Emissions Displacement and the Clean Power Plan

August 11, 2015

Alice Napoleon

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Webinar Logistics

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- All attendees have been muted on entry and will remain muted throughout the webinar
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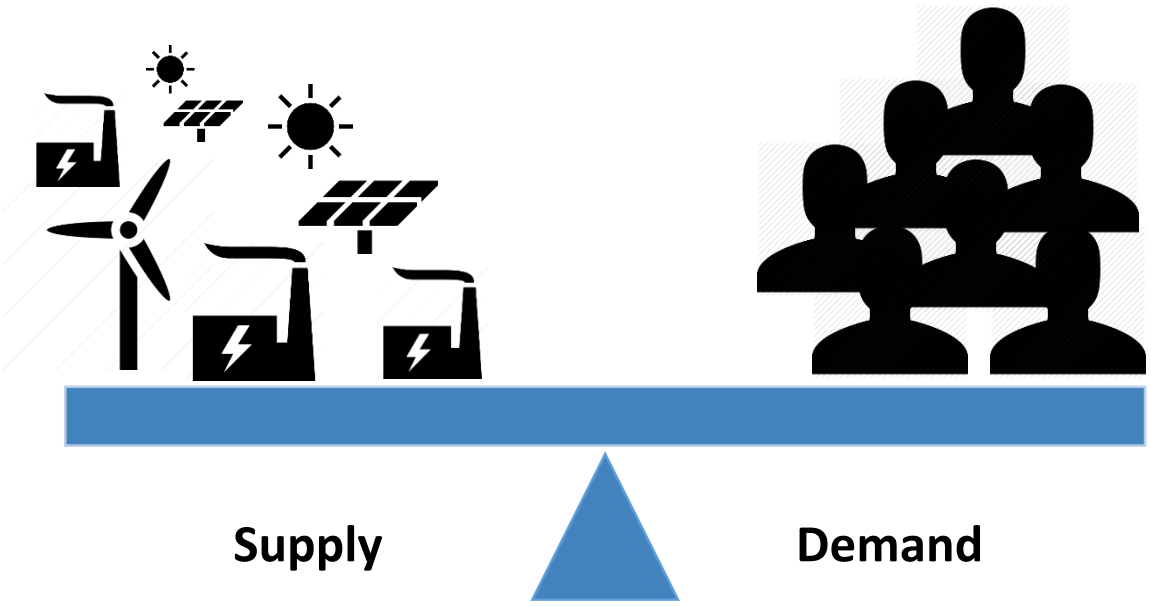
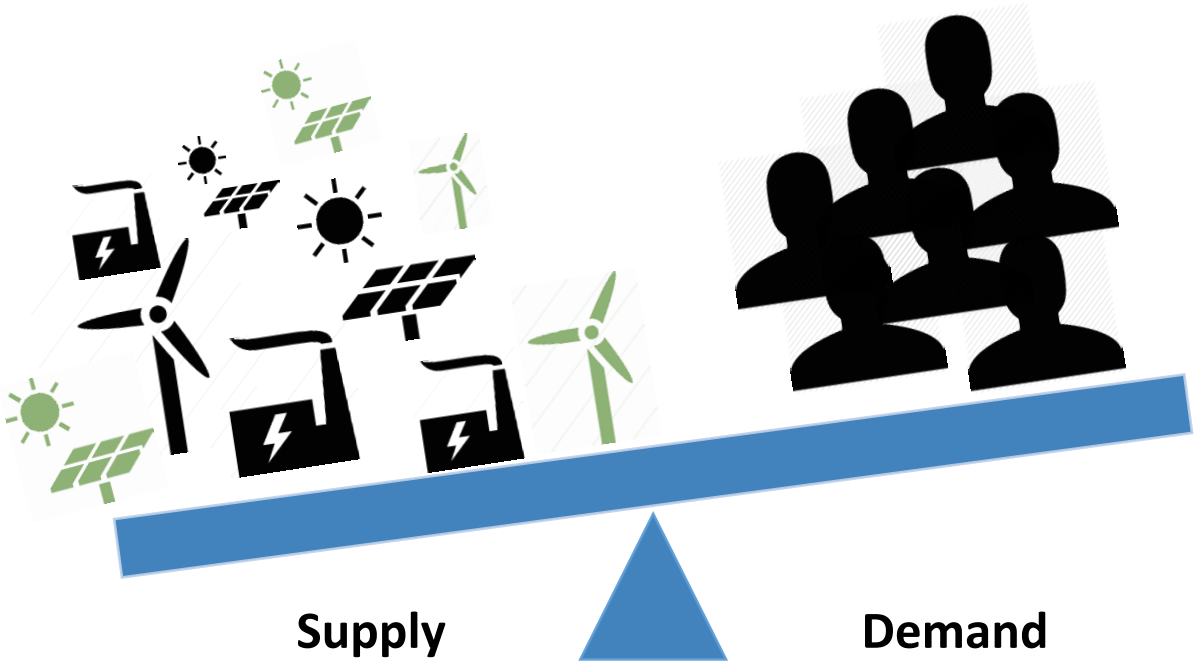
Synapse Energy Economics

- Founded in 1996 by CEO Bruce Biewald
- Leader for public interest and government clients in providing rigorous analysis of the electric power sector
- Staff of 30 includes experts in energy and environmental economics and environmental compliance

