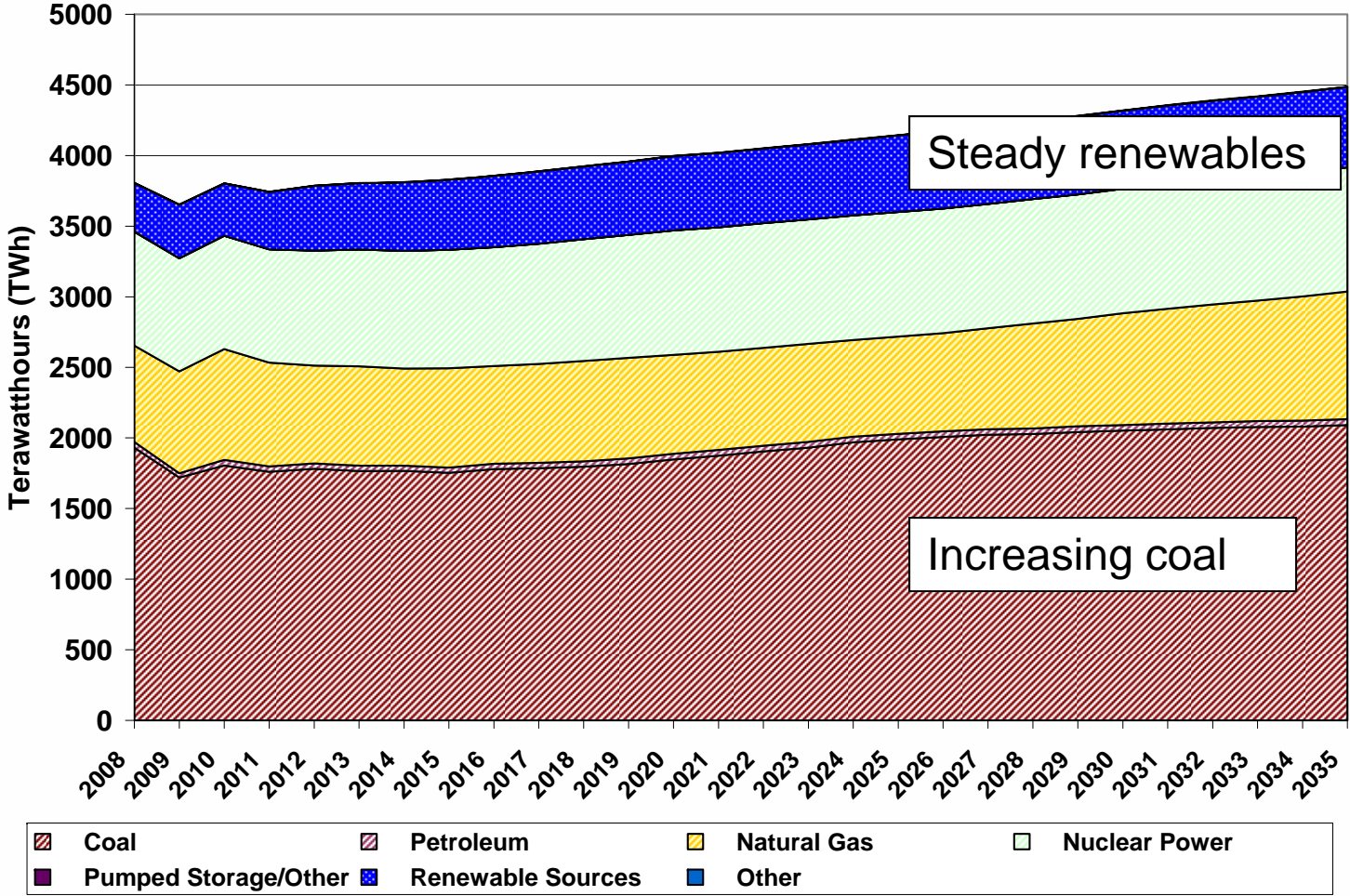


**Synapse**  
Energy Economics, Inc.

## **Economics of Existing Coal Generation and Opportunities for