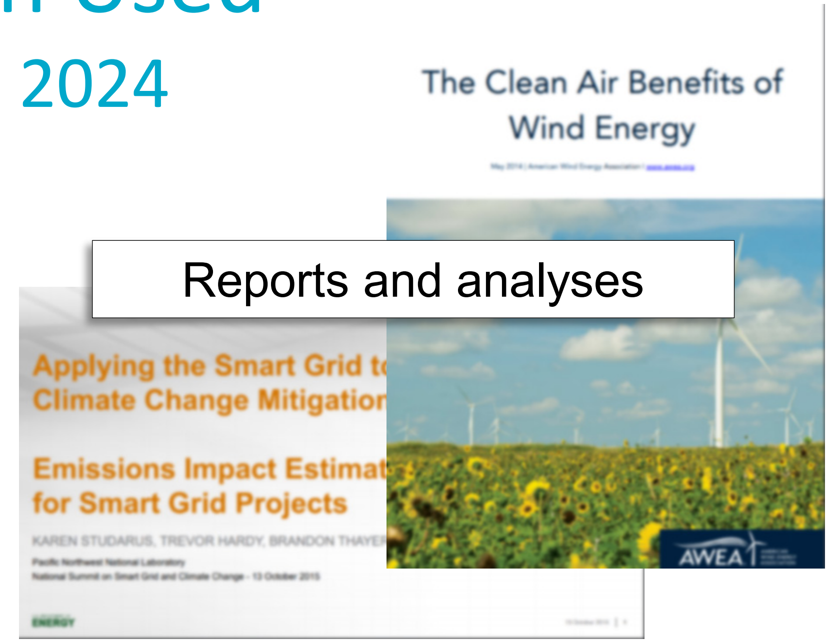
How AVERT Has Been Used

100+ citations as of spring 2024

Peer-reviewed papers

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

…and more



Reports and analyses

Resource pages and factsheets

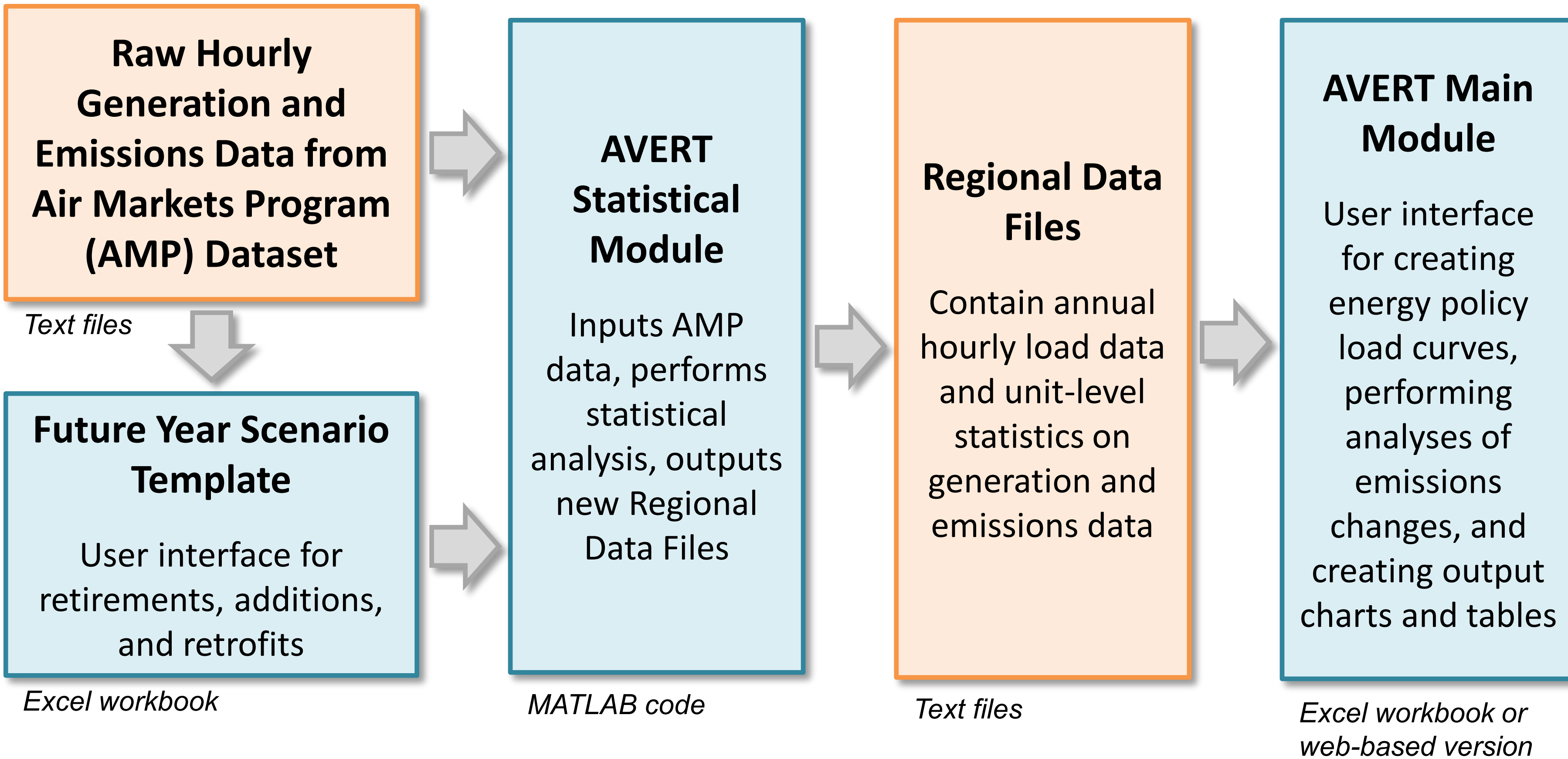
Examples Using AVERT

- Cost-Effectiveness Analysis for ASHRAE 90.1-2019 – Multiple States (Pacific Northwest National Laboratory, 2021)
- Climate and Health Benefits of Increasing Renewable Energy Deployment in the United States (Buonocore et al., 2019)
- Potential Air Quality Benefits from Increased Solar Photovoltaic Electricity Generation in the Eastern United States (Abel et al., 2017)
- The Health and Environmental Benefits of Wind and Solar Energy in the United States, 2007-2015 (LBNL, January 2017)
- Electric Vehicles and Air Quality (North Carolina Department of Environmental Quality and the South Carolina Energy Office)
- Carbon Reductions and Health Co-benefits from U.S. Residential Energy Efficiency Measures (Levy et al., 2016)
- Renewable Portfolio Standard (RPS) Benefits Report (LBNL and NREL, January 2016)
- U.S. EPA's Ozone Advance Program - Clark County, NV's Paths Forward
- Assessing Emission Benefits of Renewable Energy and Energy Efficiency Programs (U.S. EPA, April 2015)
- Maine Distributed Solar Valuation Study (Maine PUC, March 2015)
- CarbonCount™ Green Bonds Scores (Alliance to Save Energy, March 2015)

How AVERT Works

- AVERT's Main Module simulates the hourly changes in generation and air emissions ($PM_{2.5}$, NO_x, SO_2, CO_2, VOCs, and NH_3) at EGUs resulting from EE, RE, EVs, energy storage, and other energy policies and programs.
- User input: MWhs saved from energy programs, wind and solar generation (MW), number of EVs and location of EV deployment, or energy storage parameters
  - Multiple options are built into the tool
  - Users can manually enter hourly impact data
- 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.

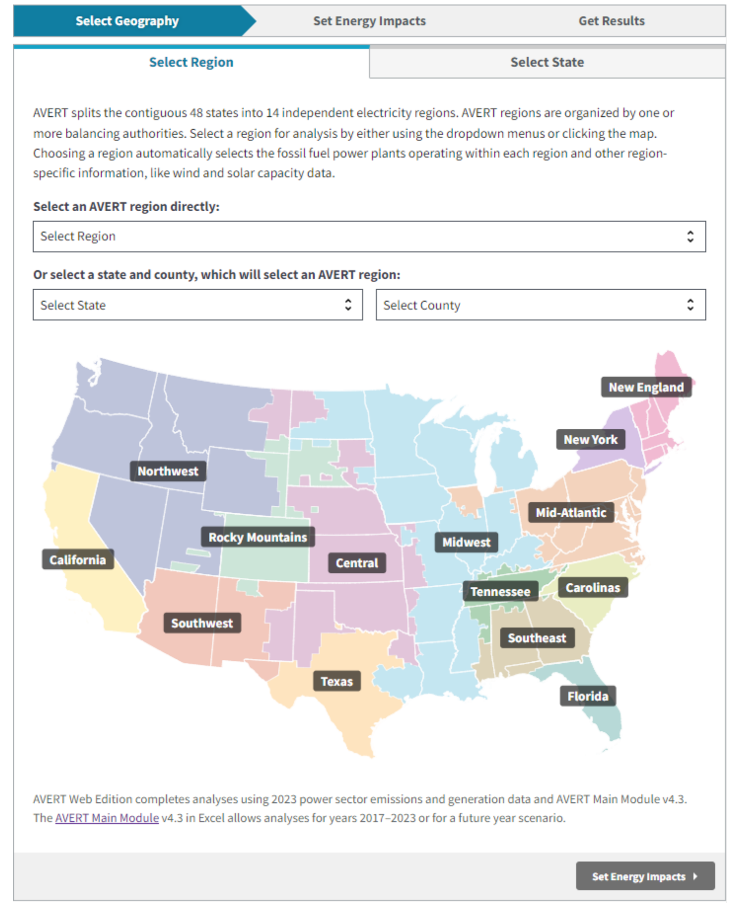
AVERT's Data Driven Analysis

- AVERT uses a data-driven analysis to distinguish which EGUs respond to marginal changes in load.
  - AVERT analyzes EGU datasets from EPA's Air Markets and Program Data (hourly, unit-by-unit generation and emissions).
    - Dataset includes EGUs with capacity of 25 MW or greater.
    - Supplemented with $PM_{2.5}$, VOCs, and NH_3 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.

