State-Federal RPS Collaborative Webinar

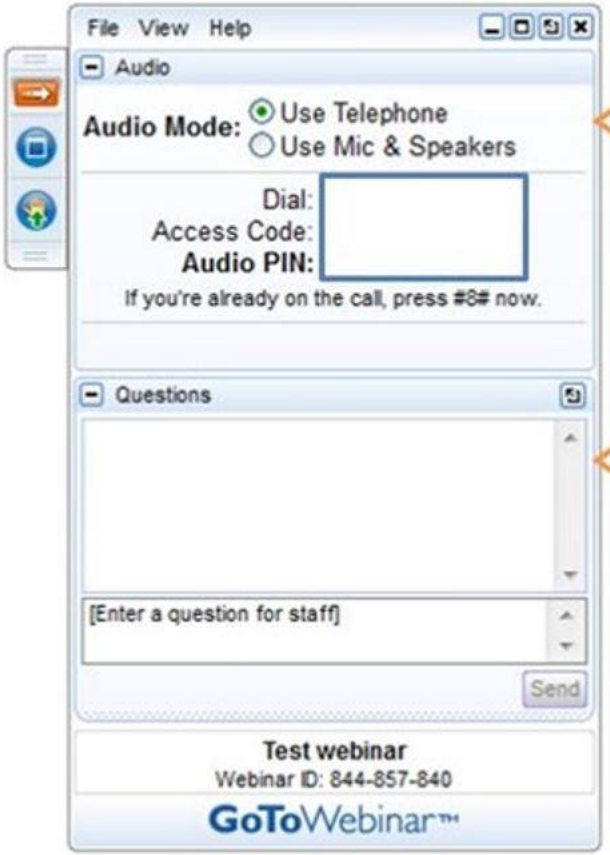
Using AVERT to Estimate the Emissions Benefits of Clean Energy Policies and Programs

Hosted by
Warren Leon, Executive Director, CESA

Monday, June 1, 2015

CleanEnergy States Alliance

Housekeeping



All participants are in "Listen-Only" mode. Select "Use Mic & Speakers" to avoid toll charges and use your computer's VOIP capabilities. Or select "Use Telephone" and enter your PIN onto your phone key pad.

Submit your questions at any time by typing in the Question Box and hitting Send.

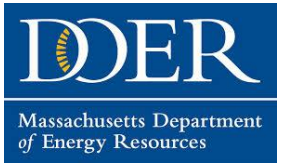
This webinar is being recorded.

You will find a recording of this webinar, as well as all previous CESA webcasts, archived on the CESA website at

www.cesa.org/webinars

Clean Energy States Alliance (CESA) is a national nonprofit coalition of public agencies and organizations working together to advance clean energy.

Renewable Development Fund



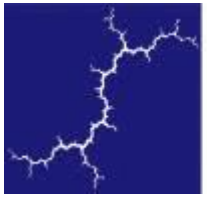
State-Federal RPS Collaborative

- With funding from the Energy Foundation and the US Department of Energy, CESA facilitates the **Collaborative**.
- Includes **state RPS administrators**, **federal agency representatives**, and other stakeholders.
- Advances dialogue and learning about RPS programs by **examining the challenges and potential solutions** for successful implementation of state RPS programs, including **identification of best practices**.
- To sign up for the Collaborative listserve to get the **monthly newsletter** and announcements of **upcoming events**, see: www.cesa.org/projects/state-federal-rps-collaborative

Today's Guest Speakers

Robyn DeYoung, State Climate and Energy Program Manager, U.S. Environmental Protection Agency (EPA)

Jeremy Fisher, Principal Associate, Synapse Energy Economics



Synapse
Energy Economics, Inc.

Overview of EPA's AVoided Emissions and geneRation Tool (AVERT)

Robyn DeYoung, US EPA
Jeremy Fisher PhD, Synapse Energy Economics
June 1, 2015

State and Local Climate and Energy Program

Synapse Energy Economics, Inc.

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

EPA United States Environmental Protection Agency

Today's Presenters

Robyn DeYoung

US EPA State and Local Climate and Energy Program

Co-Author of Roadmap for Incorporating EE/RE Policies in SIPs

Previously at Ohio EPA

Jeremy Fisher

Principal Associate, Synapse Energy Economics

Work for public interest clients, including state and federal agencies, consumer advocates, and environmental groups

Long-term planning, market systems, energy & env. policies

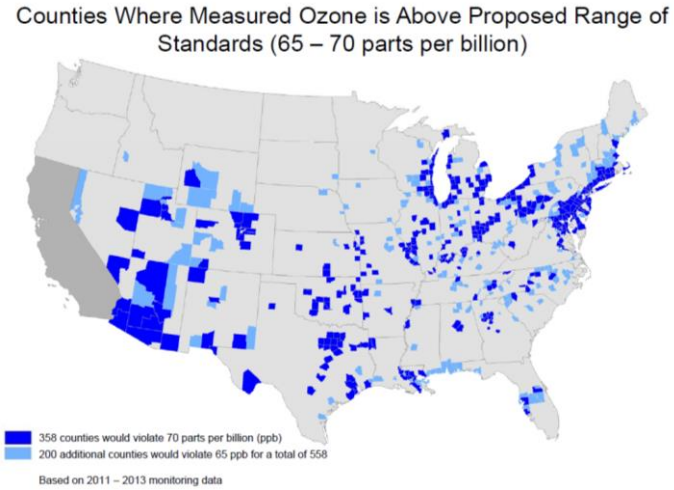
Introduction on Building Energy Efficiency and Renewable Energy (EE/RE) Resources

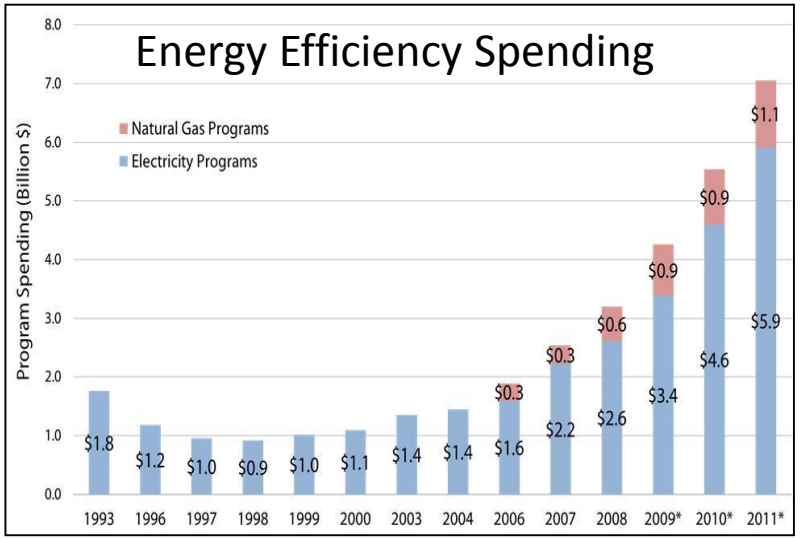
In 2009, EPA:

