US EPA Emissions Inventory Conference Training
US GHG Inventory
and
AVERT

April 14, 2015

AVERT

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

United States
Environmental Protection
Agency

Today's Agenda

| TIME	ACTIVITY	PRESENTERS
8:00am-8:10am	Introductions	All
8:10am-8:45am	US Inventory of GHG Emissions and Sinks	Leif Hockstad, US EPA
8:45am-8:55am	Break	All
9:00am-9:45am	**AVERT training**: When to use AVERT How AVERT works Main Module demo	Robyn DeYoung, US EPA and Jeremy Fisher, Synapse Energy Economics
9:45am-10:10am	Hands-on Main Module Testing and Q/A	All
10:10am-10:30am	AVERT's SMOKE Outputs	Allison DenBleyker
10:30am-10:40am	Break	All
10:40am-11:45am	Statistical Module and Future Scenario Template Step-by-step group following along	Jeremy Fisher, Synapse Energy Economics

Purpose of the training

- Provide overview of AVERT
  - Impetus for its development
  - How AVERT works
  - Teach you how to use all modules of AVERT
- Hands-on training
  - Ask lots of questions
  - Test different scenarios to become comfortable with the tool
- Online training available
  - Spread the word to your colleagues
   - http://www.epa.gov/avert/training-module/index.html

Introduction

- State air regulators are looking for new ways to reduce emissions, improve air quality

- Meanwhile, states and utilities are advancing proven energy efficiency and renewable energy (EE/RE) policies and programs

- Opportunity for states to include the emissions benefits in air quality plans

- But needed to remove a key barrier – emission quantification of energy impacts

Counties Where Measured Ozone is Above Proposed Range of Standards (65 – 70 parts per billion)

358 counties would violate 70 parts per billion (ppb)
200 additional counties would violate 65 ppb for a total of 558

Based on 2011 – 2013 monitoring data
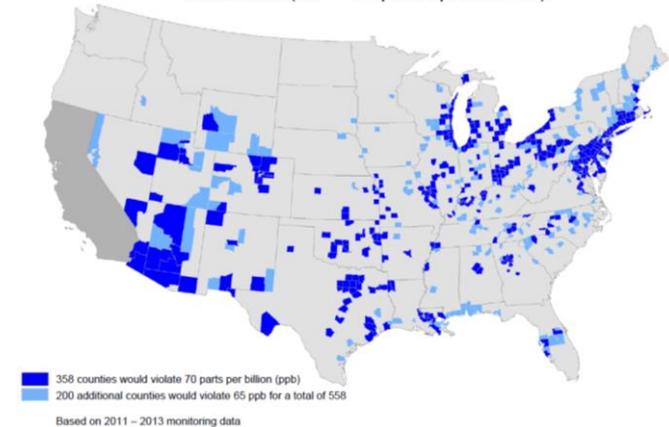
Energy Efficiency Spending

ACEEE 2011
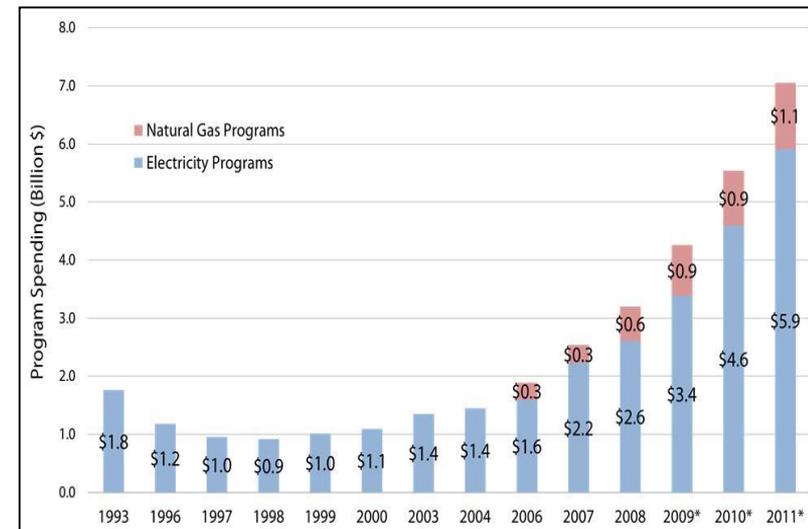
Emission Quantification Methods
Basic to Sophisticated

Basic Method	**Intermediate Method**	**Sophisticated Method**
eGRID region non-baseload emission rates	Historical hourly emission rates	Energy Modeling
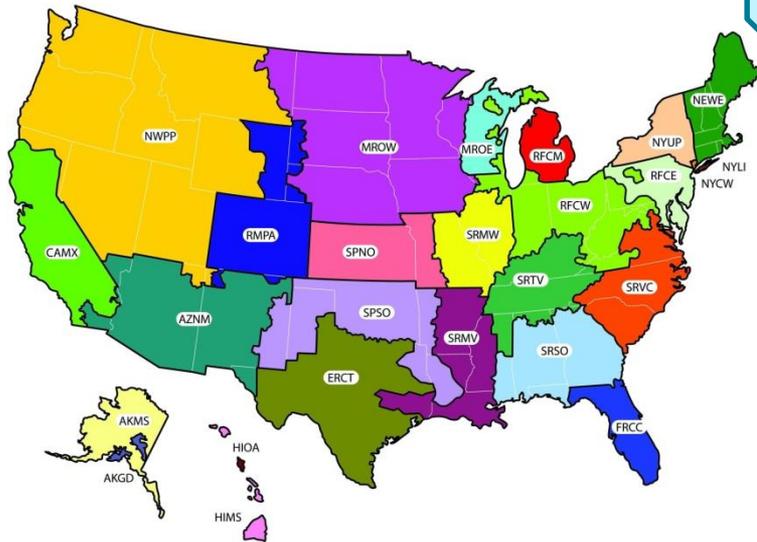
AVERT
AVoided Emissions and geneRation Tool
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Economic parameters