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 Edition
  - The online platform allows users to quickly estimate energy program impacts using current year dataset
  - Users can enter standard energy settings
  - Results are shown in graphical form and savable formats
- Allows statewide multi-region runs



www.epa.gov/avert/avert-web-edition

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

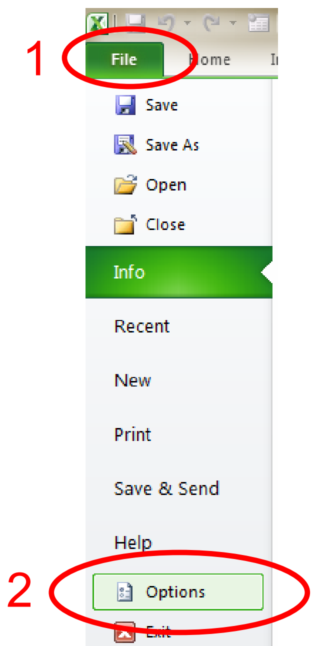
- Enabling Macros
- Using AVERT
- Step 1. Load Regional Data File
- Step 2. Set Energy Scenario
- Step 3. Run Scenario
- Step 4. Display Results

AVERT's Excel-Based Main Module Enabling Macros

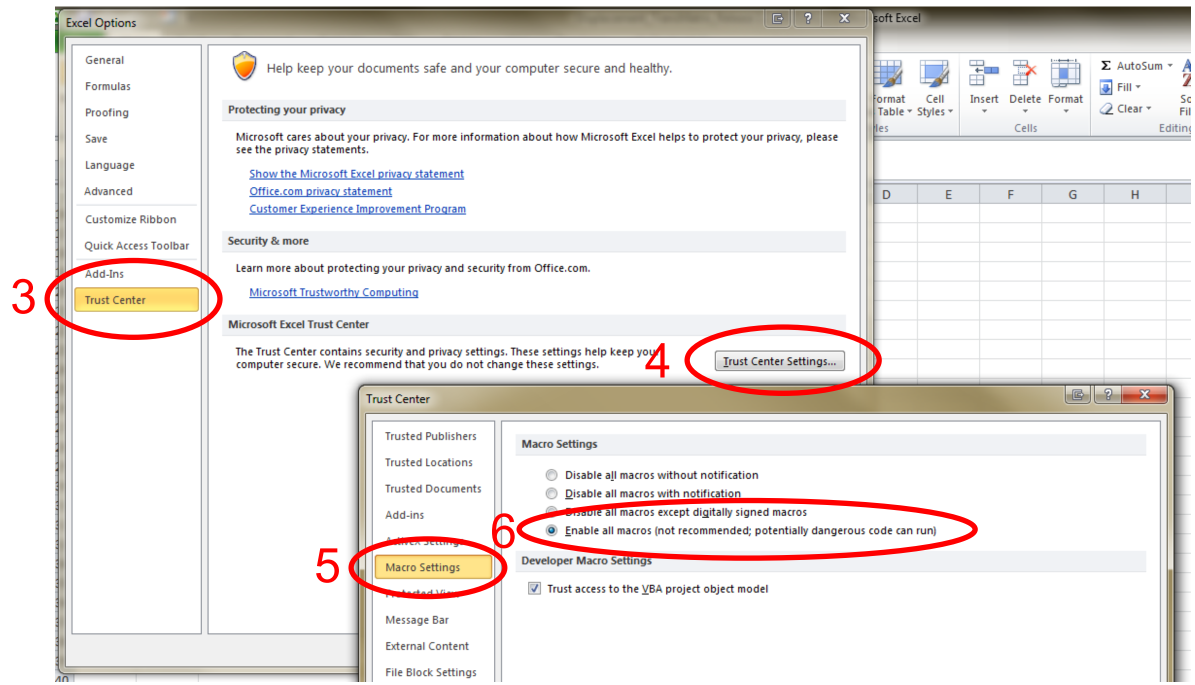
- In Windows, AVERT is compatible with Excel 2007 or newer versions.
- On a Mac, AVERT is compatible with Excel 2011 or newer versions.
  - Only the Main Module has been optimized for Mac. Other components (e.g., the Statistical Module) require Windows.
- You may want to revert to the default macro settings 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**

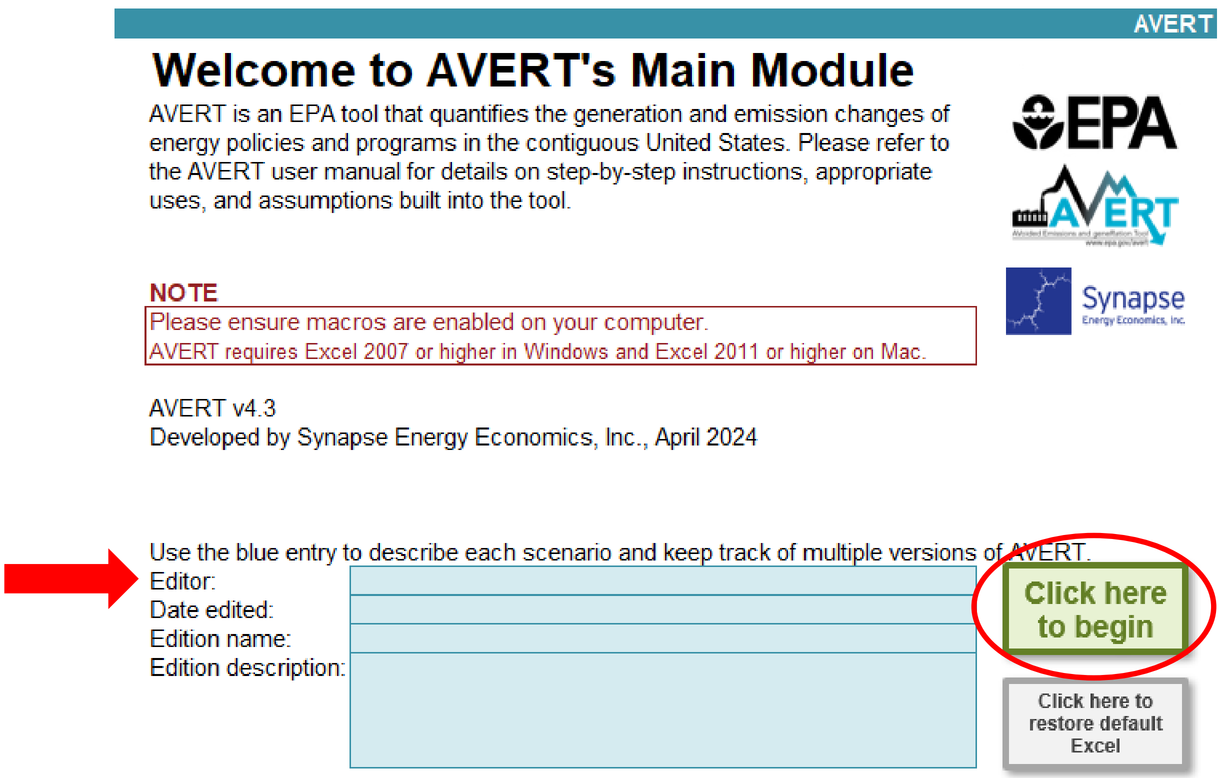


*If using Excel 2007, click the Microsoft Office Button: .

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

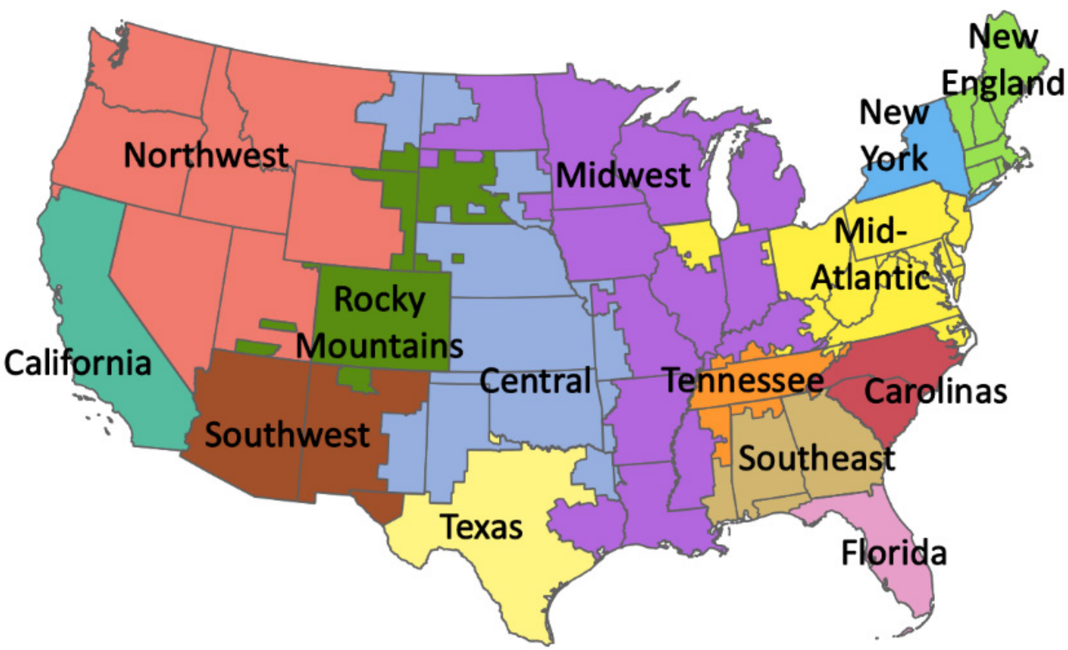
AVERT's Excel-Based Main Module Using AVERT

- Add details about the user, the date, and the energy program for which impacts are to be estimated.
- Click on the button labeled "Click here to begin."