- Began to renew our effort to encourage and remove barriers to EE/RE and CHP
- Looked for ways to make it easier to include emission benefits of EE/RE and CHP to meet clean air goals
  - States were asking for clearer guidance
- Wanted to be clear that these are viable, cost effective emission reduction strategies
  - Focused our efforts on air quality plans (e.g., State Implementation Plans (SIPs) for National Ambient Air Quality Standards (NAAQS))

Opportunity to Capture the Air Quality and Emission Benefits of EE/RE Programs

- State air quality planners are looking for new ways to reduce emissions, improve air quality
- Meanwhile, PUC and SEOs 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
- In 2012, EPA released the EE/RE SIP Roadmap… But still needed to remove a key barrier – emission quantification of energy impacts





ACEEE 2011

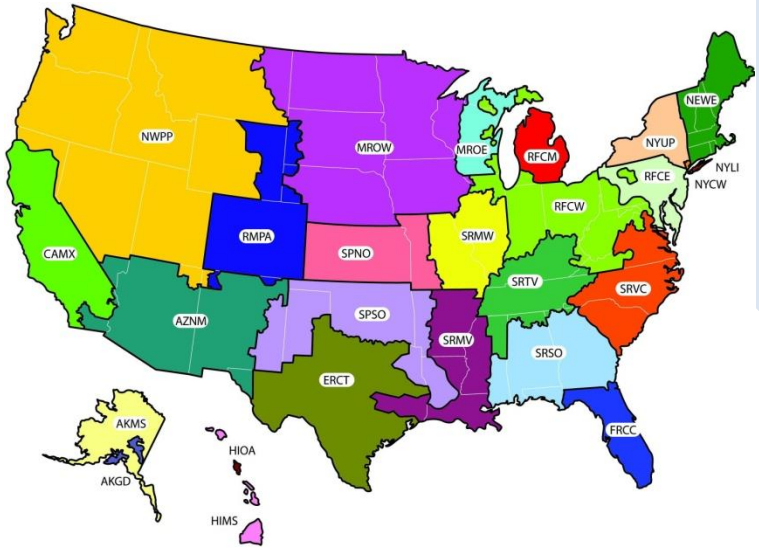
AVERT Overview

- 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 and RE (wind and solar)
  - Generating units, and thus emissions (CO_2 and criteria air pollutants), 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