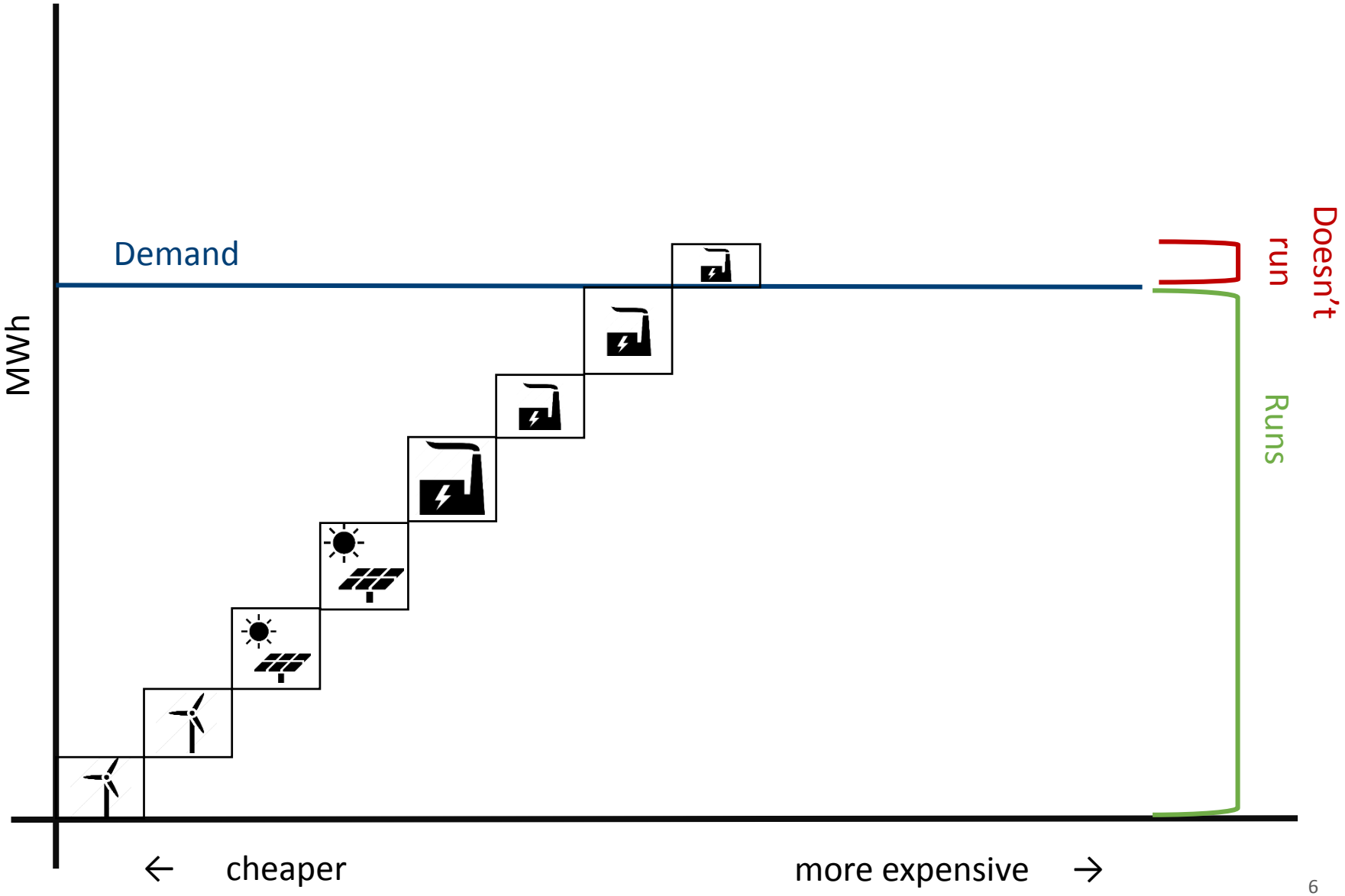
Balancing Supply and Demand



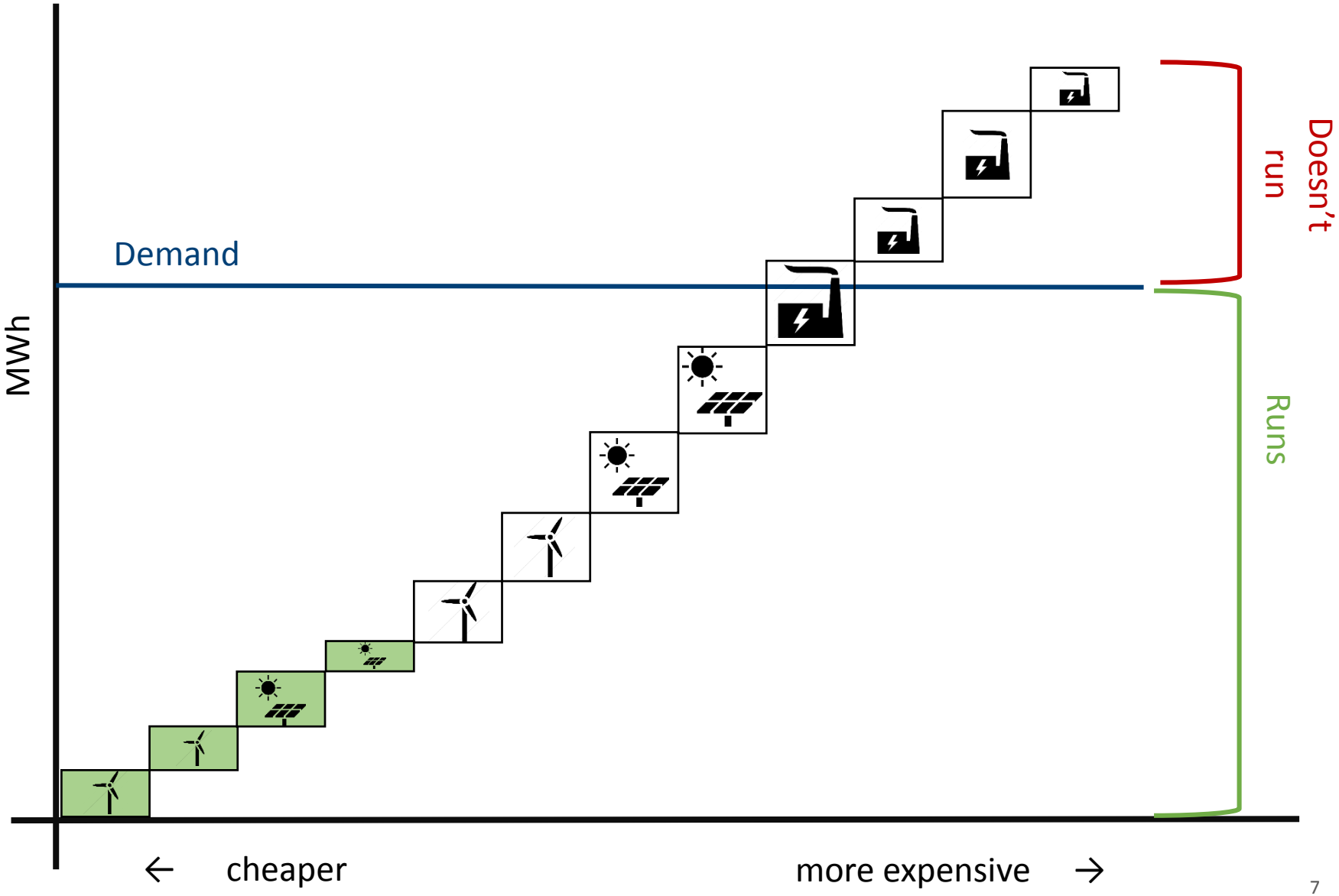
Would Adding Renewables Result in Excess Generation?