AVERT's Excel-Based Main Module
Step 1. Load Regional Data File

Regions represent relatively autonomous electricity production zones and are aggregations of one or more balancing authority.

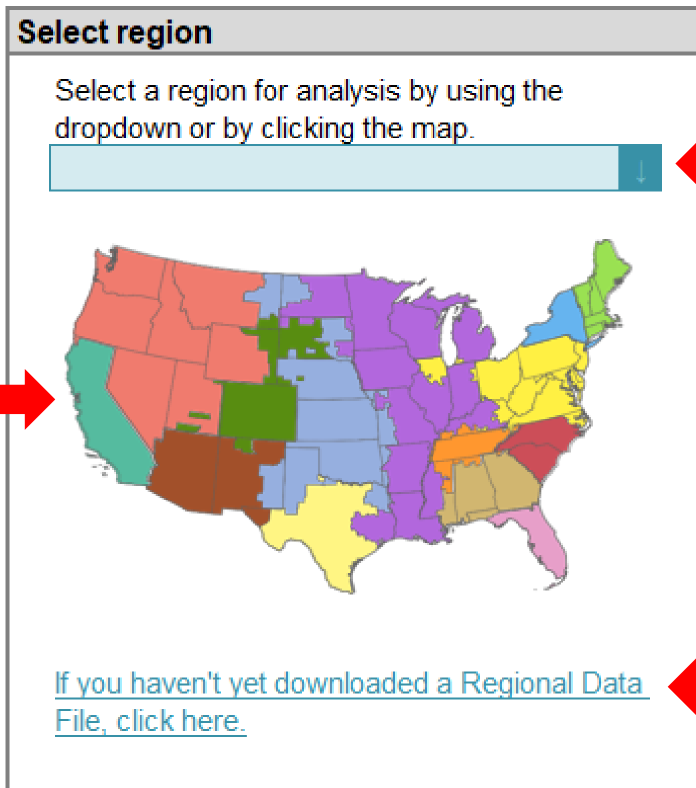


Regions include

- California
- Carolinas
- Central
- Florida
- Mid-Atlantic
- Midwest
- New England
- New York
- Northwest
- Rocky Mountains
- Southeast
- Southwest
- Tennessee
- Texas

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.

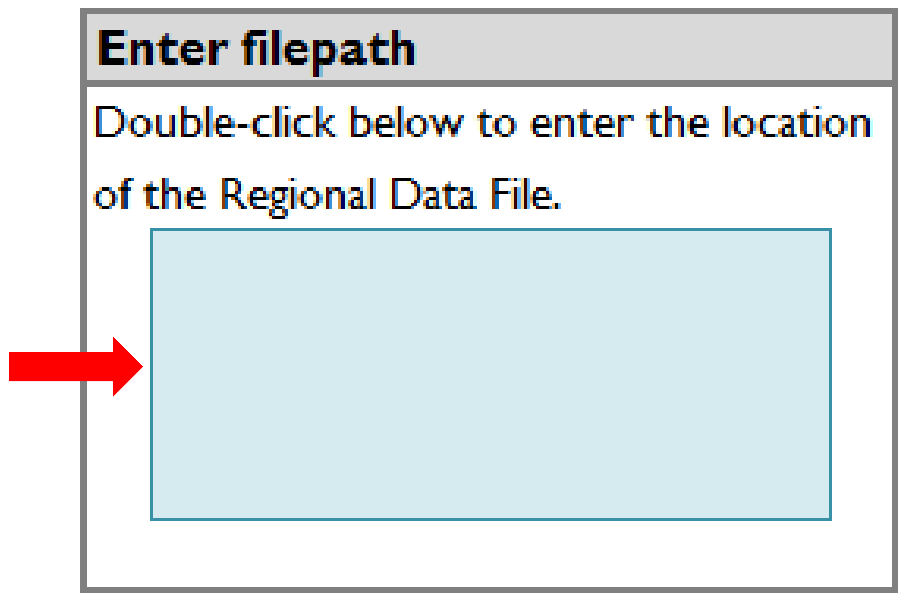


  - Selecting a region loads region-specific data for wind and solar capacity factors and dynamically creates a hyperlink to that region's data on EPA's website.

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

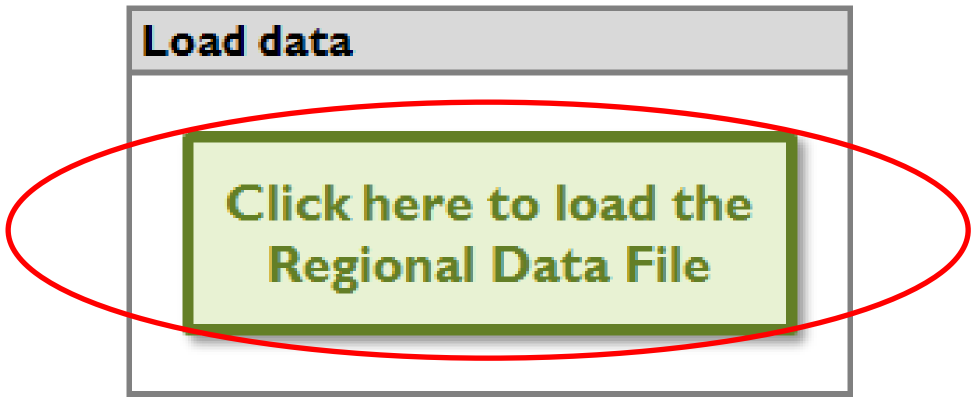
AVERT's Excel-Based Main Module Step 1. Load Regional Data File

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



AVERT's Excel-Based Main Module
Step 1. Load Regional Data File

- Click the button under "Load data" entitled:

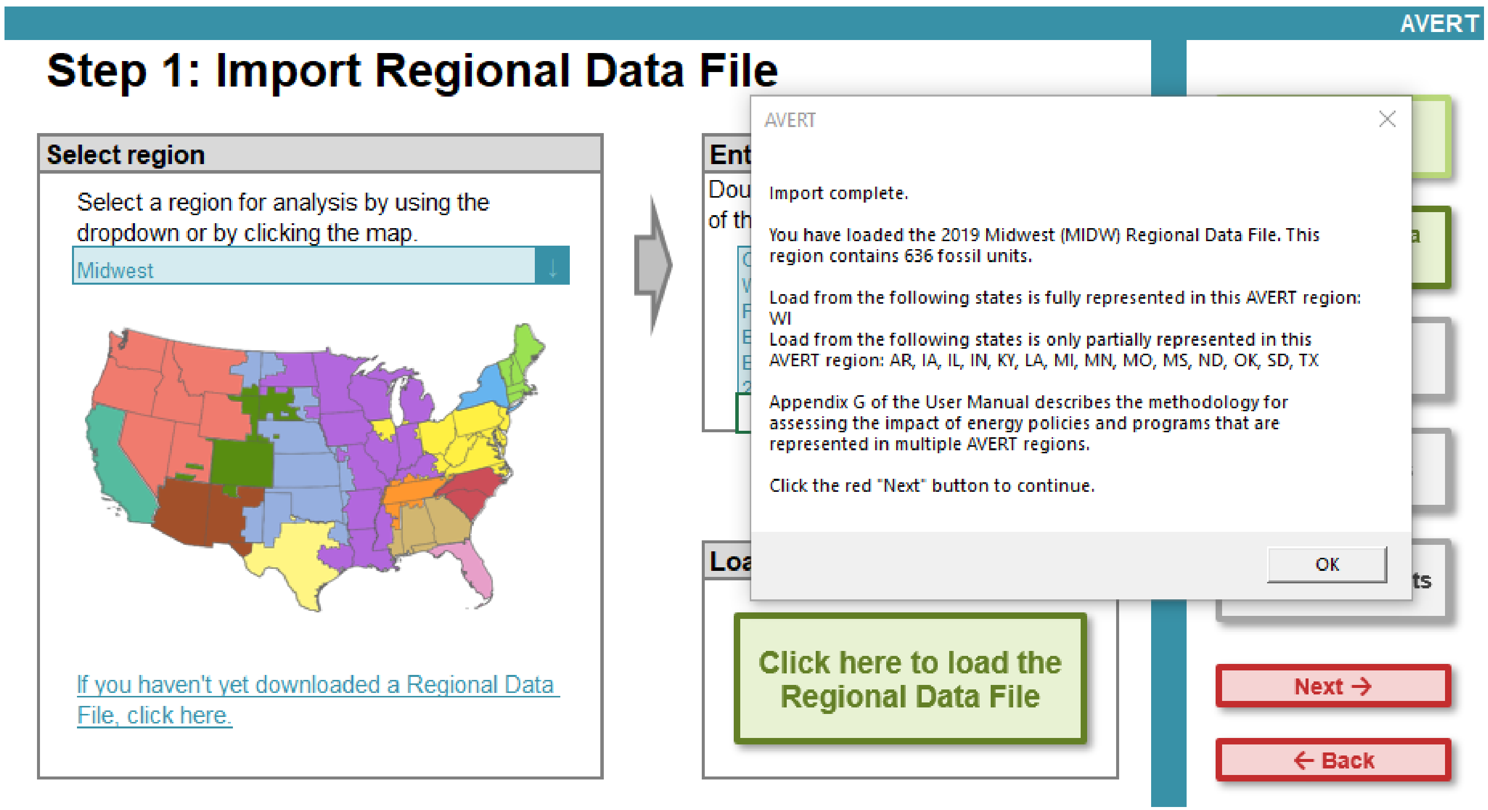


Clicking this button loads the following information from the regional data file:

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

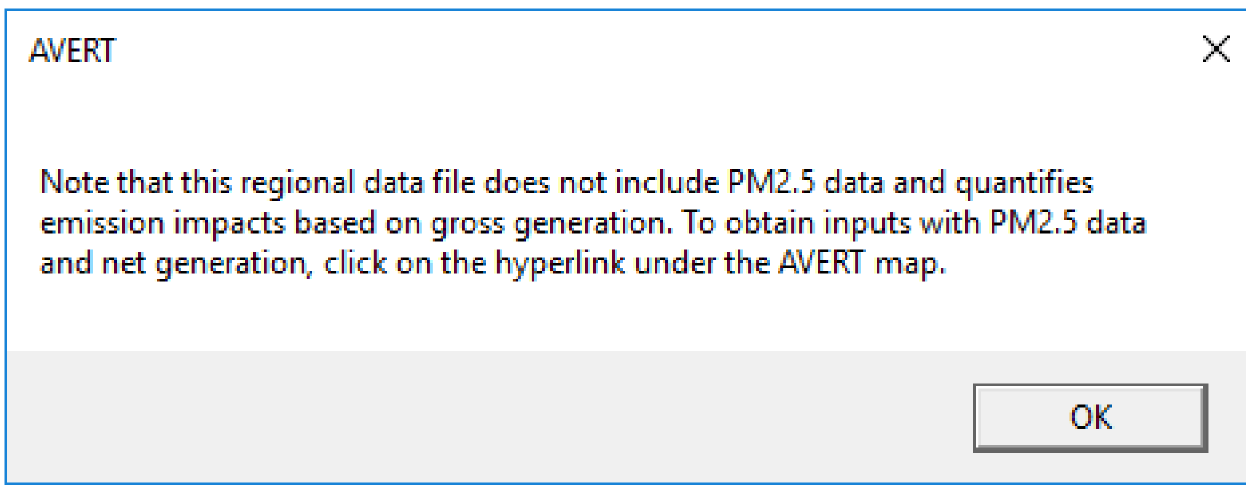
AVERT's Excel-Based Main Module
Step 1. Load Regional Data File

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



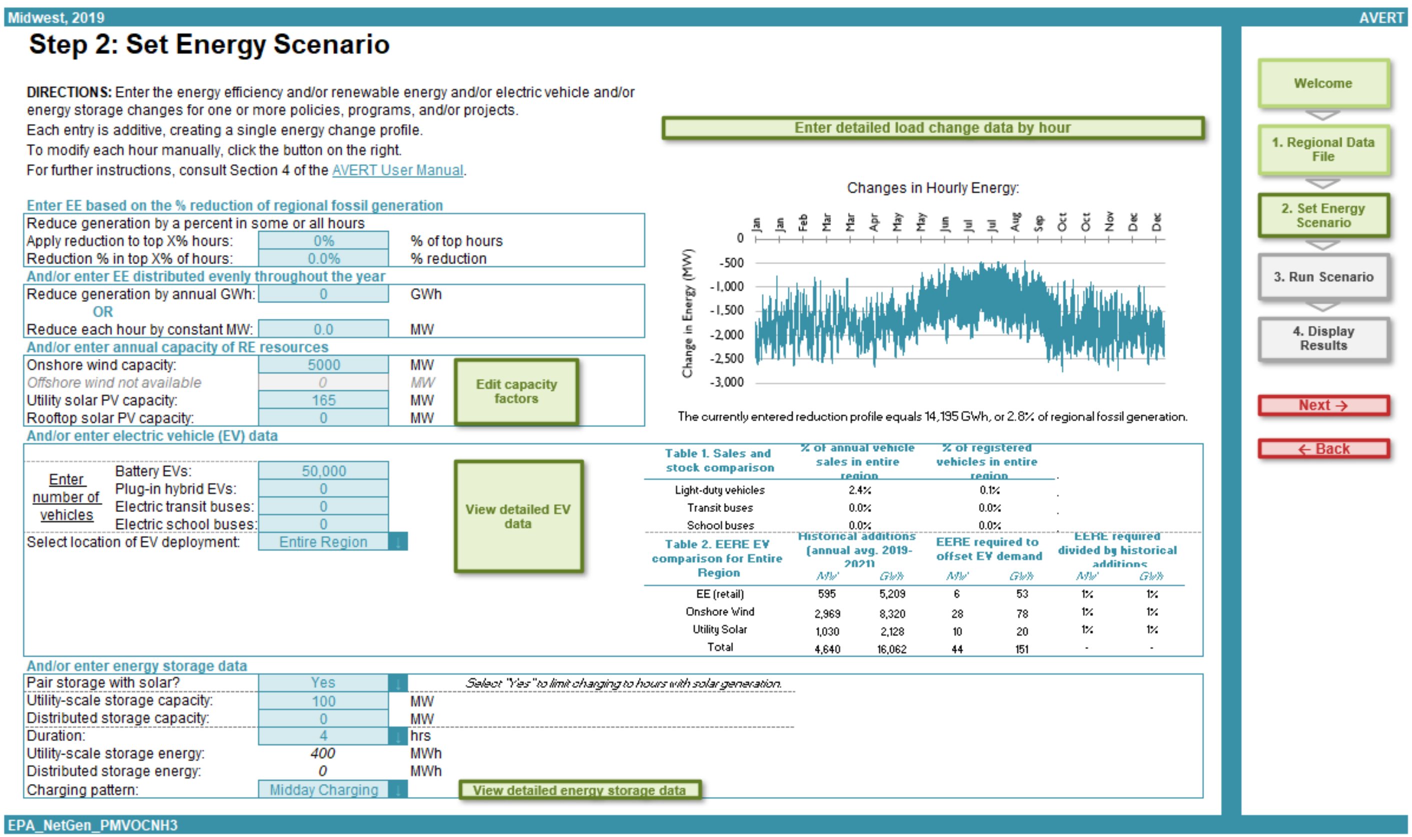
Step 1. Load Regional Data File
Regional Data File import pop-up

- 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 Energy Scenario

- This page leads you through the process of creating an energy impact profile depicting the impacts expected from an energy program.



AVERT's Excel-Based Main Module
Step 2. Set Energy Scenario

- If the hourly load impacts expected from an energy policy, program, or measure are known, a manual stream of load impact values can be entered for every hour of the year by clicking the "Enter detailed load change by hour" button. Displacements (load reductions) should be entered as positive values.

Enter detailed load change data by hour

Midwest, 2019 AVERT

Manual Energy Profile Entry

Click here to return to Step 2: Set Energy Scenario

Positive numbers entered by the user correspond to load reductions.

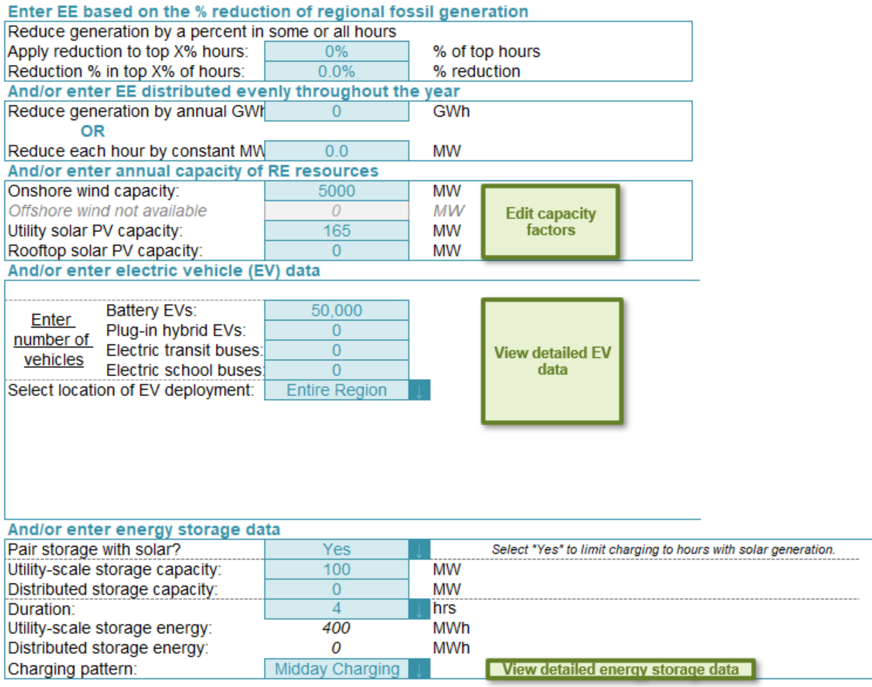
Delete all manual data

Date	Hour	Day of Week	Regional Fossil Load (MW)	Manual Profile (MW) - Utility Scale	Manual Profile (MW) - Distributed	Total Change (MW)	Larger than 15%?	Outside of Range?
1/1/2019	1	Tuesday	41,014			-2,124		
1/1/2019	2	Tuesday	39,656			-2,208		
1/1/2019	3	Tuesday	39,597			-2,310		
1/1/2019	4	Tuesday	39,994			-2,446		
1/1/2019	5	Tuesday	41,311			-2,438		
1/1/2019	6	Tuesday	43,352			-2,472		
1/1/2019	7	Tuesday	45,127			-2,432		
1/1/2019	8	Tuesday	47,024			-2,302		
1/1/2019	9	Tuesday	49,427			-2,218		
1/1/2019	10	Tuesday	52,645			-2,241		
1/1/2019	11	Tuesday	54,944			-2,214		
1/1/2019	12	Tuesday	56,125			-2,146		
1/1/2019	13	Tuesday	57,672			-1,985		
1/1/2019	14	Tuesday	58,192			-1,859		
1/1/2019	15	Tuesday	58,764			-1,746		
1/1/2019	16	Tuesday	59,484			-1,745		
1/1/2019	17	Tuesday	[illegible]			[illegible]		

