Efficiency and Renewable Energy for Carbon Constrained Electric Systems

Synapse Energy Economics, Inc.

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Topics Covered in this Presentation

Climate Policy, Efficiency, and Renewable Energy Issues for Consumer Advocates

1. Climate change and carbon policy
2. Utility system planning implications
3. Energy efficiency programs and policies
4. Renewable energy -- wind power

Topic 1: Climate Change and Carbon Policy

a. Costs of inaction on climate change

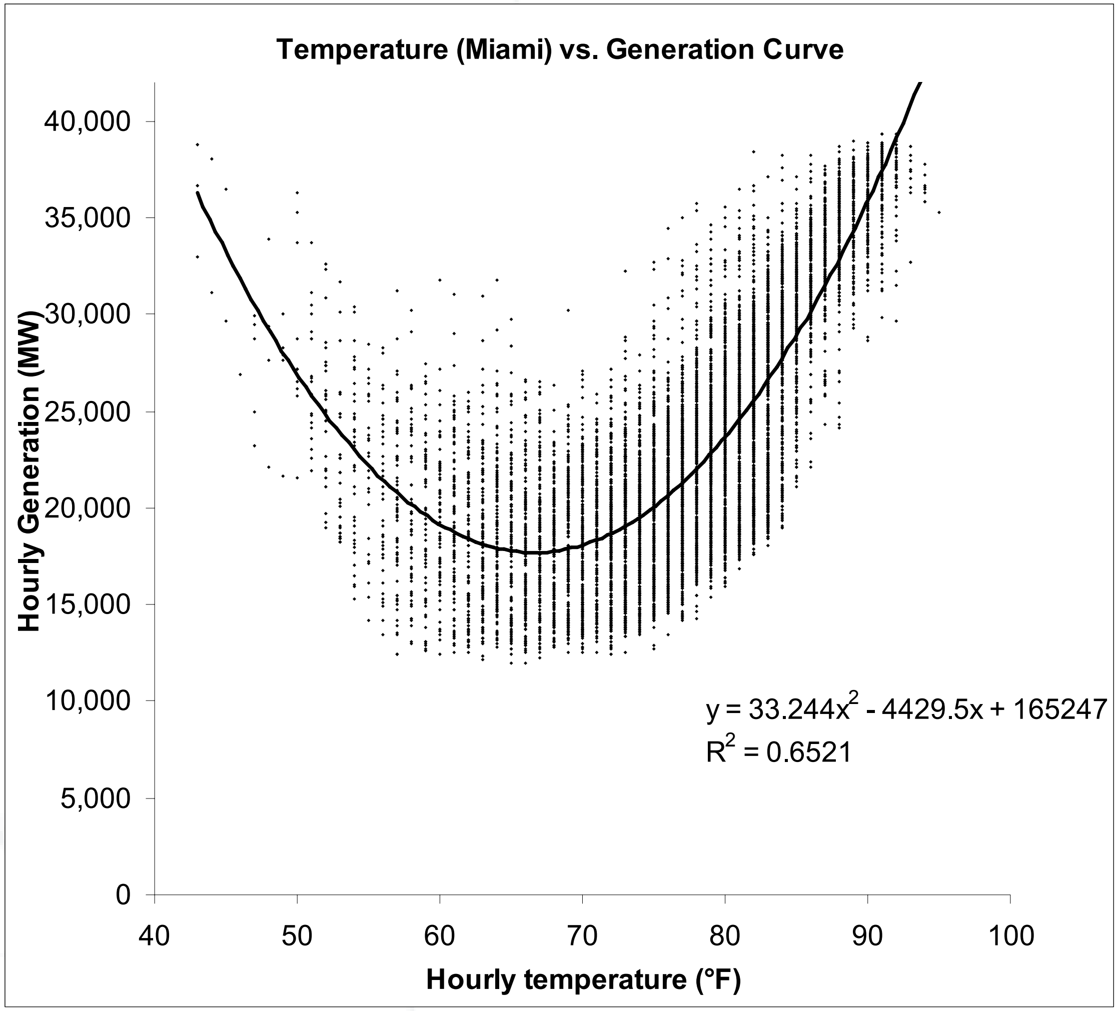
b. Implications: state and federal carbon emissions regulation

c. Electric system capacity mix trends

d. Scale of the climate challenge

Costs of Inaction on Climate Change: Storm Surge and Sea Level Rise

Costs of Inaction on Climate Change: Florida Load as a Function of Temperature



Costs of Inaction on Climate Change: Florida Estimates

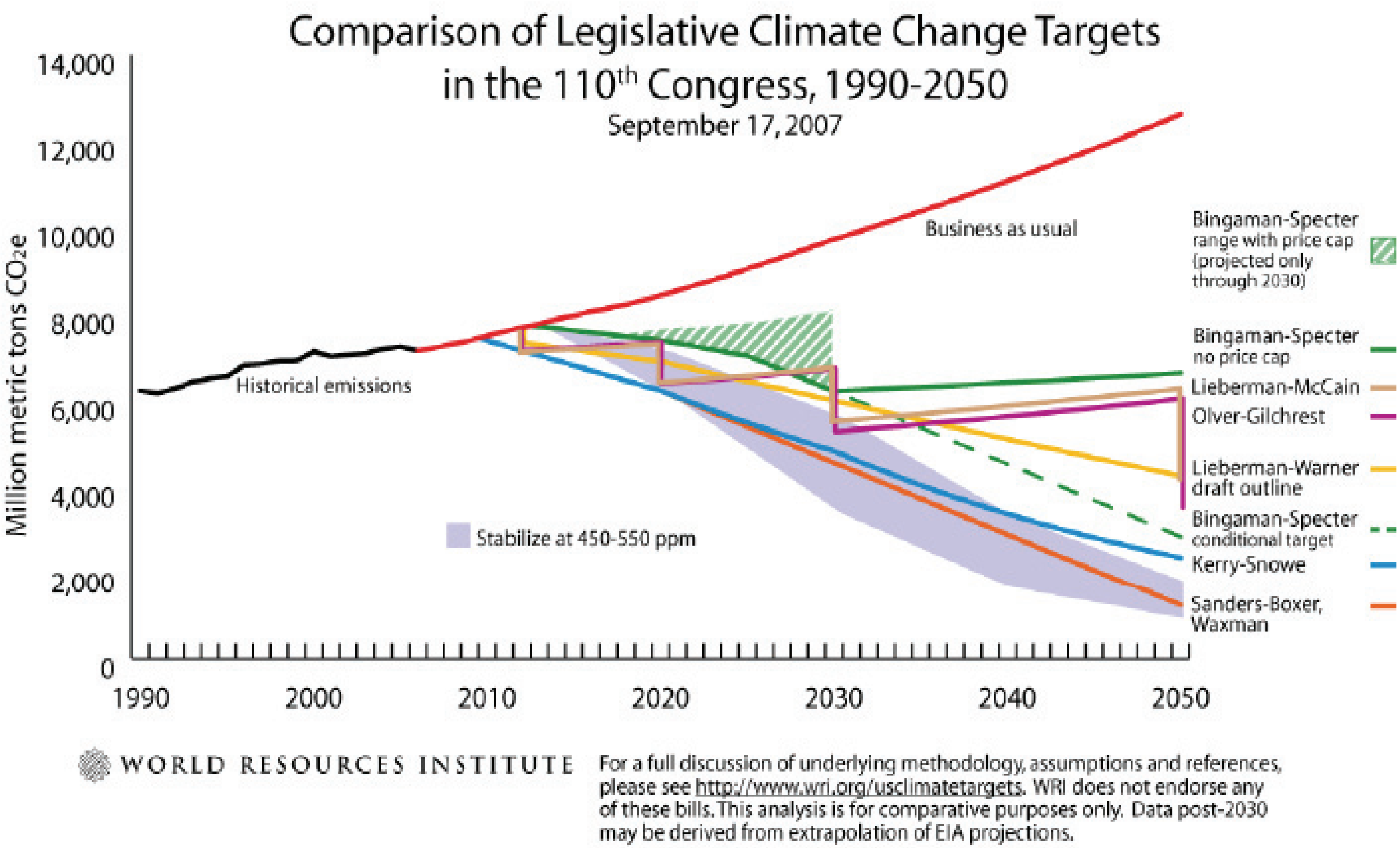
- Rapid stabilization case
  - 2.2 °F by 2100
  - Load increases by 0.07% per year due to climate alone
  - With population and demand compounded, electricity sector is 4.5 times larger in 2100 ($60 billion [Y2005] per year)
- Business-as-usual case:
  - 9.7 °F by 2100
  - Load increases by 0.34% per year due to climate alone
  - Electricity sector 5.9 times larger in 2100 than 2005
  - ($78 billion [Y2005] per year)