Clean Electricity**

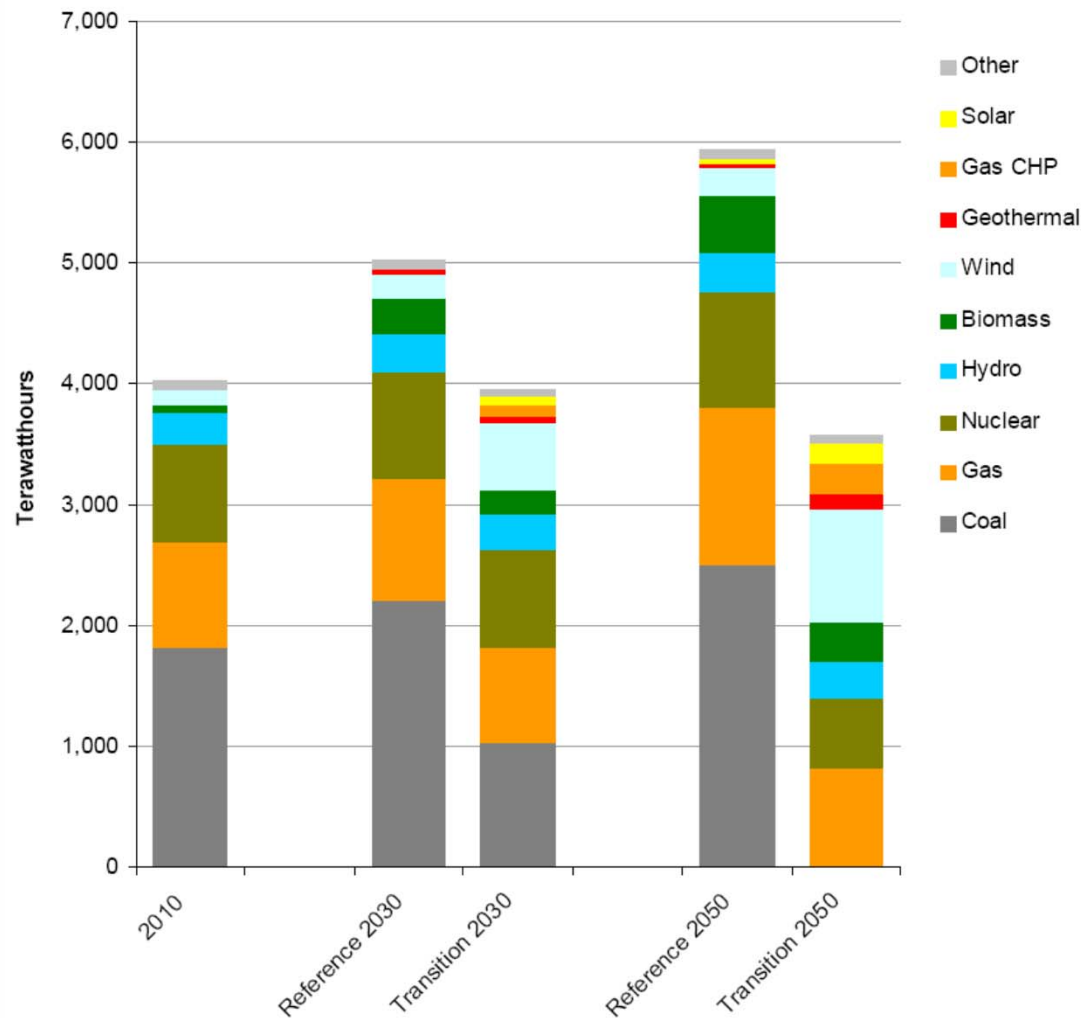
**Prepared by Synapse Energy Economics for the Energy Foundation**  
DRAFT: May 18, 2011