End use demand

User defined constraints

Environmental regulations

Energy Model

Technology data

Fuel data

Emission factors
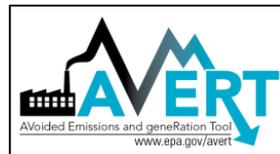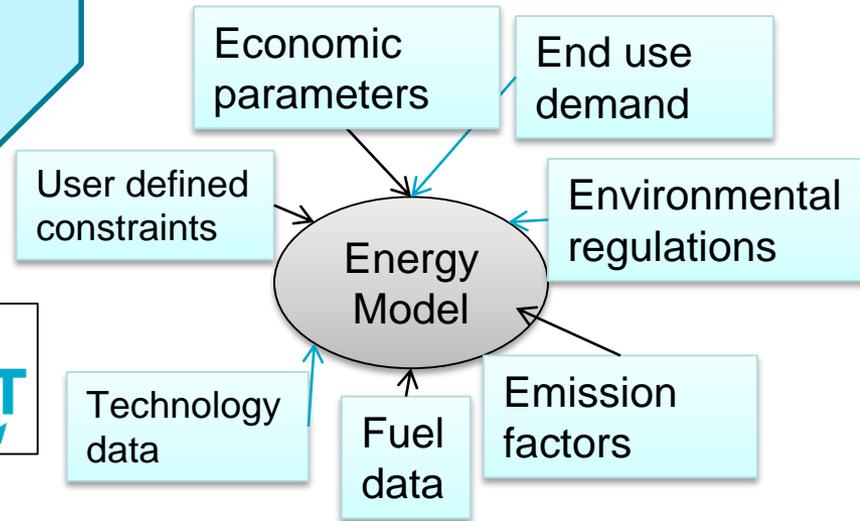
# AVERT (AVoided Emissions and geneRation Tool)

- AVERT addresses key challenges associated with quantifying emission benefits of EE/RE programs.
  - Integrated nature of the power system makes it difficult to quantify generation and emissions changes from EE/RE
    - Estimating emission impacts within the state and local air sheds
  - Generating units, and thus emissions respond differently to different programs (EE/RE);

- AVERT translates the energy savings and renewable generation of state EE/RE programs into emission reductions for NAAQS compliance
  - An Excel-based tool that allows users to understand the effect of EE and RE on emission changes at the regional, state, county and EGU levels
  - Built to be straightforward, transparent and credible
  - Peer reviewed and benchmarked against industry standard electric power sector model – PROSYM

Applications for AVERT-Calculated Emissions

- SIP credit in a state's National Ambient Air Quality Standard Clean Air Act Plan*

- Analyze emission impacts of an EE/RE program portfolio

- Identify location of emission reductions at the regional, state, and county levels
  - EGU representation also available

- Use charts and maps to communicate benefits to management and public

- This is not a projection tool, not intended for analysis more than 5 yrs from baseline

* With the concurrence of the appropriate EPA regional office

What is AVERT?

- AVERT simulates the hourly changes in generation and air emissions (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
  - EPA provides hourly profiles for some states with on-the-books EE programs not included in Energy Information Administration's Annual Energy Outlook (2013)

- User can retire, add and change emission rates of EGU and re-run simulation using AVERT's Future Year Scenario Template and Statistical Module.

For information on state EE on-the-books hourly profiles visit:
http://www.epa.gov/statelocalclimate/state/statepolicies.html

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AVERT's Modules and Data Files

Raw Hourly Generation and Emissions Data from Air Markets Program (AMP) Dataset

Text files

Future Year Scenario Template

User interface for retirements, additions, and retrofits

Excel workbook

AVERT: Statistical Module

Inputs AMP data, performs statistical analysis, outputs new Regional Data Files

MATLAB Code

Regional Data Files

Contains annual hourly load data and unit-level statistics on generation and emissions data

Text files

AVERT Main Module

User interface for creating EE/RE load curves, performs displaced emissions analysis, creates output charts and tables

