



**Synapse**  
Energy Economics, Inc.

## Air Emissions Issues Associated DER in the Mid-Atlantic Region

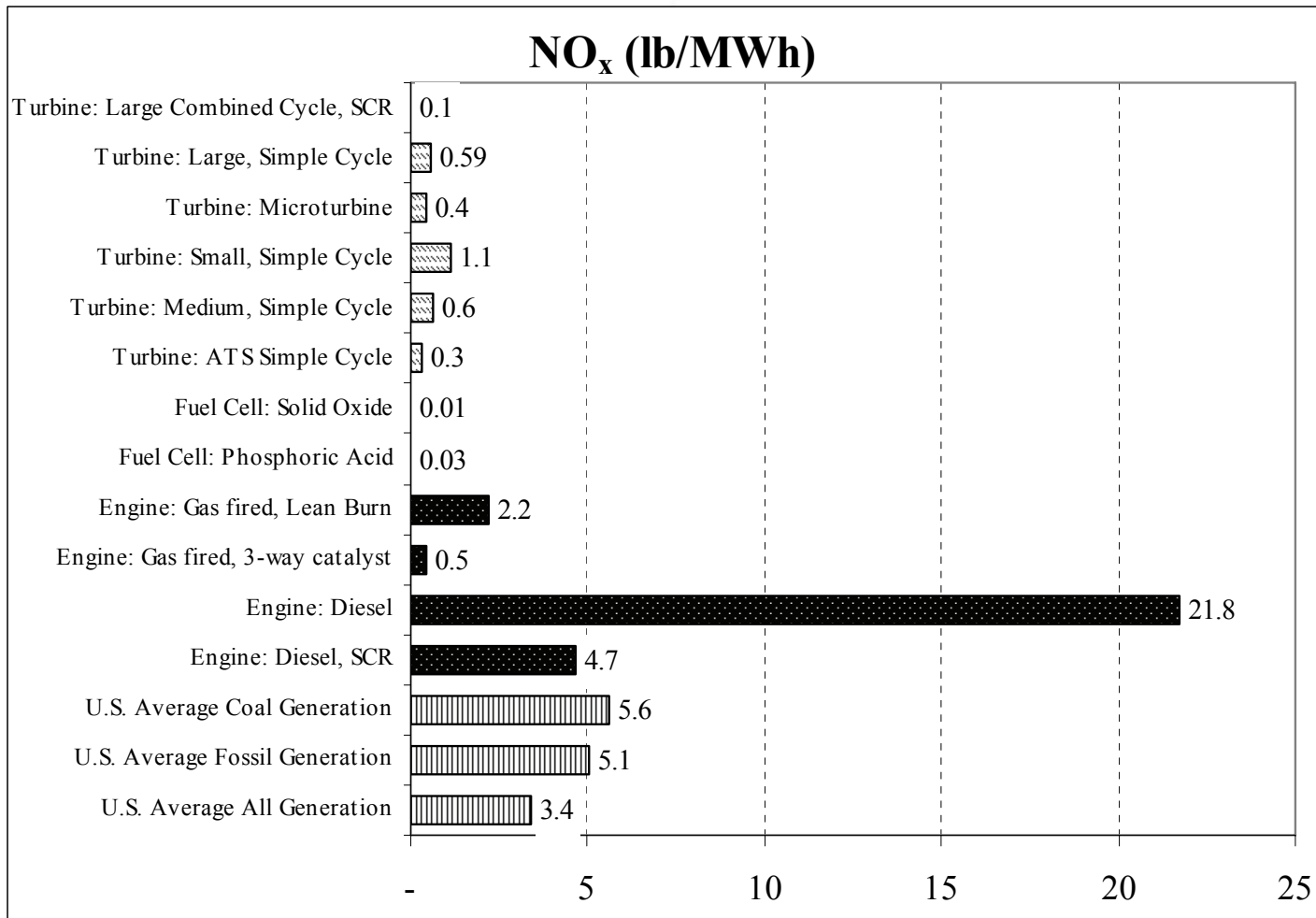
Mid-Atlantic State Energy and Environment Workshop:  
State, Local, and Federal Approaches for Distributed Energy Resources