AVERT's Excel-Based Main Module
Step 2. Set Energy Scenario

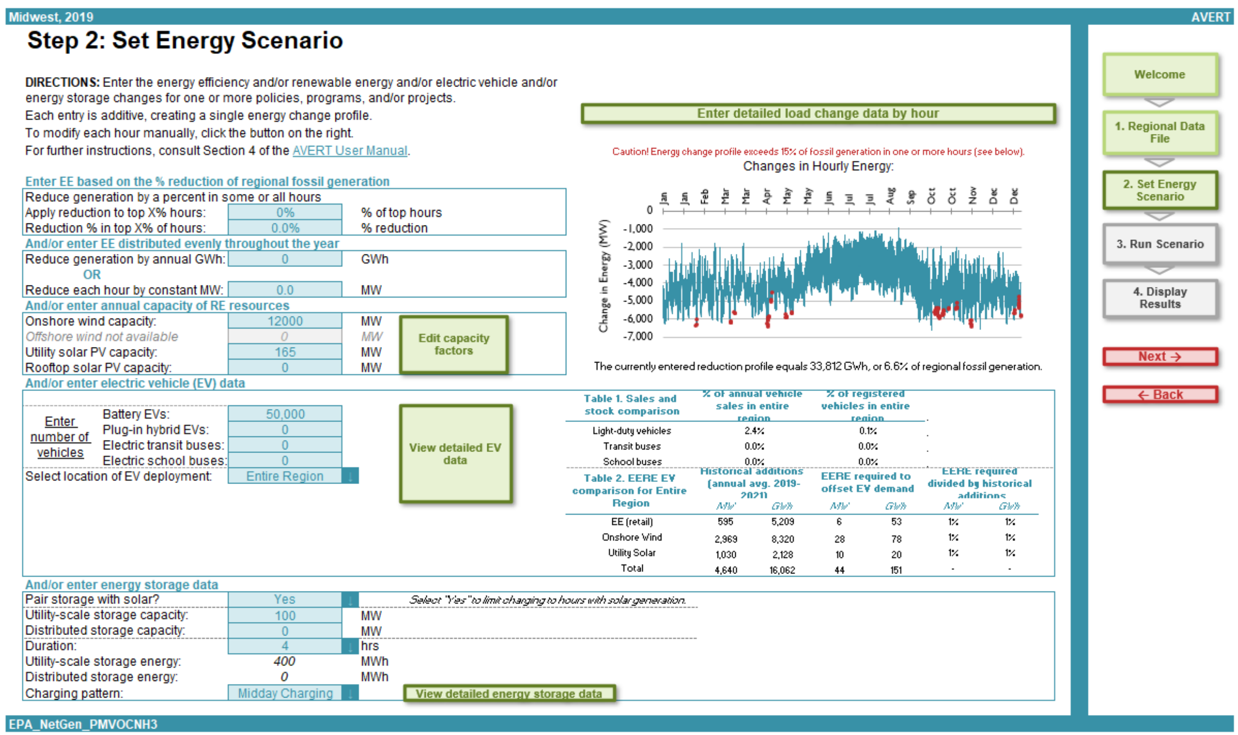
This page also allows you to estimate an energy impact from basic characteristics:

- 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, with the ability to scale hourly capacity factors
- Electric vehicle data by number of vehicles, with the ability to select a location of deployment and enter detailed data
- Energy storage data by capacity, duration, and charging pattern, with the ability to pair storage with solar generation and enter detailed data
- Combination of energy programs including combining pre-set options with manual hourly energy profile entry


Enter EE based on the % reduction of regional fossil generation
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 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
Onshore wind capacity: 5000 MW
Offshore wind not available 0 MW
Utility solar PV capacity: 165 MW
Rooftop solar PV capacity: 0 MW
Edit capacity factors
And/or enter electric vehicle (EV) data
Enter number of vehicles
Battery EVs: 50,000
Plug-in hybrid EVs: 0
Electric transit buses: 0
Electric school buses: 0
Select location of EV deployment: Entire Region
View detailed EV data
And/or enter energy storage data
Pair storage with solar? Yes
Select "Yes" to limit charging to hours with solar generation.
Utility-scale storage capacity: 100 MW
Distributed storage capacity: 0 MW
Duration: 4 hrs
Utility-scale storage energy: 400 MWh
Distributed storage energy: 0 MWh
Charging pattern: Midday Charging
View detailed energy storage data

AVERT's Excel-Based Main Module Step 2. Set Energy Scenario

- If you enter a scenario 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.



AVERT's Excel-Based Main Module

Step 2. Set Energy Scenario

- If you enter a scenario that exceeds the calculable range in any given hour, you will be directed to change load impact in the hours identified in the "Outside of Range?" column of the Manual Energy Profile Entry page. These cells must be corrected before you may proceed.

Midwest, 2019 AVERT

Manual Energy Profile Entry

Click here to return to Step 2: Set Energy Scenario

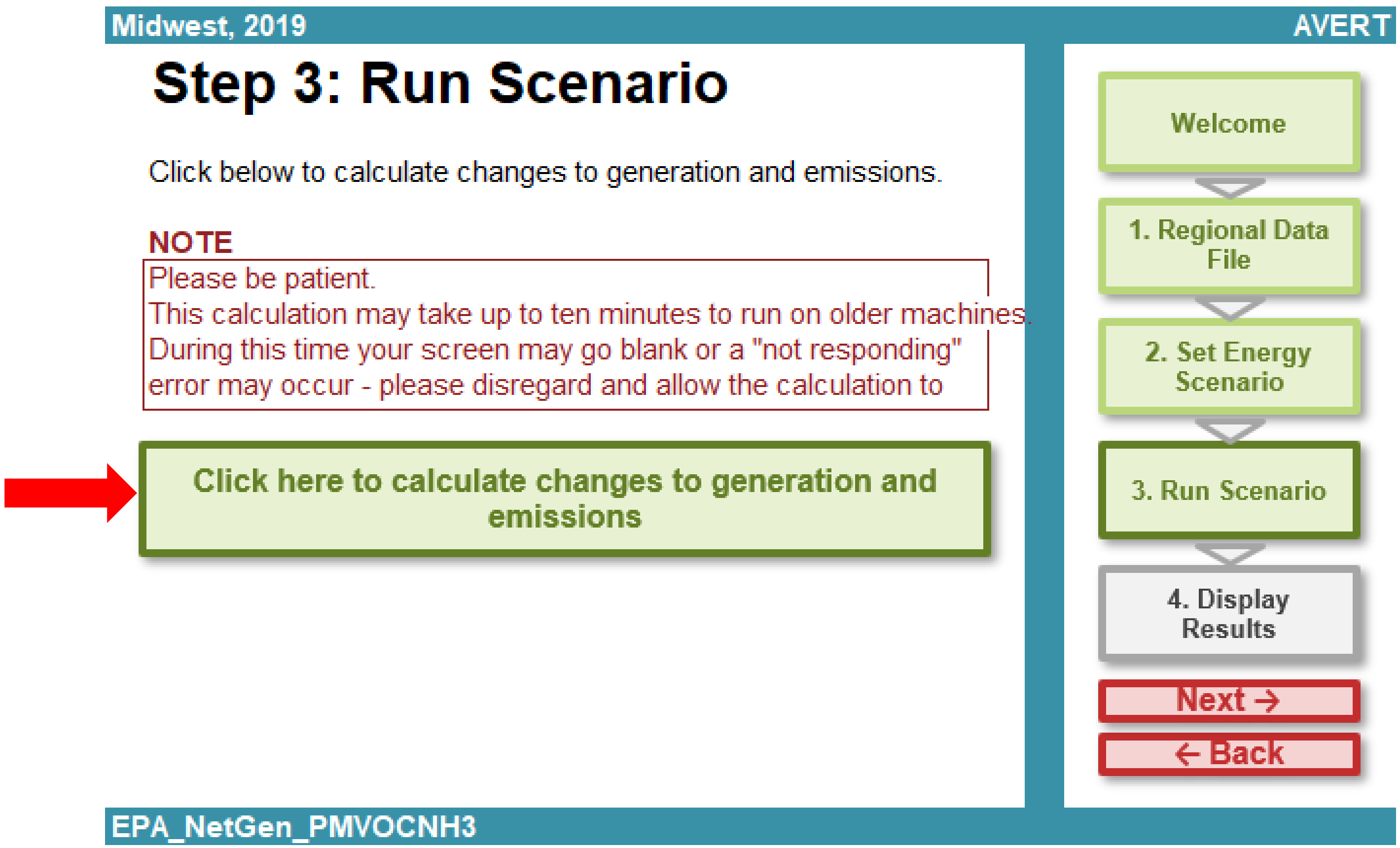
Positive numbers entered by the user correspond to load reductions.

Delete all manual data

Date	Hour	Day of We	Regional Fossil Load (MW	Manual Profile (MW) - Utility Scale	Manual Profile (MW) - Distributed	Total Change (MW)	Larger than 15%?	Outside of Range?
9/4/2019	11	Wednesday	76,612			0		
9/4/2019	12	Wednesday	79,598			0		
9/4/2019	13	Wednesday	82,462			0		
9/4/2019	14	Wednesday	84,067			-92,399	ERROR: Yes	ERROR: New load is too low, please increase
9/4/2019	15	Wednesday	85,211			-93,657	ERROR: Yes	ERROR: New load is too low, please increase
9/4/2019	16	Wednesday	86,065			-94,595	ERROR: Yes	ERROR: New load is too low, please increase
9/4/2019	17	Wednesday	84,609			-92,995	ERROR: Yes	ERROR: New load is too low, please increase
9/4/2019	18	Wednesday	82,729			0		
9/4/2019	19	Wednesday	80,189			0		
9/4/2019	20	Wednesday	77,389			0		
9/4/2019	21	Wednesday	70,940			0		
9/4/2019	22	Wednesday	63,217			0		
9/4/2019	23	Wednesday	56,250			0		
9/4/2019	24	Wednesday	50,922			0		
9/5/2019	1	Thursday	46,106			0		
9/5/2019	2	Thursday	43,436			0		

AVERT's Excel-Based Main Module
Step 3. Run Scenario

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

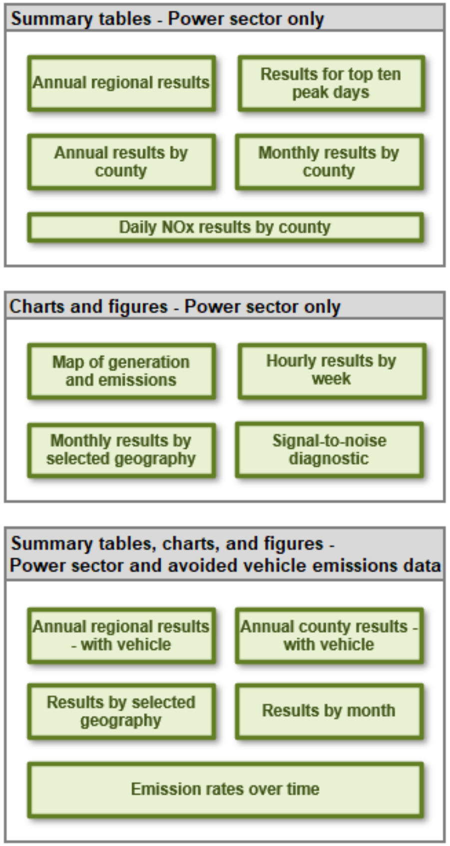


AVERT's Excel-Based Main Module Step 3. Run Scenario

- This step calculates hourly change in generation and emissions ($PM_{2.5}$, SO_2, NO_X, CO_2, VOCs, and NH_3) 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 10 minutes.