- Estimated annual cost of inaction: **$18 billion (2005 dollars)**
- 36 power plants currently at risk of flooding due to storm surge (Cat 5) and sea level rise
  - Represents 22.4 GW (38% of capacity)
- Other risks of climate
  - De-rating (gas in FL looses 1% for every 4 °F increase; nuclear plants drop 2-4% when water temperatures exceed design)
  - Transmission losses

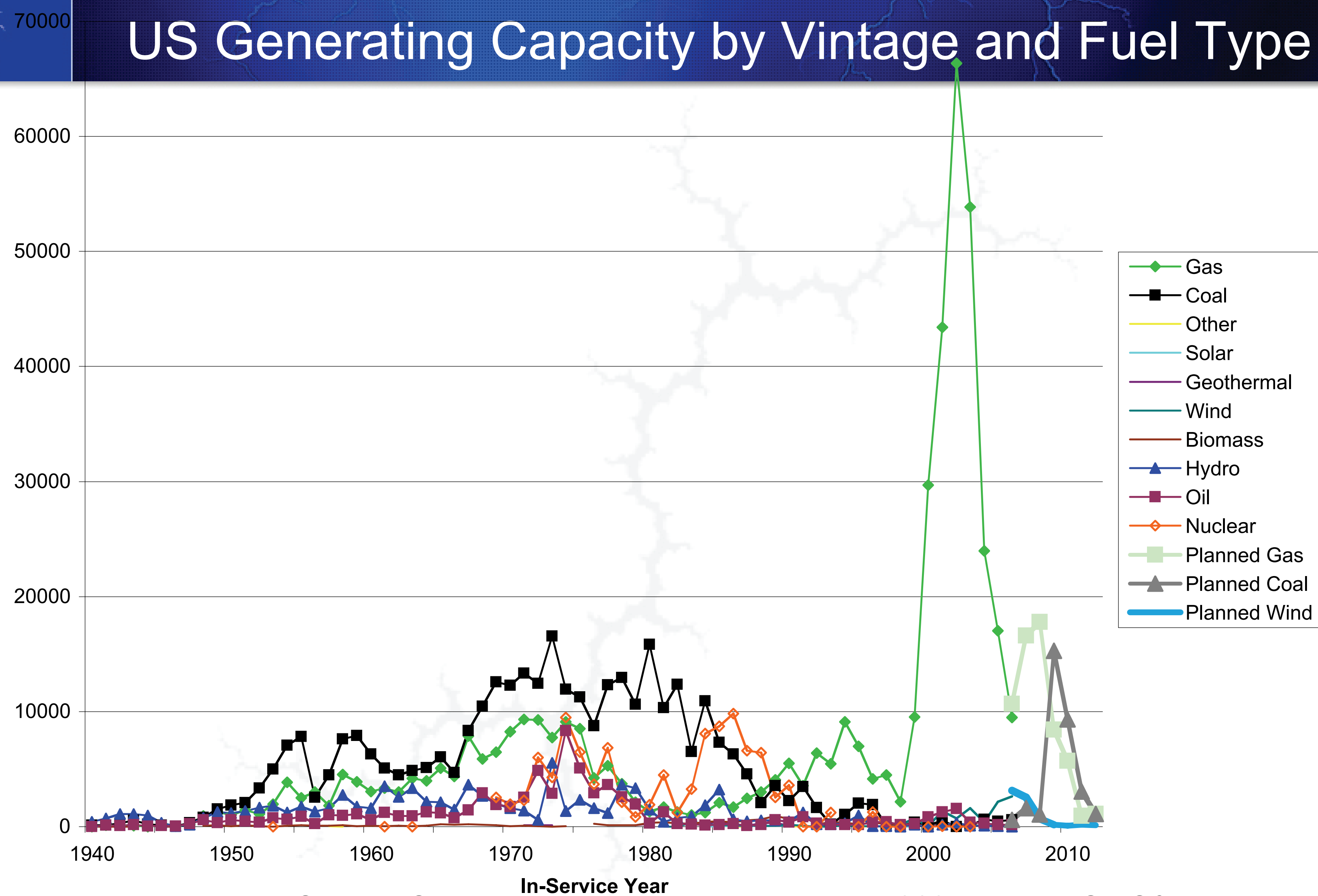
Regulatory and Planning Implications

- There is increasing acknowledgement of climate change from industry and government and that emissions from fossil fired power plants are a major contributor.
- Federal regulation of CO_2 emissions is now a question of when, not if.
- Significant reductions will be required.
- Imprudent for a utility to evaluate future resource options without fully considering carbon risks.