September 27, 2007

Presented by Bruce Biewald

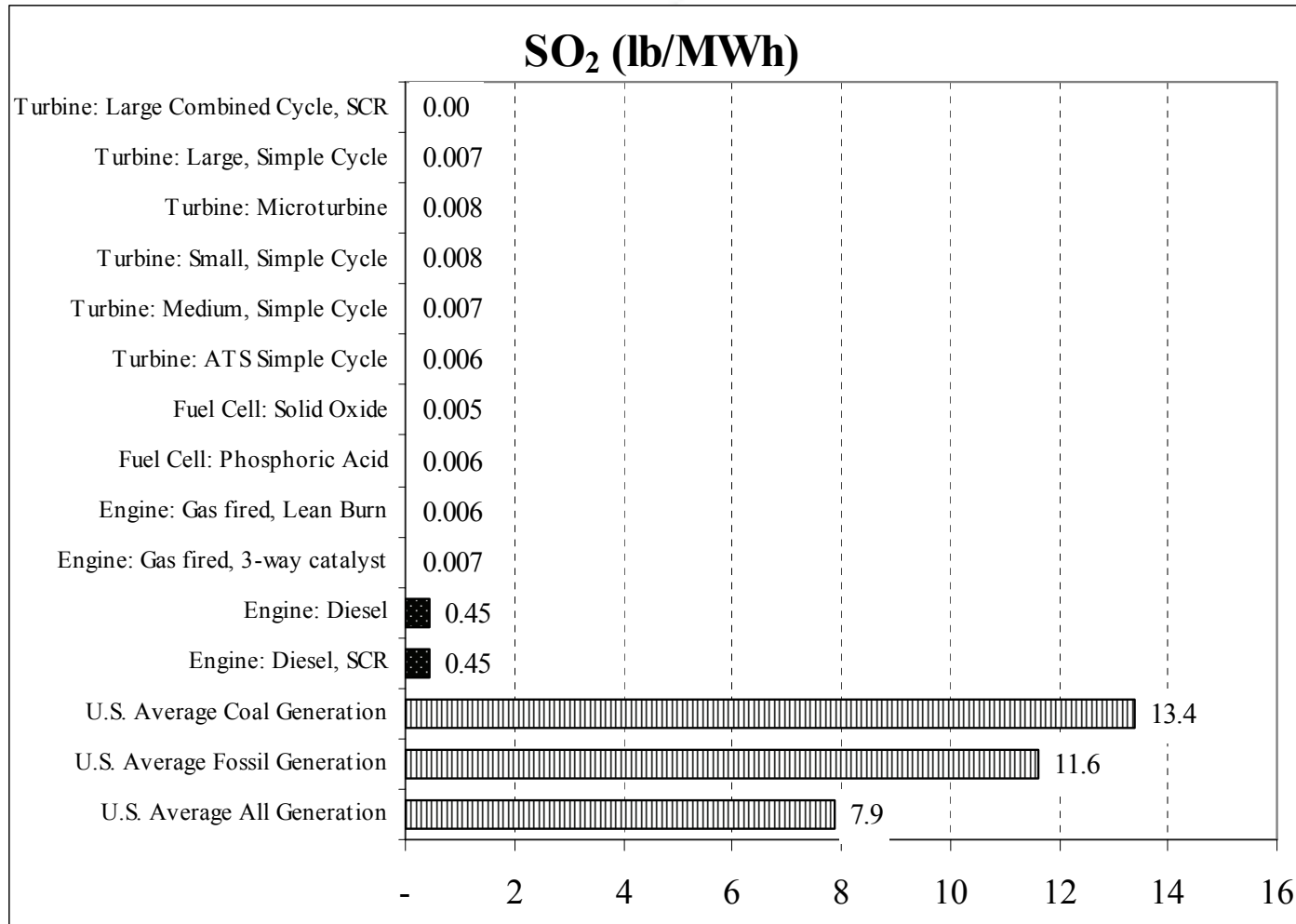
- Distributed generation emissions
- Electric system emissions
  - Methodological issues
  - Data from simulation modeling
  - Data from hourly monitoring
- Energy efficiency and peak reductions

# Emission Rates for Power Generation Technologies



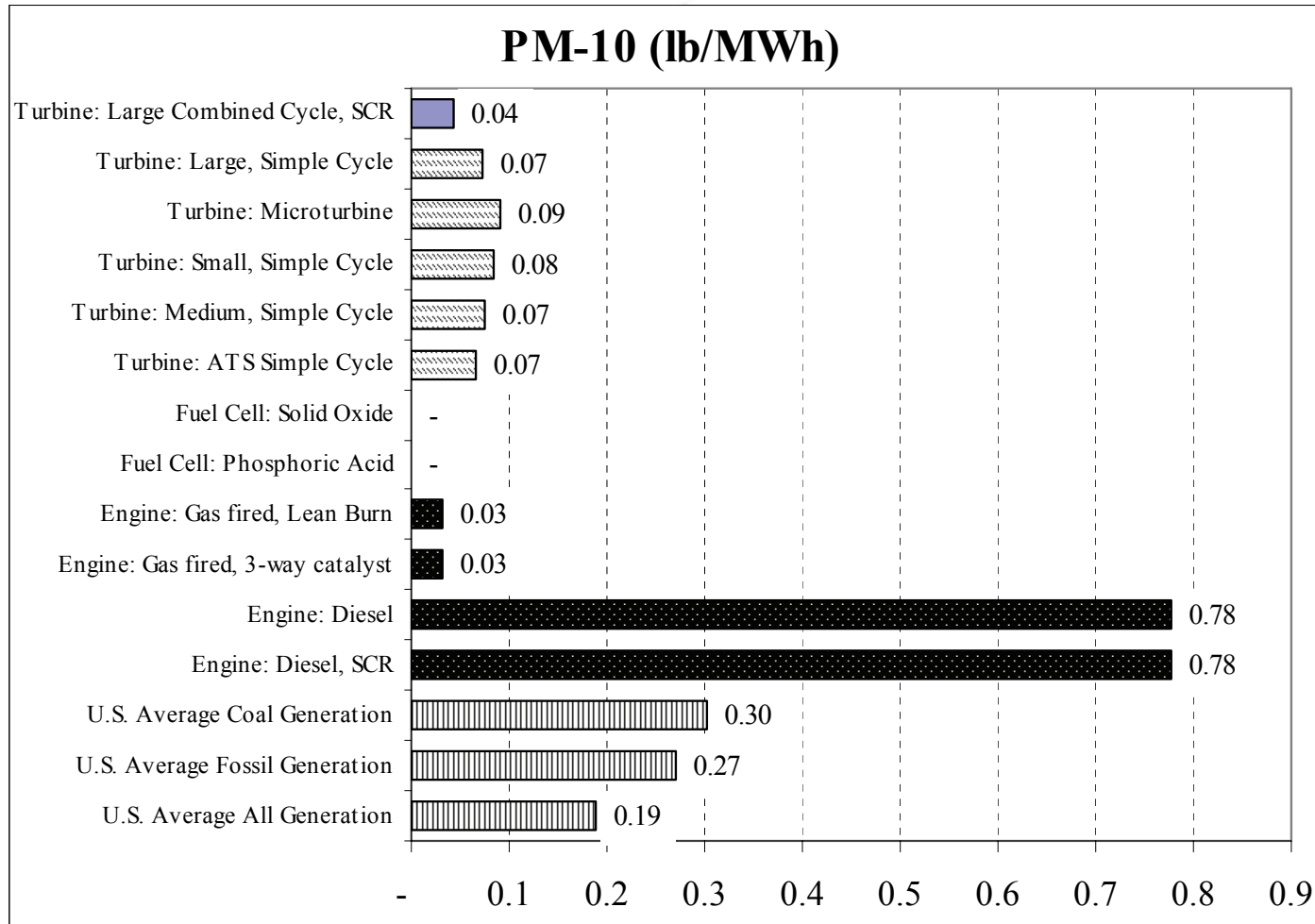
Source: The Regulatory Assistance Project, *MODEL REGULATIONS FOR THE OUTPUT OF SPECIFIED AIR EMISSIONS FROM SMALLER-SCALE ELECTRIC GENERATION RESOURCES*, Appendix B, October 2002