Excel workbook

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

# 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
  - 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 Overview
# Example: Loading order
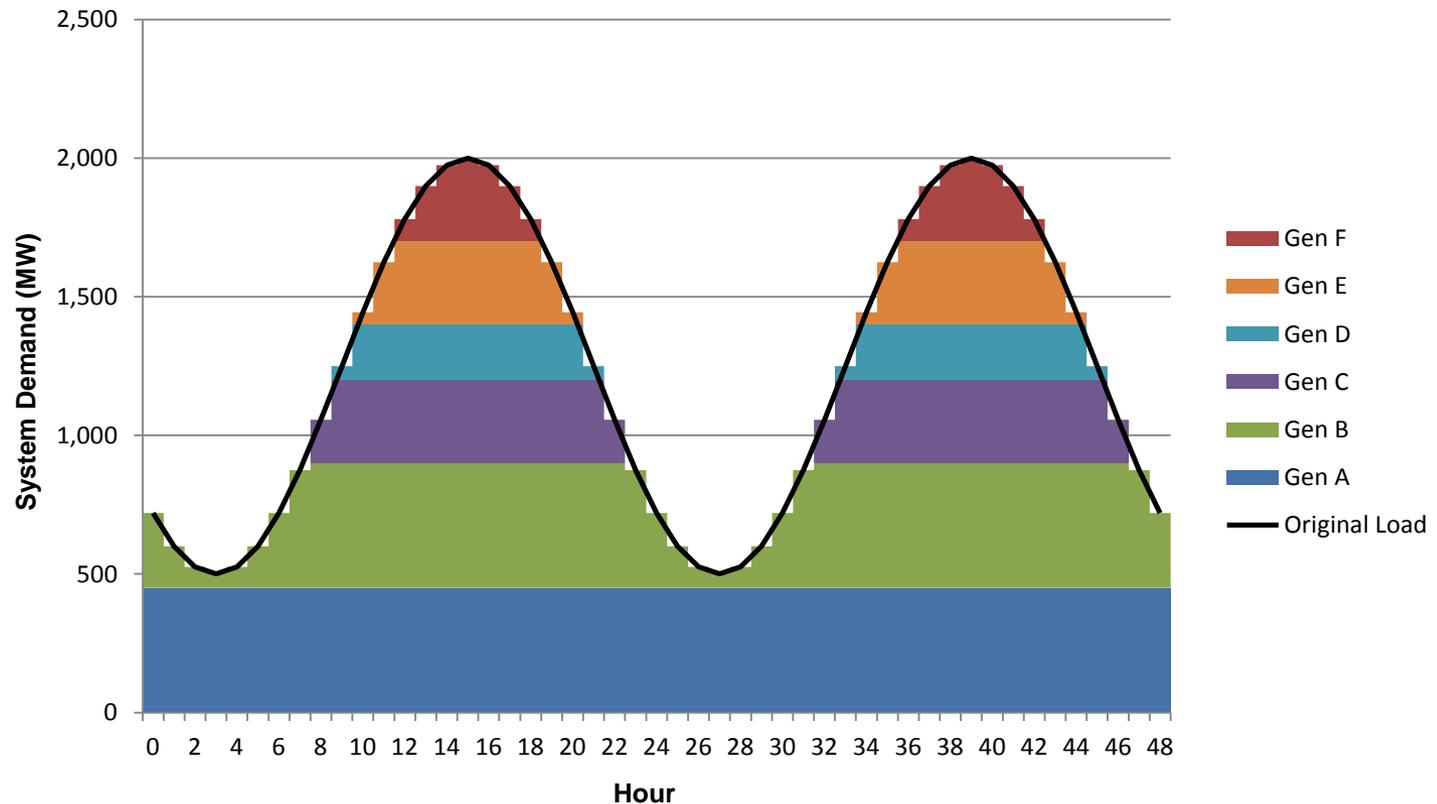
AVERT Overview