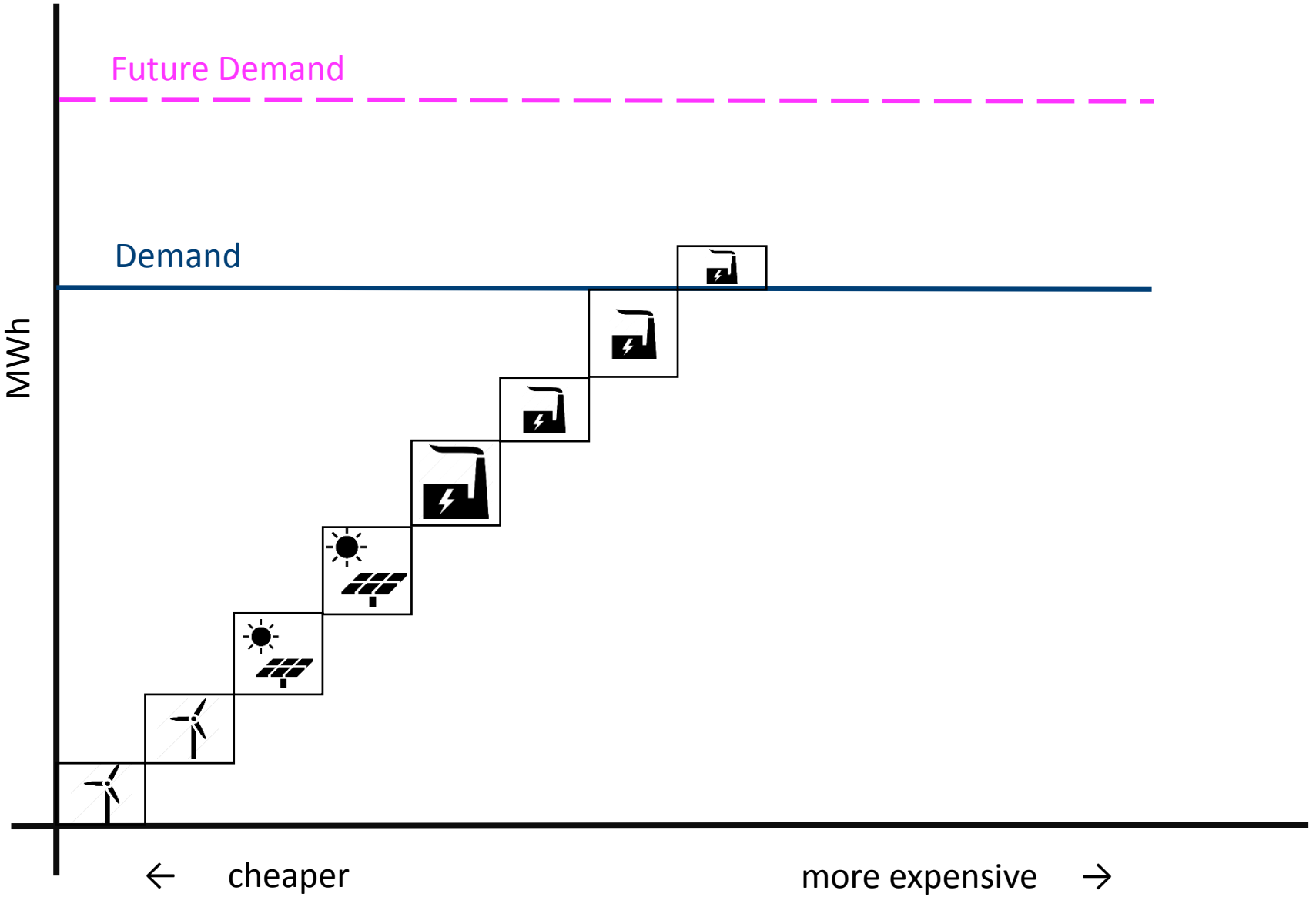
What Runs? What Doesn't?



