What is AVERT?

• In 2012, EPA published EE/RE Roadmap: guide to incorporating energy efficiency and renewable energy into State Implementation Plans.

• Open question: how to quantify emissions impacts from EE/RE?

• States, efficiency providers, and stakeholders seeking accessible method with public data.

• EPA released AVERT in February, 2014
Purpose of AVERT Development for Energy Efficiency and Renewable Energy Programs

• AVERT complements EPA’s Roadmap for Incorporating Energy Efficiency and Renewable Energy (EE/RE) Programs in State Implementation Plans (SIPs)
  – Appendix I of the EE/RE SIP Roadmap describes four quantification approaches states can use for NAAQS compliance planning
  – AVERT translates the energy savings of state EE policies into emission reductions

• AVERT addresses a key reason states have not implemented previous EE/RE SIP guidance
  – States are not clear what emission reductions from EE/RE programs are achievable

• AVERT is:
  – user friendly,
  – transparent, and
  – credible

For more information on EPA’s EE/RE SIP Roadmap visit: http://www.epa.gov/airquality/eere/manual.html
Emission Quantification Methods
Basic to Sophisticated

**Basic Method**
eGRID region non-baseload emission rates

**Intermediate Method**
Historical hourly emission rates

**Sophisticated Method**
Energy Modeling

- Economic parameters
- End use demand
- User defined constraints
- Environmental regulations
- Technology data
- Fuel data
- Emission factors

[Diagram showing the United States with regions colored in different shades]

[AVERT logo]

AVoided Emissions and generation Tool
www.epa.gov/avert
• Using data-driven analysis, how do we distinguish which EGU respond to changes in load reduction?
  – Rich dataset from EPA Clean Air Markets division (hourly, unit-by-unit generation & emissions)
  – Gather statistics on unit operations under specific load conditions, and then replicate changes through a Monte Carlo analysis

• Model divided between statistical core module, and user interface
Regions represent relatively autonomous electricity production zones, and are based on EIA’s electricity market module regions.

Regions include:
California, Great Lakes / Mid-Atlantic, Lower Midwest, Northeast, Northwest, Rocky Mountains, Southeast, Southwest, Texas, and Upper Midwest.
**Example: Loading order**

The diagram illustrates the system generation and load (MW) over a 48-hour period. Each color represents a different generation source:

- **Gen F**
- **Gen E**
- **Gen D**
- **Gen C**
- **Gen B**
- **Gen A**

The black line represents the original load. The diagram shows how the load is distributed across different hours, with peaks during certain times, indicating periods of high demand. The load is calculated in megawatts (MW), with values ranging from 0 to 2,500 MW.
AVERT Overview
Example: Loading order

System Generation & Load (MW)

Hour

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

0 500 1,000 1,500 2,000 2,500

Gen F
Gen E
Gen D
Gen C
Gen B
Gen A
Minus RE
Original Load

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Continuous Emissions Monitoring (CEMS) data from Clean Air Markets Division (CAMD) @ EPA

Hourly generation and emissions of CO₂, SO₂, and NOx.

Fossil generators > 25 MW
How often, and under what conditions, does an EGU generate power?
When an EGU is on, how much does it produce under various load conditions?

**Baseload coal**

**Intermediate gas**
How much emissions are released by an EGU at different levels of generation?
- Estimate average EGU generation and emissions through Monte Carlo simulation.

- Estimate change in EGU output per change in system demand.
**Step 1: Import Regional Data File**

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

- Texas

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

T:\AVERT Code\AVERT Regional Data Files 2012\AVERT RDF 2012 EPABase (Texas).xlsx

**Load data**
Click here to load the Regional Data File
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.

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**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 0.0% | % reduction |

And/or enter EE impacts distributed evenly throughout the year

Reduce generation by annual GWh:

| OR Reduce each hour by constant MW: 0.0 GWh |

And/or enter annual capacity of RE resources

| Wind Capacity: 500 MW |
| Utility Solar PV Capacity: 0 MW |
| Rooftop Solar PV Capacity: 0 MW |

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The currently entered reduction profile equals 1,485 GWh, or 0.6% of regional fossil load.
Select variable to display: Annual Change in CO2 (tons)

Note: The diameter of each circle indicates the magnitude of a unit's change in generation / emissions. Circles are semi-transparent; darker areas occur in regions with overlapping units. Negative changes are indicated with blue circles; positive changes are indicated with black-bordered white circles.
Change in Generation (MW) in Week of 8/1

Negative numbers indicate displaced generation and emissions.

- Total Change in Generation (MW)
- Total fossil-fuel load, pre-EERE

High capacity factor units
Low capacity factor units

Max Load
Min Load
• Based completely on historic data; no embedded assumptions.

• Reflects historic dispatch and economics; limited options for long-term projections

• No transmission; hard regional boundaries.
Where is AVERT Used?

- Ozone Advance Program
- Value of renewable energy (ME, AWEA)
- Quantify emissions impacts of EE (WI, UT)
- Listed in EPA CPP Toolbox

www2.epa.gov/cleanpowerplantoolbox
Questions?

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www.epa.gov/avert
AVERT Overview
Example: Generation Statistics

System Demand (MW)

When demand = 1,000-1,500 MW:
Gen A = 450 MW (100%)
Gen B = 450 MW (100%)
Gen C = 252 MW (84%)
Gen D = 83 MW (42%)
Gen E = 15 MW (5%)
Gen F = 0 MW (0%)

When demand = 1,000-1,500 MW:
Gen A = 450 MW (100%)
Gen B = 450 MW (100%)
Gen C = 156 MW (52%)

When demand = 1,500-2,000 MW:
Gen A = 450 MW (100%)
Gen B = 450 MW (100%)
Gen C = 252 MW (84%)
Gen D = 83 MW (42%)
Gen E = 15 MW (5%)
Gen F = 0 MW (0%)

When demand = 2,000-2,500 MW:
Gen A = 450 MW (100%)
Gen B = 525 MW (100%)
Gen C = 252 MW (84%)
Gen D = 83 MW (42%)
Gen E = 15 MW (5%)
Gen F = 0 MW (0%)

When demand = 2,500 MW:
Gen A = 450 MW (100%)
Gen B = 525 MW (100%)
Gen C = 252 MW (84%)
Gen D = 83 MW (42%)
Gen E = 15 MW (5%)
Gen F = 18 MW (3%)

Gen A at 450 MW (100%)
Gen B at 450 MW (100%)
Gen C at 300 MW (100%)
Gen D at 200 MW (100%)
Gen E at 44 MW (15%)
Gen F = 0 MW (0%)

Original Load