Emission Quantification Methods
Basic to Sophisticated

Basic Method

eGRID region non-baseload emission rates

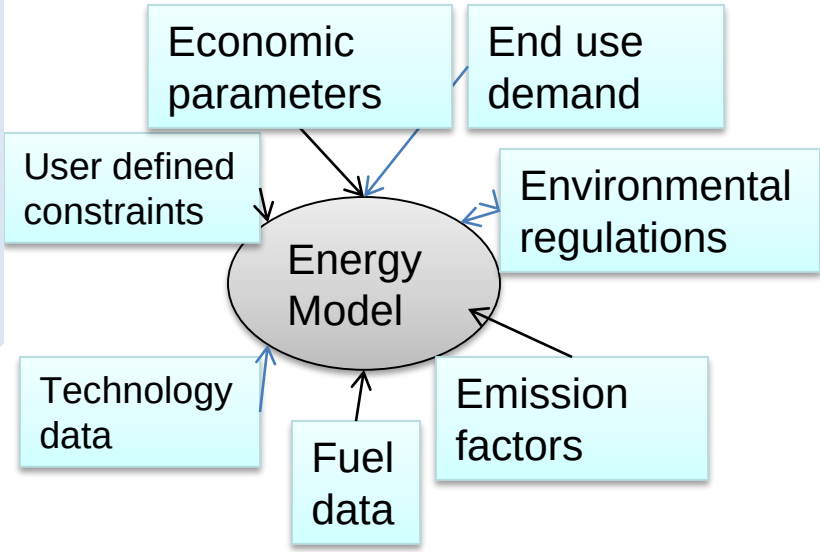


Intermediate Method

filling the gap

Sophisticated Method

Energy Modeling



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

Applications for AVERT-Calculated Emissions

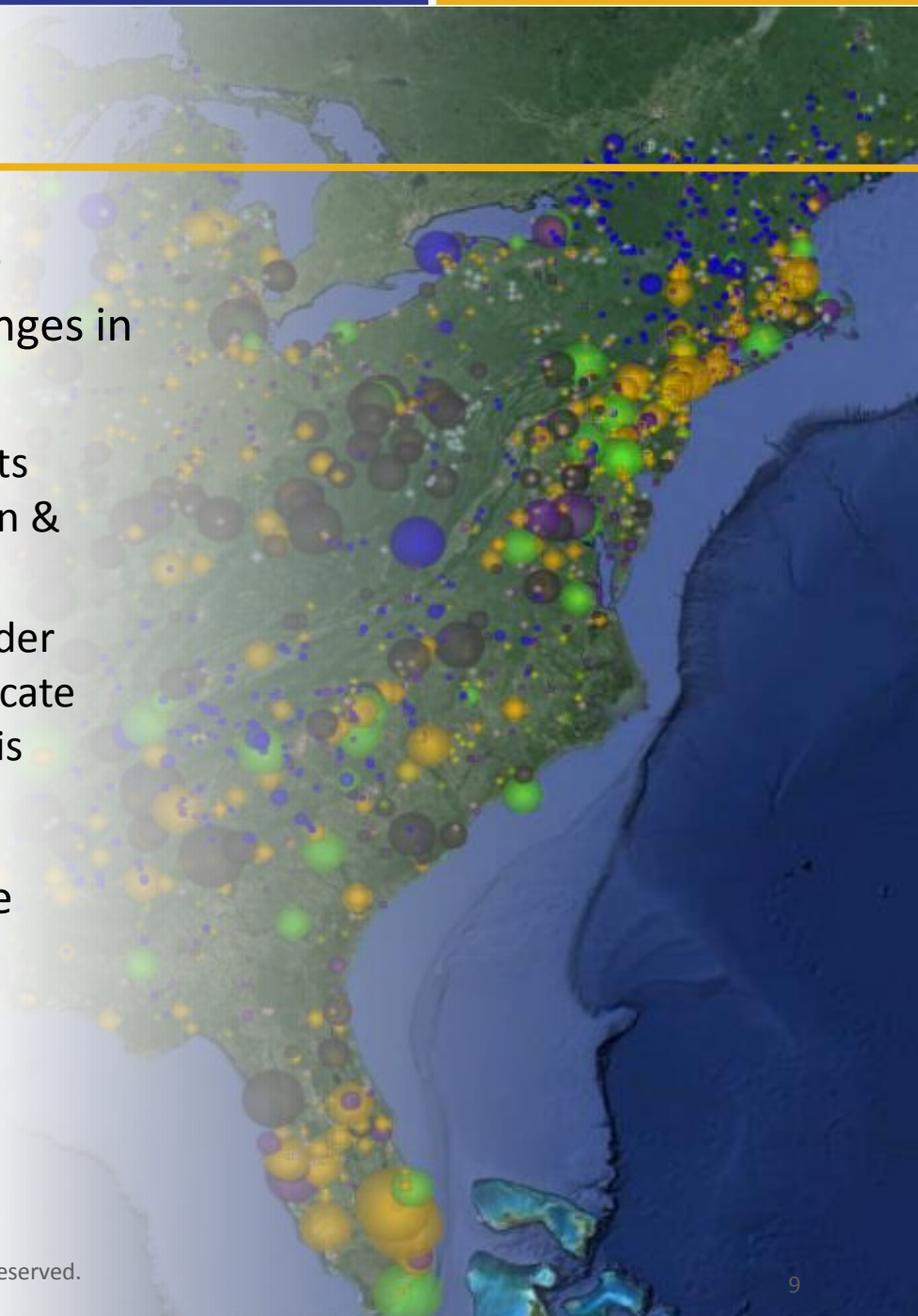
- SIP credit in a state's National Ambient Air Quality Standard Clean Air Act Plan*
- Analyze NO_x, SO_2 and CO_2 emission impacts of an EE/RE program portfolio
- Compare emission impacts between different EE/RE resources
- Identify location of emission reductions at the regional, state, and county levels
  - EGU representation also available
- Promote emission benefits of EE/RE with easy-to-interpret maps and charts
- 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

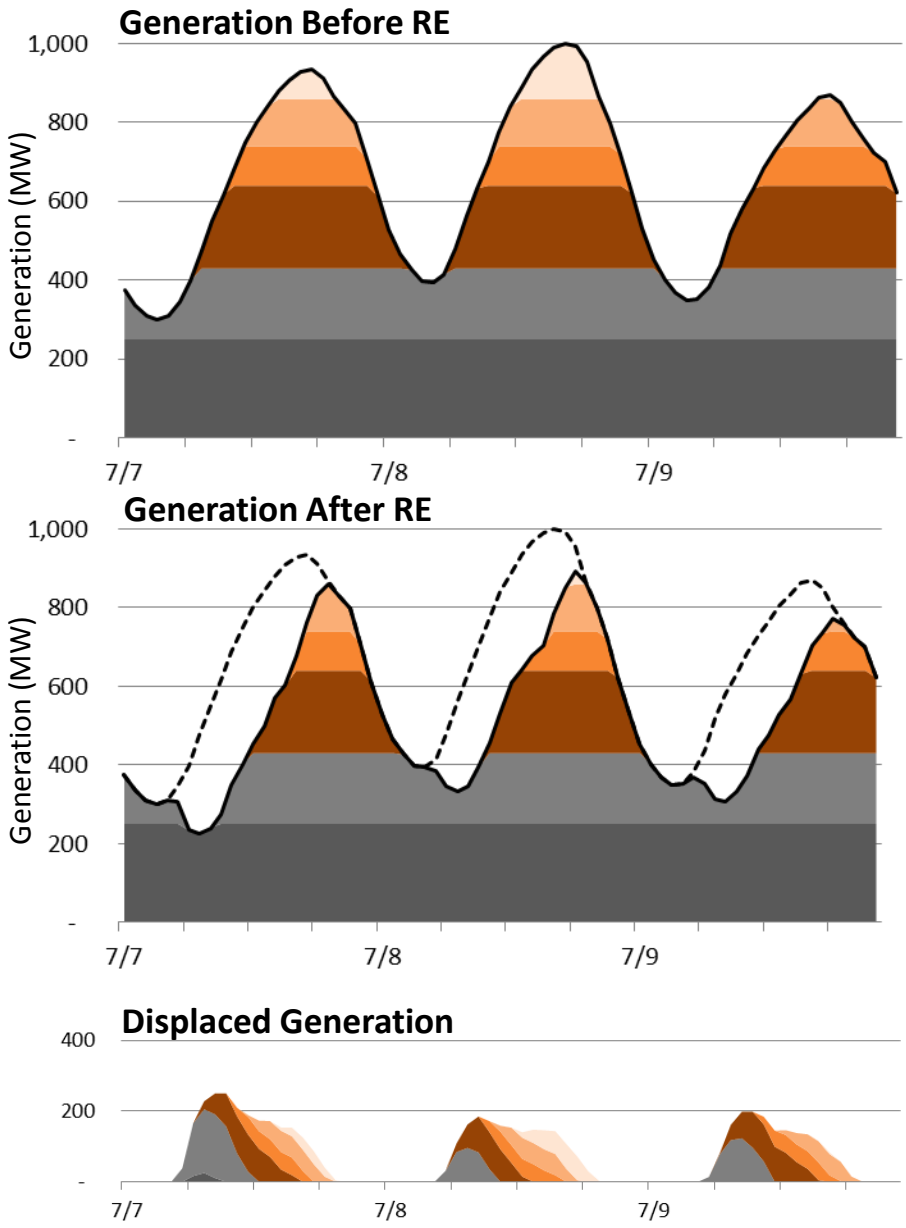
Examples Using AVERT

- The Clean Air Benefits of Wind Energy
  - AWEA, May 2014
- Maine Distributed Solar Valuation Study
  - Maine PUC March 2015
- Scoring Green Bonds using AVERT
  - The Alliance to Save Energy's CarbonCount™ May 2015
- U.S. EPA's Regional Comparison of Wind, Solar and EE programs
  - US EPA and Synapse Energy Economics, April 2015
- U.S. EPA's Ozone Advance Program
  - Various states & local governments, ongoing
- DOE's Online Smart Grid Calculator
  - PNL, Fall 2015