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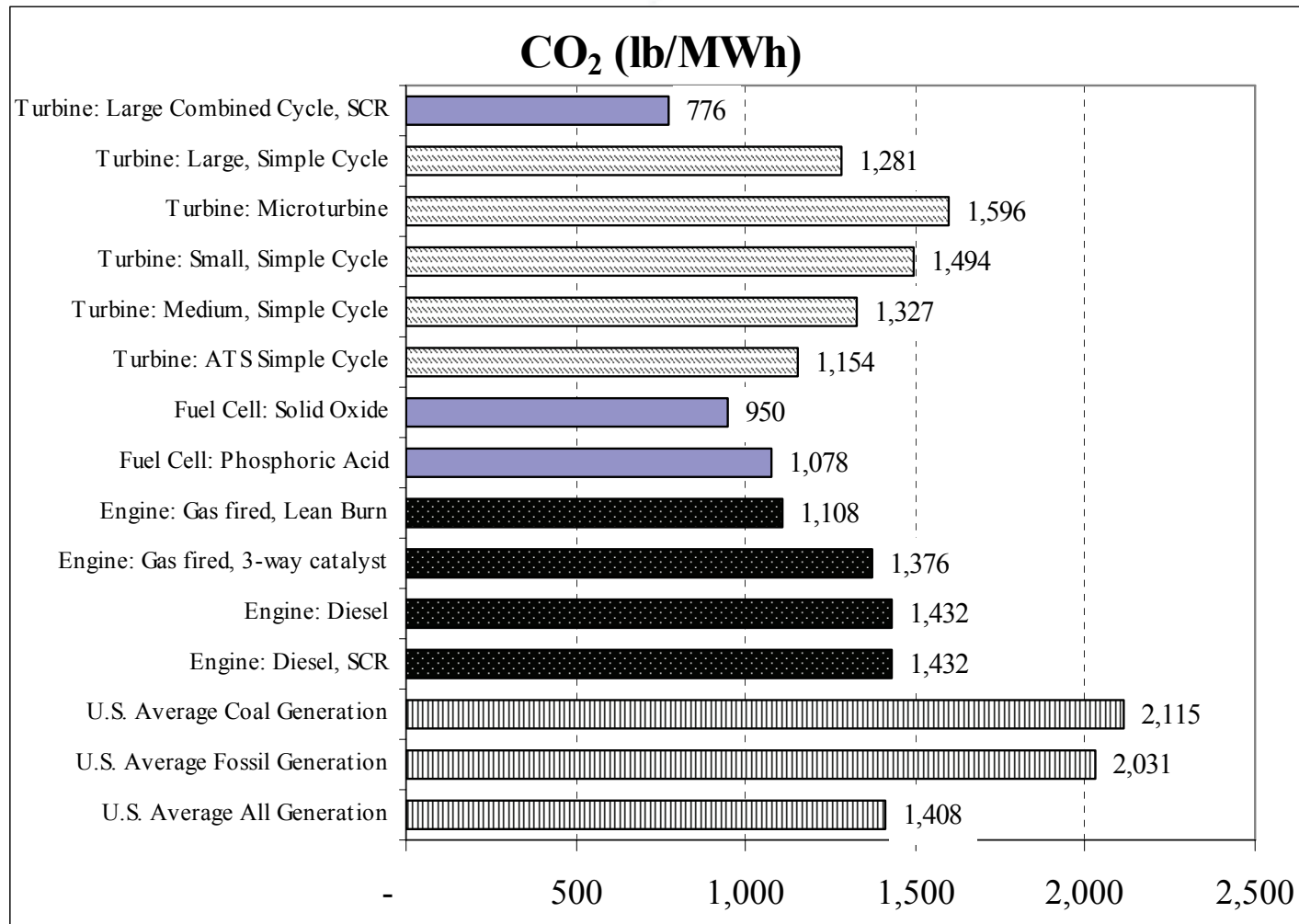
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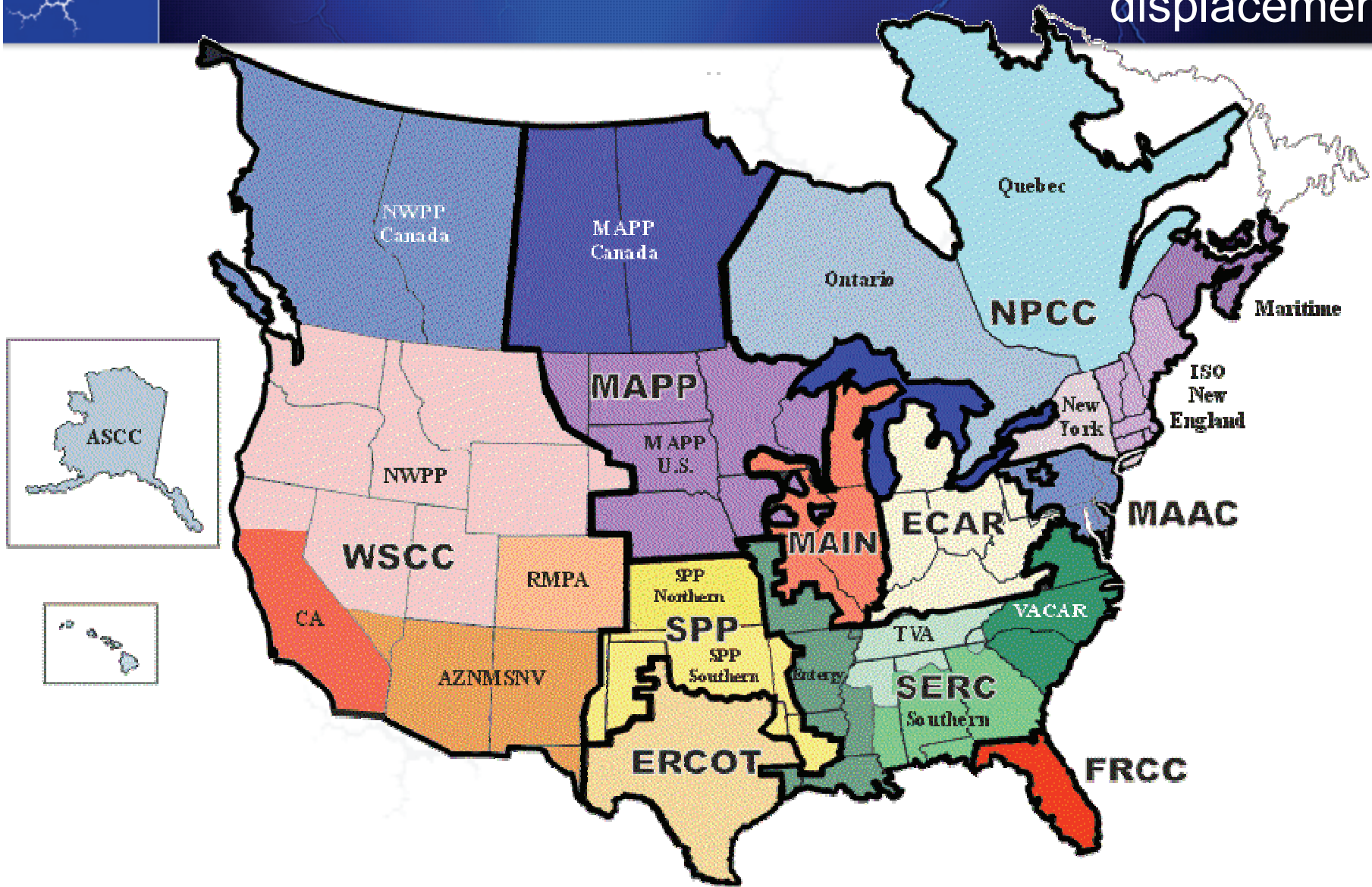
## Emission rates for existing DR generators (lb/MWh)