# A Business As Usual Future



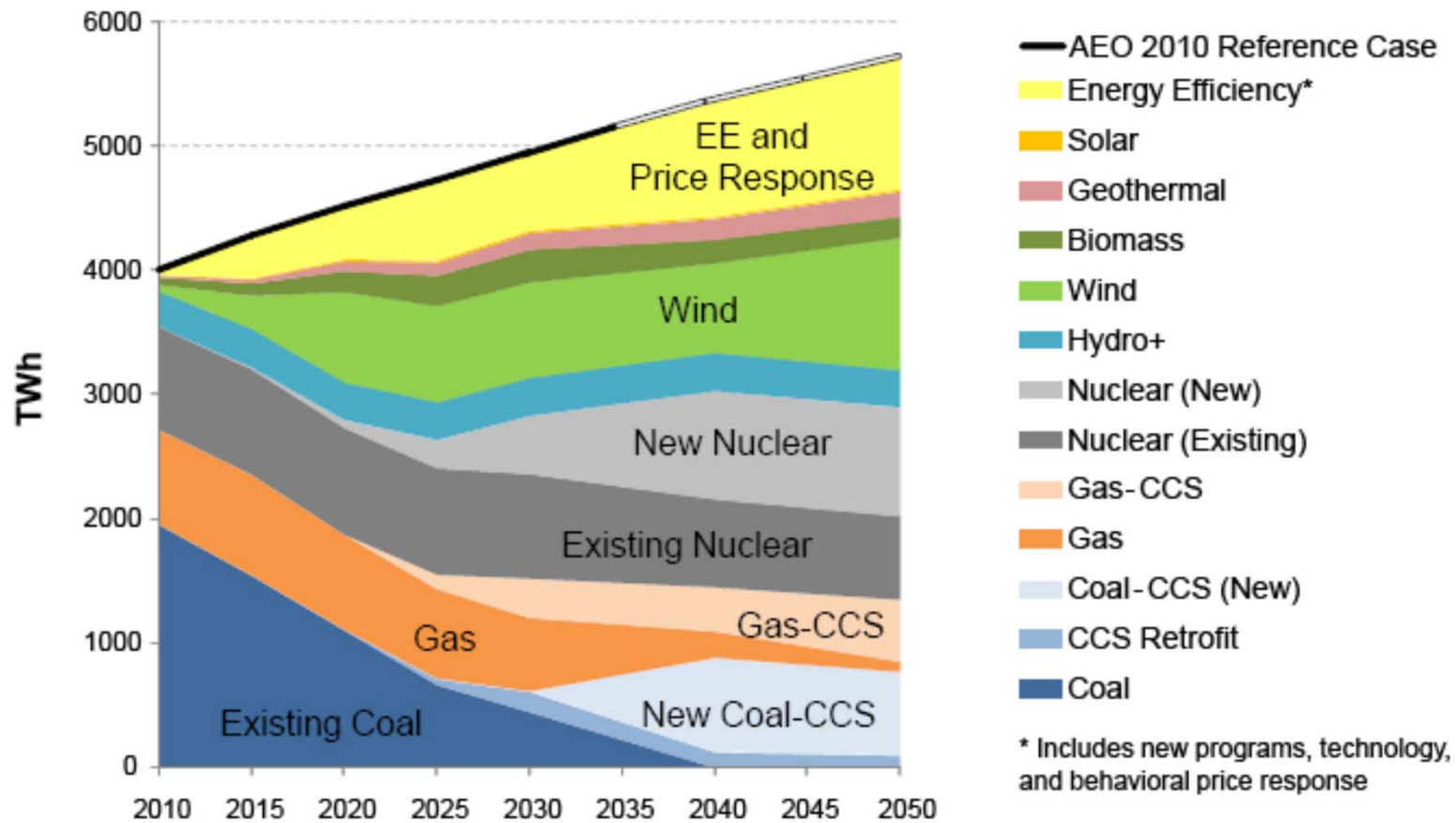
Source: EIA AEO 2011

# Two Contrasting Futures



Source: Synapse. *Beyond Business as Usual*, May 2010.