AVERT Overview



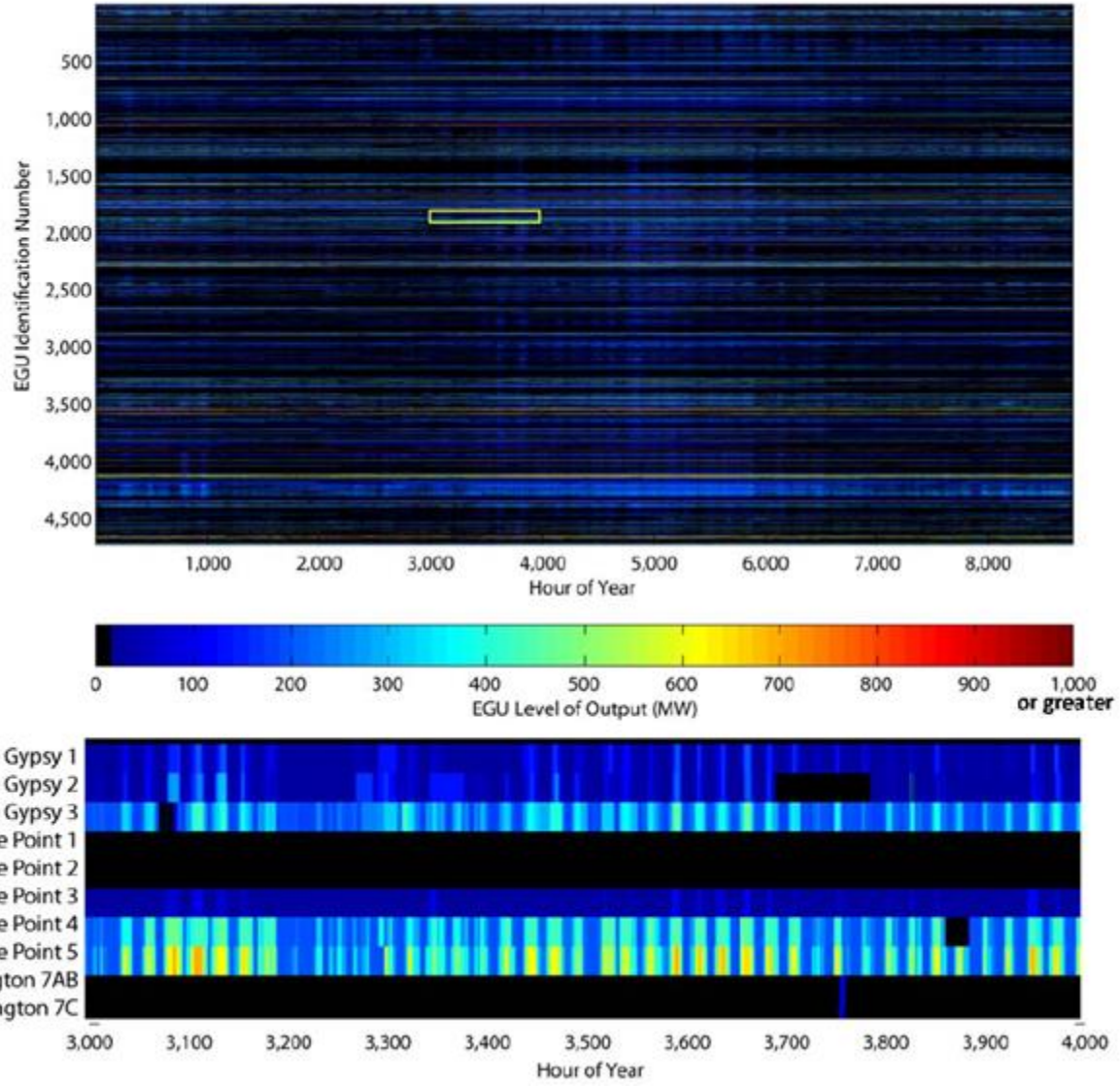
- Using data-driven analysis, how do we distinguish *which* EGU respond to changes in load reduction?
  - Rich dataset from EPA Clean Air Markets division (hourly, unit-by-unit generation & emissions)
  - Gather statistics on unit operations under specific load conditions, and then replicate changes through a Monte Carlo analysis
- Model divided between statistical core module, and user interface



