

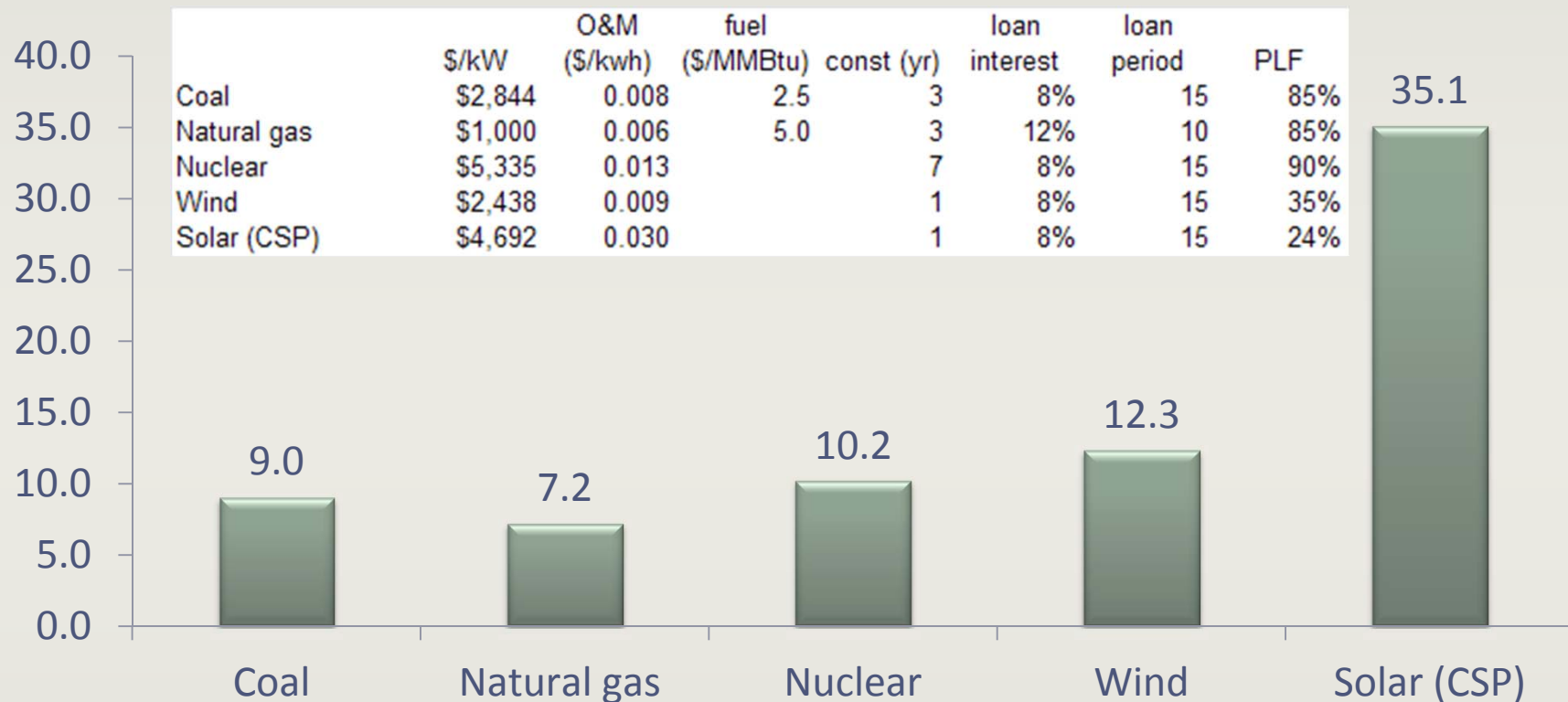


**Bureau of Economic Geology,
The University of Texas at Austin**



**Renewable Technologies & RPS
programs**

CEE Model (cents/kWh)