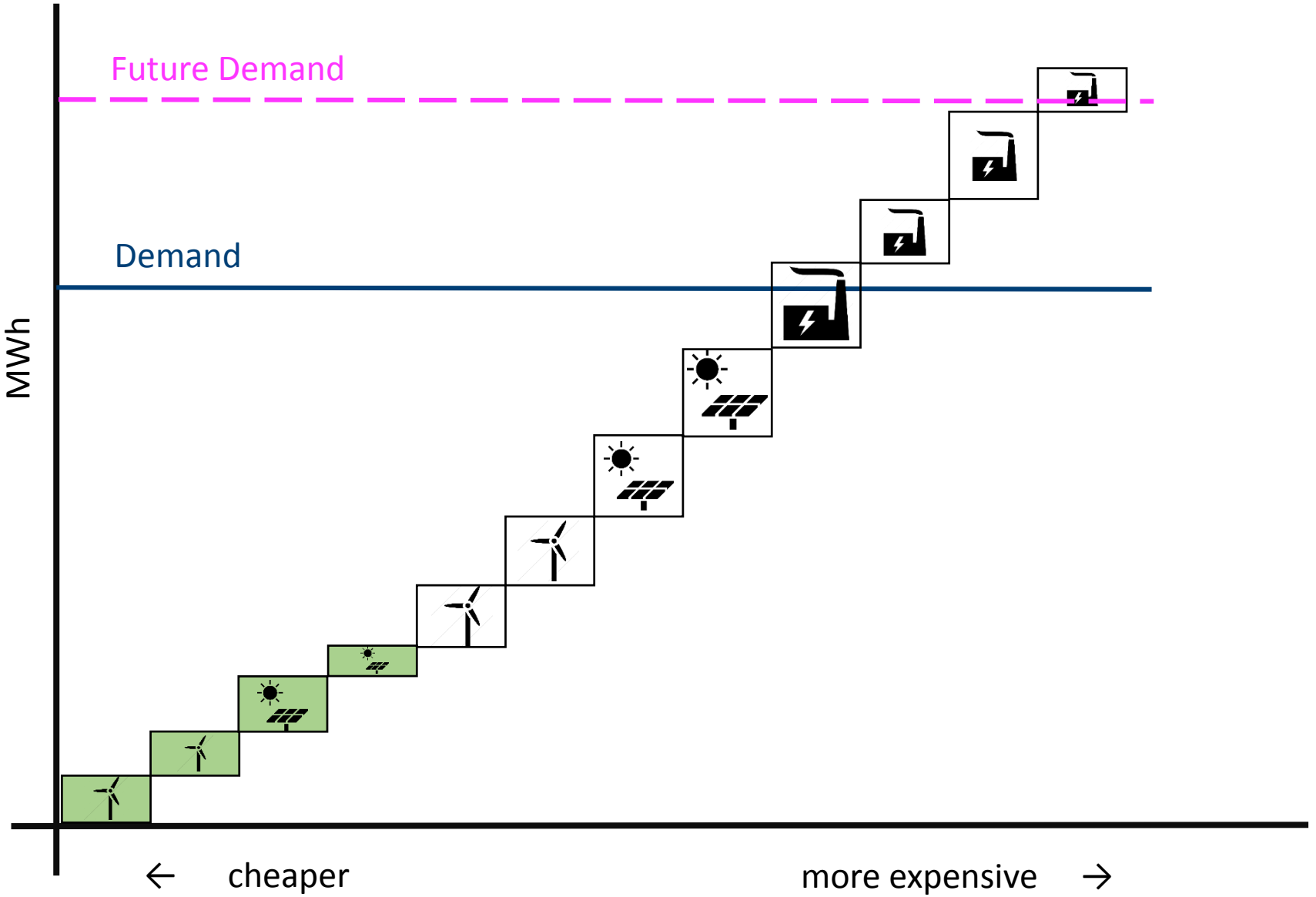
Generation with Low Running Costs Runs First



With Higher Demand: Need to Build New Power Plants?