Example: Loading order
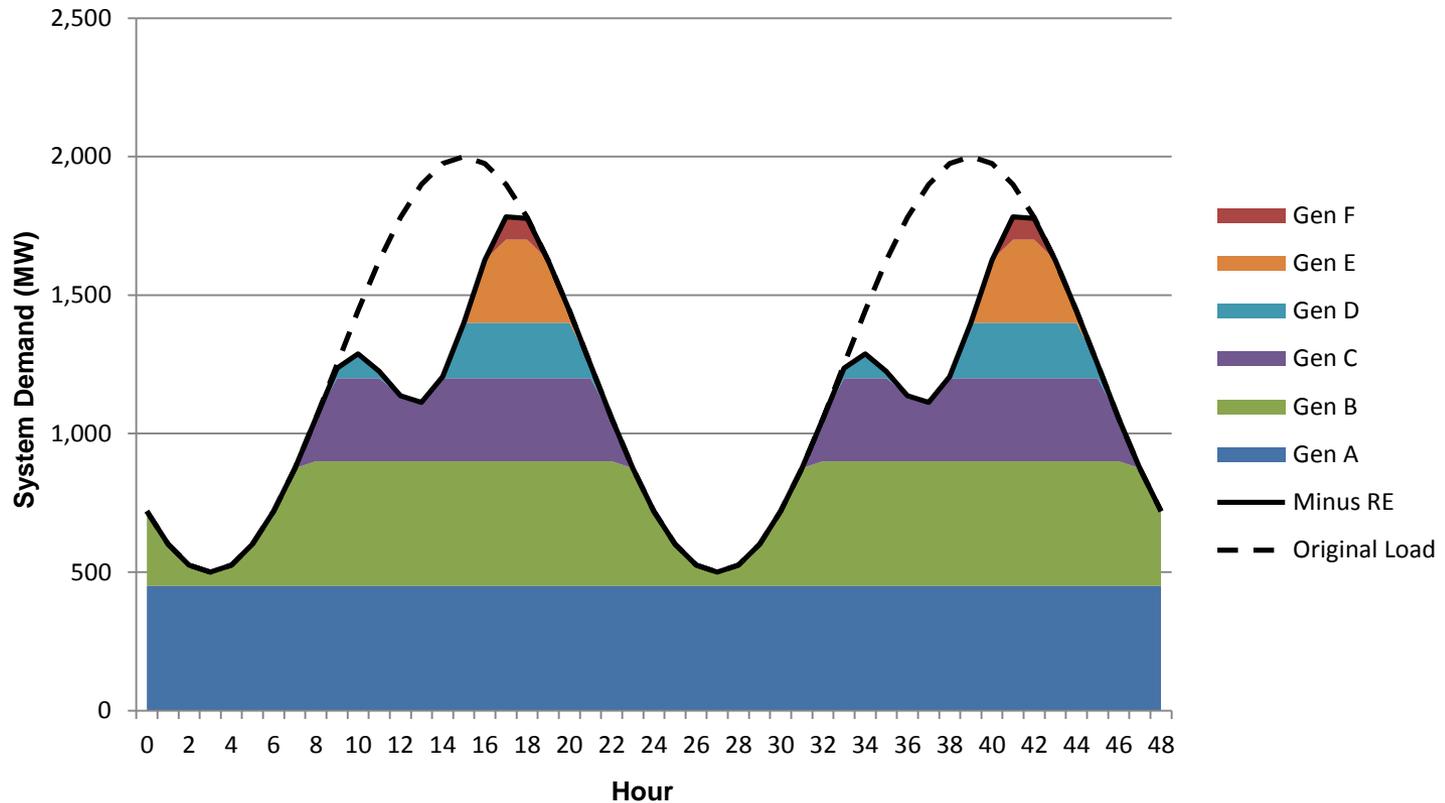
AVERT Overview
Example: Generation Statistics
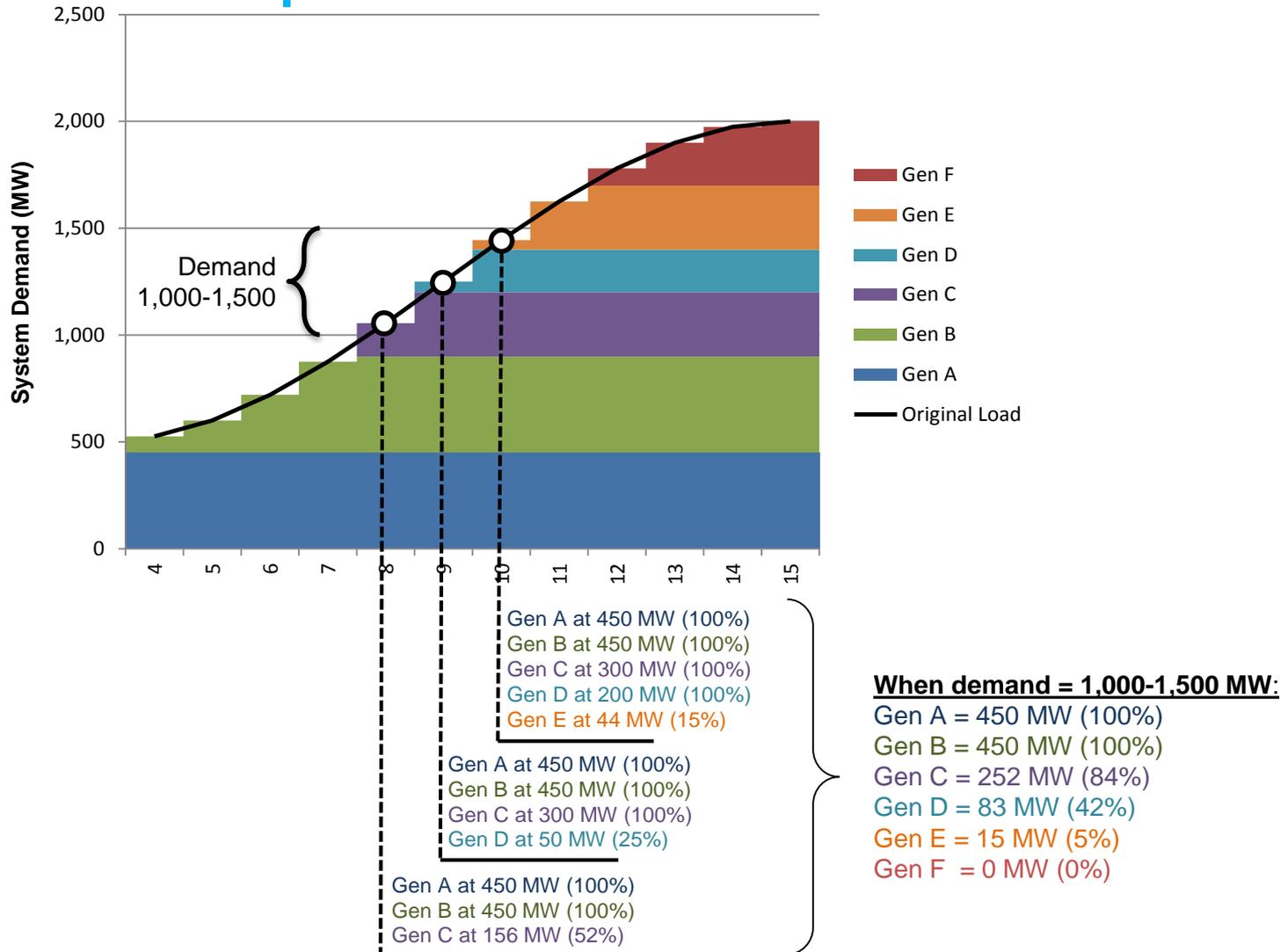
AVERT Statistical Module: Loading Order
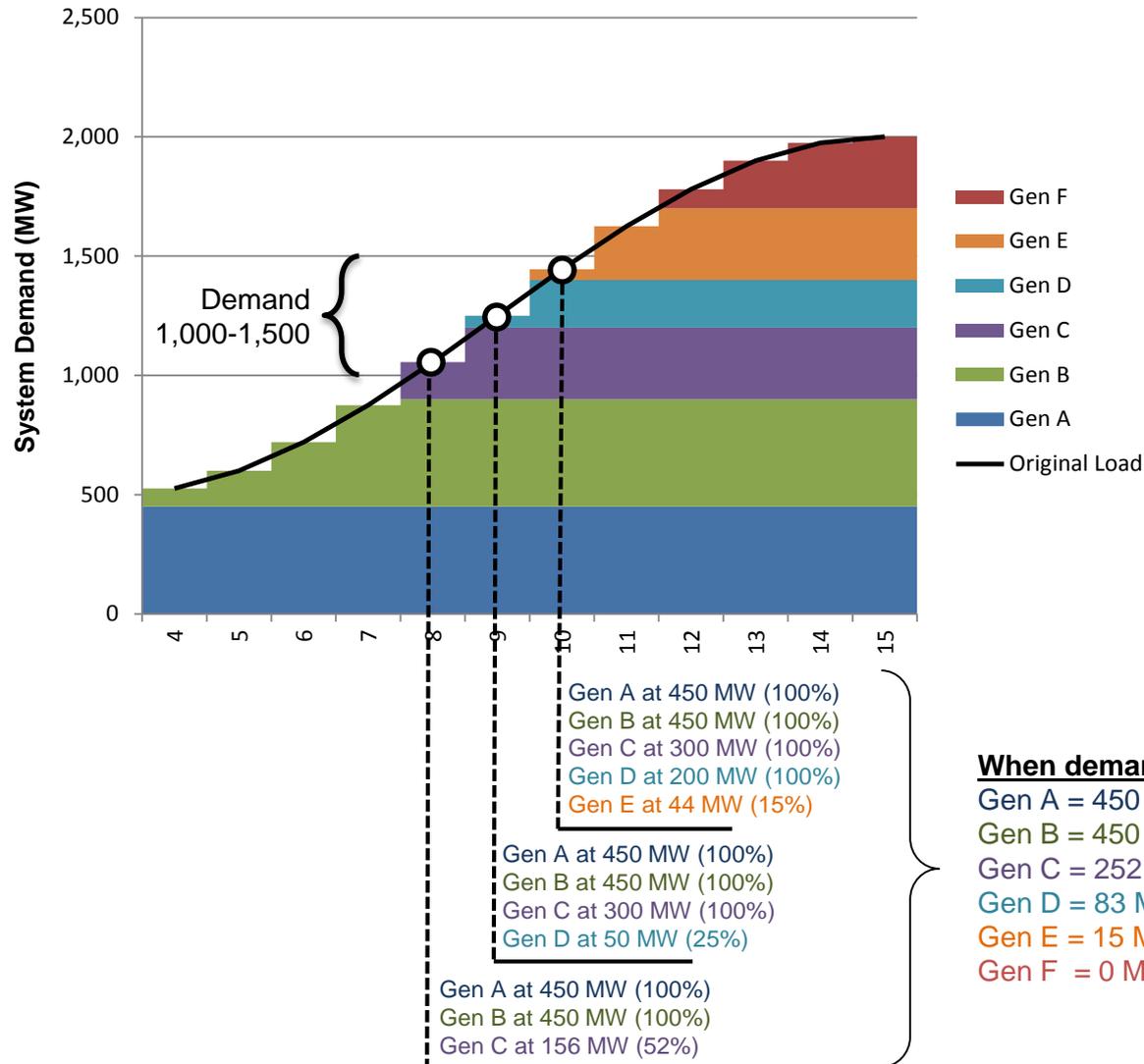
AVERT Statistical Module