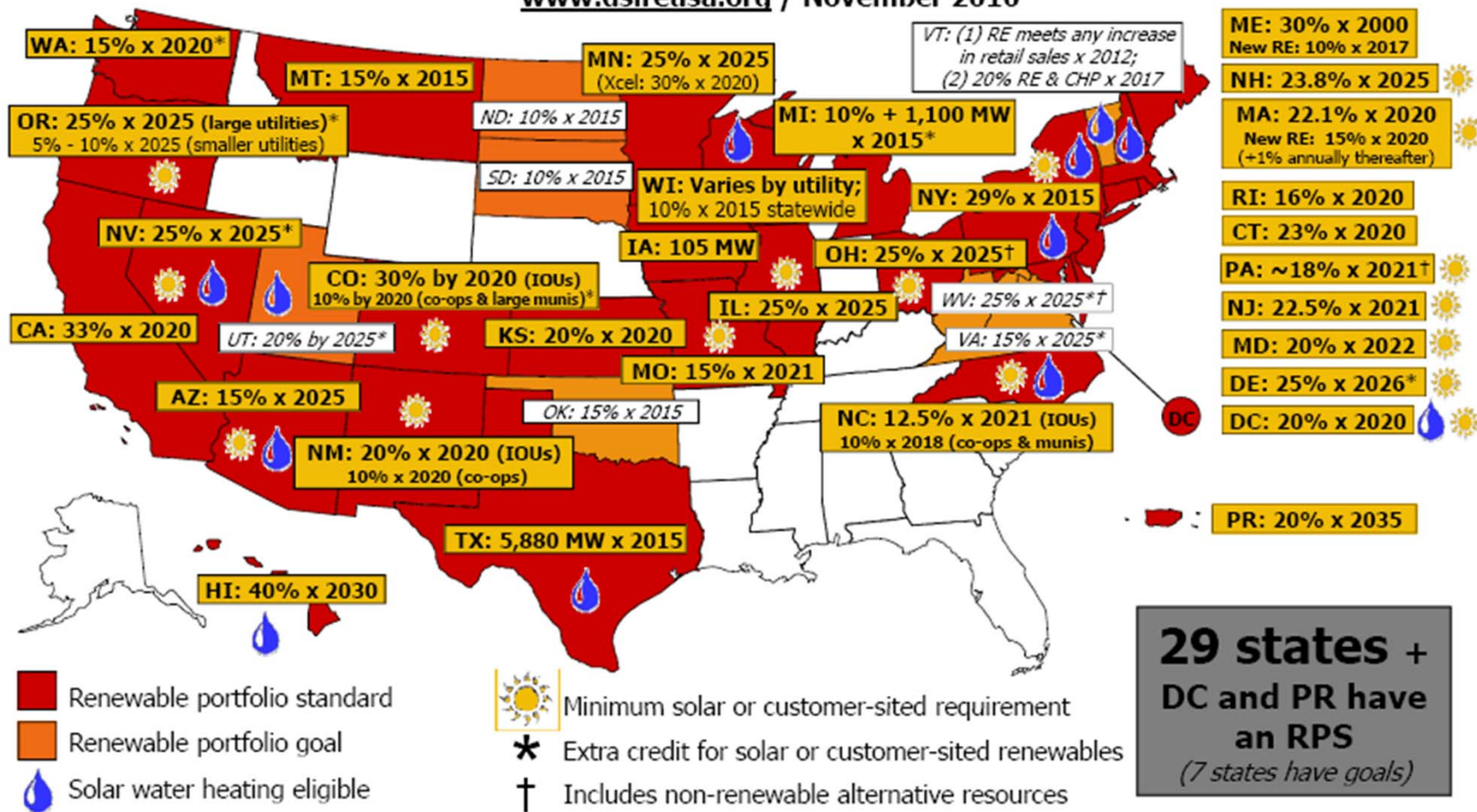
Capital and O&M costs are based on EIA's Nov 2010 report:
http://www.eia.gov/oiaf/beck_plantcosts/index.html

What Is a Renewables Portfolio Standard?