**Table 2. Emission Rates Applied to DR Generators (lb/MWh)**

Pollutant	Diesel IC	Gas IC
NOx	30	5.0
SO <sub>2</sub>	3.0	0
CO <sub>2</sub>	1,600	1,100
PM	0.7	0.10
PM <sub>2.5</sub>	0.5	0.10
Mercury	0	0
Formaldehyde	7.9E-04	0.5
Acetaldehyde	2.5E-04	7.9E-02
Acrolein	7.9E-05	4.9E-02
Benzene	7.8E-03	4.2E-03
1,3-Butadiene	0	2.5E-03
PAH	2.1E-03	2.6E-04

Source: Synapse Energy Economics, *Modeling Demand Response and Air Emissions in New England*. p.8. September 2003

# Geography of electric system emissions displacement





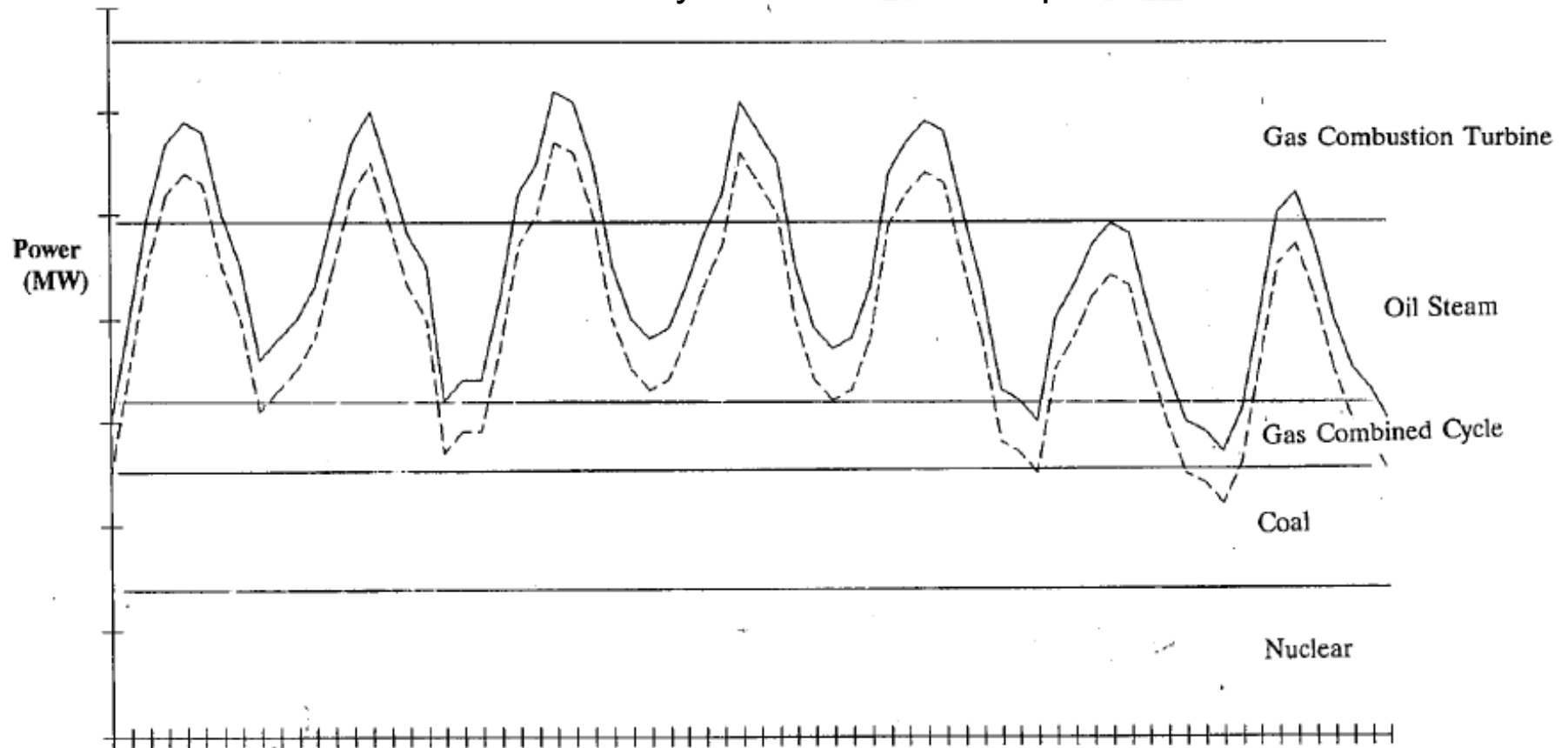
# Time scale of electric system emissions displacement: long run avoided capacity