Proposals Require Deep Carbon Emissions Reductions

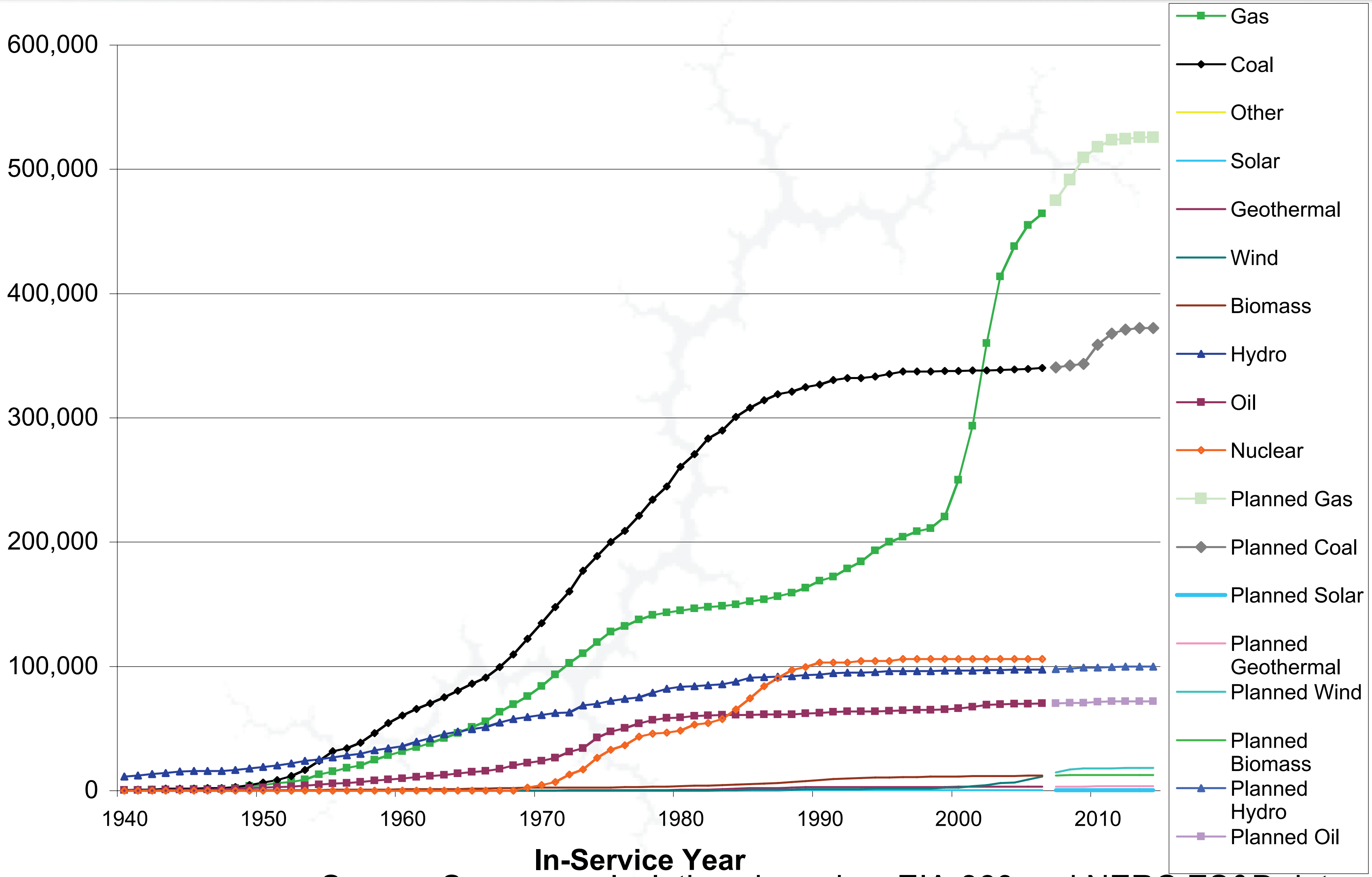


US Generating Capacity by Vintage and Fuel Type



Source: Synapse calculations based on EIA-860 and NERC ES&D data.

US Generating Capacity: Cumulative by Vintage and Fuel Type



Source: Synapse calculations based on EIA-860 and NERC ES&D data.

Scale of Investment

- Clean air act annual cost for utility SO2 and NOx reductions at about $7 billion per year in 2006 dollars (based upon EPA's 1999 Report to Congress on "The Benefits and Costs of the Clean Air Act 1990 to 2010").
- New gas capacity since 2000 of about 250,000 MW (at $800/kW this amounts to $200 billion).
- With US electric sector annual emissions at about 2.6 billion tons of CO2 (EIA's figure for 2007) at an average price of $10 per ton of CO2 (a high estimate for a prudent effort to reduce emissions?) a 30 percent reduction in CO2 emissions would cost $8 billion per year.

Electricity Market Price Effect

<u>Assumptions:</u>

- Total US CO_2 emissions = 2.6 billion tons/year
- Total US electric power generation = 3.7 billion MWh
- Average cost of CO_2 reduction = $10/ton
- Marginal cost of CO_2 reduction = $20/ton
- System marginal emission rate = 0.8 tons/MWh (coal/gas mix)
- Required emission reduction of 10%

<u>Calculations:</u>

- Cost of emission reduction
  = 2.6 billion tons/yr x 0.10 x $10/ton = $2.6 billion/year
- Value of allowances
  = 2.6 billion tons/yr x 0.90 x $20/ton = $47 billion/year
- Electricity market price increase
  = 0.8 tons/MWh x $20/ton x 3.7 billion MWh/year = $59 billion/year

Topic 2: Utility System Planning Implications

a. Bad planning practice

b. Carbon price projections

c. Good planning practice

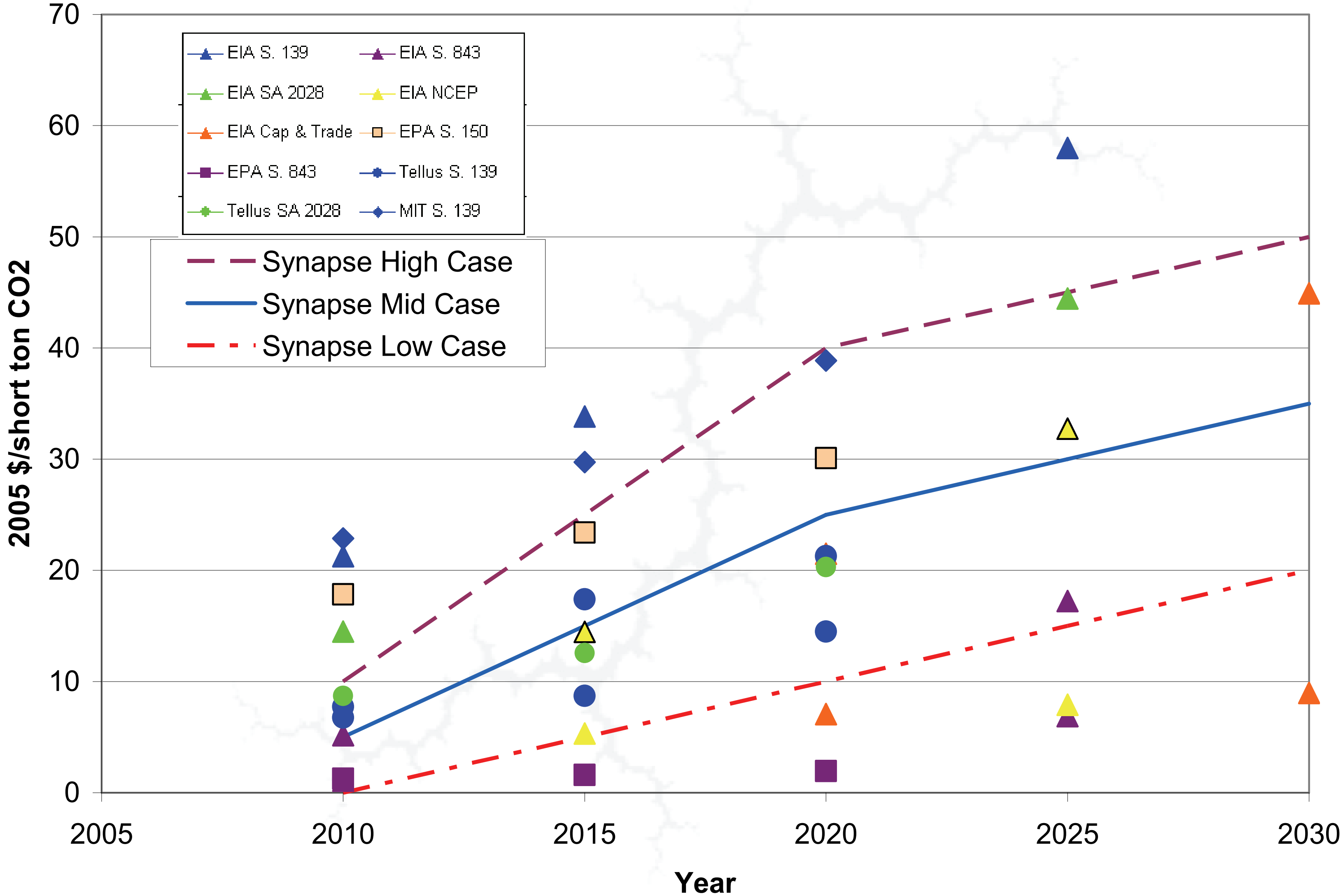
How to Make CO_2 Costs *Not* Count In Resource Planning

1. Too uncertain! – assume that CO_2 costs will be zero throughout 40-60 year operating lives of proposed generating facilities.
2. Assume CO_2 costs only as sensitivity analyses – not in base case studies.
3. Assume only a single CO_2 price trajectory, not a range of possible CO_2 prices.
4. At best, only a few non-carbon emitting resources are made available for model to select.
5. Avoided costs for energy efficiency don't reflect the cost of CO_2 regulations.
6. Assume CO_2 prices do not reflect any increases, over time, of the stringency of regulation.
7. Assume delayed adoption or implementation of CO_2 regulations, e.g., not starting until 2015.
8. Focus on decreasing carbon intensity (lbs per MWh) instead of reducing overall CO_2 emissions.
9. Assume that new units will be grandfathered.