- A requirement on retail electric providers to supply a minimum percentage or amount of their retail load with eligible sources of renewable energy.
- About 30 jurisdictions in the U.S. have an RPS program; no two are identical. But the following are common:
 - Penalties for non-compliance
 - Renewable energy credit/certificate (REC) trading

RPS Policies

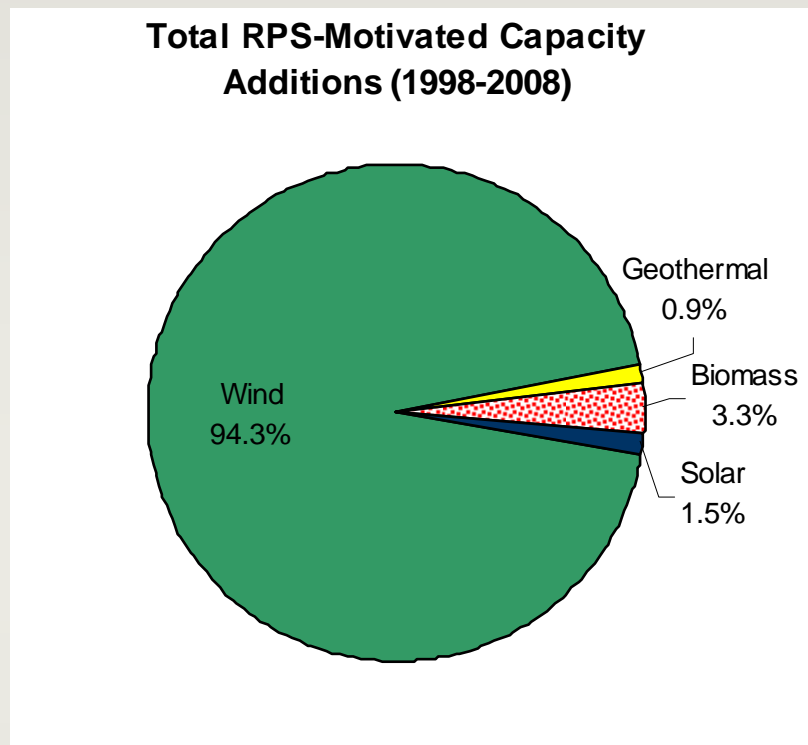
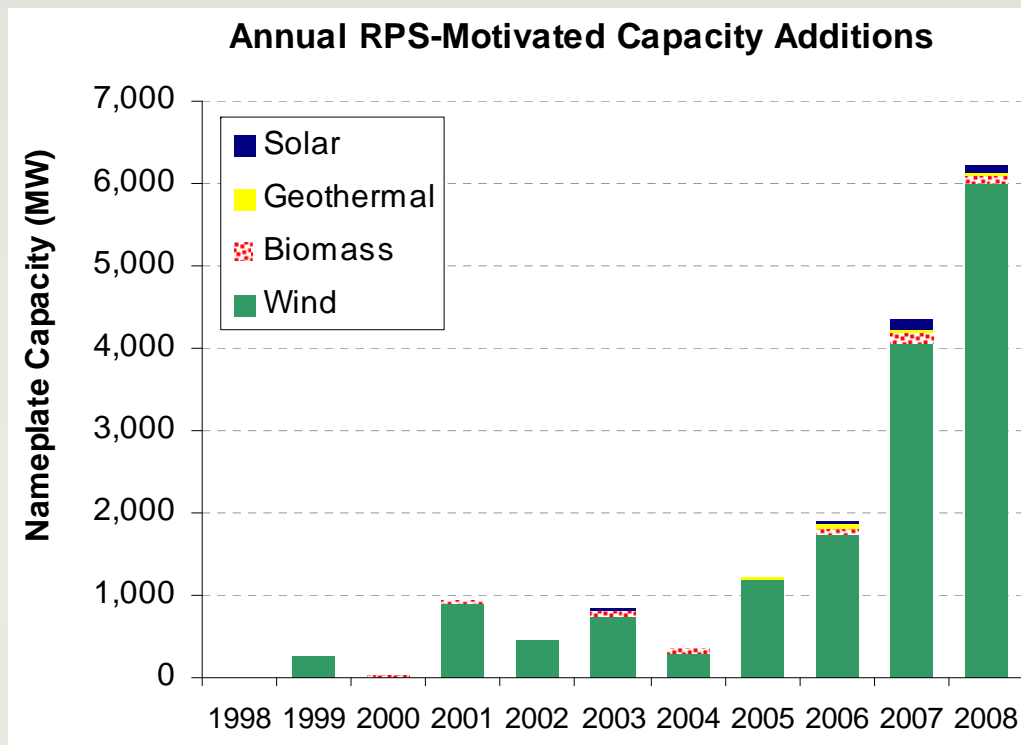
www.dsireusa.org / November 2010



Some of the design differences...