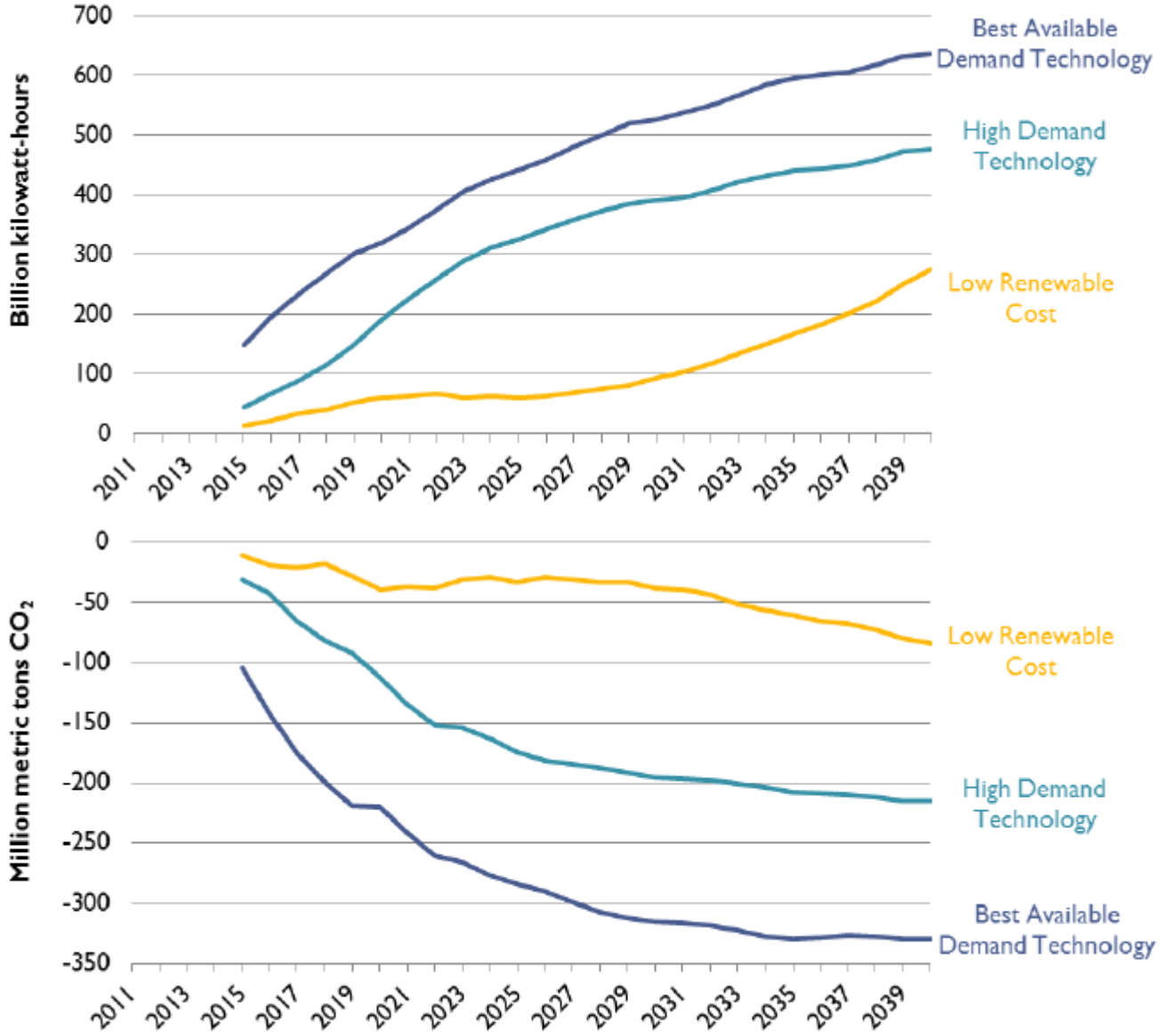
New Renewables Can Avoid Building New Power Plants



An Overview of our Research

- National studies
  - Annual Energy Outlook
  - Synapse modeling of Clean Power Plan scenarios
  - Other studies
- Integrated Resource Plans
- Regional Transmission Organization studies
- U.S. EPA **AV**oided **E**missions and gene**R**ation **T**ool (AVERT) modeling

A Closer Look: Annual Energy Outlook



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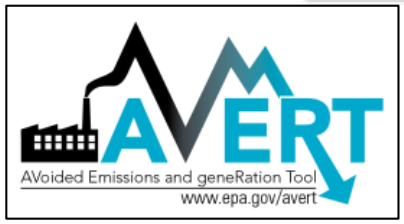
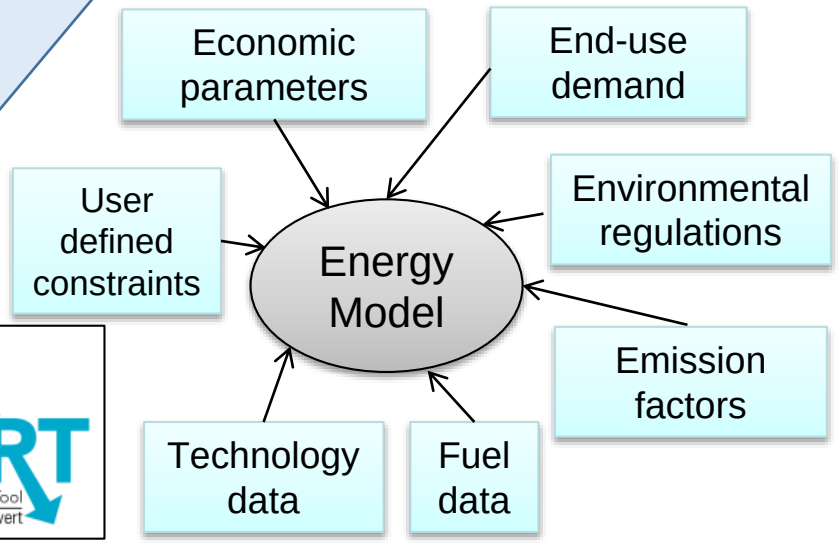
Estimating Displaced Emissions Using AVERT

Basic Method	Intermediate Method	Sophisticated Method
Regional displaced emission rates	Historically Hourly emission rates	Energy System Modeling





Key AVERT References:

(1) Download the tool and user guide at: http://epa.gov/avert/

(2) Read a recent EPA-Synapse academic conference paper at: http://www.epa.gov/ttn/chief/conference/ei21/session9/deyoung.pdf