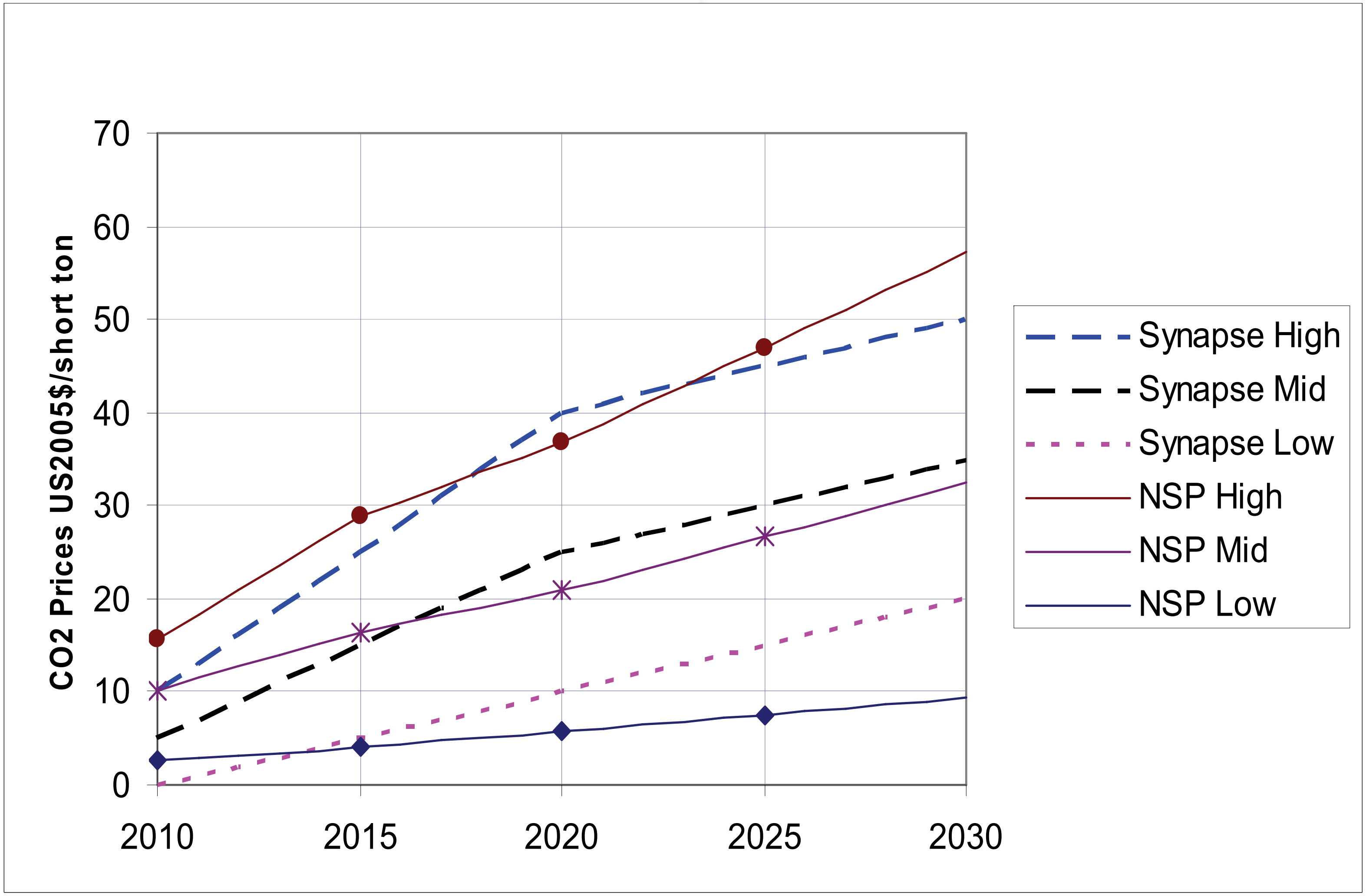
Examples of Bad Resource Planning Practices

- Big Stone II Co-Owners included no CO_2 costs in analyses of proposed coal-fired power plant.
- Statute in North Dakota prevents utilities and Public Service Commission from considering costs associated with future environmental laws and requirements. Thus, utilities and Commission are not allowed to consider CO_2 costs in resource planning.
- Dominion Virginia Power included no CO_2 costs in its planning analyses for a proposed coal-fired power plant and considered buying capacity and energy from the market for 60 years as the only alternative to building the proposed plant.
- SWEPCO (AEP subsidiary) and Entergy Louisiana did not include any energy efficiency or renewable resources as alternatives in analyses of proposed coal-fired power plants.
- In resource planning in Iowa, Alliant Energy limited the amount of new wind energy its model could select each year even if the early addition of new wind resources lowered the cost of the resource plans. When the model was corrected, the Company's preferred generation expansion plan with a new coal-fired power plant was not the lowest cost resource plan.

Synapse's CO_2 Price Forecast



Synapse CO2 Price Forecast Compared to Nova Scotia Power



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Examples of the Impact of Synapse CO_2 Price Forecast on Costs of Fossil Supply Options

For a new plant online in 2011	Supercritical PC	Combined Cycle	IGCC
Size (MW)	600	600	535
CO_2 (lb/MMBtu)	208	110	200
Heat Rate (Btu/KWh)	9,369	7,400	9,612
CO_2 Low Price (2005$/ton)	7.8	7.8	7.8
CO_2 Mid Price (2005$/ton)	19.1	19.1	19.1
CO_2 High Price (2005$/ton)	30.5	30.5	30.5
CO_2 Low Cost per MWh	$7.60	$3.17	$7.50
CO_2 Mid Cost per MWh	$18.61	$7.77	$18.36
CO_2 High Cost per MWh	$29.72	$12.41	$29.32

Proposed Big Stone II Coal-Fired Generating Unit – 600 MW at an average 88% annual capacity factor

- Low Synapse CO_2 Price Forecast: 4,856,000 MWh · $7.74/MWh = $38 million per year
- Mid Synapse CO_2 Price Forecast: 4,856,000 MWh · $19.60/MWh = $95 million per year
- High Synapse CO_2 Price Forecast: 4,856,000 MWh · $30.39/MWh = $148 million per year

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Prudent Planning Requires

Forecast carbon regulatory requirements, and include these in base case modeling.

Prudent planning includes actively seeking relevant information, not just using information that falls on the planner’s desk.

Analysis of uncertainty and risk exposure.