Air Markets Program Data
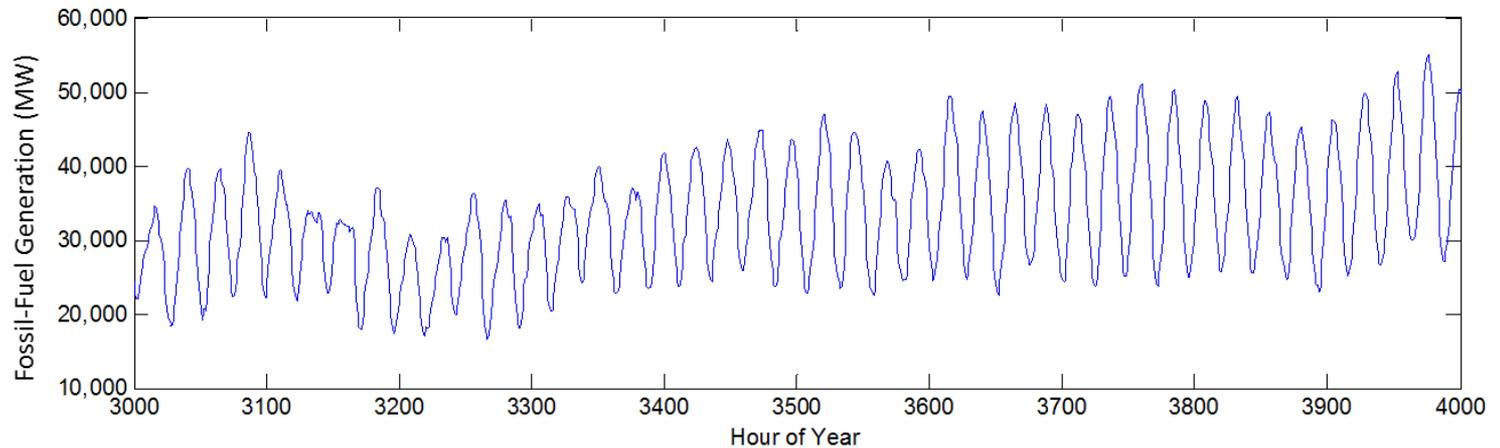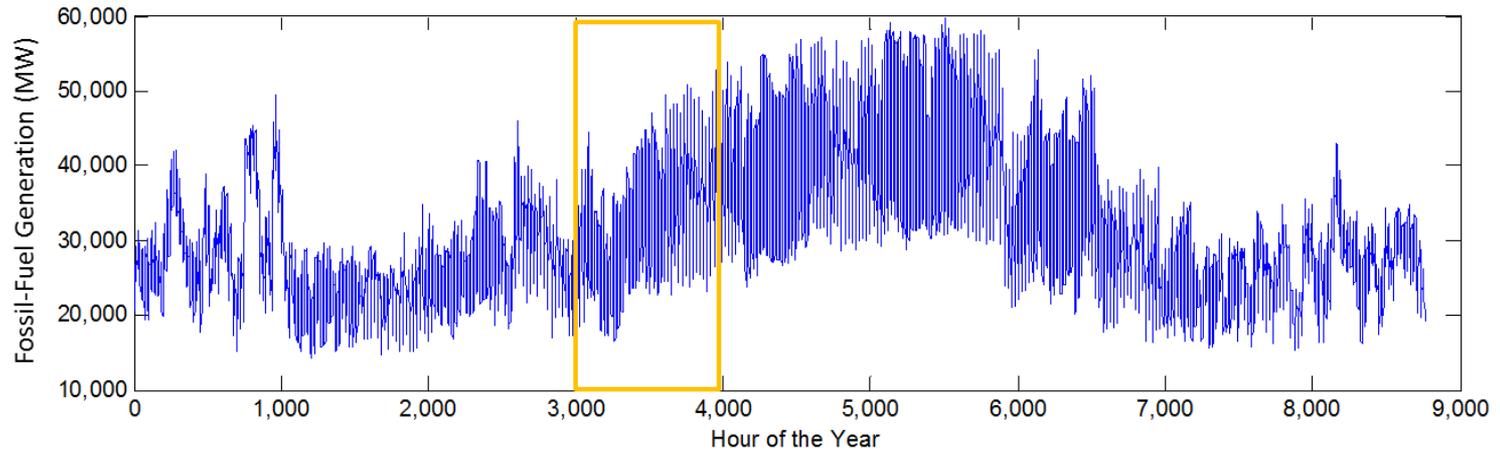
AVERT Statistical Module:
Gather Operating Statistics (I)
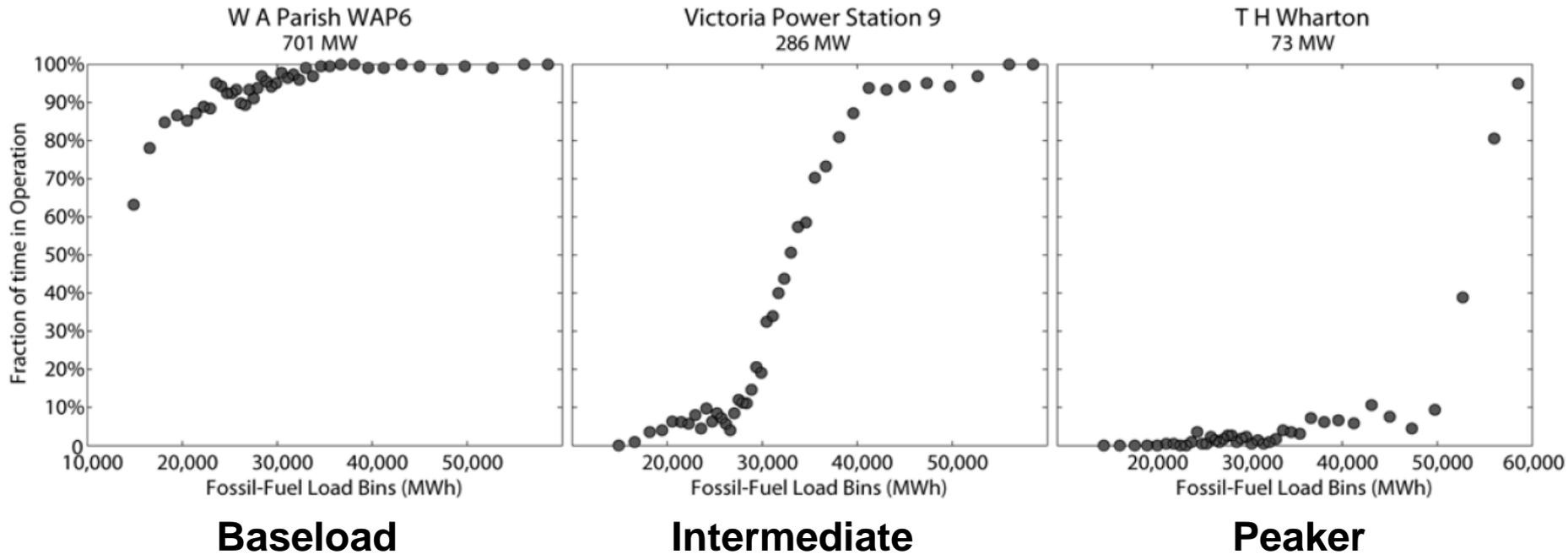
Frequency of operation level by load bin for three indicative units.

