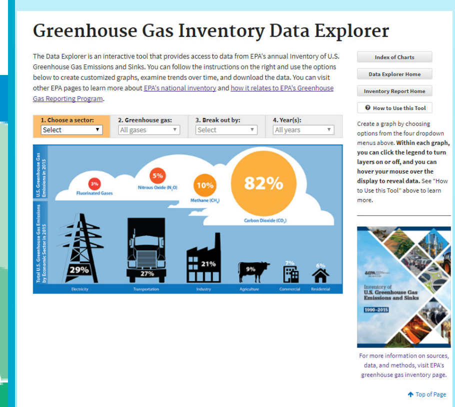
Emission Inventory Conference 2017

Baltimore, MD
August 15, 2017

AVERT and COBRA
GHG Inventory and Reporting Program

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

COBRA
Co-Benefits Risk Assessment
Health Impacts Screening and Mapping Tool



United States
Environmental Protection
Agency

Today’s AGENDA

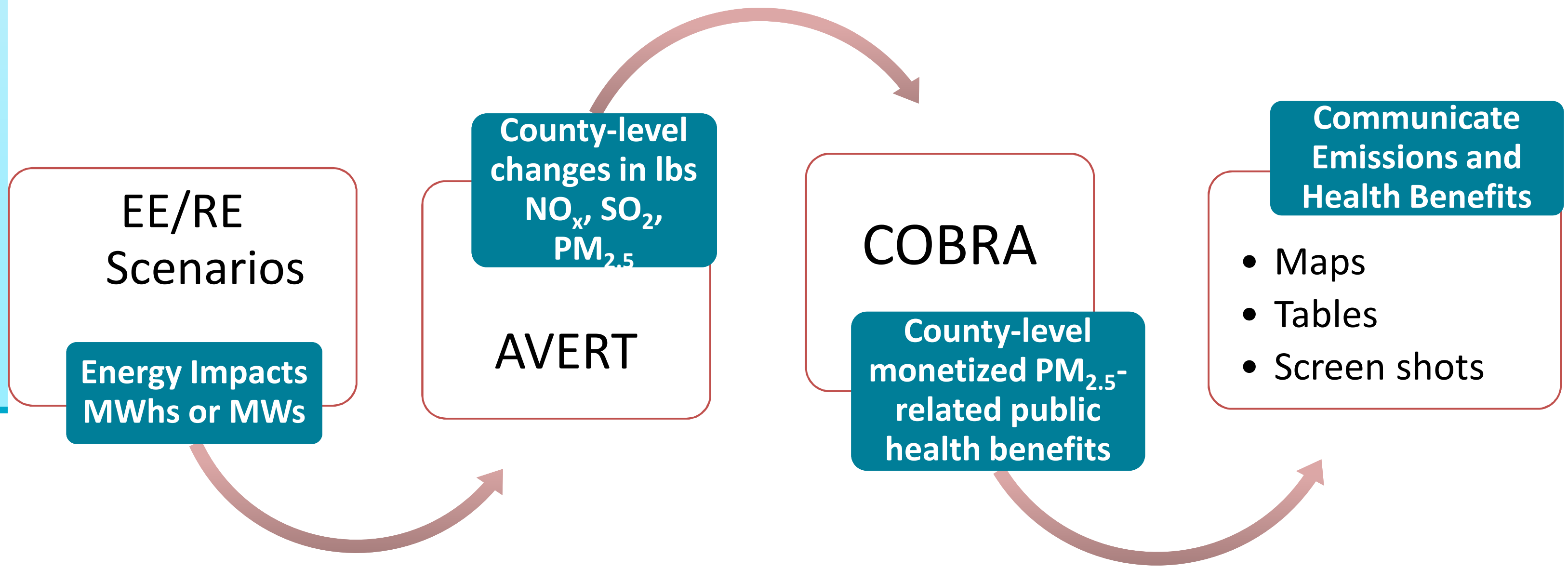
- 8:00am – 8:10 am: Introductions
- 8:10 am - 9:20 am: Session 1 AVERT (Robyn DeYoung)
- 9:20 am – 9:30 am: Break
- 9:30 am – 10:50 am: Session 2 COBRA (Denise Mulholland)
- 10:50 am - 11:00 am: Break
- 11:00 am – 11:30 am: Session 3 GHG Inventory & Reporting Program (Mausami Desai & Adam Eisele)

Supporting Health Benefits Quantification of Energy Choices

Energy efficiency and renewable energy (EE/RE) delivers health and environmental benefits by:

- Avoiding fossil-fired power plant emissions, which improves AQ, and enhances public health

AVERT and COBRA quantify the emissions and health benefits of existing EE/RE programs, policies and future scenario planning



Goals for AVERT Training

- Provide an overview of AVERT (AVoided Emissions and geneRation Tool)
  - Impetus for developing AVERT
  - What it is and when to use it
  - Data sources
  - How AVERT estimates emission changes
    - Focus on the main module
- Hands-on participation
  - Get comfortable using AVERT
  - Example scenario for AVERT's Texas region
    - Prepare outputs for COBRA
  - Ask lots of questions
- Online training available:
  - https://www.epa.gov/statelocalenergy/avert-tutorial-homepage

Impetus for Developing AVERT

- Environmental professionals and air quality planners are looking for new ways to reduce emissions, improve air quality
- Meanwhile, states, municipalities and utilities are advancing proven energy efficiency and renewable energy (EE/RE) policies and programs
- There is an opportunity to demonstrate the emission benefits of EE/RE programs.
  - CAA Plans, Advance Program, etc.
- But need to remove a key barrier: emission quantification of energy impacts

Annual Energy Efficiency and Natural Gas Program Spending 1993-2015

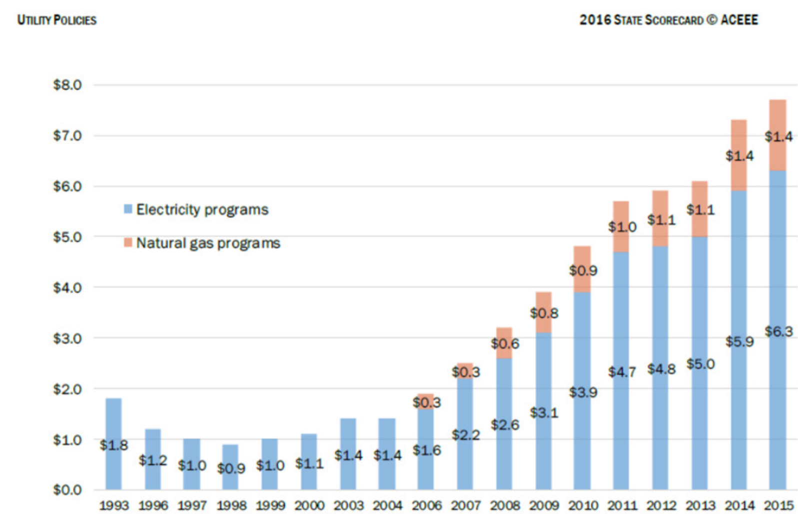


Figure 2. Annual electric and natural gas energy efficiency program spending. Natural gas spending is not available for the years 1993–2004. *Sources:* Nadel, Kubo, and Geller 2000; York and Kushler 2002, 2005; Eldridge et al. 2007, 2008, 2009; CEE 2012, 2013, 2014, 2015; Gilleo et al. 2015.