- Resource eligibility
- Geographic eligibility
- Trading of RECs
- Renewable purchase targets and timeframes
- Entities obligated to meet RPS, and use of exemptions
- Treatment of existing renewable projects
- Use of credit multipliers for favored technologies
- Methods to enforce compliance
- Existence and design of cost/rate caps
- Compliance flexibility rules, and waivers from compliance
- Compliance cost recovery

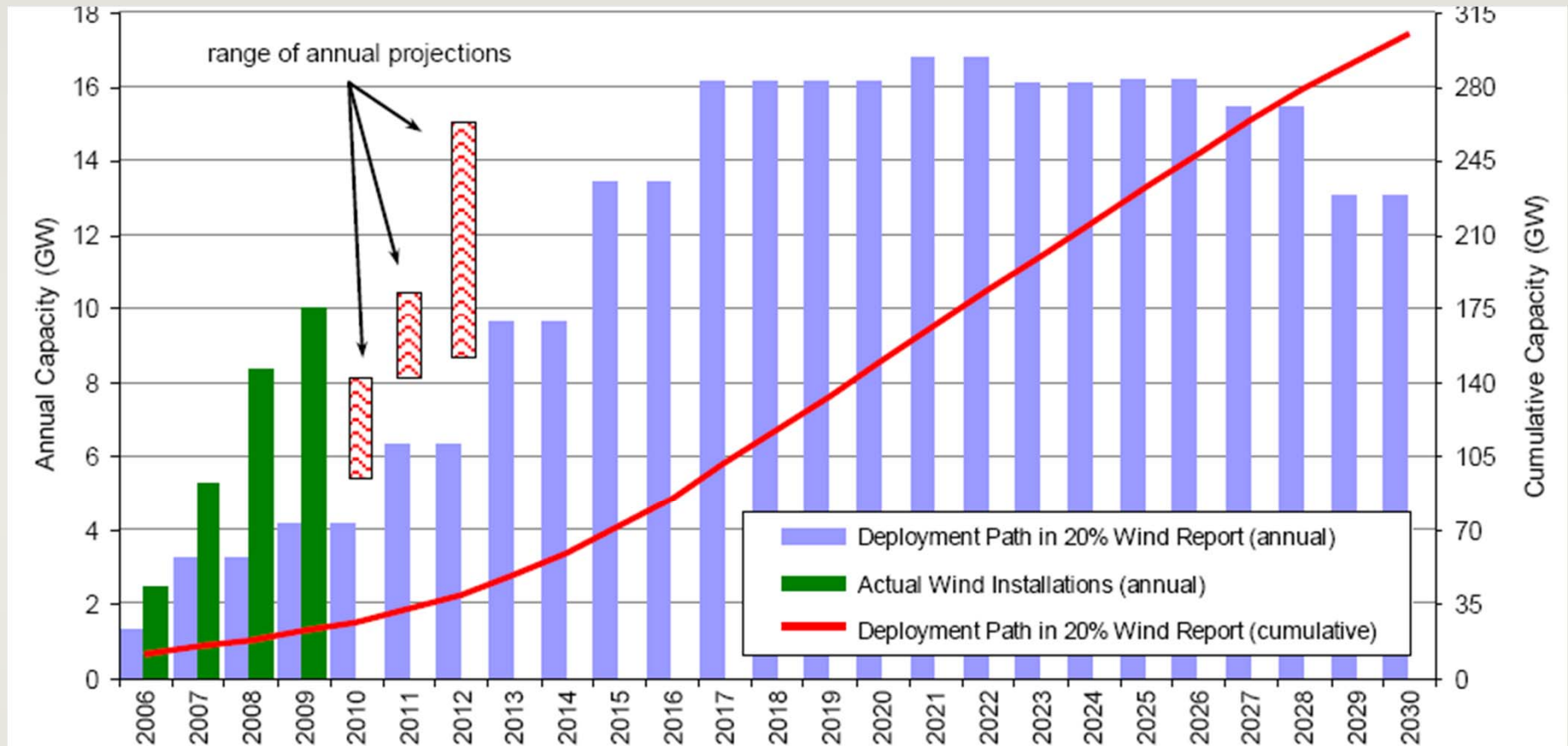
It has been a wind story so far



**Renewable additions counted as occurring in an RPS state only if commercial operation began no more than one year before the first compliance year of the host state*