Loading Order 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

AVERT Underlying Data

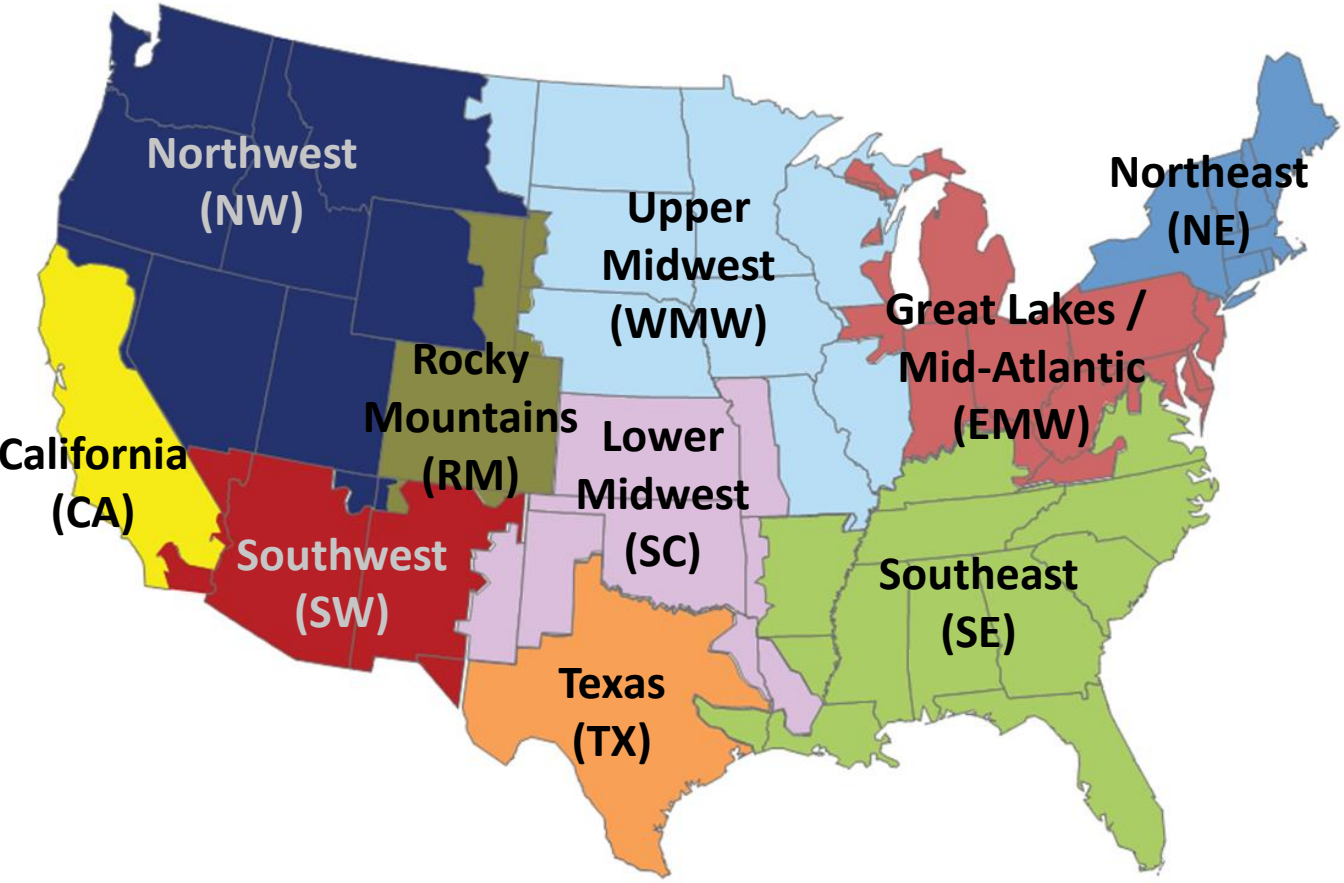


Continuous Emissions Monitoring (CEMS) data from Clean Air Markets Division (CAMD) @ EPA

Hourly generation and emissions of CO_2, SO_2, and NOx.

Fossil generators > 25 MW

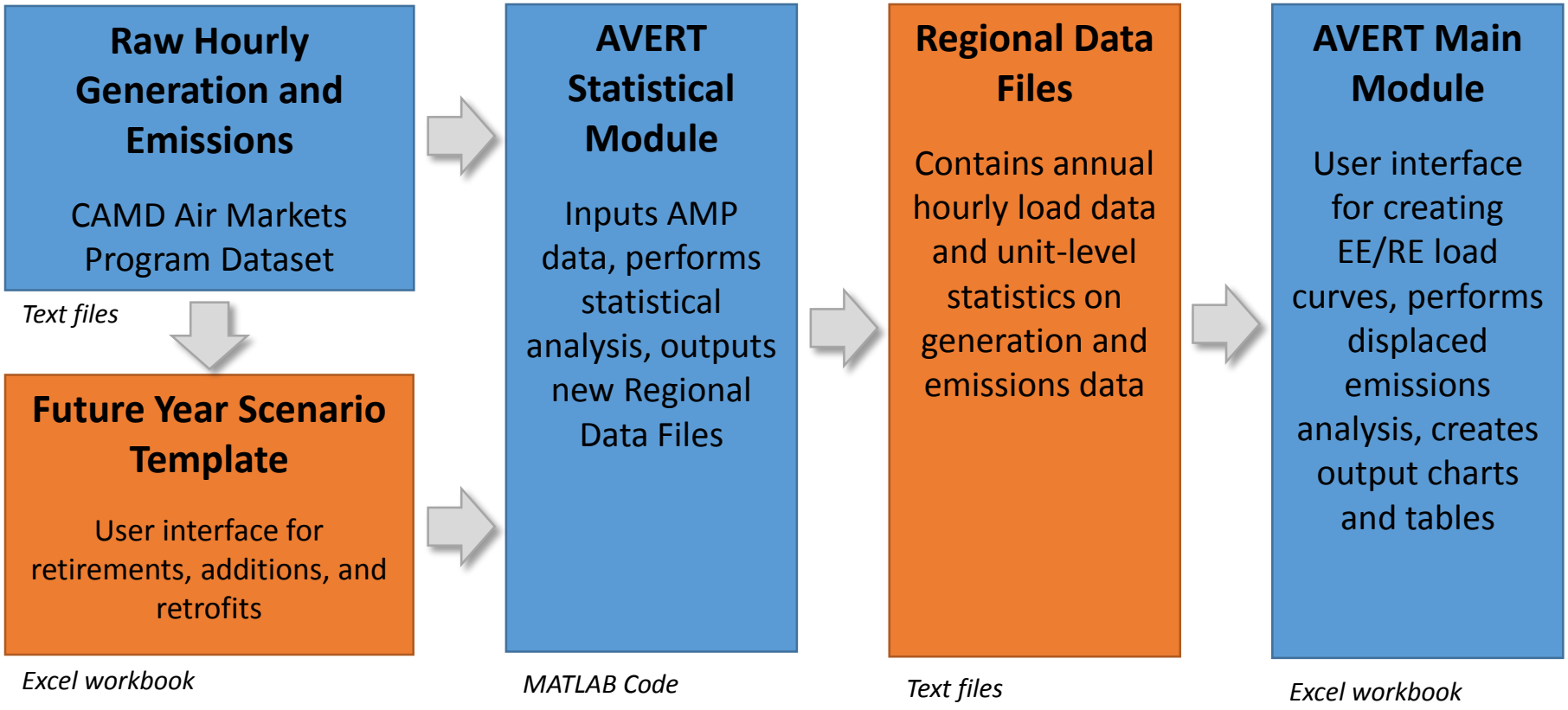
AVERT Regions



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

AVERT's Modules and Data Files



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

New U.S. EPA Paper on Assessing Emission Benefits of EE/RE Resources

- We studied the role of four different EE/RE resources in AVERT's 10 regions across the U.S.
  - Which resources are most effective at avoiding NOX and CO_2 emission impacts and are which regions more responsive?