AVERT Statistical Module: Gather Operating Statistics (II)
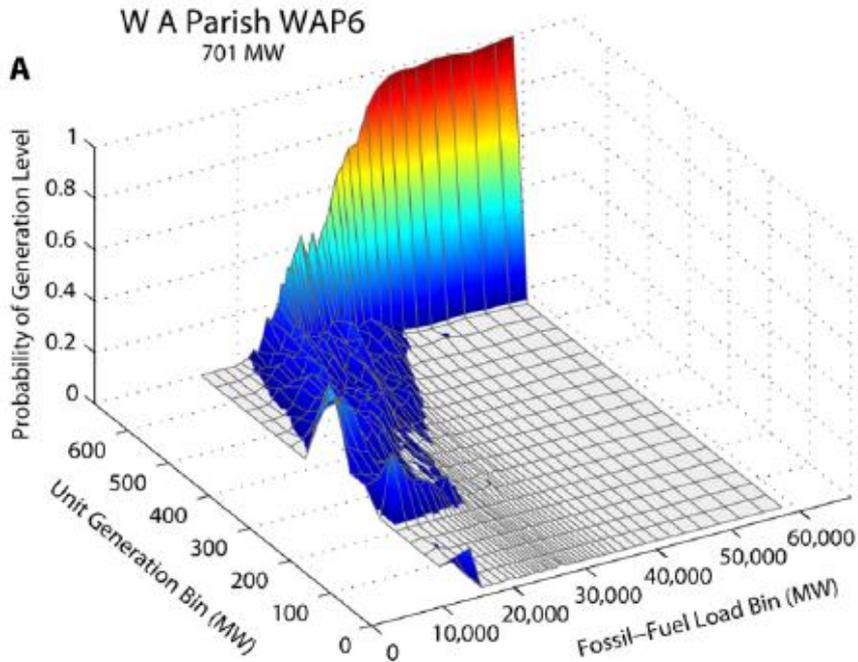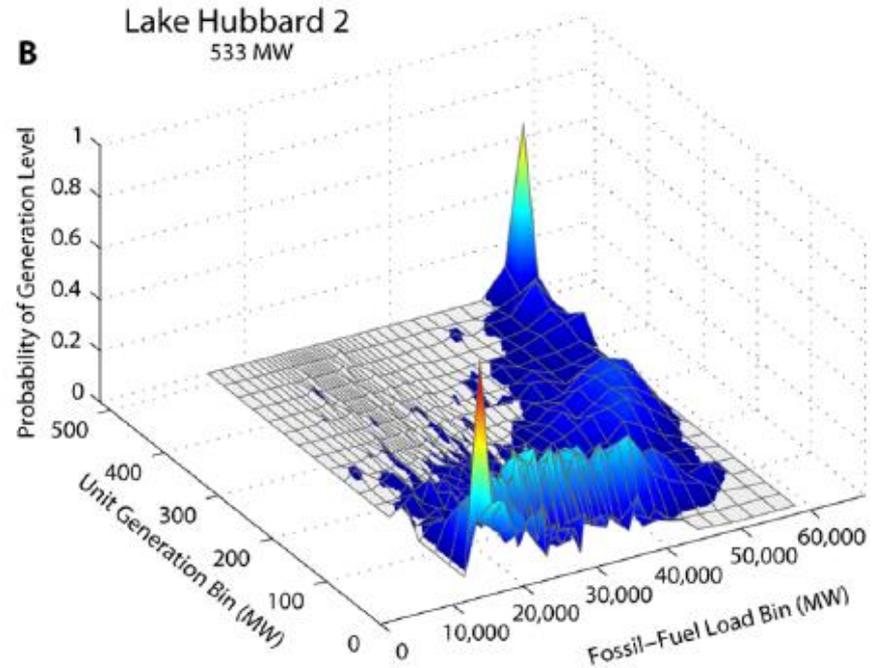
Baseload coal   **Intermediate gas**