SOURCE: 2016 STATE SCORECARD ACEEE

AVERT Overview

- AVERT addresses key challenges associated with quantifying emission benefits of EE/RE programs.
  - It aims to address a key reason states have not implemented previous EE/RE State Implementation Plan (SIP) guidance.
  - Integrated nature of the power system makes it difficult to quantify generation and emissions changes from EE/RE
    - Locating emission impacts within the state and local air sheds
  - Generating units, and thus emissions respond differently to different types of EE/RE programs
- AVERT translates the energy impacts of EE/RE policies and programs into PM2.5, NOx, SO2, and CO2 emission reductions at regional, state and county levels.
  - First released in February 2014
  - An Excel-based tool with multiple components
  - Built to be straightforward, transparent and credible
  - Peer reviewed and benchmarked against industry standard electric power sector model – PROSYM

Emission Quantification Methods
Basic to Sophisticated

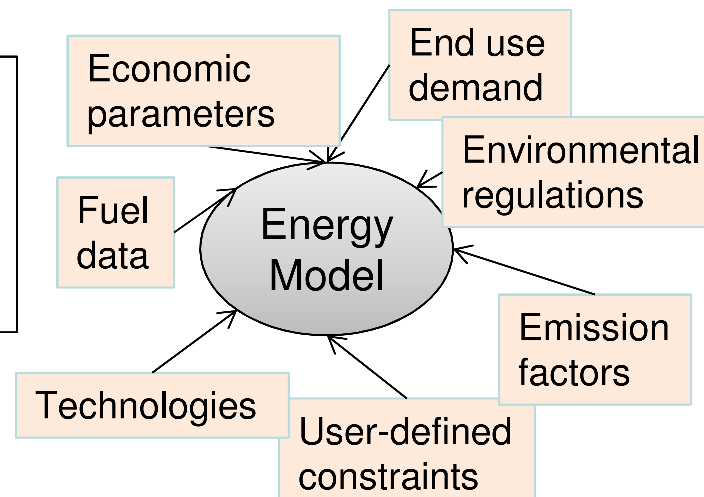
Basic Method	Intermediate Method	Sophisticated Method
eGRID region non-baseload emission rates	Historical hourly emission rates	Energy modeling Dispatch or capacity expansion

eGRID

AVERT

AVoided Emissions and geneRation Tool

www.epa.gov/avert



When to use AVERT-Calculated Emissions

AVERT-calculated emission impacts of EE/RE policies can be used as inputs to COBRA, for air quality modeling, NAAQS CAA SIPs and EE/RE scenarios.

- It Enables users to:
  - compare the emission impacts of different types of EE/RE programs, such as the impacts of wind versus solar installations
  - understand the location of emission reductions within a region, state and county
  - display results using easy-to-interpret maps and tables
- This is not a long-term projection tool, not intended for analysis more than 5 years from baseline (However, some users have asked for longer future time period)

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)*

When to use AVERT-generated Emission Factors

- Released in July 2017
- Use avoided emission factors generated from AVERT to estimate magnitude of emission reductions without running the tool.
  - Four categories include wind, solar, portfolio EE, and baseload EE programs.
  - Represents 5% regional impacts

Data Year: 2016

National Emission Factors

National Weighted Averages (lbs/MWh)	Wind	Utility PV	Portfolio EE	Baseload EE
Avoided CO_2 Rate	1,557	1,559	1,641	1,640
Avoided NO_x Rate	1.06	1.09	1.14	1.12
Avoided SO_2 Rate	1.50	1.45	1.53	1.55
Avoided $PM_{2.5}$ Rate	0.11	0.11	0.12	0.12

- Wind = Wind power generation
- Utility PV = Utility-scale photovoltaic power generation
- Portfolio EE = Represents a wide range of EE program types
- Baseload EE = Represents consistent energy savings throughout the year

National factors presented here reflect a weighted average of the avoided emission rates of AVERT's 10 regions. Averages are weighted by the fraction of 2016 fossil generation in each region.

Regional Emission Factors

Avoided CO_2 Rate (lbs/MWh)	Wind	Utility PV	Portfolio EE	Baseload EE
Northeast	1,070	1,114	1,181	1,143
Great Lakes / Mid-Atlantic	1,711	1,706	1,798	1,795
Southeast	1,456	1,499	1,578	1,557
Lower Midwest	1,677	1,662	1,751	1,760
Upper Midwest	1,922	1,872	1,971	2,004