Source: Galen Barbose, Lawrence Berkeley National Lab, presentation at the IAEE Conference, June 2009.

Actual wind installations compared to 20% Wind Report

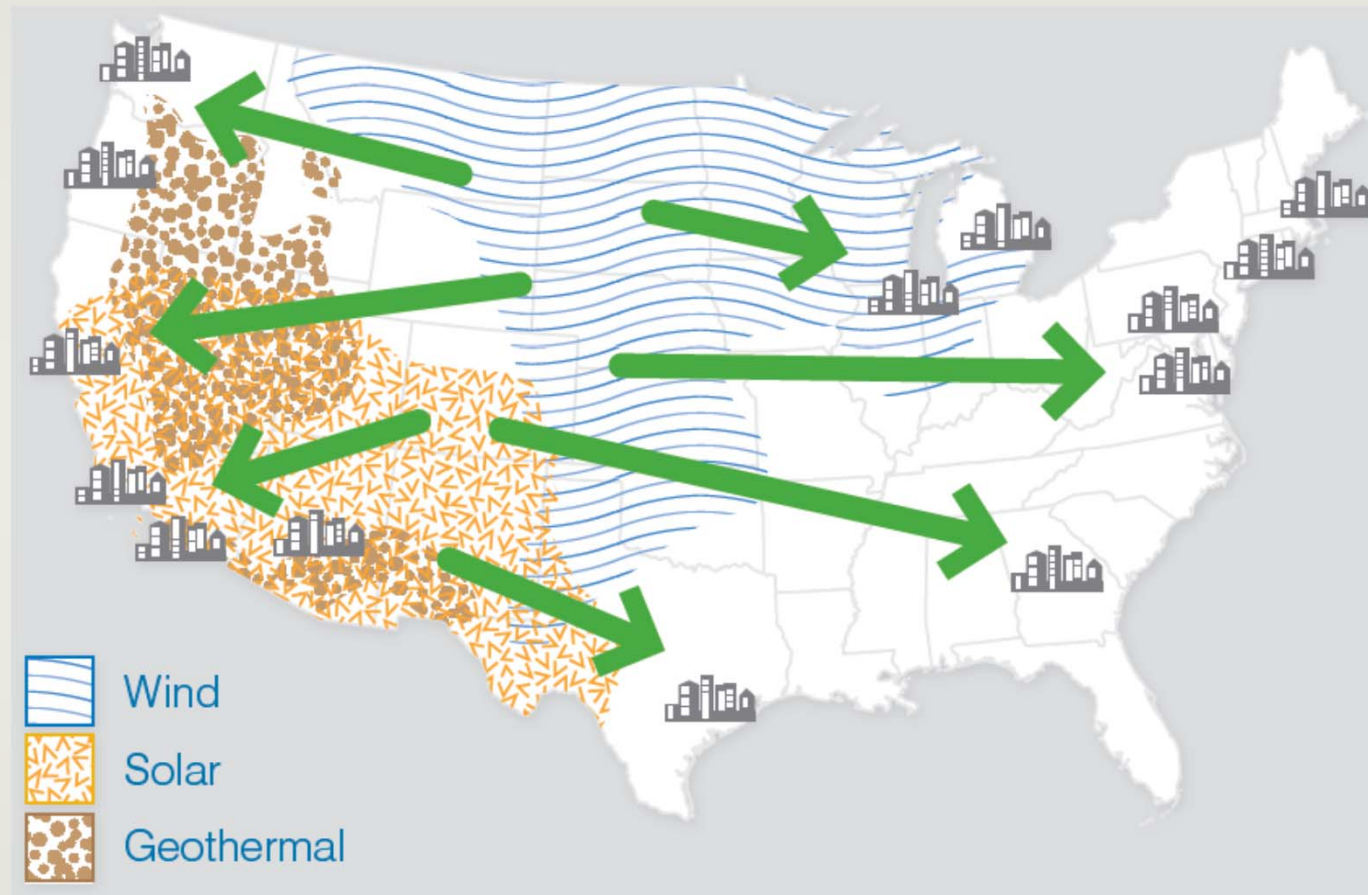


Source: 2009 Wind Technologies Market Report, Energy Efficiency and Renewable Energy, DOE, August 2010. Main