Topic 3: Energy Efficiency Programs and Policies

a. Utility DSM spending trends

b. Capacity credit for energy efficiency

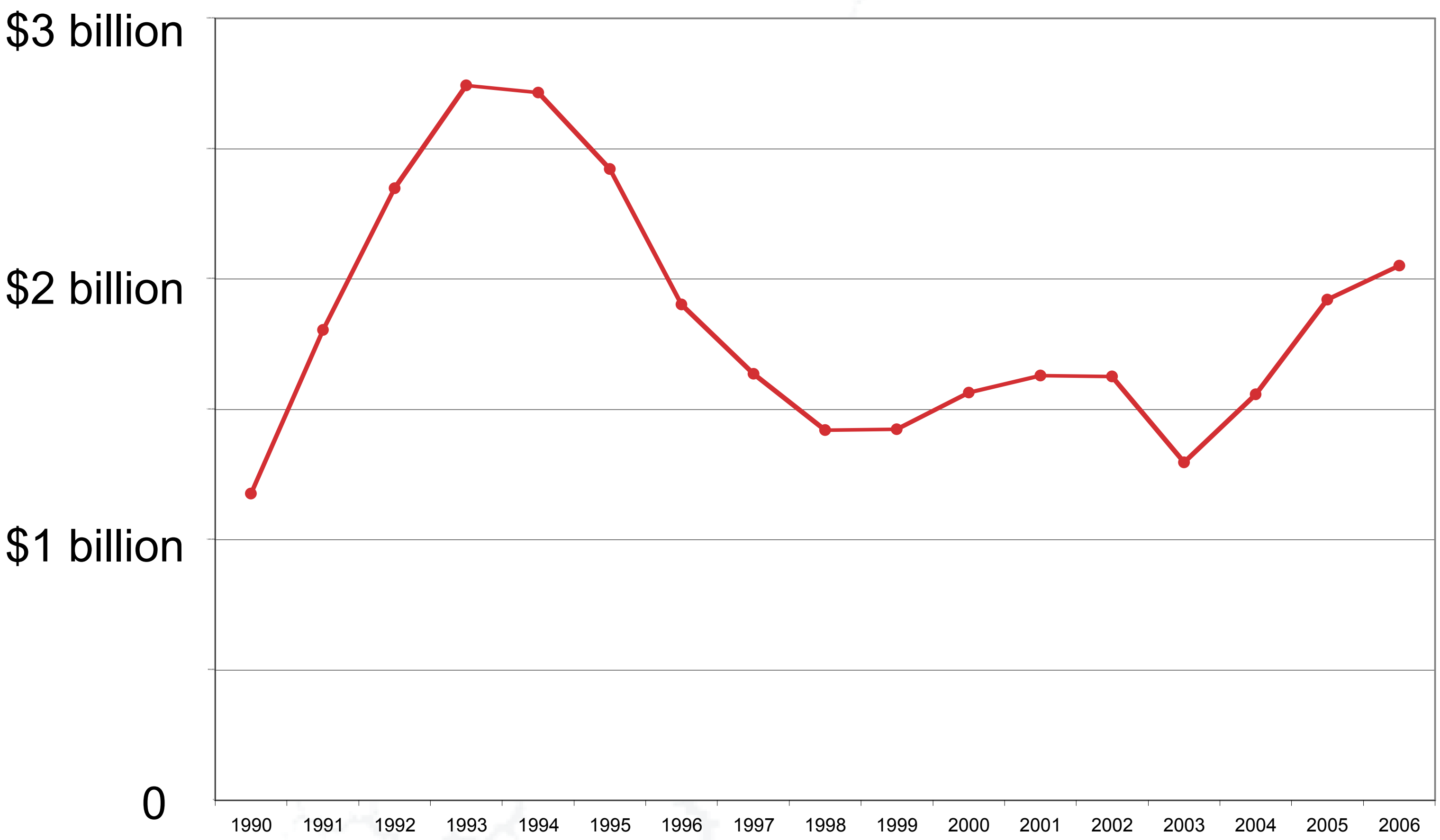
c. Reasonable estimates of avoided cost and effect on market clearing price

d. Checklist for good demand-side management programs

e. Ratemaking issues

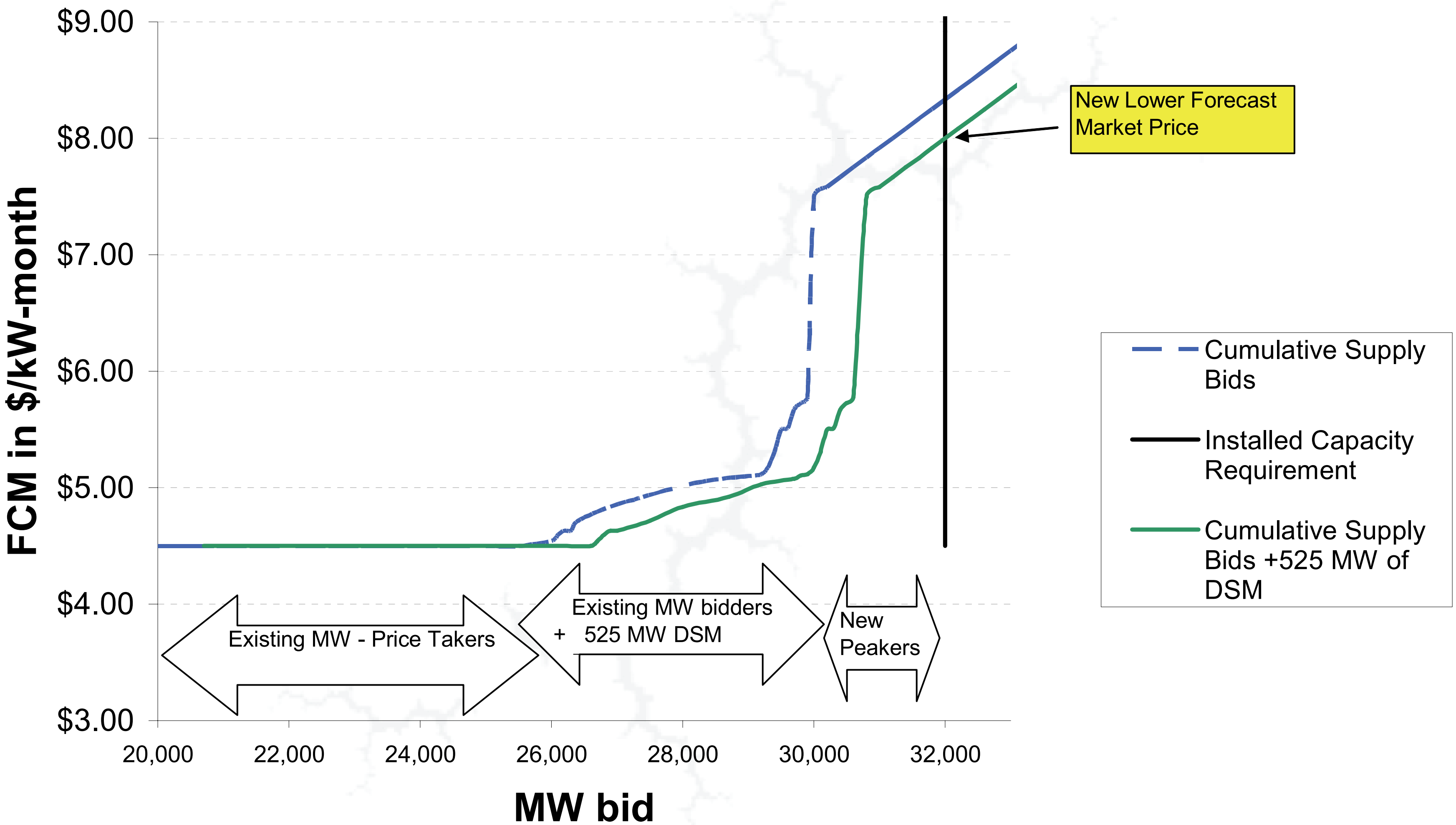
f. Save-a-Watt

Utility DSM Spending 1990 to 2006



Source: Data for 1995 to 2006 is from EIA's Electric Power Annual 2006.
Data prior to 1995 is from EIA's "U.S. Electric Utility Demand-Side Management 1994 Report."

DSM can qualify for capacity credit in New England



Avoided Costs and "DRIPE" (New England Example)

Avoided Cost Results, Boston zone, Summer Peak (15 year levelized, constant 2007$):

	cents/kWh
Avoided energy costs	10.1
Avoided capacity costs ($107.30 per kw-year @ 55% LF)	2.2
DRIPE- energy	1.6
DRIPE- capacity ($ 22.80 per kw-year @ 55% LF)	0.4
CO2 environmental cost	3.1

Synapse report *Avoided Energy Supply Costs in New England*, August 10, 2007

Check List for Good DSM

1. Target a reasonable portion of cost-effective opportunity.
2. Avoid cream-skimming.
3. Prioritize lost opportunity programs.
4. Distinguish peak load reduction and energy efficiency.
5. Be skeptical about purely educational programs.
6. Oppose promotional programs.
7. Question AMI (advanced metering), particularly large scale programs for small customers.
8. Provide reasonable cost recovery.

DSM Ratemaking

1. Stability of the effort over time.
2. Regular monitoring and evaluation.
3. Decoupling? Details matter. Who should bear which risks and what is appropriate ROE? Trends and timing of rate cases.
4. Incentives? Rewards for exceptional performance and penalties for poor performance.
5. Utility or other administrator for DSM?