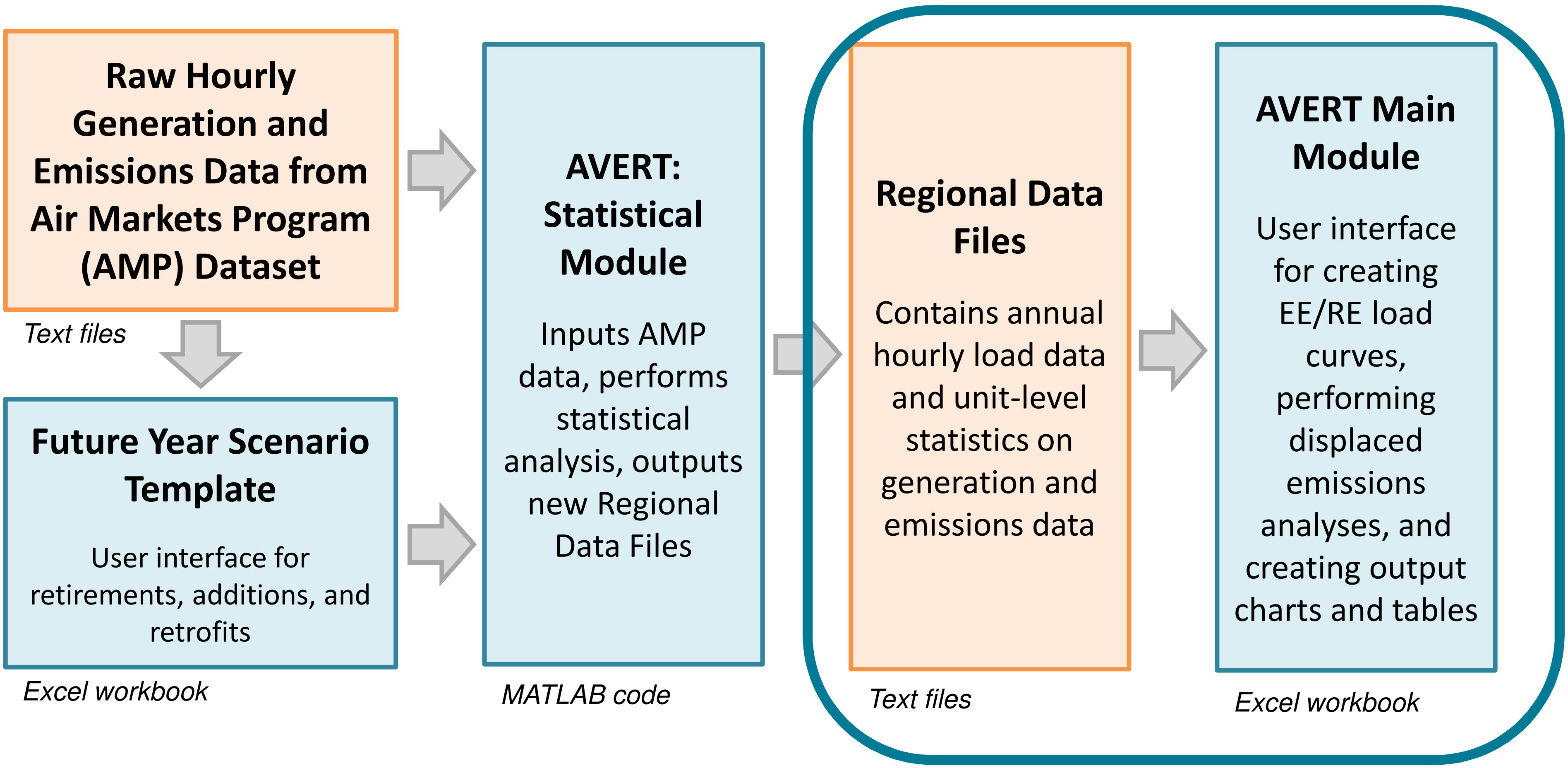
Avoided NO_x Rate (lbs/MWh)	Wind	Utility PV	Portfolio EE	Baseload EE
Northeast	0.41	0.53	0.59	0.49
Great Lakes / Mid-Atlantic	1.33	1.30	1.38	1.36
Southeast	0.92	1.02	1.06	1.01
Lower Midwest	1.16	1.26	1.32	1.26
Upper Midwest	1.51	1.47	1.54	1.57

Download at:
https://www.epa.gov/statelocalenergy/avoided-emission-factors-generated-avert

AVERT's Data Driven Analysis

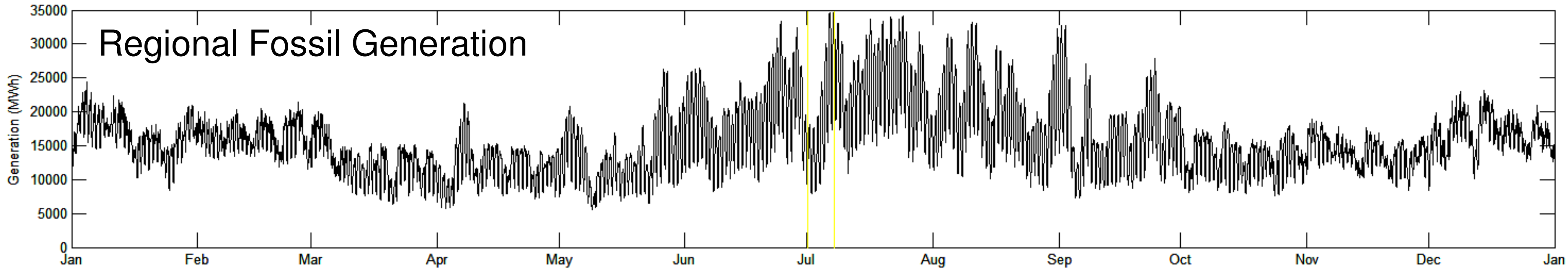
- AVERT's Main Module simulates the hourly changes in generation and air emissions ($PM_{2.5}$, NO_x, SO_2, and CO_2) at EGU resulting from EE/RE policies and programs.
  - AVERT analyzes EGU datasets from EPA's Air Markets and Program Data (hourly, unit-by-unit generation & emissions).
    - Dataset 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 throughout the year.
  - AVERT's Regional Data Files contain hourly and unit-level emissions and generation data.