<u>Technology</u>	<u>Idealized Lead time (in years)</u>
Coal	4
Gas combined cycle	3
Combustion turbine	2
Fuel cells	3
Nuclear	6
Biomass	4
Landfill gas	3
Geothermal	4
Wind	3
Solar thermal	3
Photovoltaic	2

Source: US Energy Information Administration, Annual Energy Outlook.

# Time scale of electric system emissions displacement: short run avoided energy

Illustrative week system economic dispatch

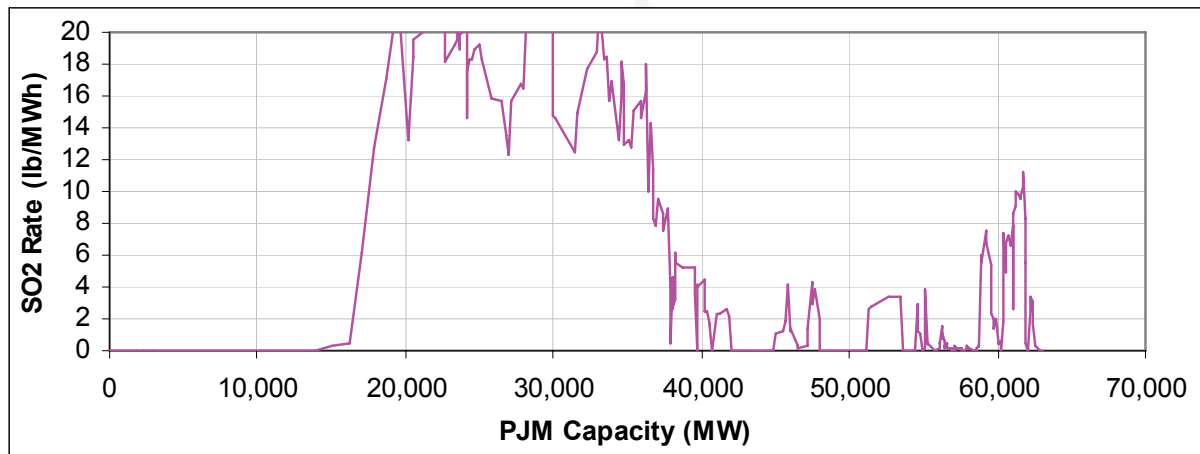
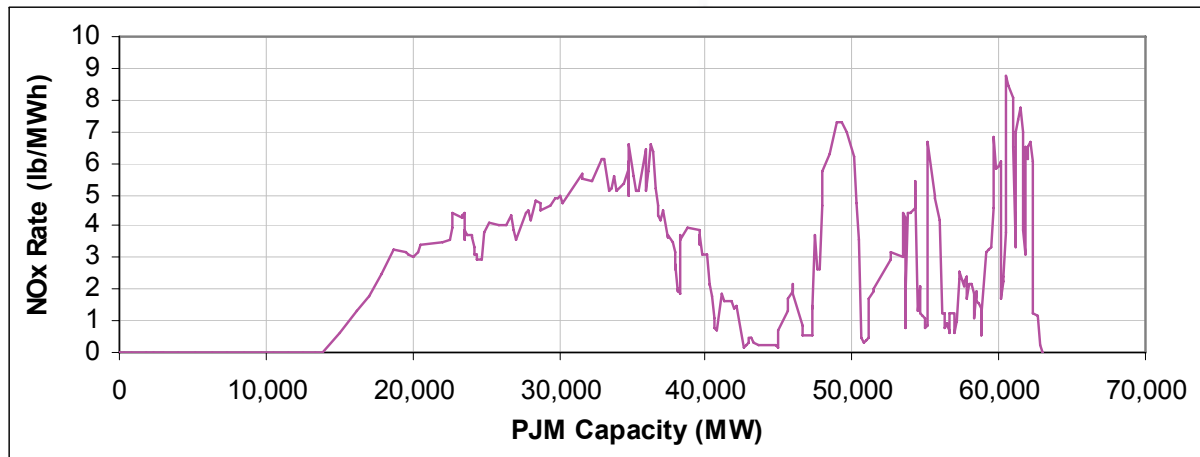