Proposal

- Duke's proposal (NC, SC, IN, OH, KY).

1. Energy efficiency is a "virtual power plant"
2. Company recovers 90% of the avoided costs.

Problems

1. Poorly defined (details are not specified).
2. Company over-recovers costs, in some cases obscenely.

Conclusion

1. Support cost-effective DSM
2. Oppose Save-a-Watt

Section 4: Renewable Energy -- Wind Power

a. Wind has significant system capacity value
b. Wind integration costs are manageable
c. Wind potential is large
d. Wind price is competitive

Wind Plants Add "Capacity Value" to the System

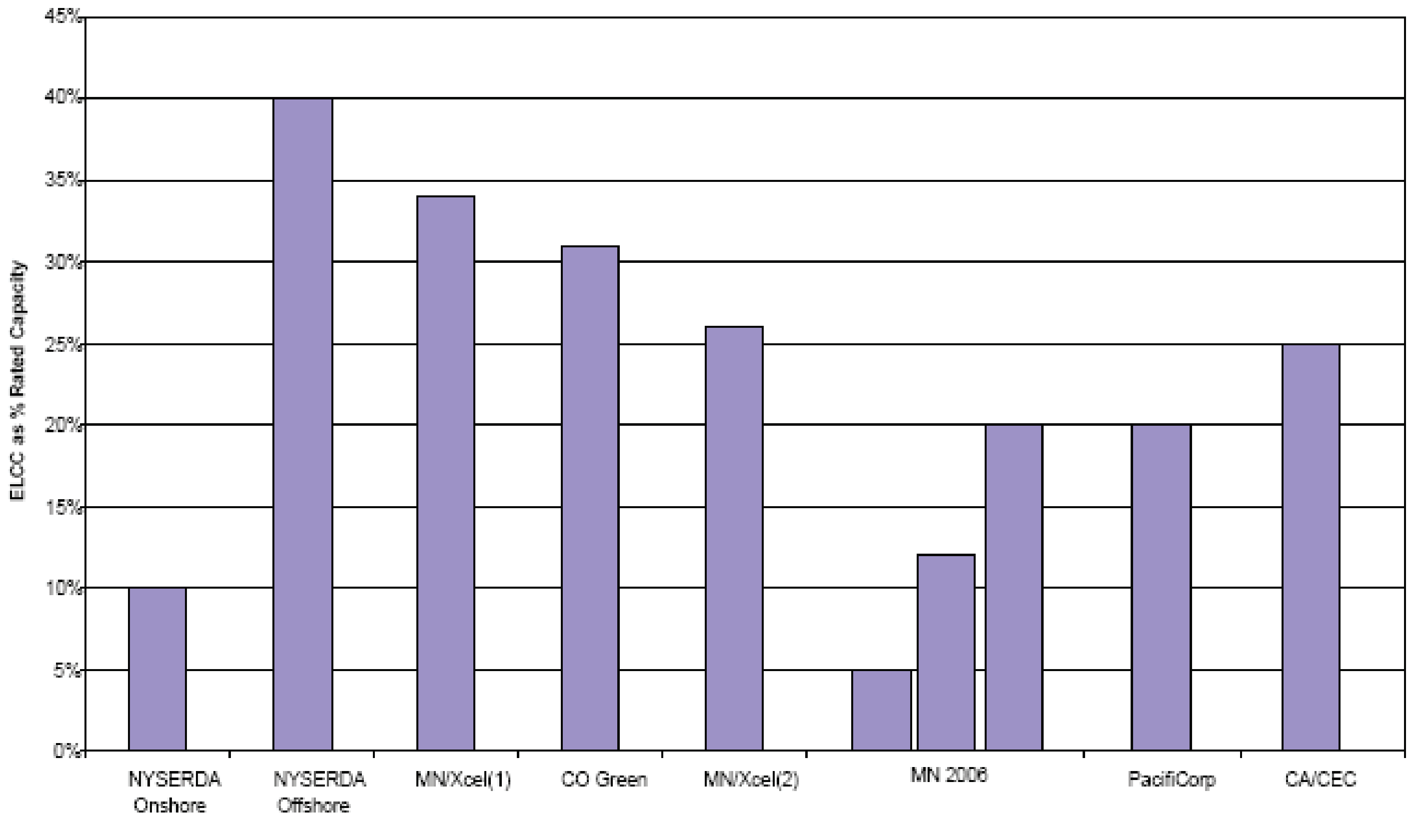


Fig. 4. Wind Plant Capacity Value from Selected Studies [UWIG]

Source: Presentation by UWIG members at European wind conference, 2007.

Wind Unit Commitment Cost Estimates

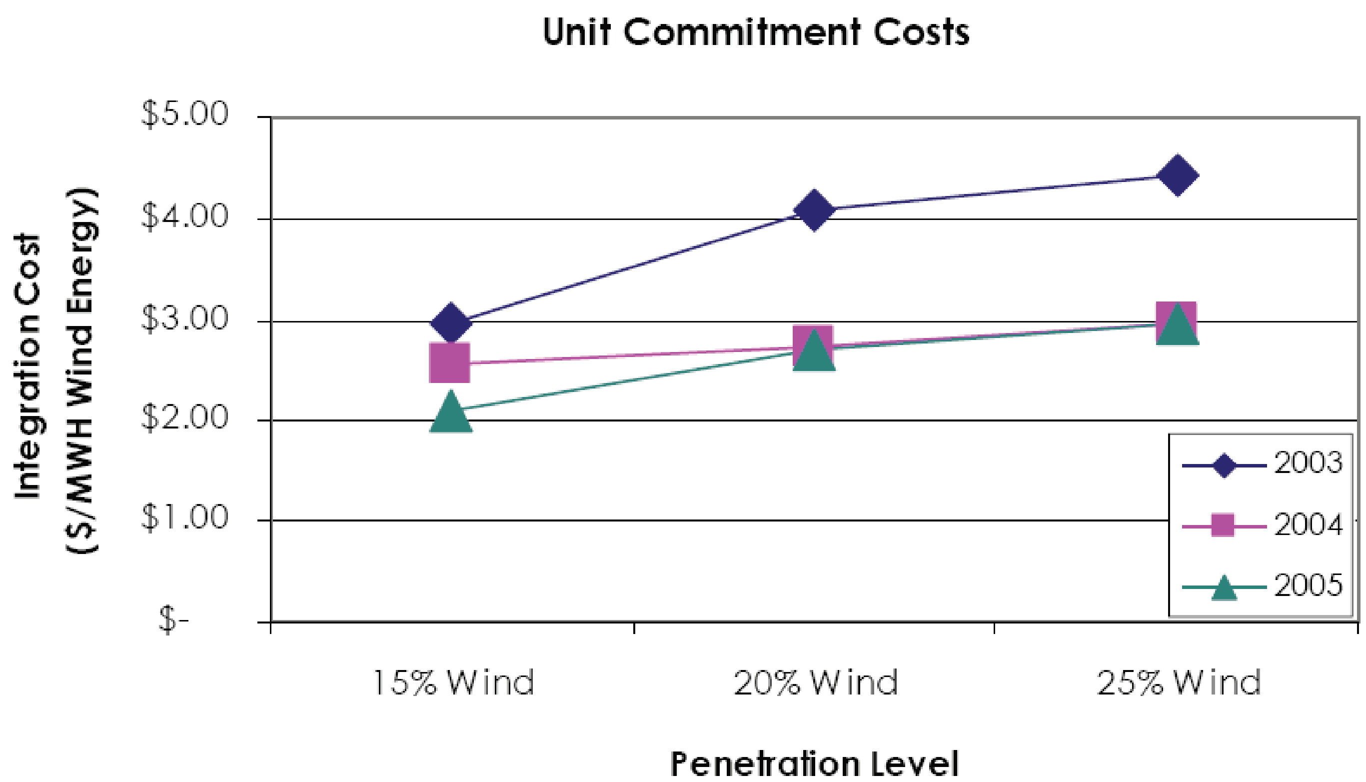


Figure 2: Unit commitment costs for three penetration levels and pattern years. Cost of incremental operating reserves is embedded.