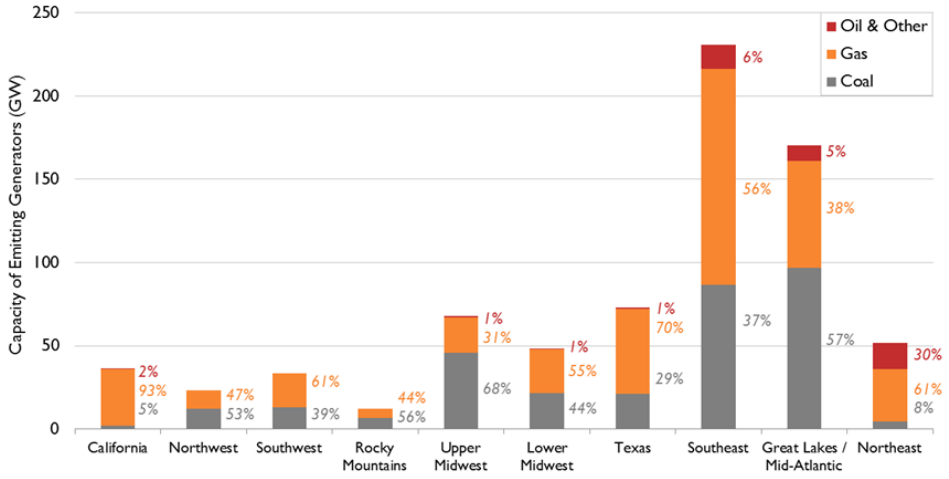
(3) Read Synapse's recent displaced emissions report at: http://synapse-energy.com/project/air-emissions-displacement-energy-efficiency-and-renewable-energy

(4) See AVERT in the CPP Toolbox for States at: http://www2.epa.gov/cleanpowerplantoolbox

AVERT Case Study Results:
The Geography of Displaced Emissions

Displaced CO_2 emissions in U.S. regions based on AVERT (tCO_2/MWh)

AVERT Region	Wind	Utility PV	Portfolio energy efficiency	Base load energy efficiency
Northeast	0.46	0.49	0.49	0.48
Great Lakes / Mid-Atlantic	0.73	0.73	0.73	0.73
Southeast	0.63	0.64	0.64	0.64
Lower Midwest	0.72	0.69	0.70	0.71
Upper Midwest	0.83	0.80	0.81	0.82
Rocky Mountains	0.81	0.77	0.78	0.79
Texas	0.59	0.59	0.59	0.59
Southwest	0.58	0.54	0.54	0.56
Northwest	0.70	0.70	0.69	0.70
California	0.44	0.46	0.46	0.45



Displaced Emissions <u>are not</u> created equally.
Ex: 1 MWh RE in the Northeast displaces a different amount of CO_2 than 1 MWh RE in the Great Lakes.

Source: Synapse 2015 Report: Air Emissions Displacement by Energy Efficiency and Renewable Energy. Available at: http://synapse-energy.com/project/air-emissions-displacement-energy-efficiency-and-renewable-energy

Displaced Emissions and CPP BSER

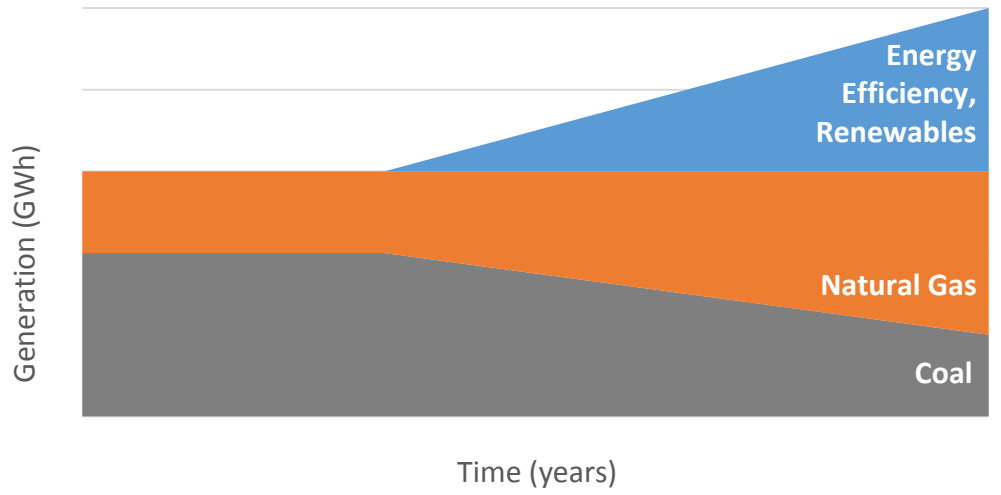
$$\text{Proposed 111(d) Emission Rate} = \frac{\text{Fossil Fuel Emissions (lbs of } CO_2\text{)}}{\text{Fossil Fuel Generation (MWh)} + \text{Nuclear Generation (MWh)} + \text{Renewable Generation (MWh)} + \text{Energy Efficiency (MWh)}}$$

$$\text{Final 111(d) BSER Emission Rate for Fossil Steam} = \frac{\text{Fossil Steam Emissions (lbs of } CO_2\text{)}^{1} + \text{NGCC Incremental Emissions (lbs of } CO_2\text{)}}{\text{Fossil Steam Generation (MWh)} + \text{NGCC Incremental Generation (MWh)} + \text{Renewable Generation (MWh)}^{2}}$$

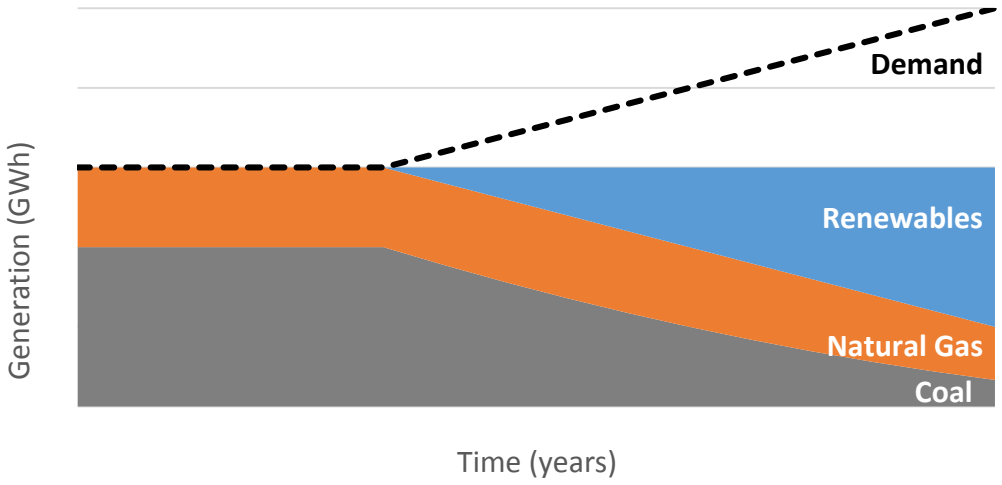
$$\text{Final 111(d) BSER Emission Rate for NGCC} = \frac{\text{NGCC Emissions (lbs of } CO_2\text{)}^{3}}{\text{NGCC Generation (MWh)}^{3} + \text{Renewable Generation (MWh)}^{2}}$$