AVERT's Modules and Data Files

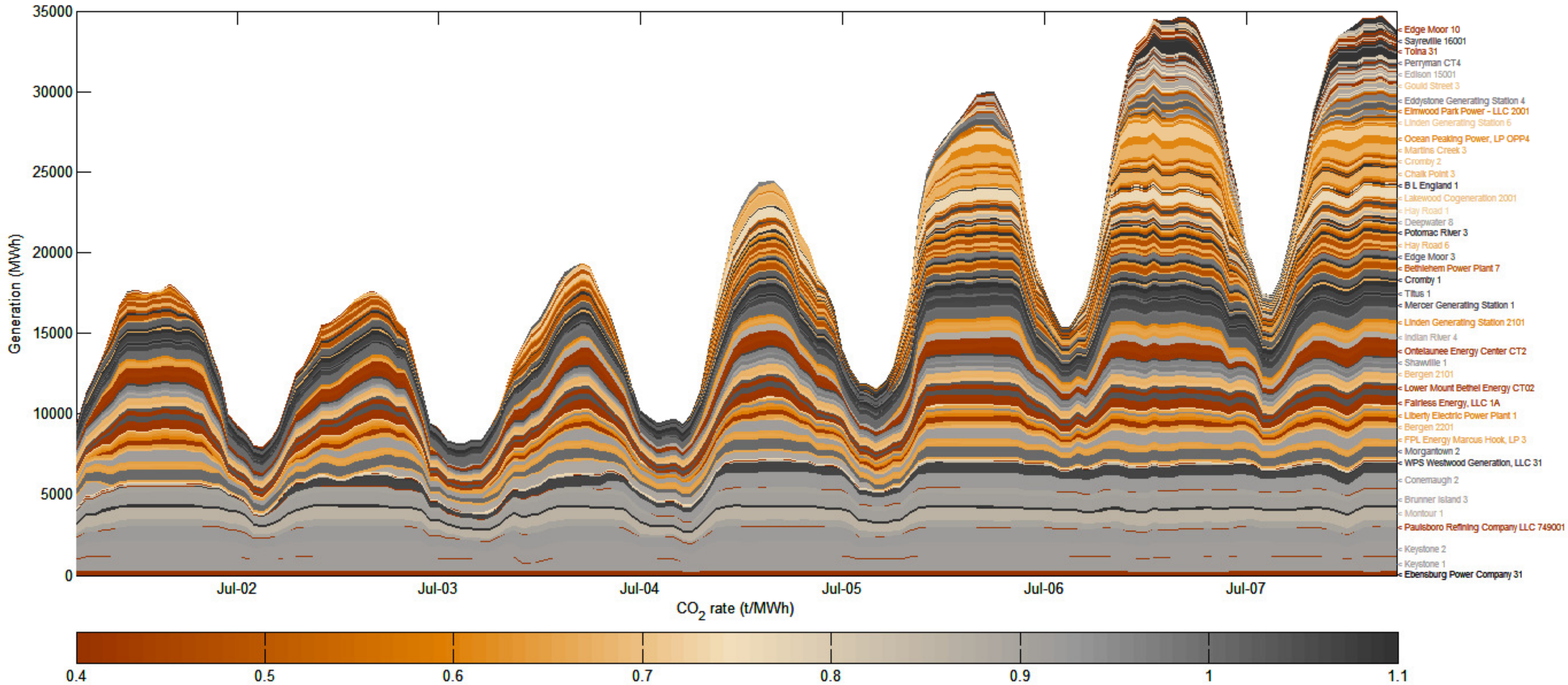


Most users will only need to use the Regional Data Files and AVERT Main Module to calculate emissions.

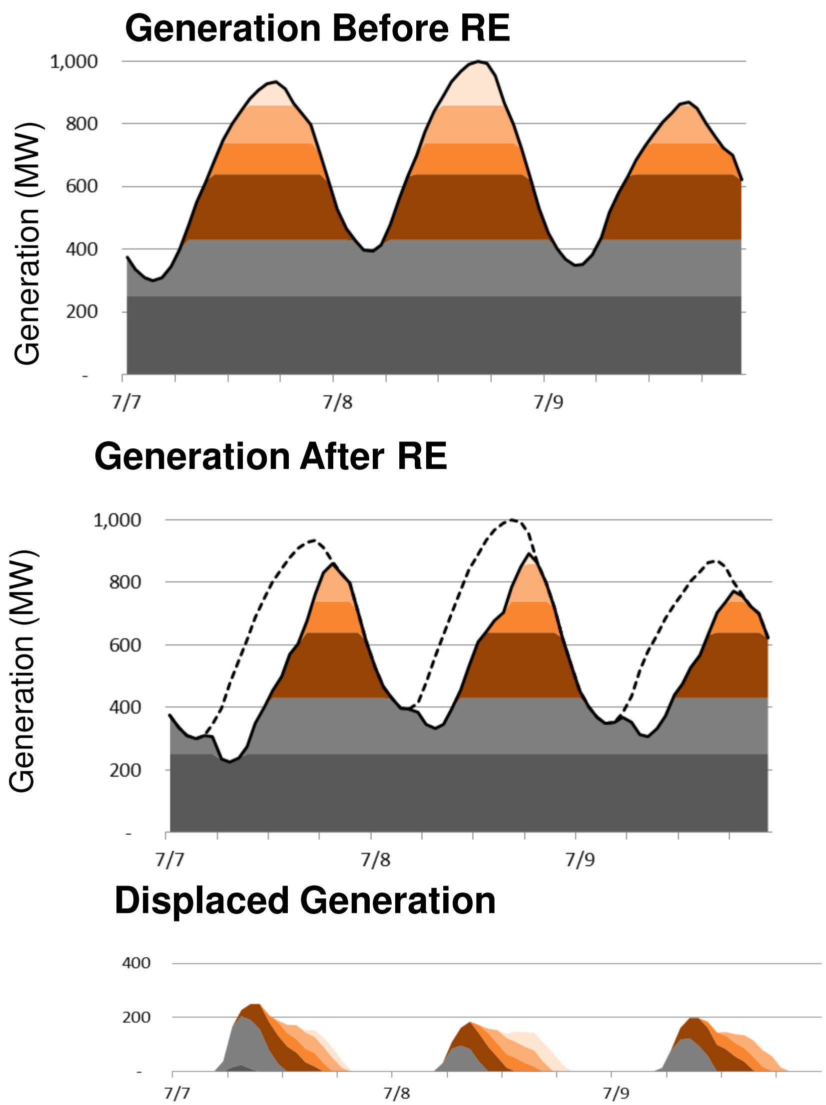
AVERT's Regional Load Profile from Air Markets Program Data



Generation and CO_2 in RFCE



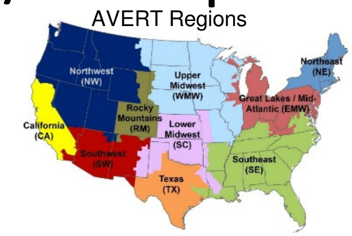
Loading Order and Displacement Example



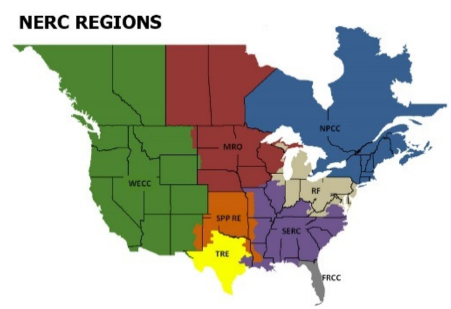
- AVERT is an **operational** simulation model.
- Conceptually, generation is dispatched in a **loading order**, least expensive generators first
- EE/RE (generally) reduces requirement for fossil generation
- Reduced generation = reduced emissions

Information needed to use AVERT

- Obtain energy saved (MWhs) for EE programs, or the capacity of wind and solar installation (MW)
  - Multiple options are built into the tool
- It's best to bundle all of the EE/RE impacts in one AVERT run.



- Locate your AVERT region
  - Save the appropriate region on your computer
  - AVERT regions are similar to North American Electric Reliability Corporation (NERC) Regions



Today's Example: AVERT's Texas Region - Wind and Solar Scenario

- Use 2016 AVERT's Texas Regional Data File (RDF) which represents Electric Reliability Council of Texas (ERCOT)
  - 82% of Texas generation
  - 3% of Oklahoma generation
- Enter 2017 wind and solar capacity installed and planned in AVERT to estimate emission changes for 2017.
  - EIA publishes wind and solar installations by year and planned additions on a monthly basis in form 860M
    - Texas: 2772 MWs of wind and 915 MWs of solar
    - Oklahoma: 851 MWs of wind