Source: Minnesota Department of Commerce, 2006.

Key Results form Wind Integration Studies

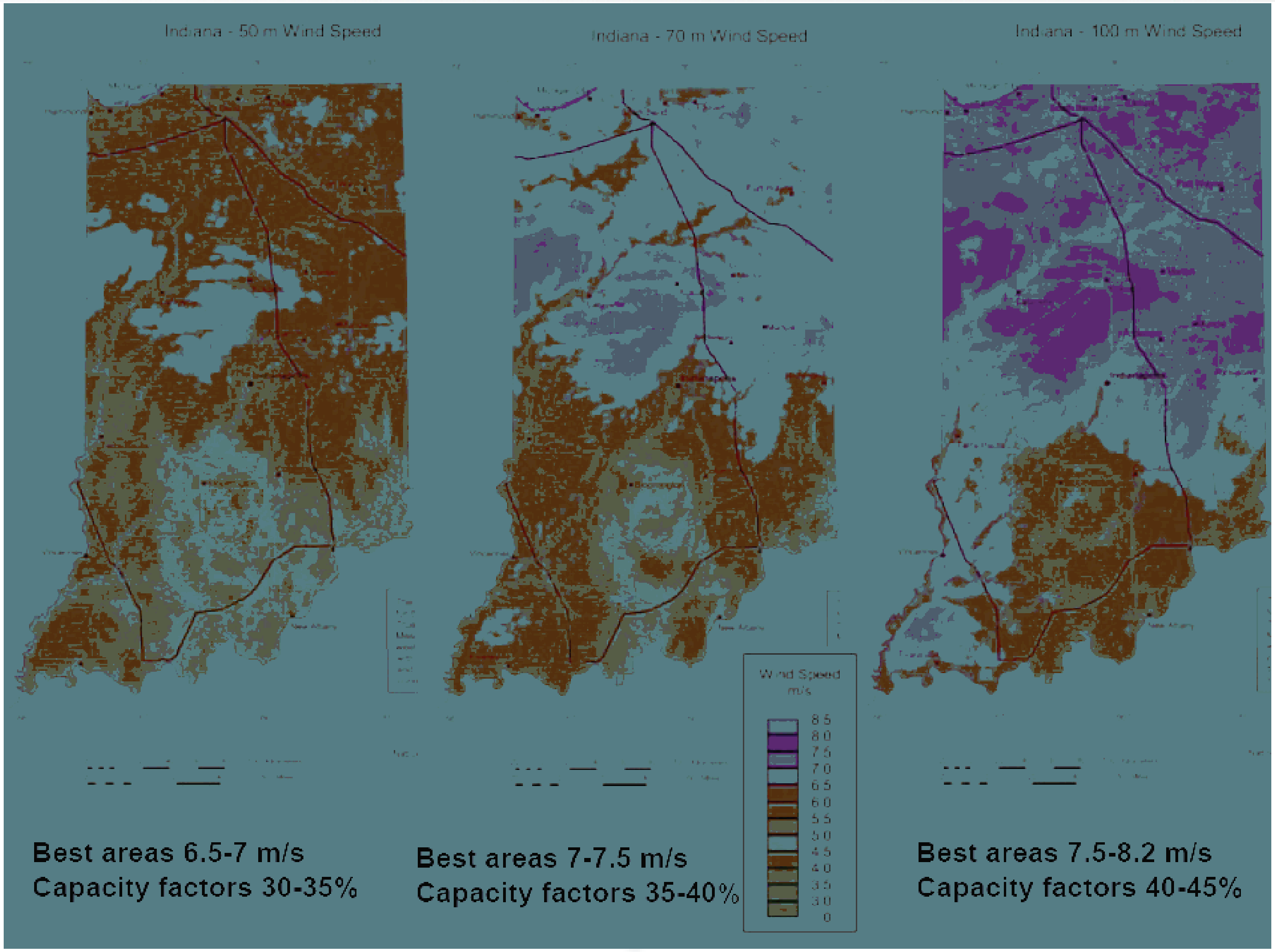
Table 6. Key Results from Major Wind Integration Studies Completed 2003-2006

Date	Study	Wind Capacity Penetration	Cost ($/MWh)				
			Regulation	Load Following	Unit Commitment	Gas Supply	TOTAL
2003	Xcel-UWIG	3.5%	0	0.41	1.44	na	1.85
2003	We Energies	4%	1.12	0.09	0.69	na	1.90
2003	We Energies	29%	1.02	0.15	1.75	na	2.92
2004	Xcel-MNDOC	15%	0.23	na	4.37	na	4.60
2005	PacifiCorp	20%	0	1.6	3	na	4.60
2006	CA RPS (multi-year)	4%	0.45*	trace	na	na	0.45
2006	Xcel-PSCo	10%	0.2	na	2.26	1.26	3.72
2006	Xcel-PSCo	15%	0.2	na	3.32	1.45	4.97
2006	MN-MISO 20%	31%	na	na	na	na	4.41**

** 3-year average* *** highest over 3-year evaluation period*

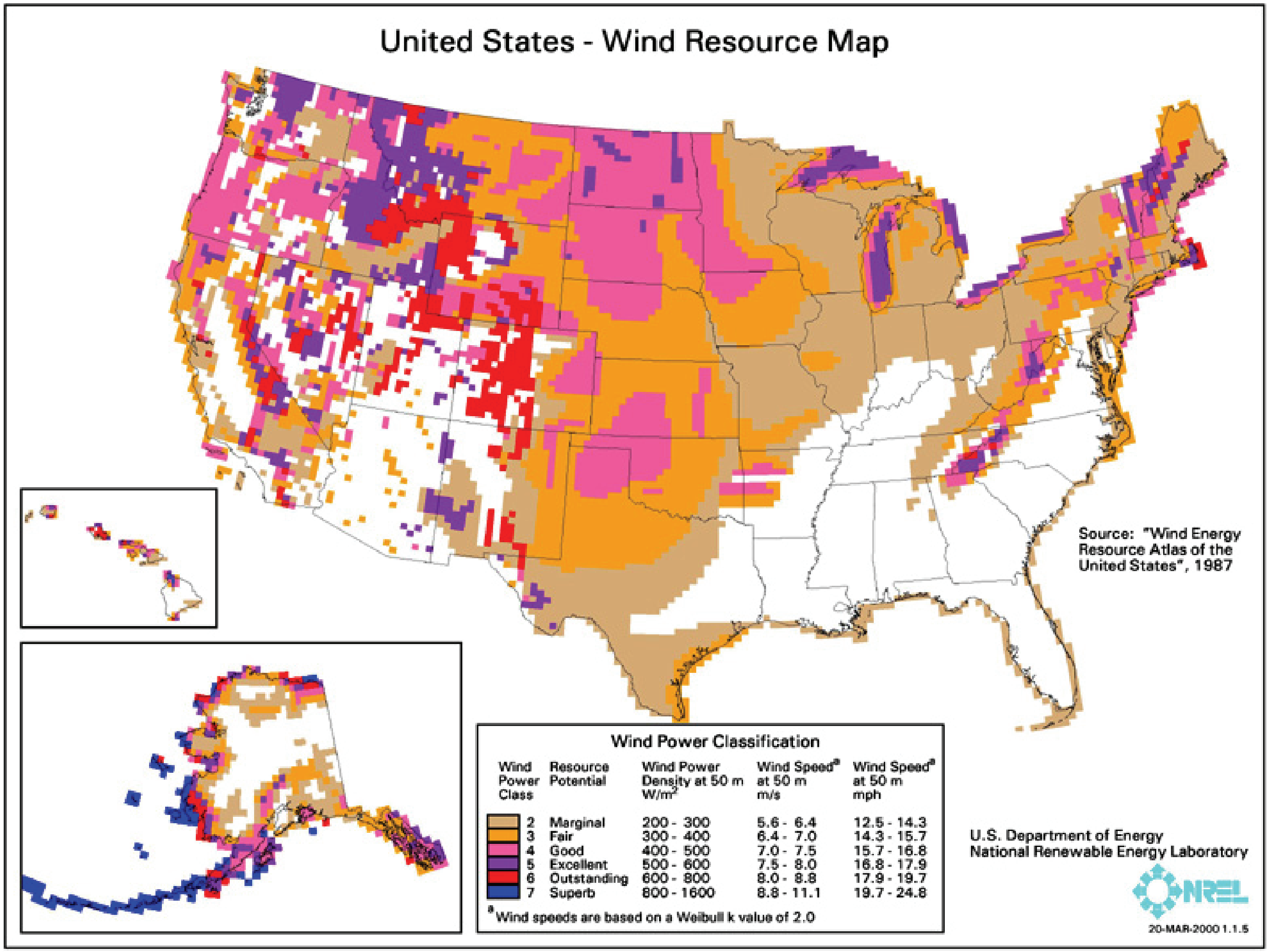
Source: National Renewable Energy Laboratory.