Generation level by load bin and unit generation for two indicative units.

AVERT Statistical Module:
Gather Operating Statistics (II)
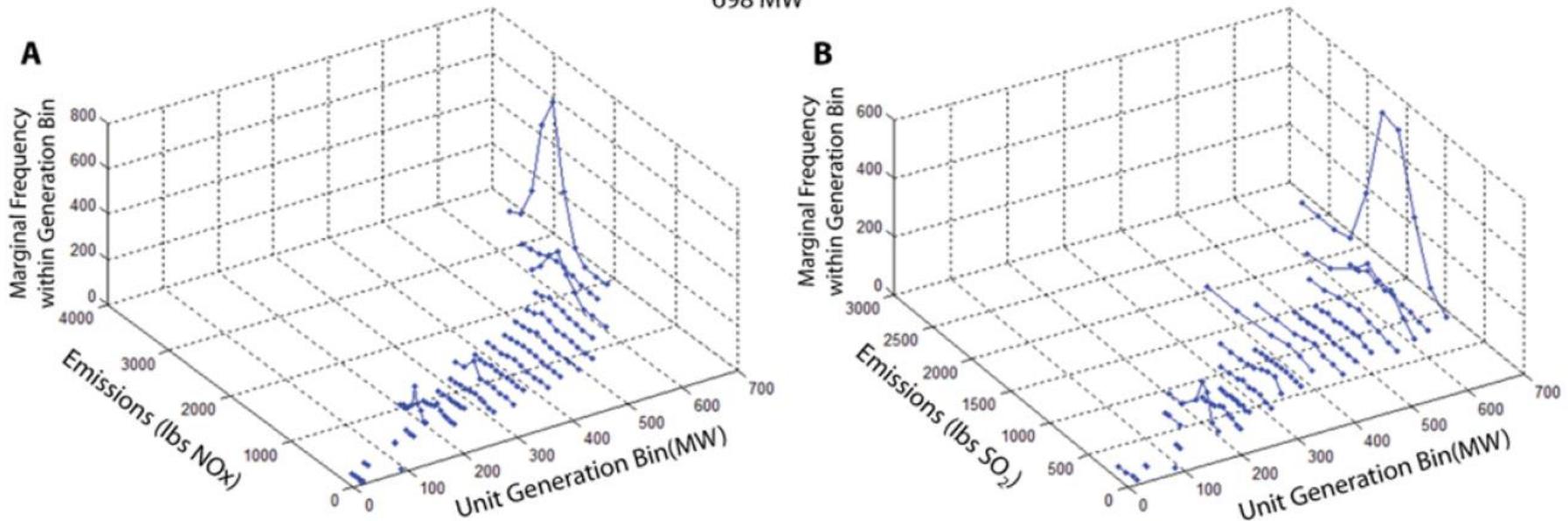
Emissions level (NOx and SO2) by unit generation level.

ERCOT Generation Curve

Detail

JK Spruce

670 MW

370 MW

40,000 MW

34,000 MW

Sum of System Generation (Load Bin)
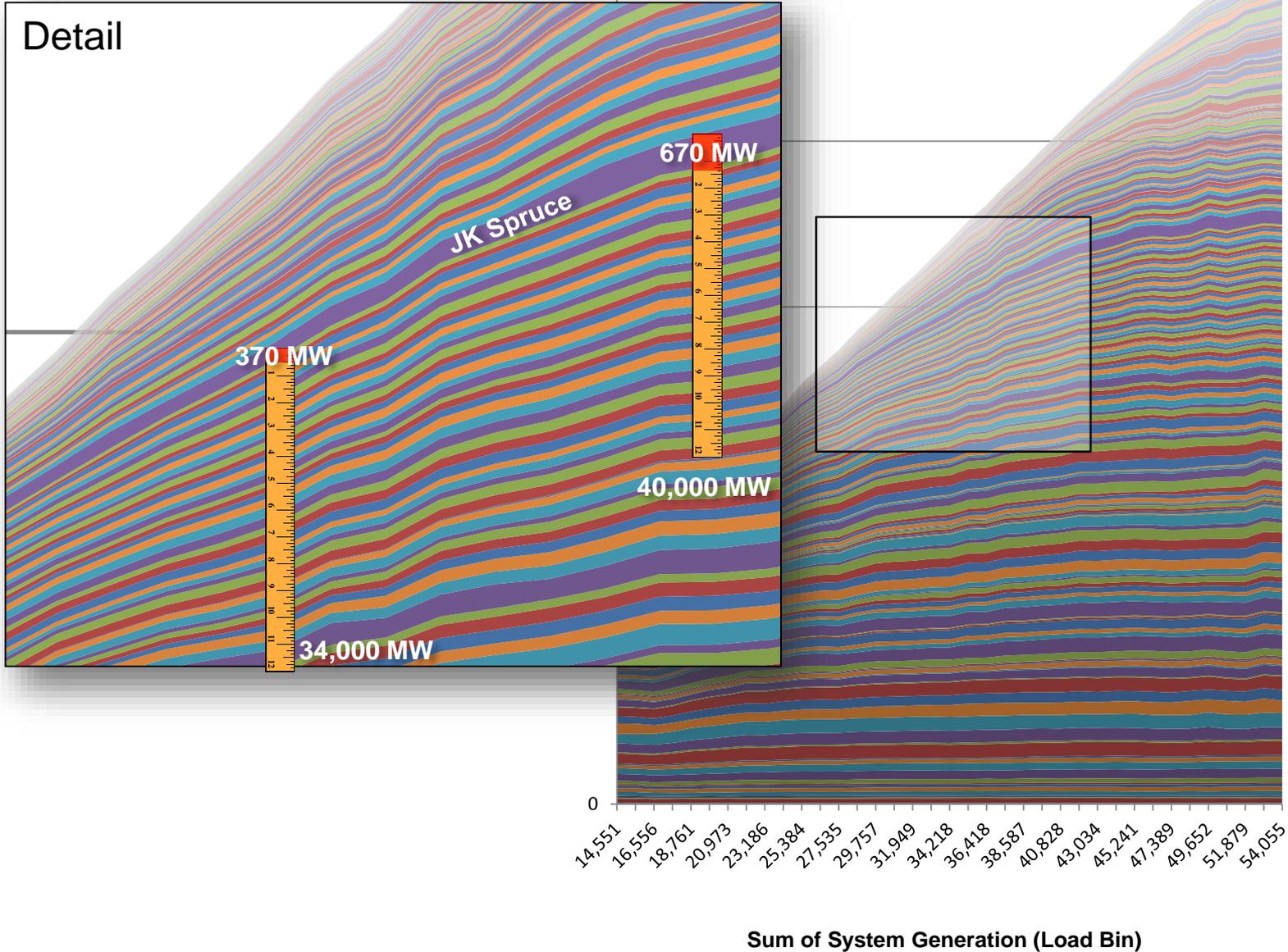
Legend:
- Spencer 5
- Hardin County Peaking Facility HCCT1
- Hardin County Peaking Facility HCCT2
- R W Miller **4
- Leon Creek CGT1
- W A Parish WAP1
- W A Parish WAP2
- Leon Creek CGT4
- Exelon Laporte Generating Station GT-2
- Decker Creek GT-1A
- Decker Creek GT-1B
- Sam Bertron SRB4
- Sam Bertron SRB3
- Permian Basin 5
- W A Parish WAP3
- Spencer 4
- Permian Basin CT5
- Mustang Station Units 4 and 5 GEN1
- V H Braunig CGT5
- Exelon Laporte Generating Station GT-1
- Handley Generating Station 3
- Decker Creek GT-2B
- Power Lane Steam Plant 2
- Greens Bayou GBY5
- Graham 1
- Ray Olinger BW3
- Decker Creek GT-2A
- Exelon Laporte Generating Station GT-3
- Sand Hill Energy Center SH6
- Permian Basin CT2
- Ray Olinger BW2
- Barney M. Davis 1
- Roland C. Dansby Power Plant 3
- Tradinghouse 2
- Sim Gideon 1
- Valley (TXU) 2
- Cedar Bayou CBY2