[1] Fossil Steam emissions adjusted for heat rate improvements
[2] Renewable generation is the amount of renewables that displace either Fossil Steam or NGCC
[3] NGCC emissions and generation include all NGCC generation and emissions, including the incremental pieces

Displaced Emissions and the Clean Power Plan

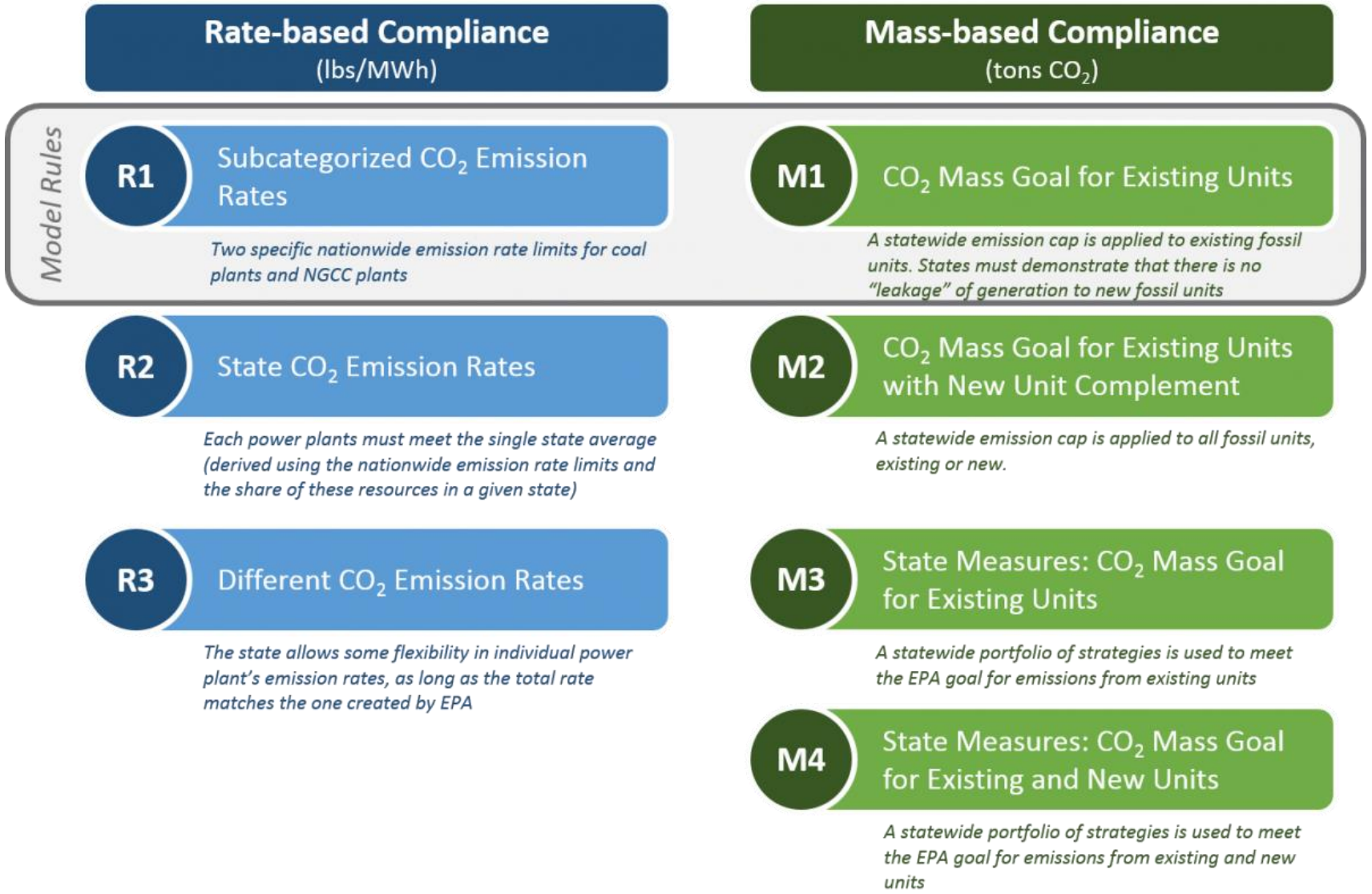


Schematic of Proposed Rule Approach to EERE



Schematic of Final Rule Approach to EERE:
RE Displaces Fossil GWh

Clean Power Plan Compliance Pathways



Rate Compliance, ERCs, and Displaced Emissions

R1. Rate-based, technology specific "Performance Rates"