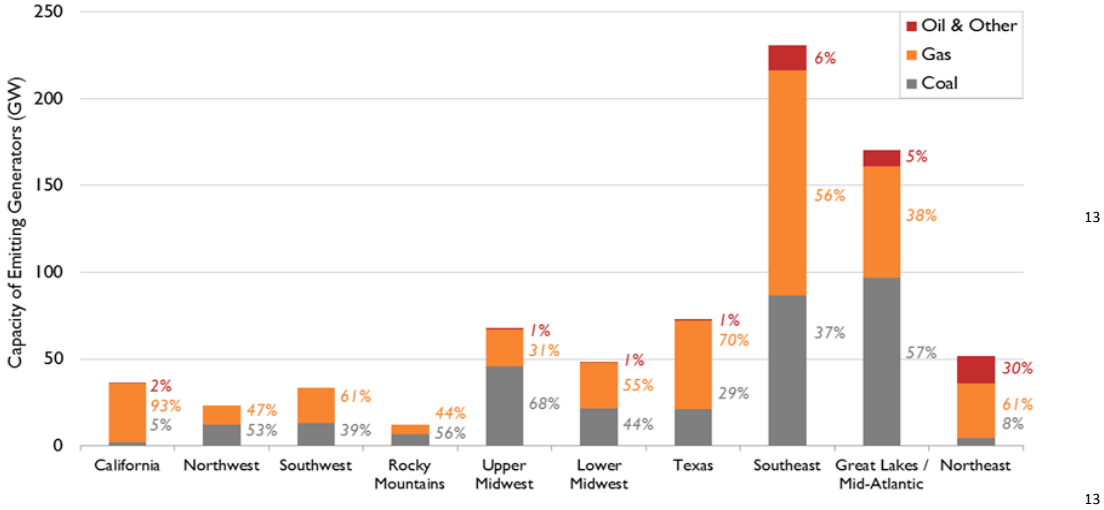


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Figure 1. Electricity generation resource base in US regions.

New U.S. EPA Paper on Assessing Emission Benefits of EE/RE Resources – Results

- We found that there is variation in emission impacts across the AVERT regions.
  - Results from 3% penetration of EE Portfolio for CO_2 and NOx are shown below.

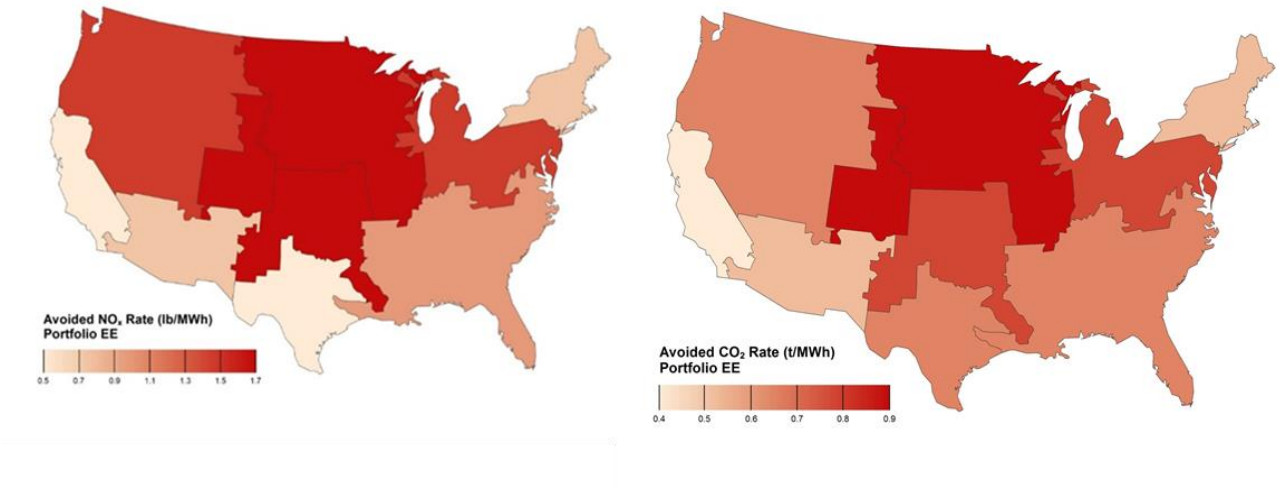


Figure 1. Regional distribution of avoided NOx (left side) and CO2 (right side) (tons per MWh) from a 3% avoided generation portfolio energy efficiency resource.

For details, visit: http://www.epa.gov/ttn/chief/conference/ei21/index.html

New U.S. EPA Paper on Assessing Emission Benefits of EE/RE Resources - Results

Avoided CO2 Rate (t/MWh)				
	Wind	Utility PV	Portfolio EE	Baseload EE
Northeast	0.52	0.53	0.54	0.53
Great Lakes / Mid-Atlantic	0.78	0.77	0.77	0.77
Southeast	0.66	0.67	0.67	0.67
Lower Midwest	0.82	0.78	0.79	0.81
Upper Midwest	0.91	0.89	0.89	0.90
Rocky Mountains	0.85	0.83	0.83	0.84
Texas	0.67	0.64	0.64	0.66
Southwest	0.57	0.56	0.56	0.56
Northwest	0.68	0.68	0.66	0.68
California	0.49	0.49	0.49	0.49

Avoided NOx Rate (lbs/MWh)				
	Wind	Utility PV	Portfolio EE	Baseload EE
Northeast	0.62	0.68	0.72	0.65
Great Lakes / Mid-Atlantic	1.27	1.30	1.31	1.29
Southeast	0.97	1.02	1.02	1.00
Lower Midwest	1.59	1.62	1.61	1.60
Upper Midwest	1.55	1.54	1.54	1.54
Rocky Mountains	1.63	1.56	1.57	1.59
Texas	0.66	0.68	0.68	0.67
Southwest	0.91	0.85	0.79	0.84
Northwest	1.32	1.35	1.38	1.37
California	0.73	0.70	0.67	0.70

Across EE and RE options

- ***Wind*** *and* ***Baseload EE*** *create the highest level of displaced CO_2 emissions per MWh avoided*
- *There is* ***more variation*** *in the effect of programs on displaced NO_x emissions per MWh avoided*