authors are Ryan Wiser and Mark Bolinger from Lawrence Berkeley National Laboratory.

Biggest obstacles facing renewables

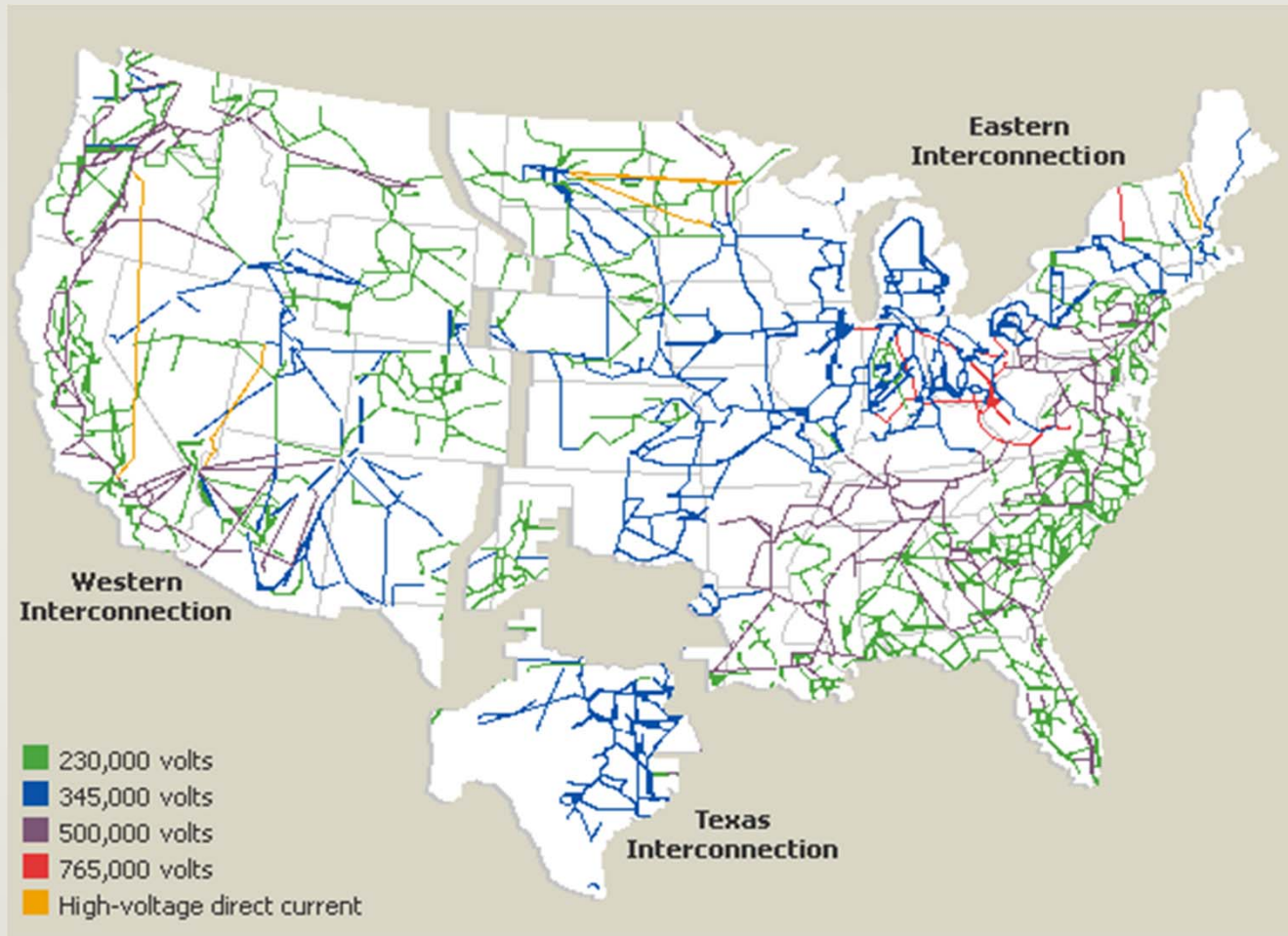
- Transmission
 - Expensive
 - Siting resisted by various stakeholders
 - Questions about cross-jurisdictional authority
- Cost
- Intermittency