## Default Displaced Emission Rates for PJM (lb/MWh)

2005 Default Displaced Emission Rates for PJM (lb/MWh)				
	Nox	SO2	CO2	Hg
PJM Ozone Season Weekday	1.8	3.4	1,230	3.0E-05
PJM Ozone Season Night/Weekend	1.7	5.9	1,380	6.5E-05
PJM Non-Ozone Season Weekday	1.3	1.8	1,160	1.1E-05
PJM Non-Ozone Season Night/Weekend	2.8	8.0	1,510	7.5E-05
PJM Annual Average	2.1	7.1	1,130	7.4E-05
PJM Peak Day	4.6	1.8	1,240	0.0E+00
PJM Peak Hours	4.0	1.5	1,330	0.0E+00

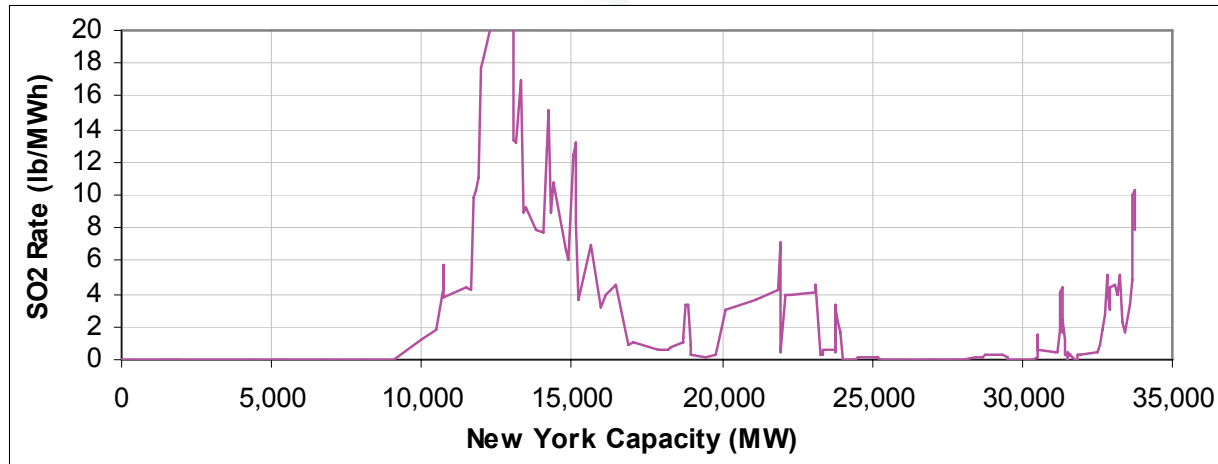
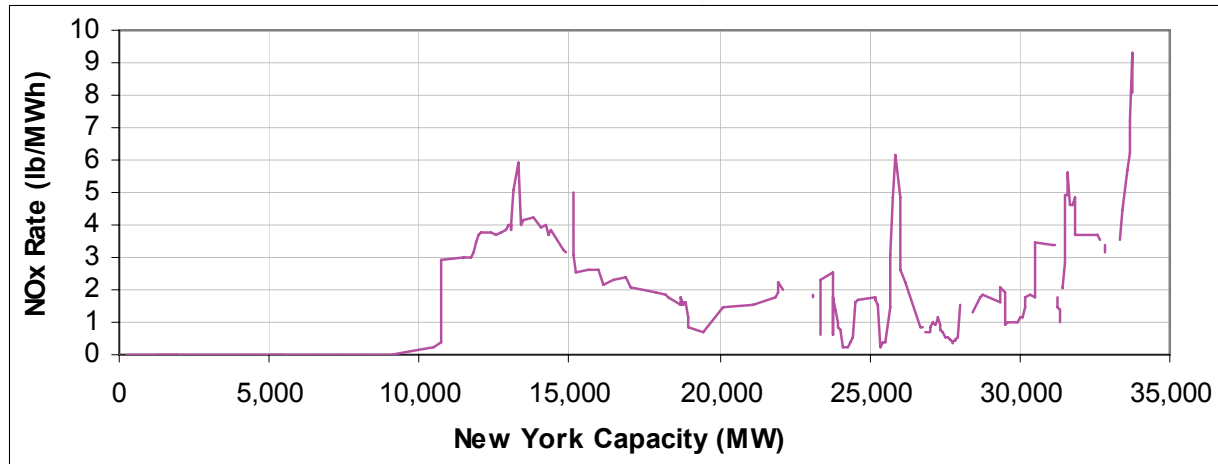
Source Data Derived from: Synapse Energy Economics, *The OTC Emission Reduction Workbook*  
2.1. Dec 2002