Demonstration

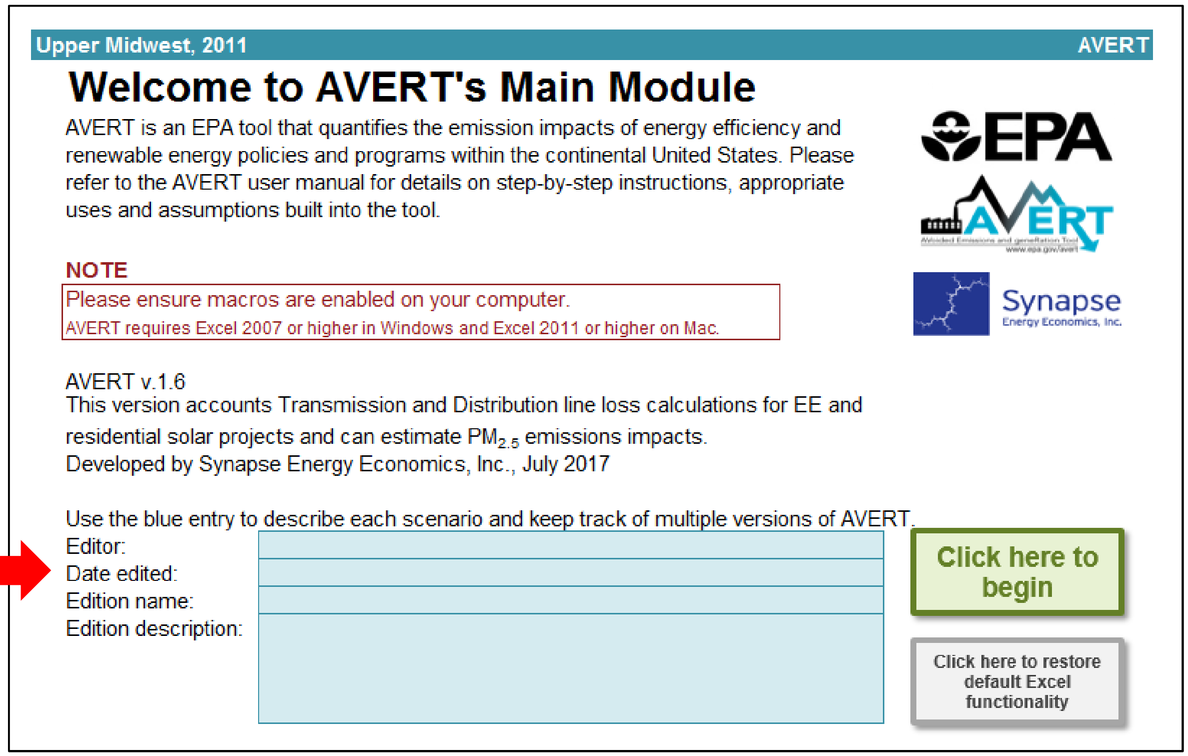
AVERT Main Module

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

- Save Regional Data file on computer
- Enable Macros
- Step 1. Load Regional Data File
- Step 2. Set Energy Efficiency and Renewable Energy Data
- Step 3. Run Displacement
- Step 4. Display Outputs

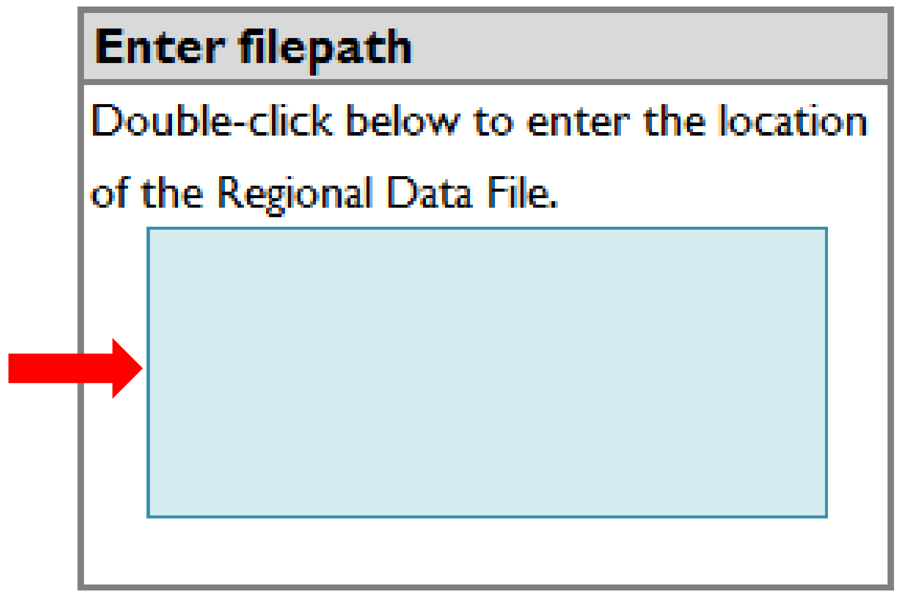
AVERT's Excel-Based Main Module Using AVERT

- 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".



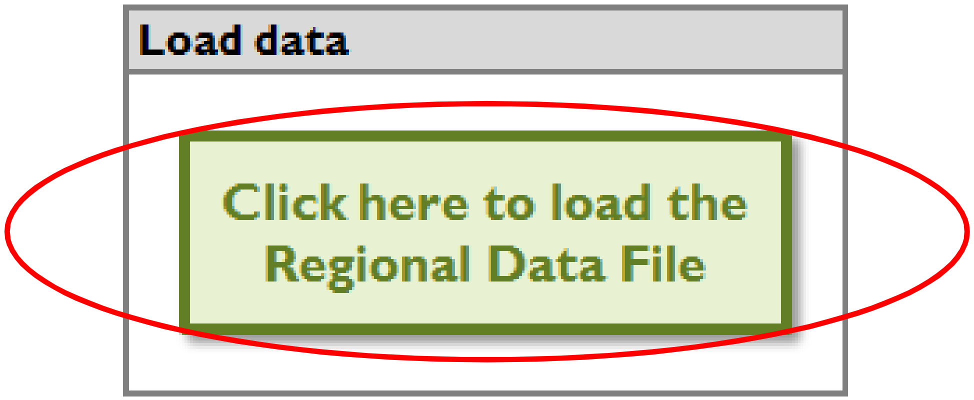
AVERT's Excel-Based Main Module Step 1. Load Regional Data File