# EPRI'S PRISM Version of the Future

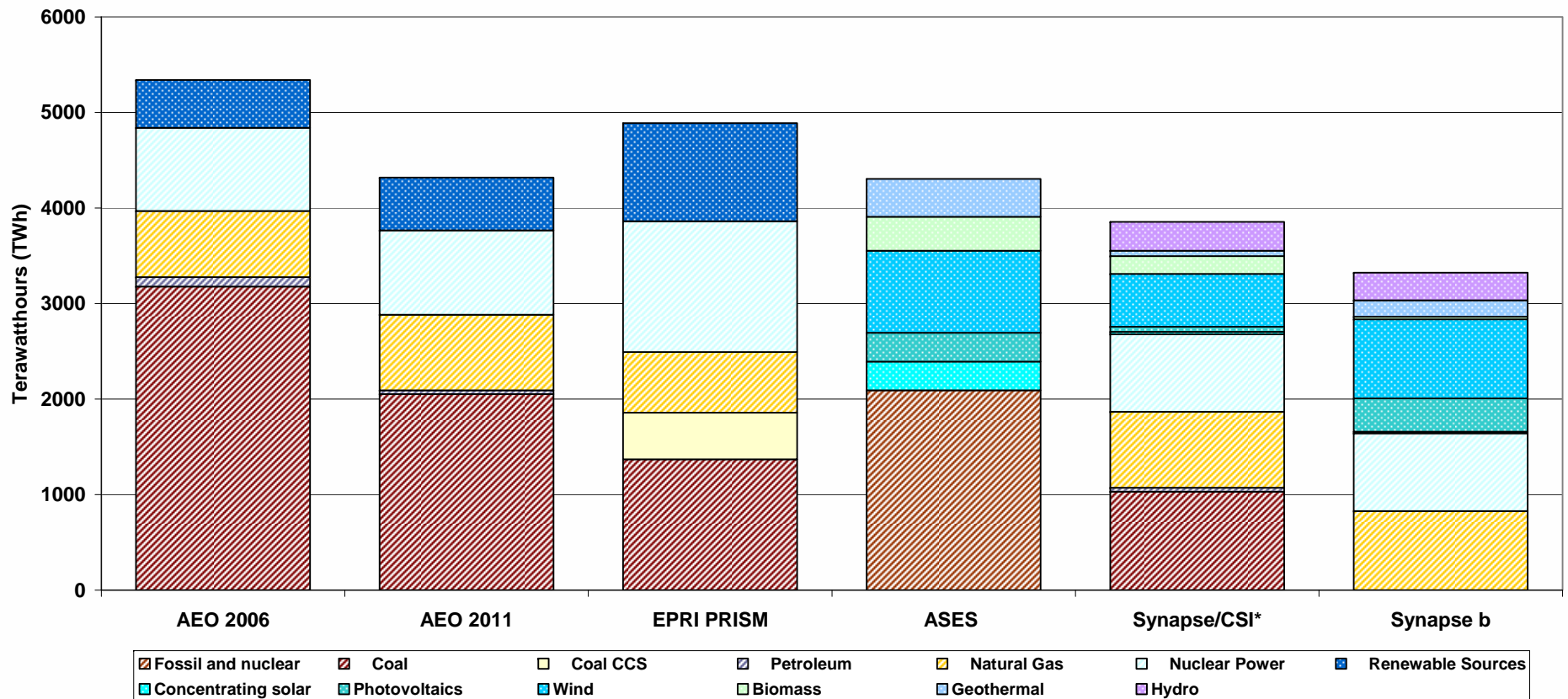