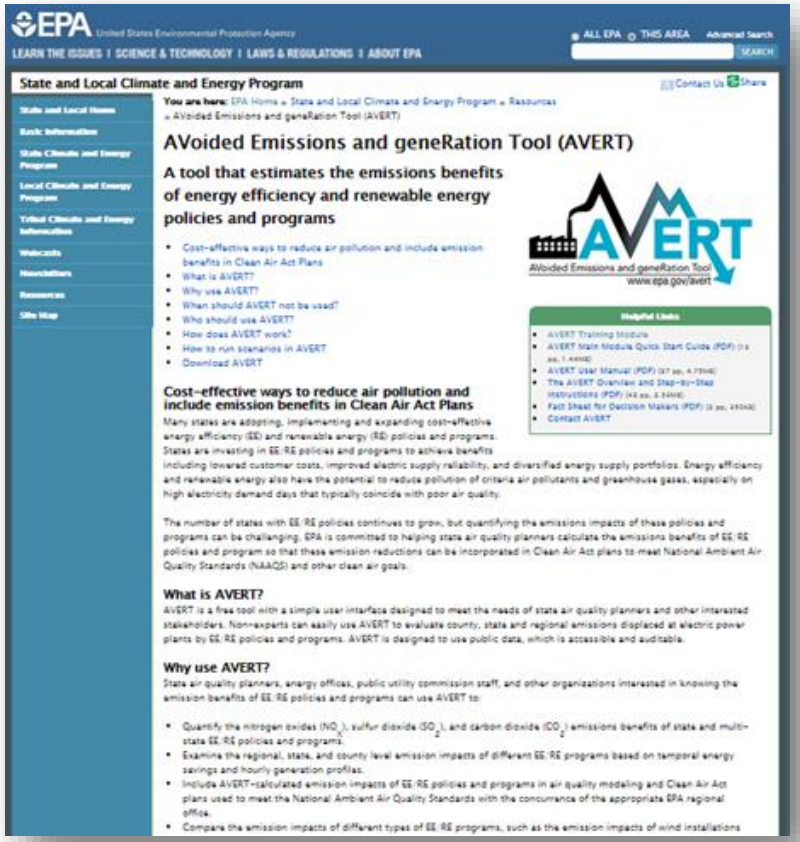
Across US Regions

- *Regions with a disproportionately* ***high coal resource base*** *(i.e., Midwest, Great-Lakes, and Rockies) experience the greatest emission displacements*

DEMONSTRATION

AVERT Resources

- For more information on AVERT visit: www.epa.gov/avert
- AVERT Online training: http://epa.gov/avert/training-module/directory.html
- Contact us at AVERT@epa.gov



State and Local Climate and Energy Program

Questions ???

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

EPA United States Environmental Protection Agency

Thank you for attending our webinar

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Visit our website to learn more about the State-Federal RPS Collaborative and to sign up for our e-newsletter:
http://www.cesa.org/projects/state-federal-rps-collaborative/

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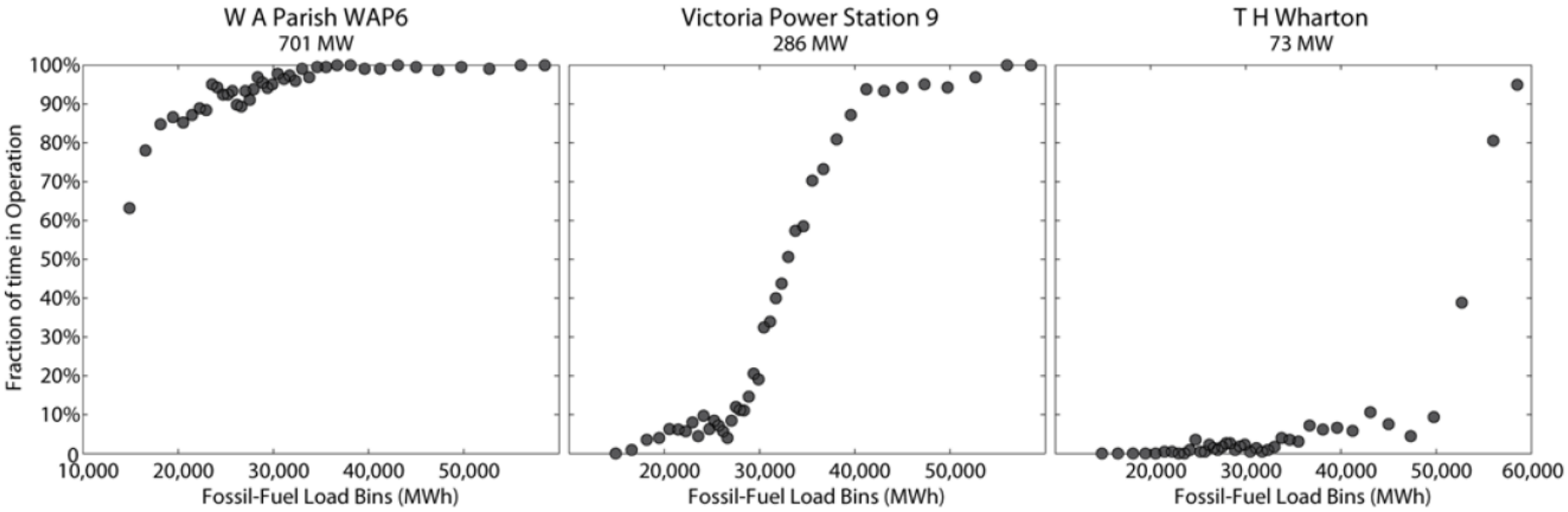
Additional Slides

Statistical Module
Operating Statistics (1)

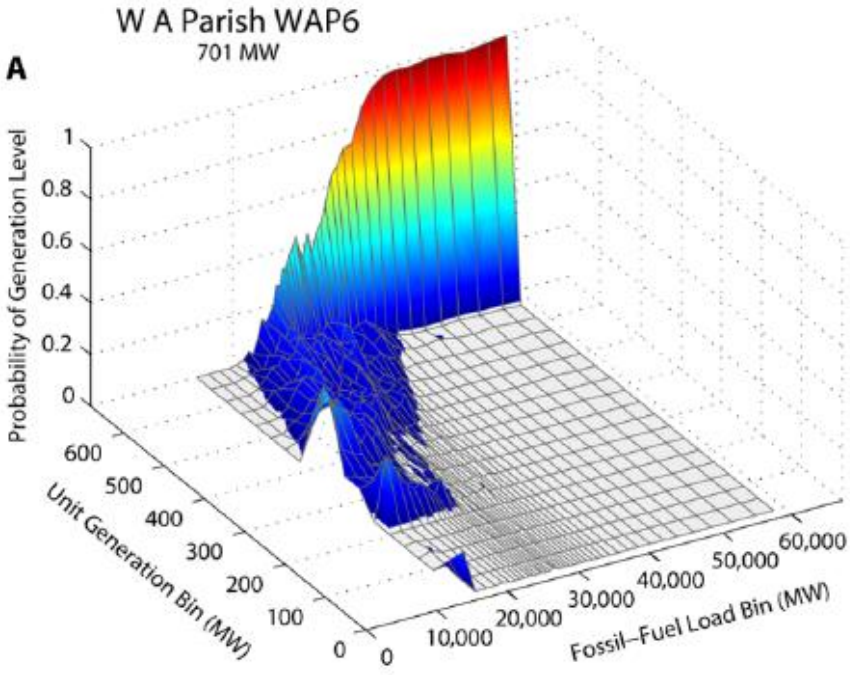
How often, and under what conditions, does an EGU generate power?