- 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

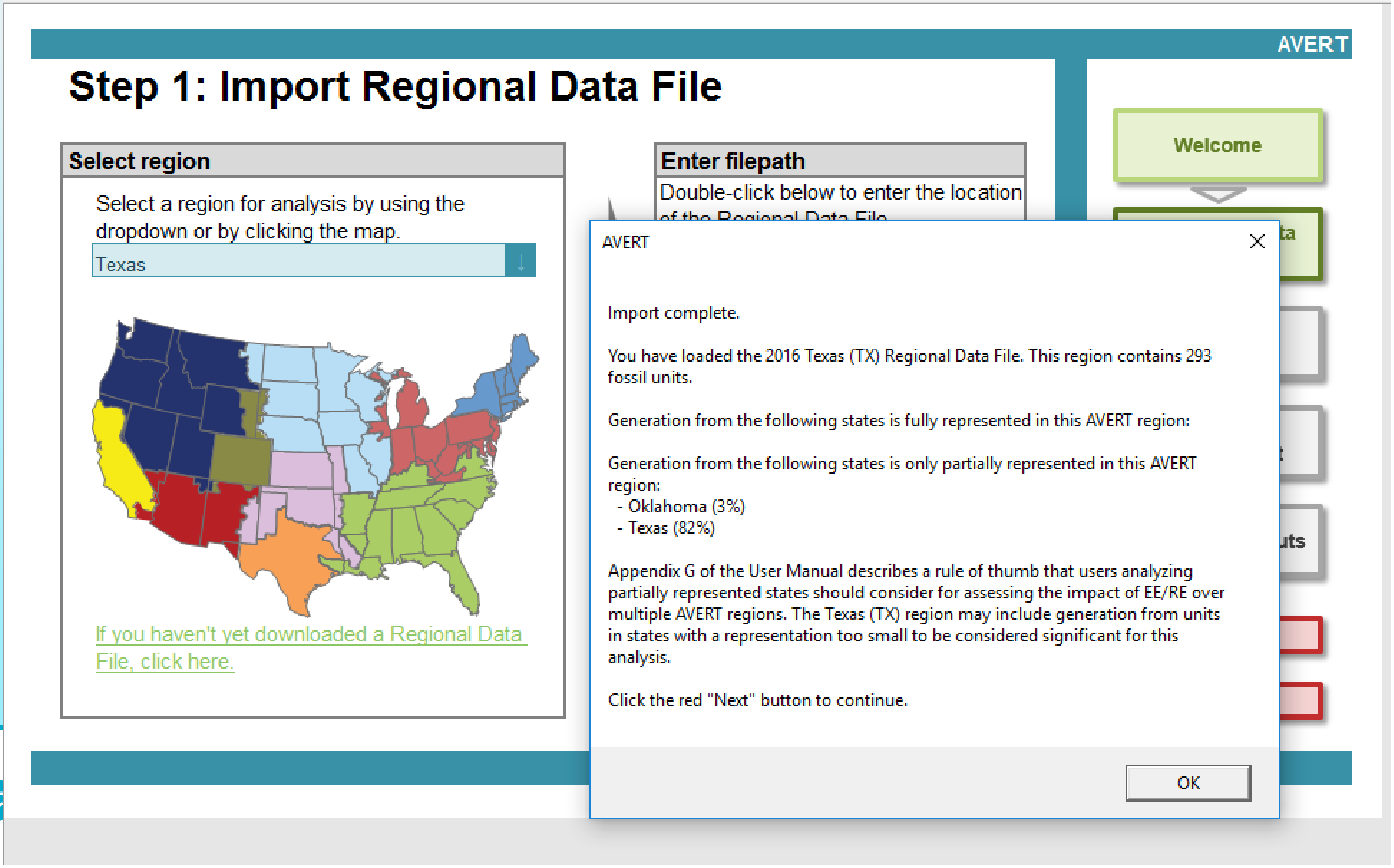
- Click the button under "Load data" entitled:



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

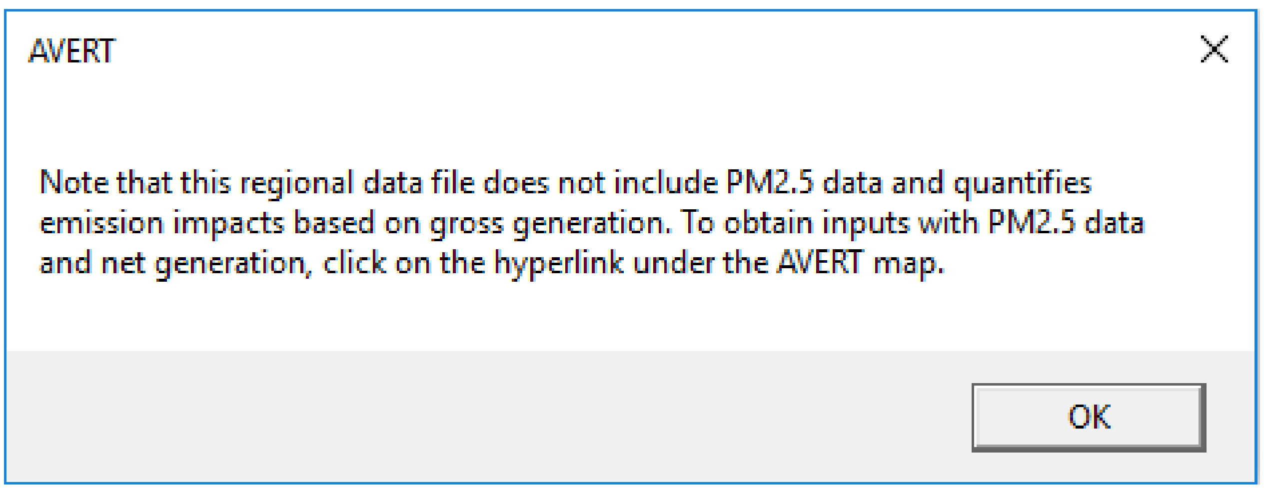
- – Hourly fossil load
- – EGU information (e.g., location, fuel type)
- – Typical EGU performance for generation and emissions at a given regional load