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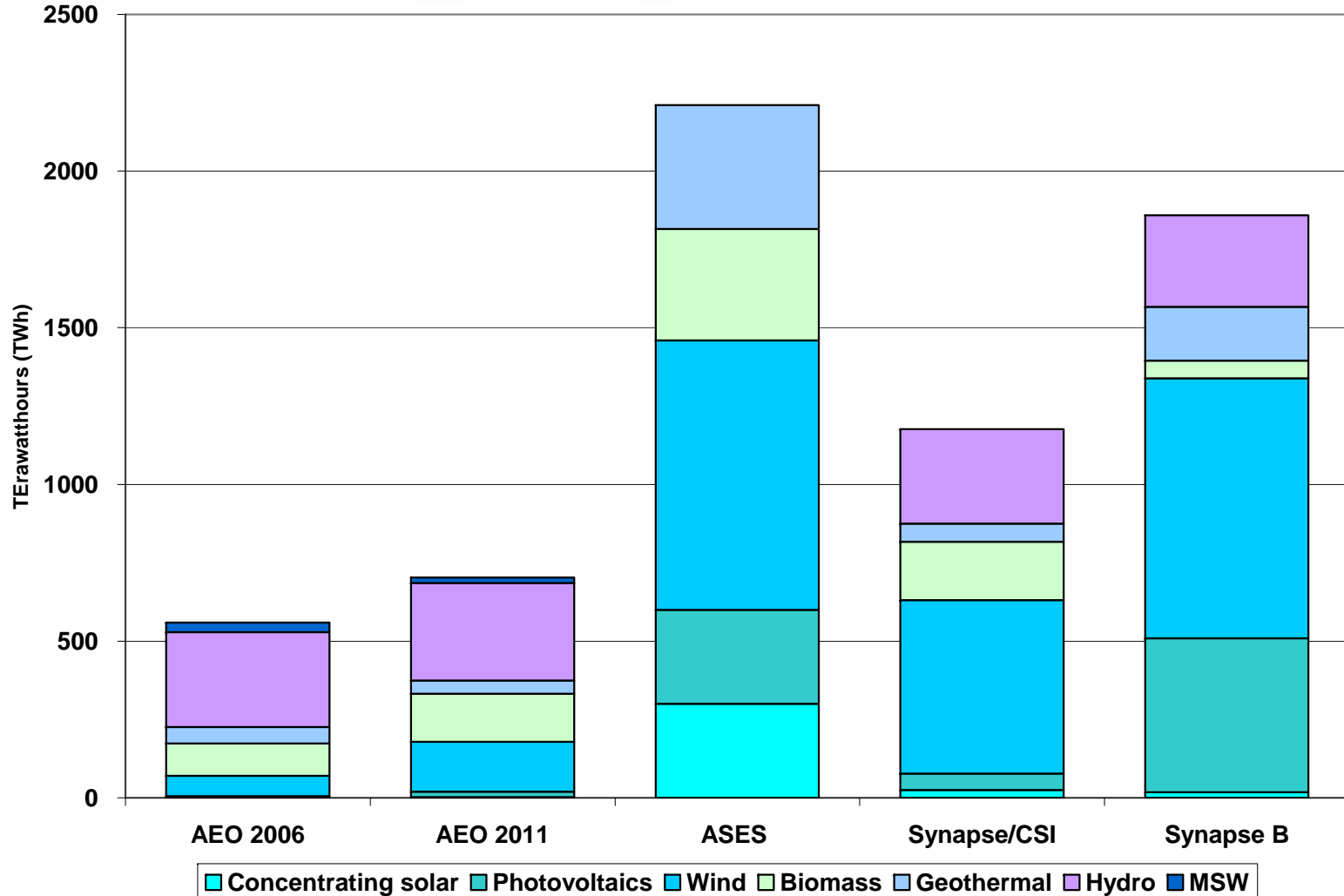
21