# PJM NOx and SO2 emission rates



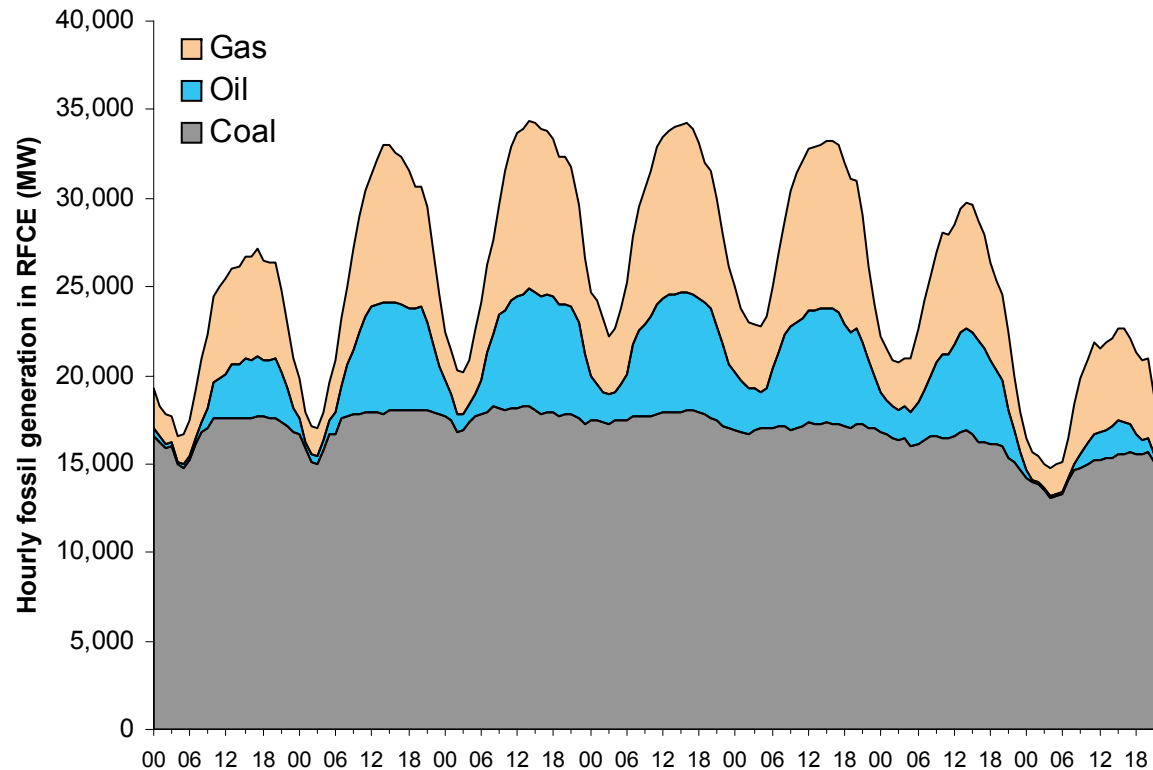
Source: Synapse Energy Economics, *The OTC Emission Reduction Workbook 2.1: Description and User's Manual*, p.42, Dec 2002. Note: PJM "Classic."

# New York NOx and SO2 emission rates



Source: Synapse Energy Economics, *The OTC Emission Reduction Workbook 2.1: Description and User's Manual*, p.42. Dec 2002. PJM "Classic."

# Generation in RFCE from July 30th to August 5th 2006



Source: Synapse Energy Economics, derived from hourly generation data provided to US EPA. RFCE includes PA, NJ, DE, and MD.

## New England comparison of DR, baseload EE, and peak-targeted EE

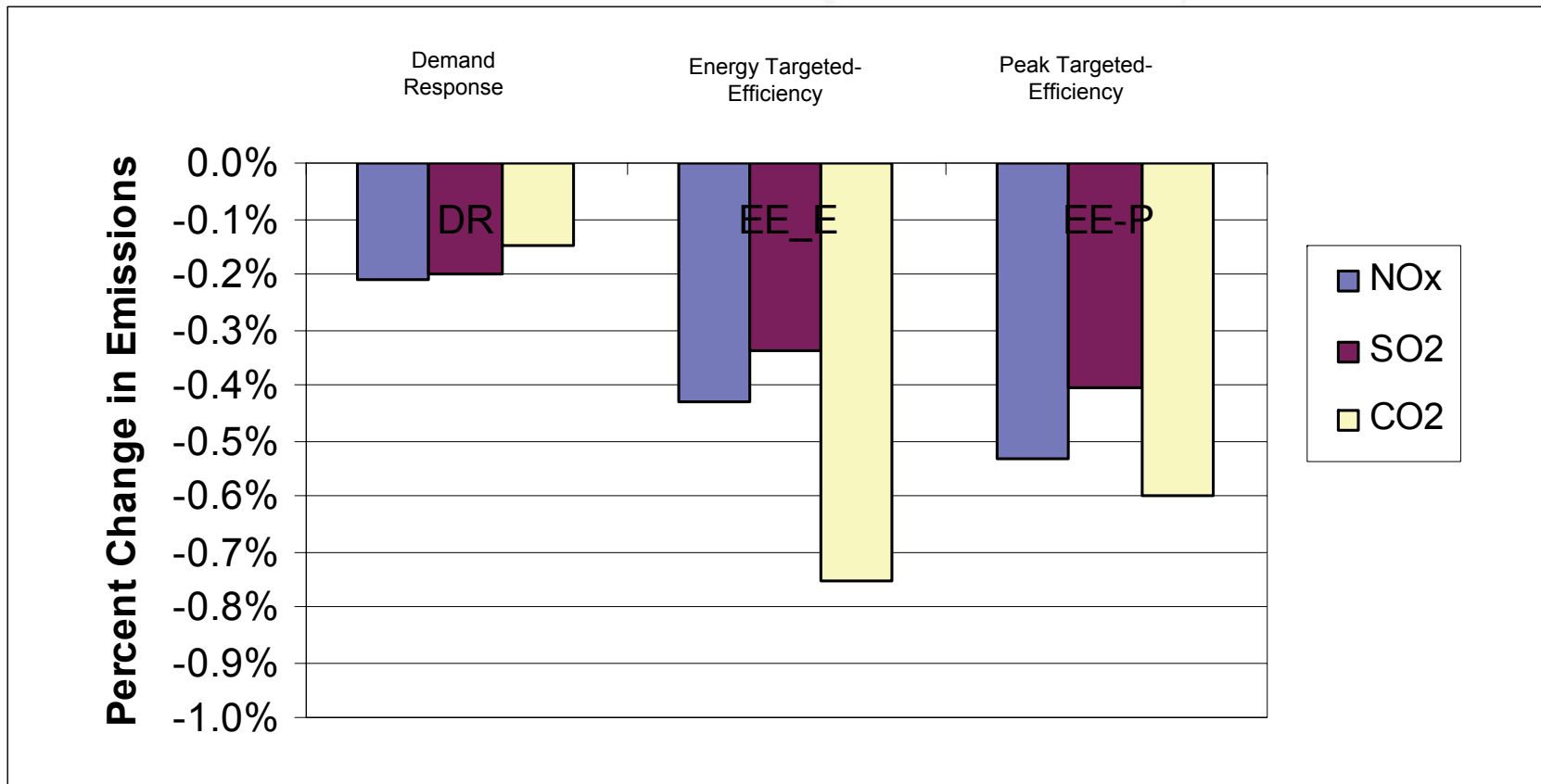
1. Demand response of about 100 MW (3,400 MWh)