AVERT's Excel-Based Main Module
Step 4. Display Results

- The results generated in Step 3 are aggregated in three groups of charts and tables in Step 4.



AVERT's Excel-Based Main Module

Step 4. Display Results

Annual regional impacts

- 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 modeled energy impact ("Post Impact").
- See the user manual for information on additional AVERT outputs that include vehicle emissions.

Midwest, 2019 **AVERT**

Output: Annual Regional Results

Click here to return to Step 4: Display Outputs

	Original	Post Change	Change
Generation (MWh)	510,511,950	496,346,300	-14,165,650
Heat Input (MMBtu)	4,917,277,270	4,781,000,140	-136,277,130
Total Emissions from Fossil Generation Fleet (lb)			
SO_2	710,791,670	688,590,480	-22,201,180
NO_X	528,845,720	512,351,890	-16,493,840
Ozone season NO_X	224,707,220	219,219,340	-5,487,880
CO_2	881,078,630,540	856,608,184,030	-24,470,444,170
$PM_{2.5}$	47,484,740	46,181,070	-1,303,670
VOCs	15,329,350	14,879,660	-449,690
NH_3	10,163,730	9,893,010	-270,720
AVERT-derived Emission Rates (lb/MWh)	Average Fossil		Marginal Fossil
SO2	1.392		Ø
NO_X	1.036		Ø
Ozone season NO_X	0.976		Ø
CO_2	1,725.873		Ø
$PM_{2.5}$	0.093		Ø
VOCs	0.030		Ø
NH_3	0.020		Ø

Select unit for emissions: lb

Ozone season is defined as May 1 - September 30. Ozone season emissions are a subset of annual emissions.
Negative numbers indicate displaced generation and emissions.
All results are rounded to the nearest 10. A dash ("—") indicates non-zero results, but within +/- 10 units.
When users evaluate a portfolio scenario including EVs and EE or RE, marginal fossil values are not reported and a null sign ("Ø") is shown.
Data on this page do not include changes to ICE vehicle emissions (e.g., emissions from tailpipes).

AVERT's Excel-Based Main Module

Step 4. Display Results

Annual Results by County

- This table presents a summary of the changes in generation and emissions, not including vehicle 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.

Midwest, 2019

Output: Annual Results by County

Click here to return to Step 4: Display Outputs

State	County	Peak Generation, Post-Change (MW)	Annual Generation, Post-Change (MWh	Annual Change in Generation (MW	Annual Change in SO2 (lb)	Annual Cha NOx (l
AR	Craighead County	73	22,770	-3,350	-30	-5,06
AR	Hot Spring County	1,248	4,629,020	-178,740	-650	-54,01
AR	ndependence County	1,399	5,314,450	-297,080	-1,613,720	-404,9
AR	Jefferson County	1,718	8,230,440	-366,070	-1,811,200	-488,5
AR	Mississippi County	1,142	7,020,830	-165,550	-173,290	-98,48
AR	Pulaski County	402	320,570	-38,740	-50	-50,70
AR	Union County	1,784	10,861,670	-261,910	-860	-16,85
IA	Allamakee County	212	421,460	-34,900	-18,520	-16,00
IA	Audubon County	84	101,680	-9,880	-820	-9,88
IA	Black Hawk County	8	3,870	-500	–	-2,48
IA	Cerro Gordo County	461	2,427,620	-119,390	-440	-5,05
IA	Des Moines County	193	1,123,640	-23,090	-135,000	-40,01
IA	Louisa County	677	3,081,720	-226,710	-723,380	-387,4
IA	Marshall County	708	3,624,360	-143,380	-470	-13,93
IA	Muscatine County	150	923,040	-24,720	-33,160	-69,65
IA	Polk County	312	268,650	-28,280	-190	-3,65
IA	Pottawattamie County	1,351	7,595,430	-322,030	-646,710	-500,7
IA	Scott County	38	5,040	-1,030	–	-1,87
IA	Story County	27	131,200	-4,950	-490	-7,03
IA	Union County	35	5,220	-1,100	-20	-12,05
IA	Wapello County	685	3,608,080	-153,200	-120,720	-163,6
IA	Woodbury County	1,086	2,934,430	-259,640	-911,980	-518,7

For each county, annual output statistics are given for:

- Peak Gross Generation Post-Impact
- Annual Gross Generation Post-Impact
- Annual Change in Generation
- Annual Change in Heat Input/$PM_{2.5}$/SO_2/NO_X/CO_2/VOCs/NH_3
- Ozone Season Change in SO_2/NO_X/$PM_{2.5}$
- Ozone Season, 10 Peak Days Change in SO_2/NO_X/$PM_{2.5}$

AVERT’s Excel-Based Main Module Step 4. Display Results

Results 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, not including changes to vehicle emissions.

Midwest, 2019 AVERT

Output: Results for Top Ten Peak Days

Click here to return to Step 4: Display

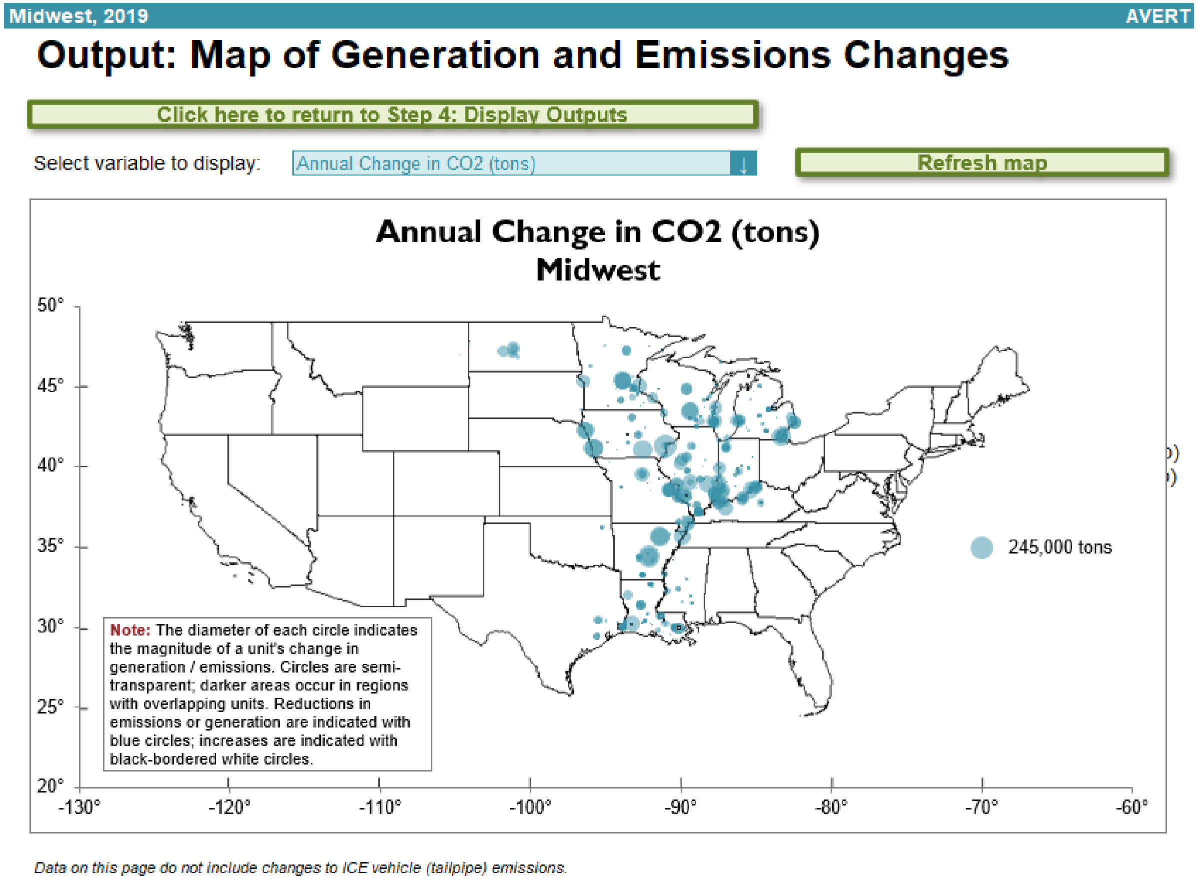
Day Rank	Date	Total Fossil Generation (MWh)	Expected Change in Generation (MWh)	Change in Generation	Change in NO_x (lb)	Change in SO_2 (lb)	Change in CO_2 (tons)	Change in $PM_{2.5}$ (lb)
1	Jul 19	1,966,680	-23,210	-23,430	-33,220	-26,670	-17,990	-2,180
2	Jan 30	1,930,570	-31,960	-32,170	-26,800	-35,940	-23,230	-3,010
3	Jul 17	1,900,580	-30,600	-30,450	-44,130	-35,760	-26,670	-3,030
4	Jan 31	1,897,480	-41,200	-41,790	-31,460	-49,550	-28,810	-3,900
5	Jul 02	1,895,160	-33,240	-33,310	-46,410	-41,120	-27,570	-3,110
6	Jul 18	1,887,940	-28,370	-28,470	-42,420	-34,100	-24,780	-2,850
7	Aug 06	1,879,770	-29,460	-29,560	-41,760	-36,260	-24,730	-2,850
8	Aug 12	1,863,210	-27,270	-26,720	-38,000	-30,180	-22,680	-2,720
9	Aug 19	1,842,710	-29,090	-28,640	-39,040	-32,880	-24,030	-2,870
10	Jul 16	1,841,700	-31,180	-31,090	-42,750	-37,100	-27,220	-3,170

Negative numbers indicate displaced generation and emissions.
All results are rounded to the nearest 10. A dash ("—") indicates non-zero results, but within +/- 10 units.
Data on this page do not include changes to ICE vehicle emissions (e.g., emissions from tailpipes).