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# Contrasting Generation Mixes 2030



# Renewables in 2030



# Enormous Opportunity for Clean Energy Technologies

## Total Cumulative Investment in Wind and PV

Synapse B Coal Phase-Out Scenario  
(in constant 2009 \$)

### For new wind

2015: \$130 Billion

2030: \$600 Billion

### For new PV

2015: \$120 Billion

2030: \$670 Billion

## One Significant Factor: Upcoming Environmental Rules

- Clean Air Transport Rule (CAA)
- Power plant mercury and air toxics standards (CAA)
- Coal combustion waste (RCRA)
- Cooling water intake structure, and water effluent (CWA)
- GHG (Tailoring and New Source Review, New Source Performance Standards)
- Revisions of NAAQS for SO<sub>2</sub>, ozone, PM 2.5



# Upcoming EPA Rules

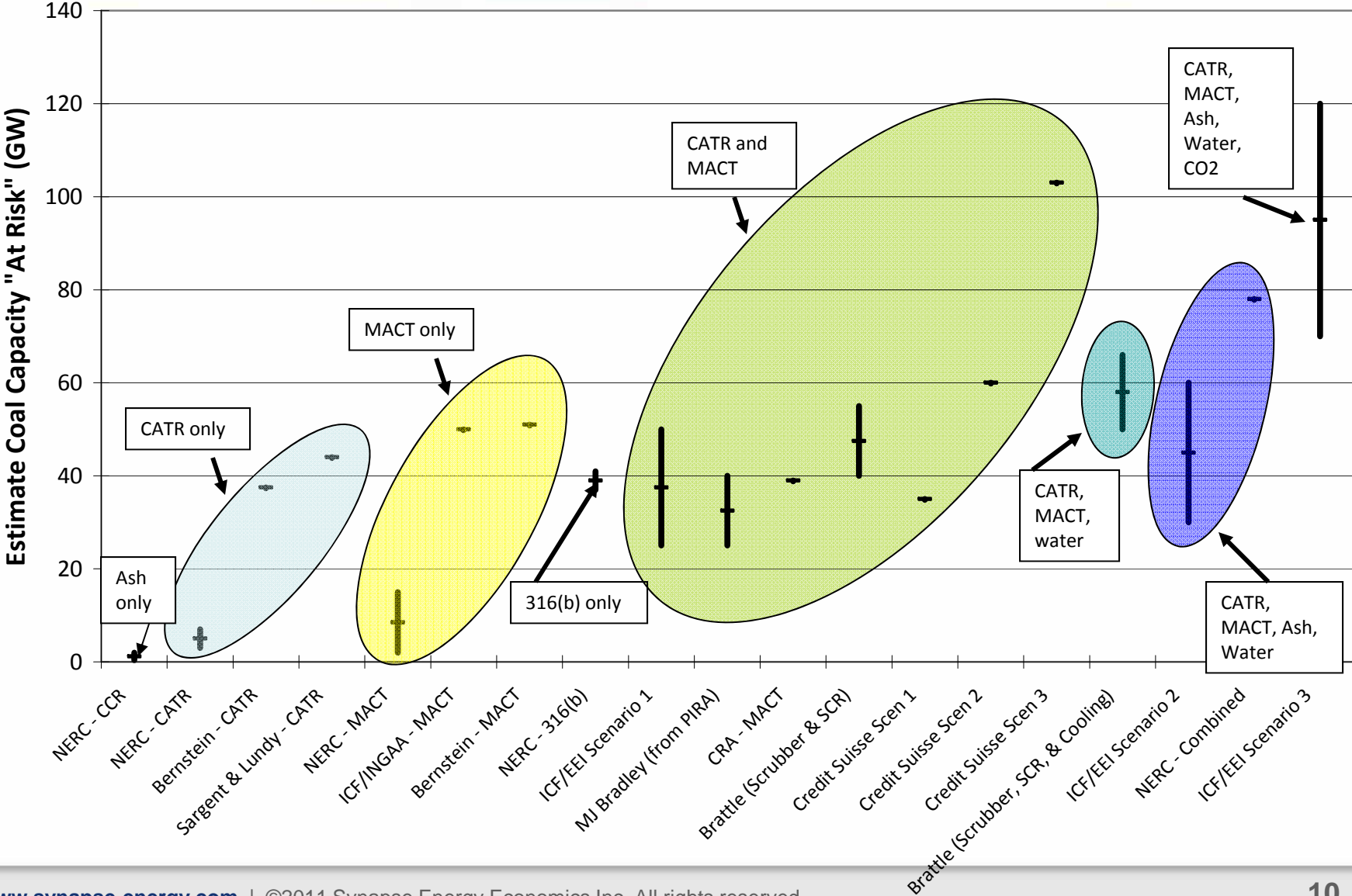
2011	2012	2013	2014	2015	2016	2017	2018	Beyond
		Clean Air Transport Rule (SO <sub>2</sub> /NO <sub>x</sub> )						
		Coal Combustion Residuals (Ash)						
		Hazardous Air Pollutants (including mercury)						
		Cooling Water Intake						
		Water Effluent						
CO <sub>2</sub> Prevention of Significant Deterioration								
		CO <sub>2</sub> New Source Performance Standards						