In addition to estimating the net air impacts of DR programs, EPA and NEDRI were interested in comparing these impacts to those of common energy efficiency programs. To make this comparison, we modeled the following two energy efficiency programs:

2. An energy-targeted program providing a peak load reduction of one percent and an annual energy reduction of 0.75 percent
3. A peak-targeted program providing a peak load reduction of 1.2 percent and an annual energy reduction of 0.50 percent

*Source: Synapse Energy Economics, Modeling Demand Response and Air Emissions in New England. p.19. September 2003.*

# New England estimates of air emission reductions from DR and EE

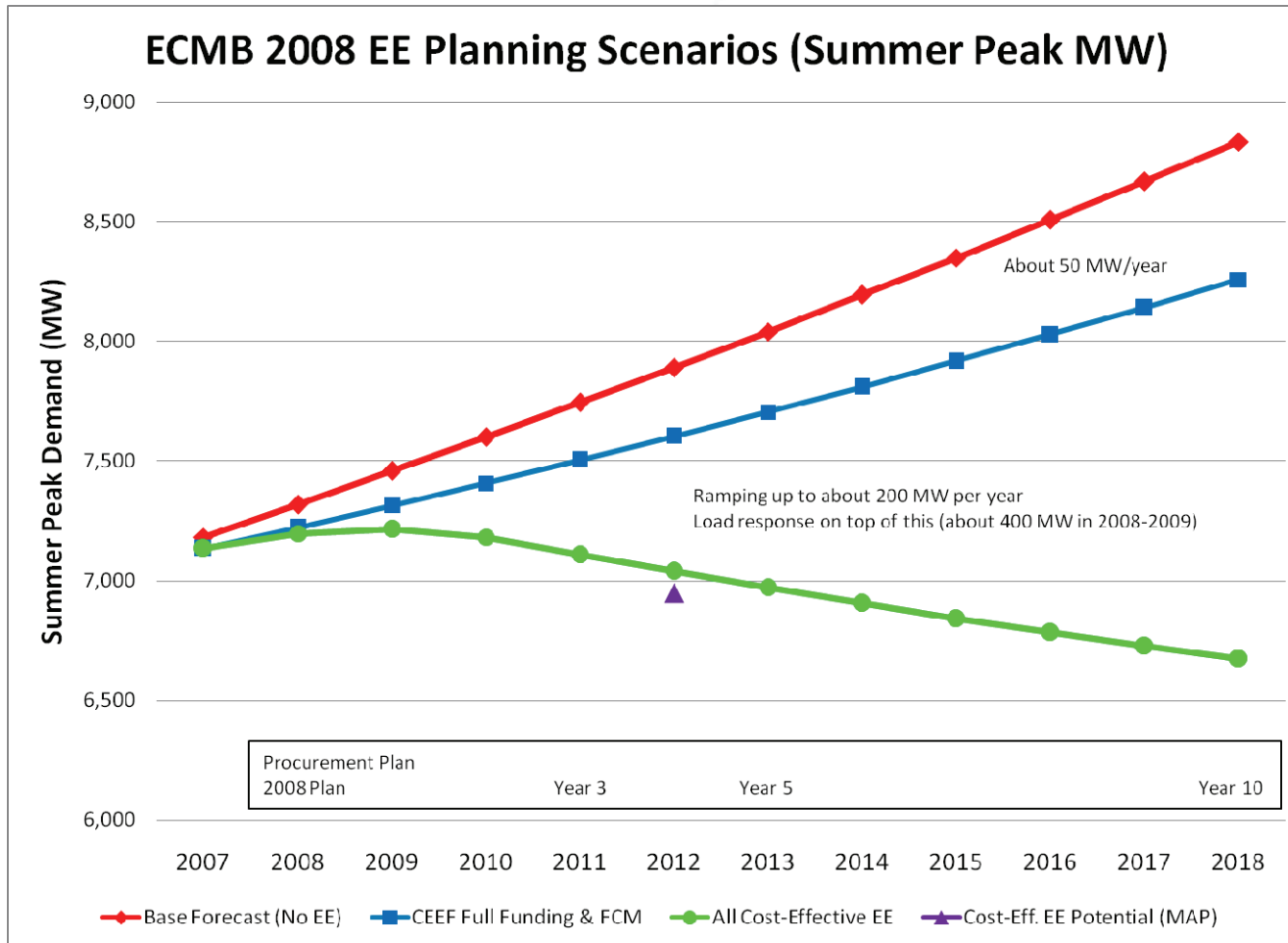


Source: Synapse Energy Economics, *Modeling Demand Response and Air Emissions in New England*. p.20. September 2003



- PJM has been ordered by FERC to identify barriers to EE participating in the capacity market (“RPM”).

# Connecticut plans for all cost-effective efficiency



Source: Jeff Schlegel for the Connecticut Energy Conservation and Management Board.

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