Wind Potential Increases with Height (Indiana Example)



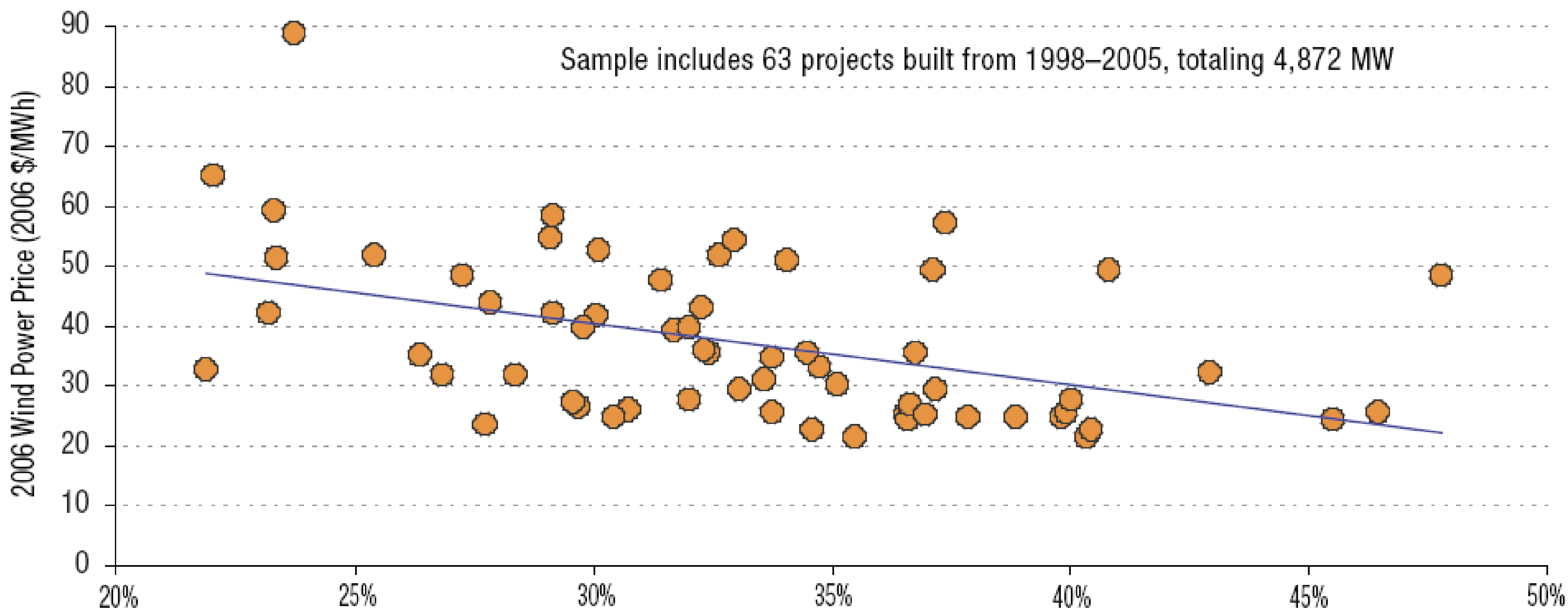
Source: Wind Powering America, NREL

United States Wind Resource Map



Source: Wind Powering America

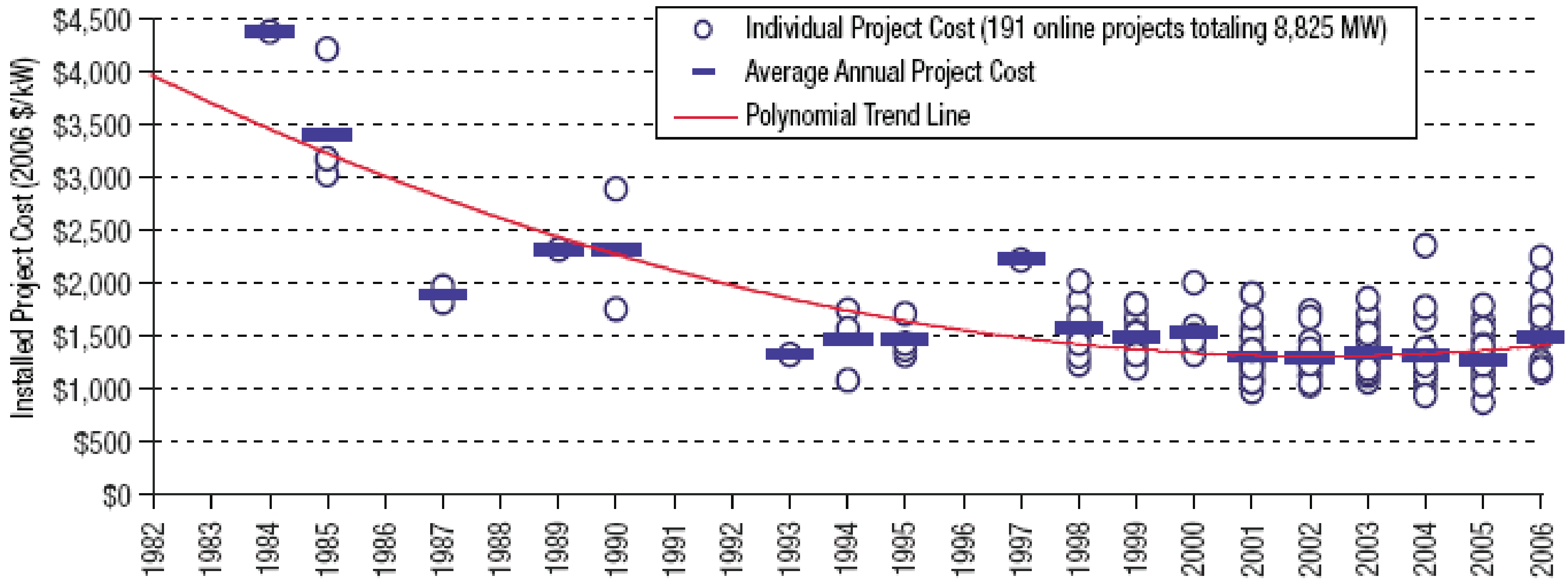
Wind Power Price



Source: Berkeley Lab database.

Figure 17. 2006 Wind Power Price as a Function of 2006 Capacity Factor

Wind Installed Cost Over Time



Source: Berkeley Lab database (some data points suppressed to protect confidentiality).

Figure 18. Installed Wind Project Costs over Time

Suggested Approach for Consumer Advocates

Support efforts to anticipate climate change regulations and to develop cost-effective energy efficiency and renewable energy.

Watch out for and oppose programs, projects, and policies that are wasteful or unfair.