AVERT's Excel-Based Main Module
Step 4. Display Results

Map of generation and emissions changes

- This dynamic map allows the user to view where emissions change within the selected region, not including changes from vehicle emissions. Users can view changes in generation, heat input, $PM_{2.5}$, SO_2, NO_X, and CO_2.

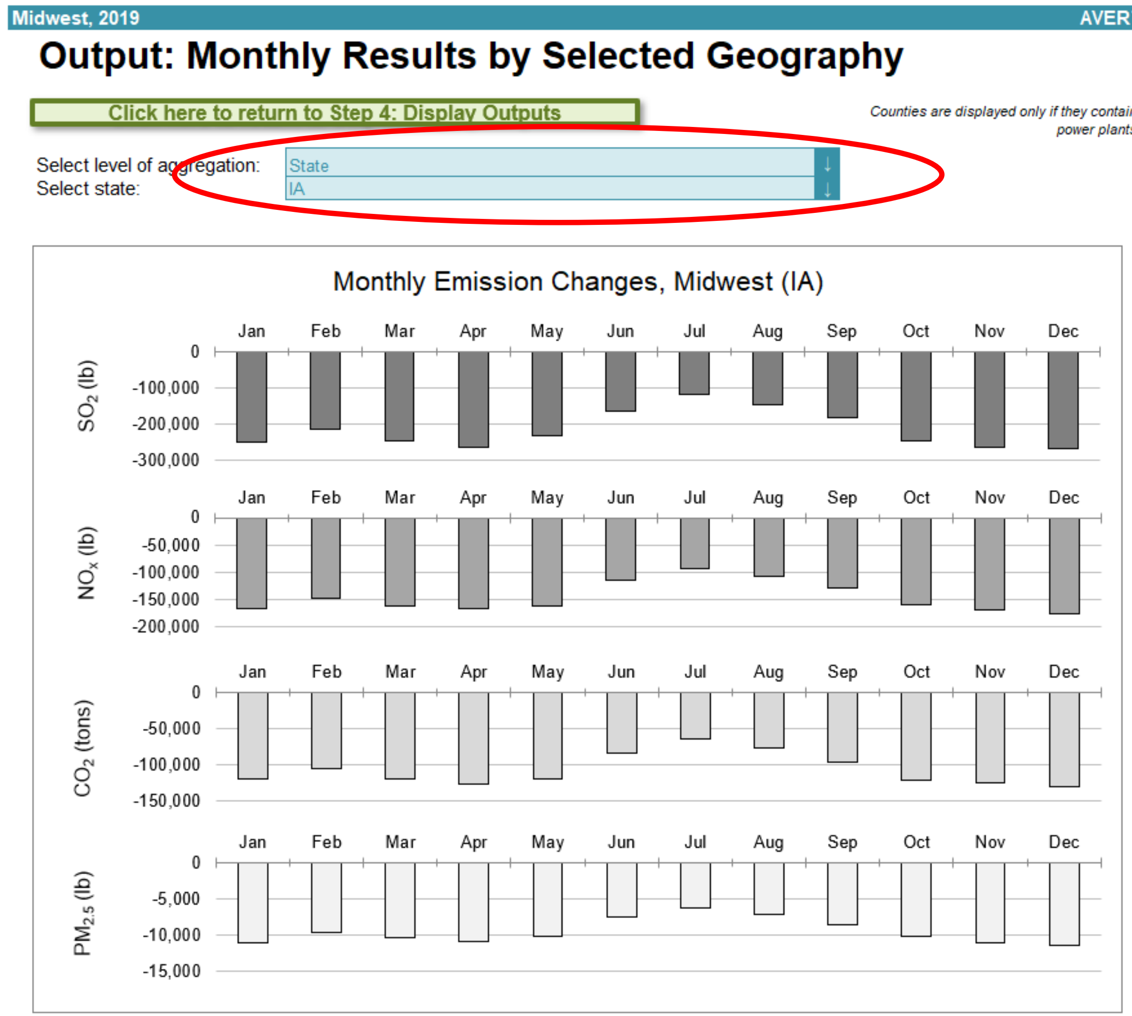


AVERT's Excel-Based Main Module Step 4. Display Results

Results by month

Monthly output can be viewed over the entire region, or a specific state or county within the region.

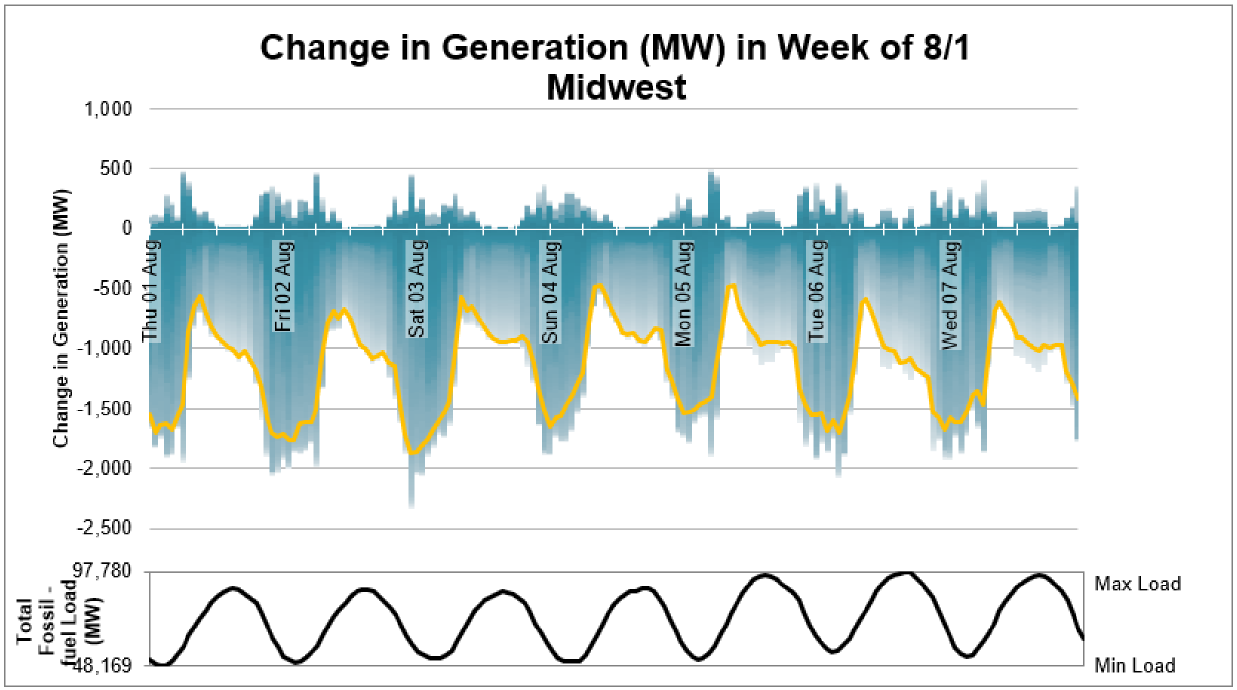
- First select region, state, or county in the top dropdown menu.
- If selecting a state, choose the state in the next dropdown menu.
- If selecting a county, choose both the state and the county in the next two dropdown menus.
- See the user manual for information on additional AVERT outputs that include vehicle emissions.



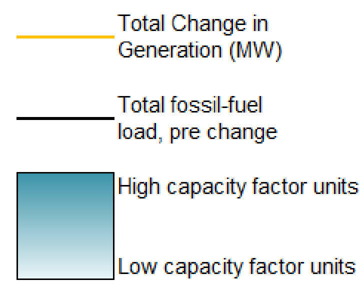
AVERT's Excel-Based Main Module
Step 4. Display Results