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



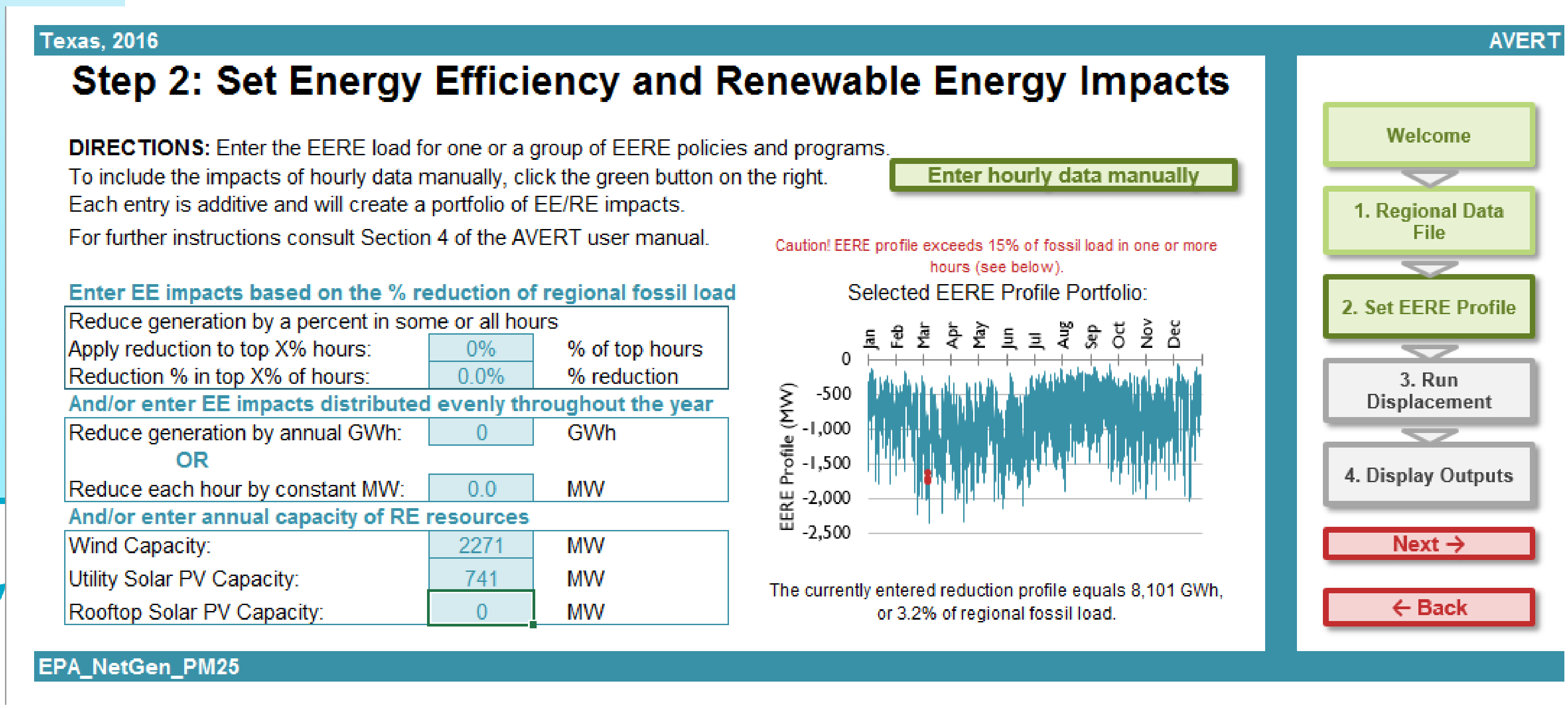
Step 1. Load Regional Data File
Regional Data File import pop-up

- 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.



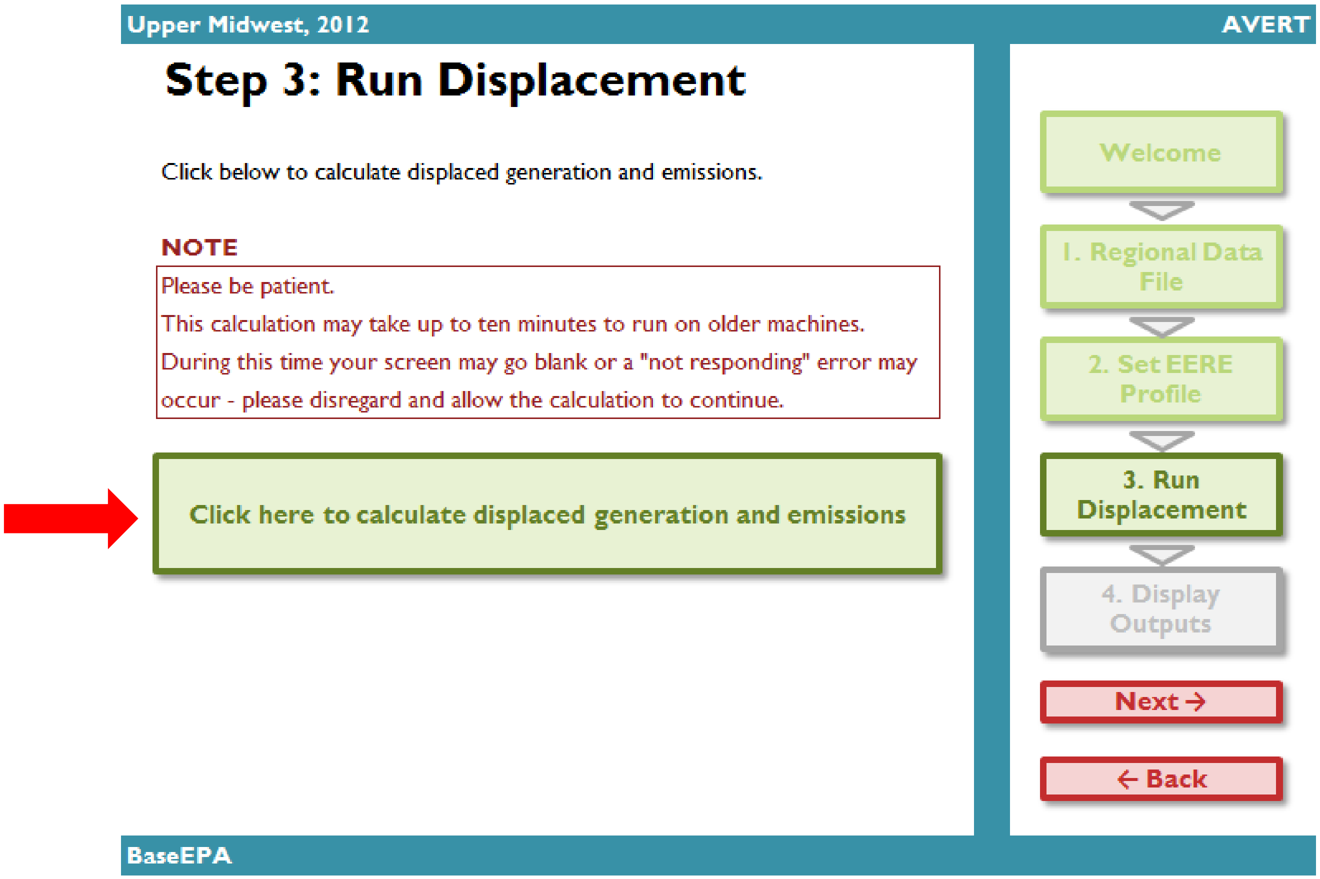
AVERT's Excel-Based Main Module Step 2. Set EE and RE Data

- 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.