AVERT Main Module Step-by-Step Demonstration

- Step 1. Load Regional Data File for historic baseline year (available years: 2007-2013)

- Step 2. Set energy efficiency and renewable energy data

- Step 3. Run displacement

- Step 4. Display outputs
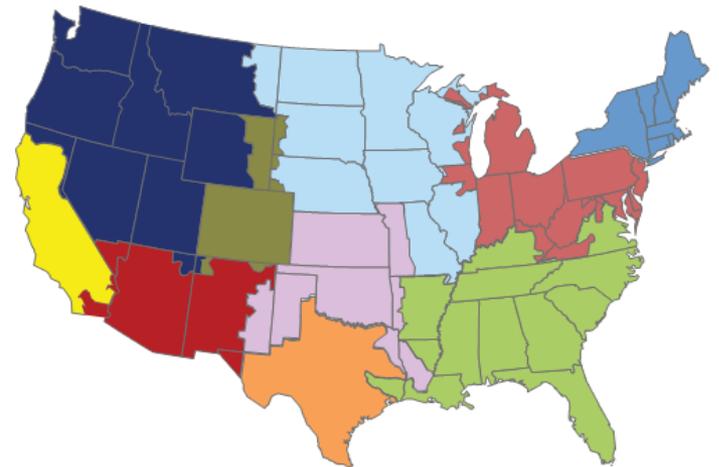
State apportionment by AVERT region, based on generation from 2010 to 2013:

State (number of regions)	Northeast	Great Lakes / Mid-Atlantic	Southeast	Lower Midwest	Upper Midwest	Rocky Mountains	Texas	Southwest	Northwest	California
Alabama			100.0%							
Arkansas (2)			88.7%	11.3%						
Arizona								100.0%		
California								0.3%		99.7%
Colorado						100.0%				
Connecticut	100.0%									
District of Columbia		100.0%								
Delaware		100.0%								
Florida			100.0%							
Georgia			100.0%							
Iowa					100.0%					
Idaho									100.0%	
Illinois (2)		38.8%			61.2%					
Indiana		100.0%								
Kansas				100.0%						
Kentucky (2)		9.4%	90.6%							
Louisiana (2)			76.1%	23.9%						
Massachusetts	100.0%									
Maryland		100.0%								
Maine	100.0%									
Michigan		99.6%			0.4%					
Minnesota					100.0%					
Missouri (3)			21.0%	33.8%	45.2%					
Mississippi (1)			98.9%		1.1%					
Montana (1)					2.3%				97.7%	
North Carolina			100.0%							
North Dakota					100.0%					
Nebraska					100.0%					
New Hampshire	100.0%									
New Jersey (2)	23.4%	76.6%								
New Mexico (1)				2.9%				97.1%		
Nevada (2)								72.0%	28.0%	
New York	100.0%									
Ohio		99.7%			0.3%					
Oklahoma (1)			4.1%	92.8%			3.1%			
Oregon									100.0%	
Pennsylvania		100.0%								
Rhode Island	100.0%									
South Carolina			100.0%							
South Dakota					99.7%	0.3%				
Tennessee			100.0%							
Texas (3)			6.0%	11.7%			81.6%	0.7%		
Utah (2)									65.1%	34.9%
Virginia (2)		5.1%	94.9%							
Vermont	100.0%									
Washington									100.0%	
Wisconsin (2)		45.2%			54.8%					
West Virginia (2)		87.7%	12.3%							
Wyoming (2)						38.3%			61.7%	

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)

- **Output file can be used directly in Main Module**

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 historic base year

For More Information

- Visit the AVERT website at www.epa.gov/avert.
    - Online training will be available at: http://www.epa.gov/avert/training-module/index.html

    - Contact us with questions at avert@epa.gov