Hourly results by week

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



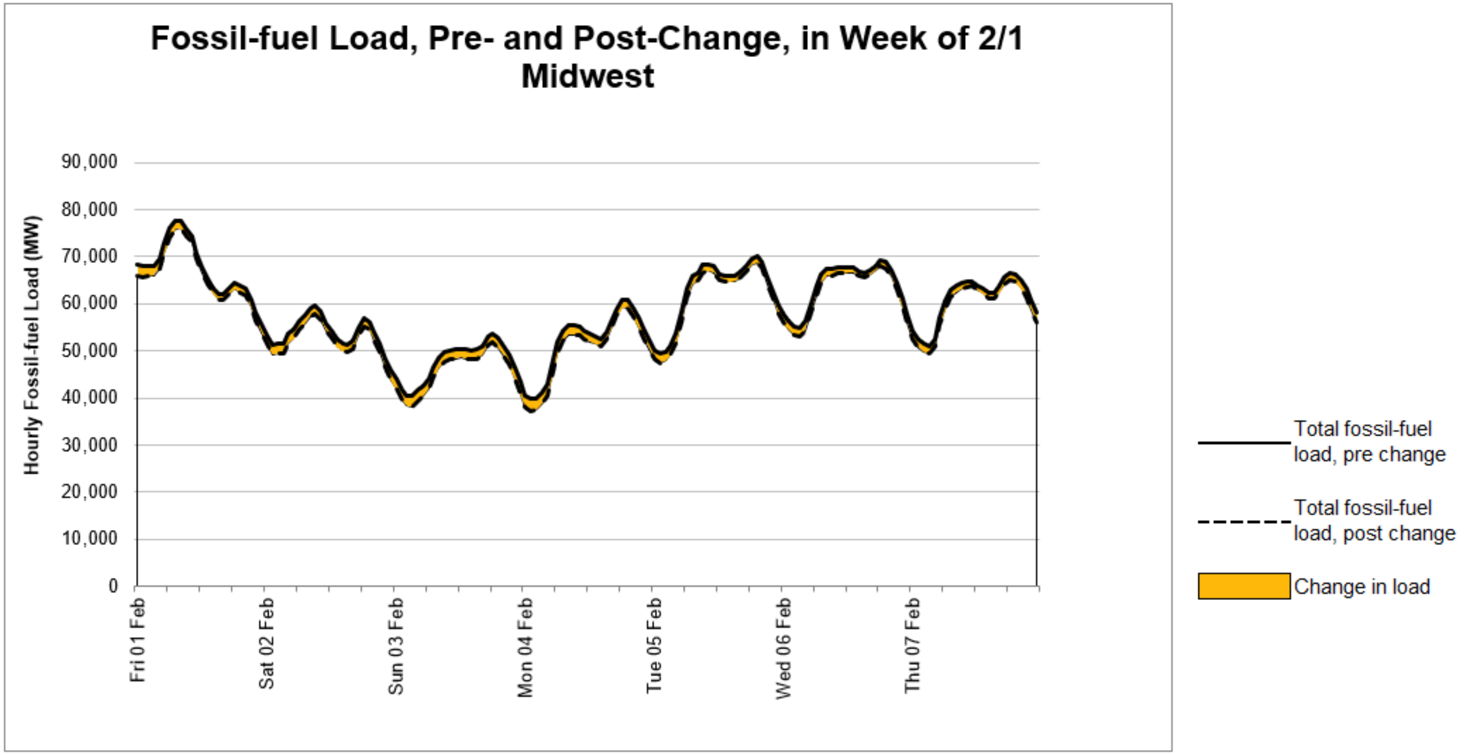
Negative numbers indicate displaced generation and emissions. Data on this page do not include changes to ICE vehicle (tailpipe) emissions.



AVERT's Excel-Based Main Module
Step 4. Display Results

Hourly results by week

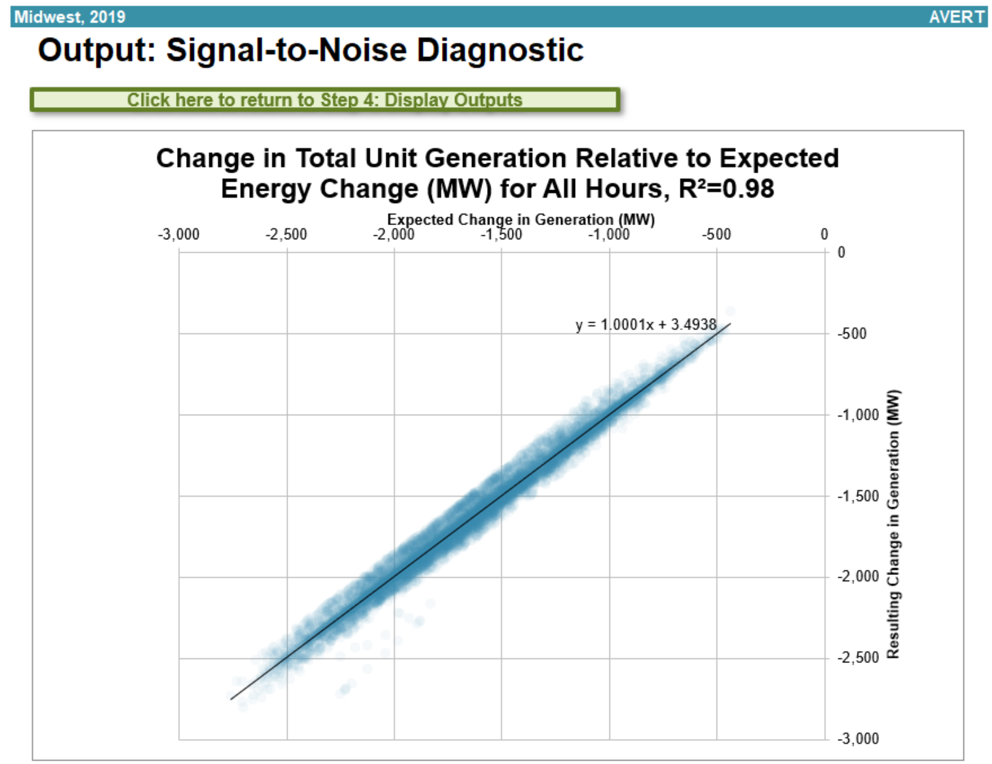
- The second figure shows the same week-long energy impact profile, but presents the change in generation in reference to the total fossil-fuel load to illustrate the degree of change represented by the energy program relative to the baseline.



AVERT's Excel-Based Main Module Step 4. Display Results

Signal-to-noise diagnostic

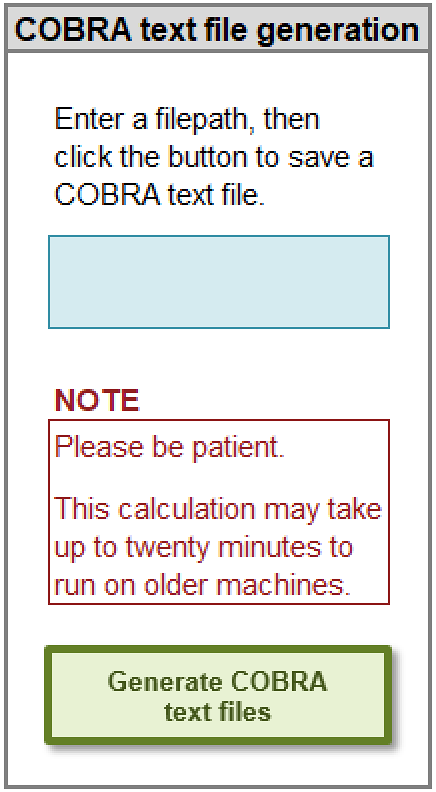
- This chart is a scatterplot of every hour of the year, showing calculated total change in generation in each hour (y-axis) against the user-input change in generation in each hour (x-axis).
- Ideally, AVERT perfectly matches change in unit generation to the amount of energy impacts requested by the user.
- This graphic shows where that assumption holds, where it does not hold, and to what extent.



AVERT's Excel-Based Main Module Step 4. Display Results

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 public health implications of the modeled scenario.
- 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 $PM_{2.5}$, SO_2, NO_X, VOCs, and NH_3 and will be ready for upload into COBRA.
- AVERT is only able to generate SMOKE emissions data for the power sector. Vehicle emissions will not be included.

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FIPS,STATE,COUNTY,TIER1NAME,NOx_REDUCTIONS_TONS,SO2_REDUCTIONS_TONS,PM25_REDUCTIONS_TONS
01001,Alabama,Autauga County,FUEL COMB. ELEC. UTIL.,-1.13,-0.05,-0.765
01015,Alabama,Calhoun County,FUEL COMB. ELEC. UTIL.,-0.315,-0.005,-0.06
01033,Alabama,Colbert County,FUEL COMB. ELEC. UTIL.,-3.23,-11.365,-0.13
01039,Alabama,Covington County,FUEL COMB. ELEC. UTIL.,-0.5,-0.005,-0.09
01047,Alabama,Dallas County,FUEL COMB. ELEC. UTIL.,-0.11,0,-0.01
01063,Alabama,Greene County,FUEL COMB. ELEC. UTIL.,-3.32,-12.685,-0.735
01073,Alabama,Jefferson County,FUEL COMB. ELEC. UTIL.,-5.835,-8.575,-0.07
01081,Alabama,Lee County,FUEL COMB. ELEC. UTIL.,-0.455,-0.01,-0.225
01085,Alabama,Lowndes County,FUEL COMB. ELEC. UTIL.,-0.05,0,-0.025
01097,Alabama,Mobile County,FUEL COMB. ELEC. UTIL.,-5.89,-9.695,-0.265
01103,Alabama,Morgan County,FUEL COMB. ELEC. UTIL.,-0.395,-0.025,-0.15
01113,Alabama,Russell County,FUEL COMB. ELEC. UTIL.,-3.465,0,-0.195
01117,Alabama,Shelby County,FUEL COMB. ELEC. UTIL.,-3.57,-15.625,-0.22
01121,Alabama,Talladega County,FUEL COMB. ELEC. UTIL.,-0.13,0,-0.01
01123,Alabama,Tallapoosa County,FUEL COMB. ELEC. UTIL.,-0.12,-0.01,-0.08
01127,Alabama,Walker County,FUEL COMB. ELEC. UTIL.,-17.395,-15.505,-0.11
01129,Alabama,Washington County,FUEL COMB. ELEC. UTIL.,-7.16,-1.605,-0.415
05031,Arkansas,Craighead County,FUEL COMB. ELEC. UTIL.,-0.105,0,-0.005
05059,Arkansas,Hot Spring County,FUEL COMB. ELEC. UTIL.,-2.365,-0.015,-0.28
05063,Arkansas,Independence County,FUEL COMB. ELEC. UTIL.,-15.845,-39.095,-0.46
05069,Arkansas,Jefferson County,FUEL COMB. ELEC. UTIL.,-19.94,-42.335,-0.415
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For More Information

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