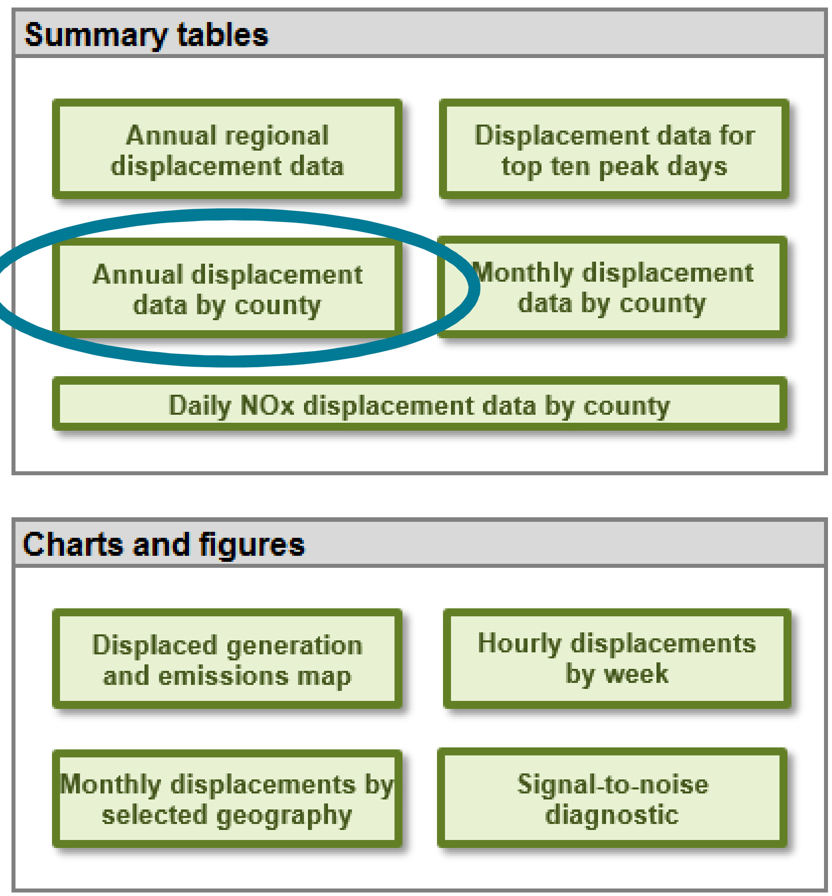
AVERT's Excel-Based Main Module Step 3. Run Displacement

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



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



AVERT Outputs for COBRA

Make sure to convert lbs to tons for COBRA

Texas, 2016

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 SO_2 (lbs)	Annual Displaced NO_x (lbs)	Annual Displaced CO_2 (tons)	A
OK	Pittsburg	1,069	1,554,170	-168,450	-680	-38,260	-73,290	
TX	Atascosa	398	2,338,140	-72,110	-640,110	-144,790	-96,430	
TX	Bastrop	1,235	4,623,580	-123,400	-680	-99,200	-69,670	
TX	Bell	1,287	4,153,610	-305,360	-1,260	-18,690	-138,880	
TX	Bexar	4,169	10,567,170	-679,650	-1,109,020	-645,330	-651,490	
TX	Bosque	593	3,879,900	-144,450	-670	-27,430	-65,510	
TX	Brazoria	453	3,422,310	260	50	1,110	1,790	
TX	Brazos	109	137,610	-5,710	-10	-2,890	-3,360	
TX	Cameron	50	85,000	-6,520	–	-9,340	-4,610	
TX	Chambers	2,427	6,491,330	-343,580	-1,690	-134,590	-182,540	
TX	Cherokee	450	112,310	-23,230	-150	-27,400	-16,870	
TX	Collin	198	28,830	-7,290	-60	-4,110	-5,010	
TX	Dallas	1,442	638,620	-81,050	-470	-67,680	-55,080	
TX	Denton	102	15,670	-4,070	–	-3,590	-2,880	
TX	Ector	1,672	4,610,220	-357,980	-2,150	-94,950	-169,900	
TX	Ellis	1,376	6,867,210	-219,260	-960	-26,400	-98,200	
TX	Fayette	1,594	9,694,870	-345,520	-93,330	-284,980	-393,490	
TX	Fort Bend	3,700	15,097,800	-886,580	-3,245,370	-528,000	-806,650	
TX	Freestone	1,919	11,113,000	-430,330	-2,835,330	-443,970	-372,100	
TX	Galveston	429	2,206,130	-14,700	-460	-15,760	-13,890	
TX	Goliad	619	2,881,810	-167,770	-930,040	-229,720	-186,300	
TX	Grayson	692	3,075,960	-128,720	-530	-6,010	-57,800	
TX	Grimes	1,260	5,005,710	-179,460	-19,330	-131,720	-131,970	
TX	Guadalupe	1,641	8,016,520	-356,100	-1,560	-79,130	-160,050	
TX	Harris	5,475	30,651,280	-525,720	-2,190	-173,700	-250,410	
TX	Hays	795	3,931,800	-70,070	-210	-6,010	-28,810	
TX	Henderson	86	16,430	-3,740	-30	-9,910	-2,970	
TX	Hidalgo	1,512	8,423,830	-239,330	-690	-34,820	-87,130	
TX	Hood	691	2,917,790	-107,190	-550	-22,560	-45,710	
TX	Howard	166	166,340	-17,250	-10	-41,140	-9,650	
TX	Hunt	35	11,650	-1,900	–	-4,540	-1,680	

Questions?

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

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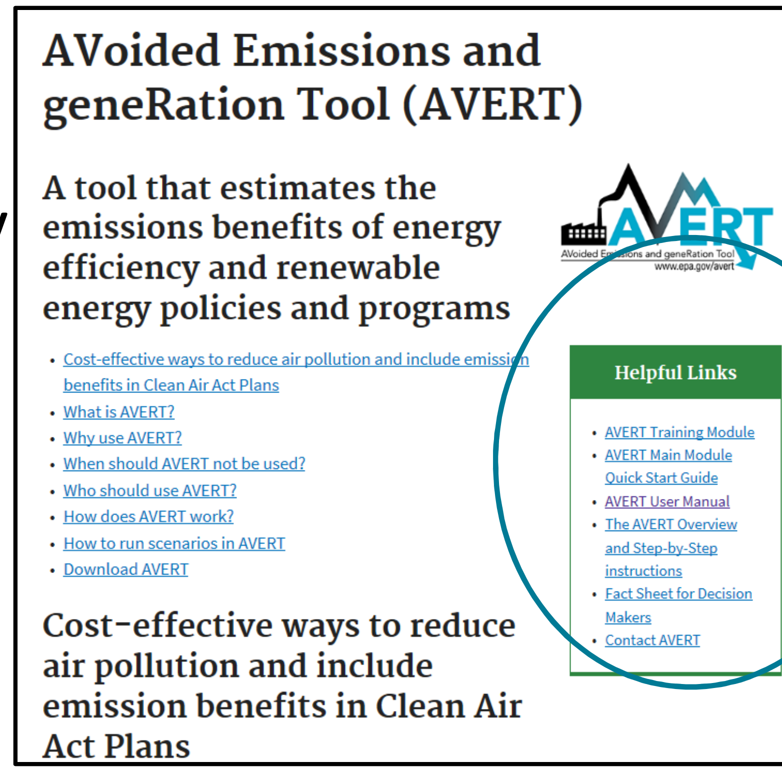

AVoided Emissions and geneRation Tool (AVERT)

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

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

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