	Proposed rules
	Final rules
	Compliance period

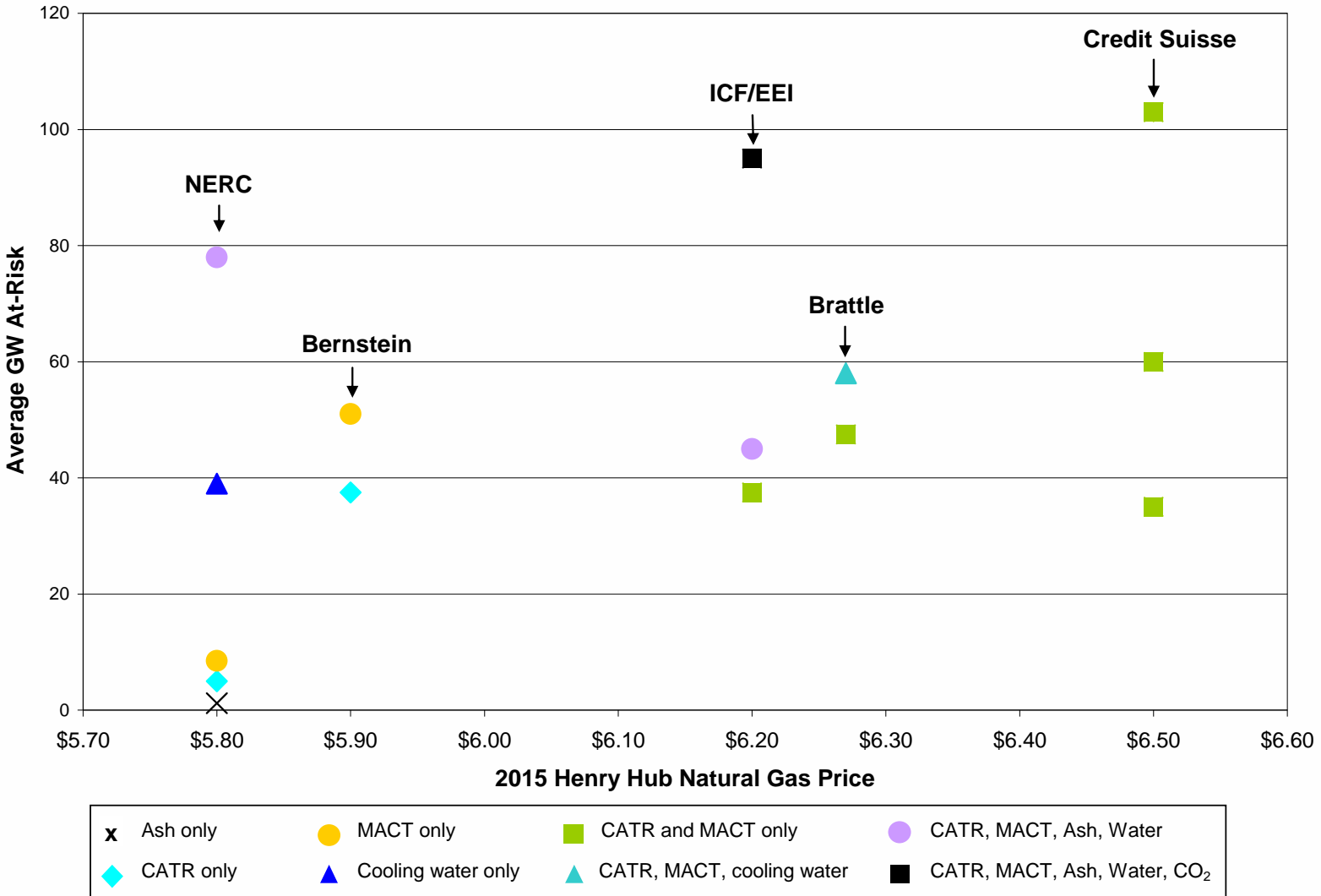
EPA is coordinating [its regulatory actions]. Together, EGUs will be able to develop strategies to reduce all pollutants in a more efficient and cost-effective way than addressing these pollutants separately

EPA Fact Sheet on GHG Settlements December 2010.