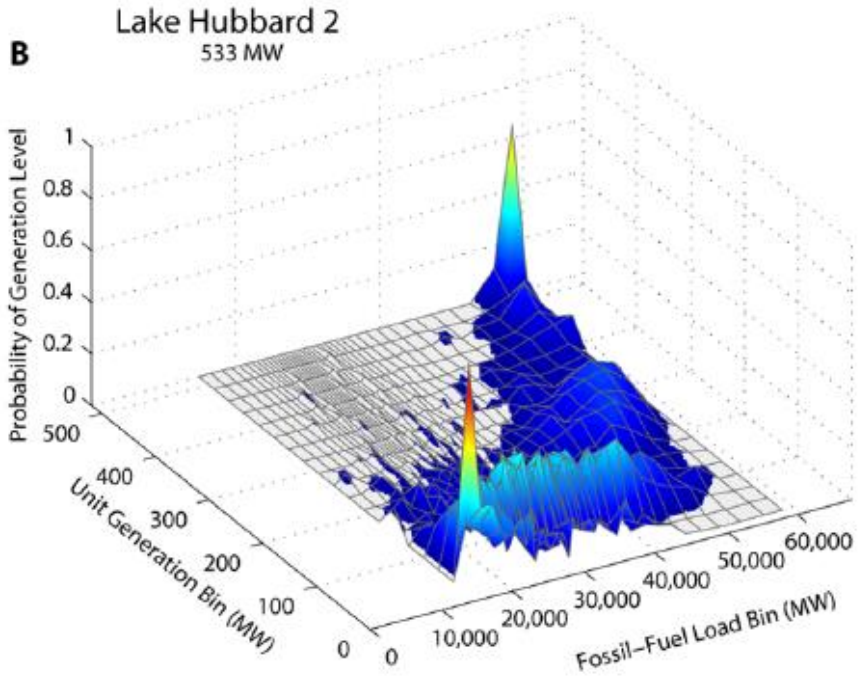
Baseload **Intermediate** **Peaker**

Statistical Module Operating Statistics (2)

When an EGU is on, how much does it produce under various load conditions?



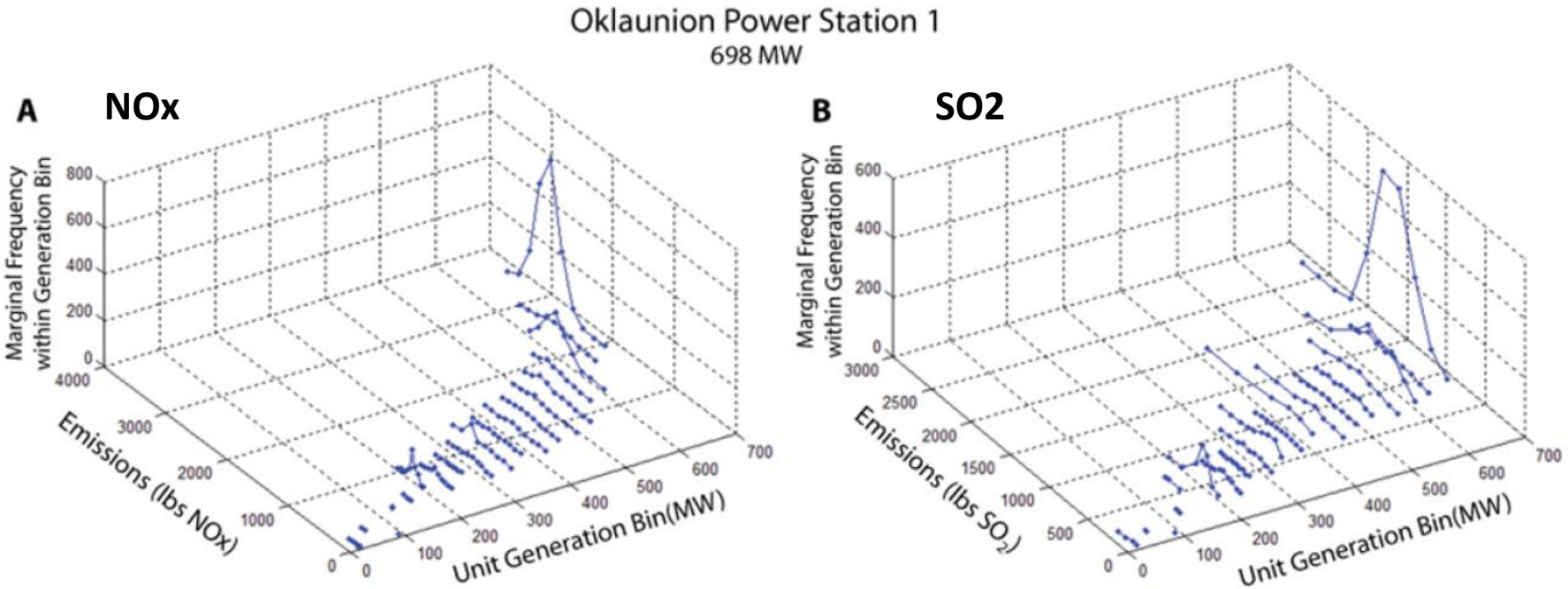
Baseload coal



Intermediate gas

Statistical Module
Operating Statistics (3)

How much emissions are released by an EGU at different levels of generation?



Statistical Module Monte Carlo

a) Estimate average EGU generation and emissions through Monte Carlo simulation.

b) Estimate change in EGU output per change in system demand