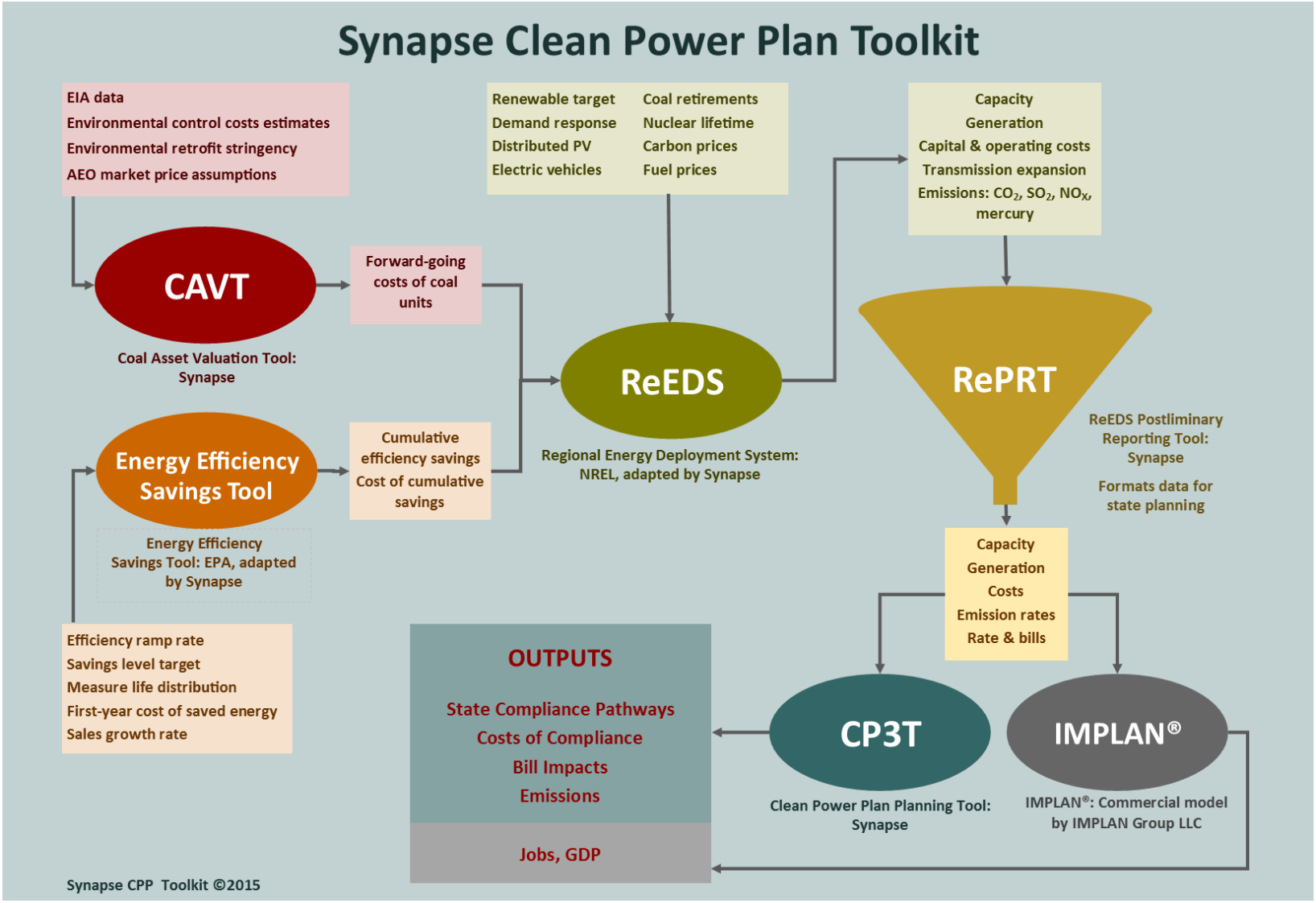
- Measured in lbs of CO_2 per MWh
- Applied at the *EGU* level, not at the state level
- Nationwide rates for NGCCs and Fossil Steam

But Wait!
Displaced Emissions are not created equally
Ex: Displacing a MWh of generation in the Northeast will reduce a different amount of CO_2 than displacing a MWh in the Great Lakes.

$$\text{Performance Rate} = \frac{\text{EGU Emissions (lbs of } CO_2\text{)}}{\text{EGU Generation (MWh)} + \text{Emission Rate Credits or "ERCs" (MWh)}}$$

- **ERCs can be produced by renewables, energy efficiency, new nuclear units, or capacity uprates at nuclear, hydro, or NGCC plants**
- **These ERCs can be traded between EGUs in any states using this compliance approach**

Synapse Clean Power Plan Toolkit



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Related Resources

Air Emissions Displacement by Energy Efficiency and Renewable Energy: http://synapse-energy.com/sites/default/files/Air-Emissions-Displacement-by-Energy-Efficiency-and-Renewable-Energy_0.pdf

Synapse Clean Power Plan Toolkit: http://synapse-energy.com/CleanPowerPlan

Past Clean Power Plan Webinars: http://synapse-energy.com/synapse-projects-and-webinars-related-clean-power-plan

Consumer Costs of Low-Emissions Futures Factsheets and Reports: http://synapse-energy.com/project/consumer-costs-low-emissions-futures

Clean Power Plan Reports and Outreach for National Association of State Utility Consumer Advocates: http://synapse-energy.com/project/clean-power-plan-reports-and-outreach-national-association-state-utility-consumer-advocates

Entering the Matrix: Compliance Options under the Final Clean Power Plan: http://synapse-energy.com/about-us/news/entering-matrix-compliance-options-under-final-clean-power-plan

Stay Tuned!

Synapse is offering a series of webinars related to the final rule, updates to our compliance model, and impacts of the rule on consumer bills.

August 18: "Final Clean Power Plan: In Detail"

August 26: "Integrating Renewables onto the Grid"

September 1: "Updates to Synapse's CP3T"

September 15: "Brief #3: Modeling the Final Rule"

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RTO studies

RTO studies: PJM