# Projected Coal Capacity "At Risk" Under Various Regulatory Policies



# Modeling Results and Gas Price



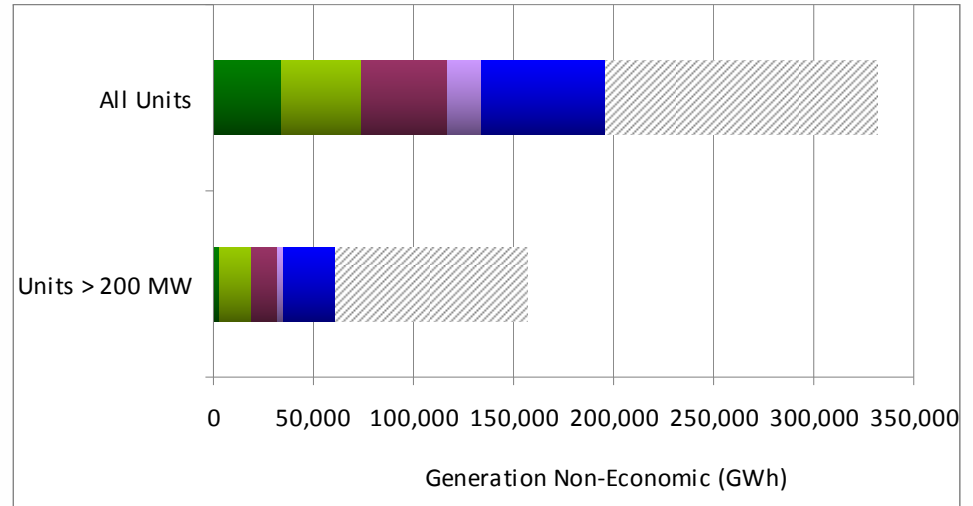
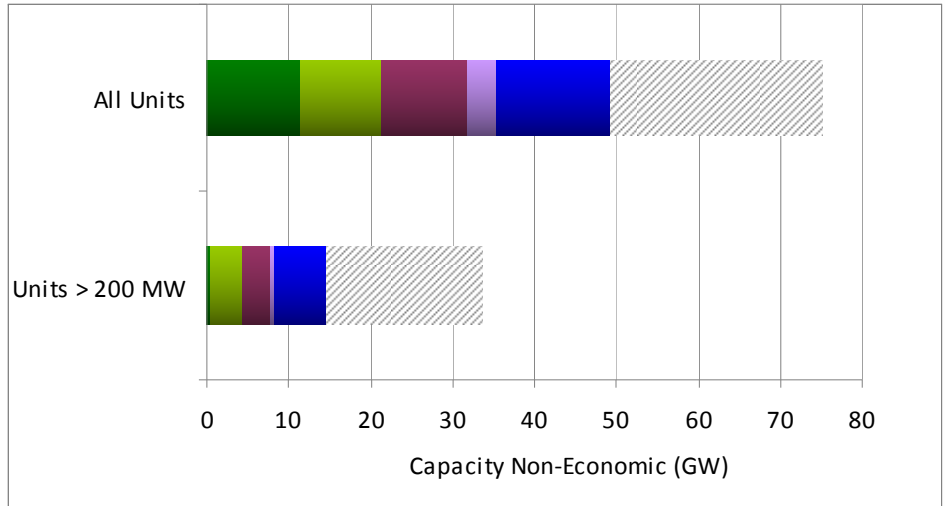
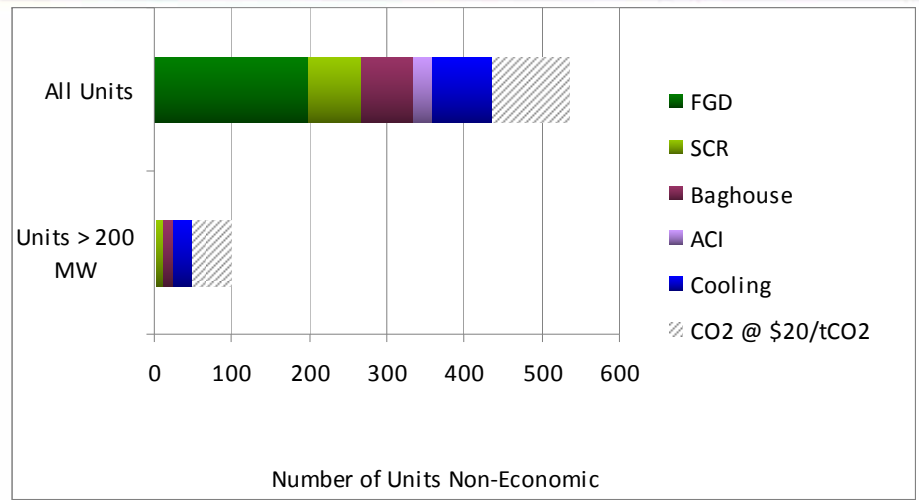
## Observations Bases on Coal-at-Risk Studies

- Comprehensive regulation results in more coal at risk
- Natural gas prices – within the bandwidth modeled – do not explain differences in study results regarding plants at risk
- Regulatory details, e.g. flexibility, have a big impact on plants at risk
- Only one analysis included CO<sub>2</sub> cost, a significant omission!

# Economics of Existing Coal in the U.S.

- Synapse conducted analysis of the approximately 1100 existing coal units in the US
- Investments environmental retrofits add to forward costs
- Many uncertainties including replacement power price and unit-specific operating costs and investments
- EPA retrofit technology costs may be optimistic (utilities are reporting higher costs for specific actual retrofits)
- The following slide shows results for number of generating units, capacity (MW), and generation (GWH), respectively.
- Each graph has two bars, one for all units and one for only "large units" (those greater than 200 MW).
- The technologies (FGC, SCR, Baghouse, ACI, Cooling, and CO<sub>2</sub>) are layered in one at a time, and the impacts are shown in the colors in the stacked bars).

# Uneconomic Coal: Number of Units, Capacity (MW), and Generation (GWh)



## Existing Coal Fleet: Results

- 75 GW out of 317 GW capacity total appears to be uneconomic on a forward basis
- If small units (less than 200 MW) are exempted from retrofit requirements, then the amount of uneconomic capacity goes down significantly (by about 1/2)
- CO<sub>2</sub> price is an important factor
- The water rule is important. A strong and well defined water fuel preventing once-through cooling would have a large impact.
- Proposed coal ash and developing effluent rules are not included here (but could also be important).
- This is based on a relatively high price for replacement power (all-in cost of new gas). To the extent that retired coal can be replaced by underutilized existing fossil capacity or cost-effective new renewable generation, the amounts of uneconomic coal will be higher.