Green Power Superhighways

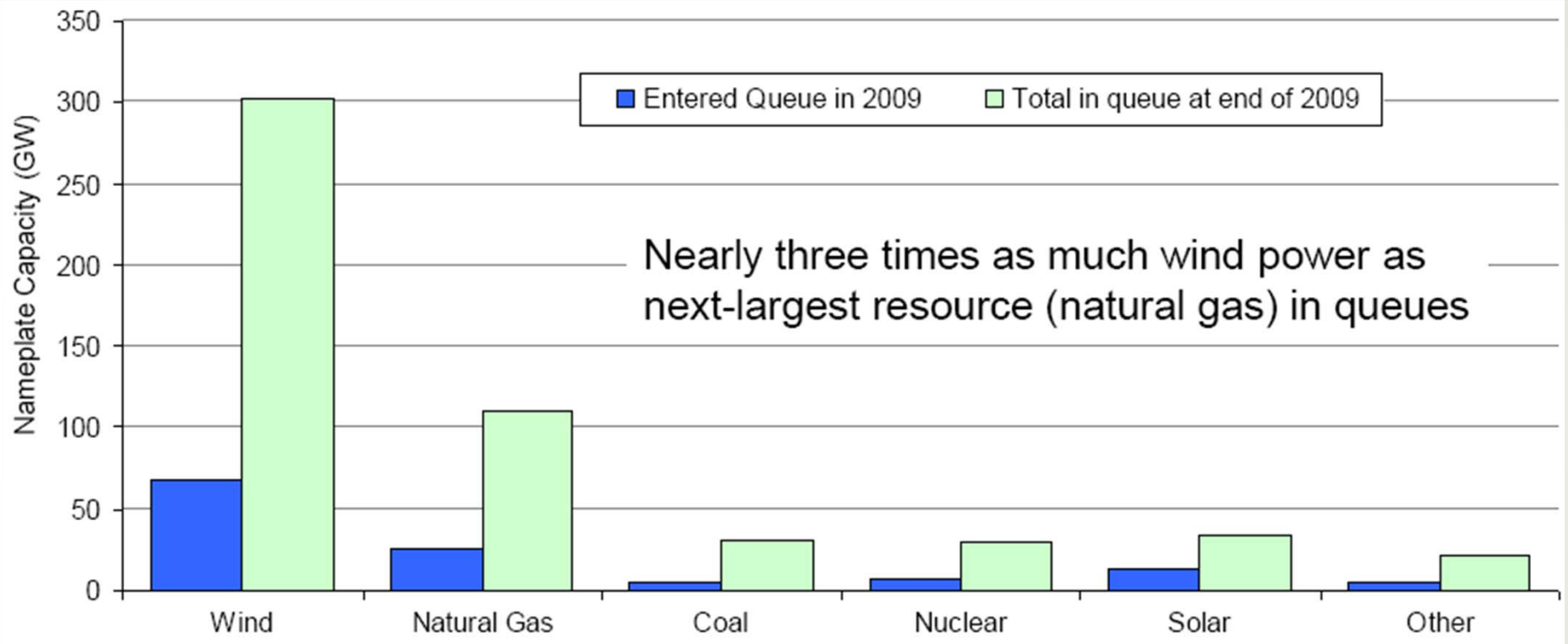


Source: Green Power Superhighways, a joint publication of AWEA and SEIA, February 2009

Current grid

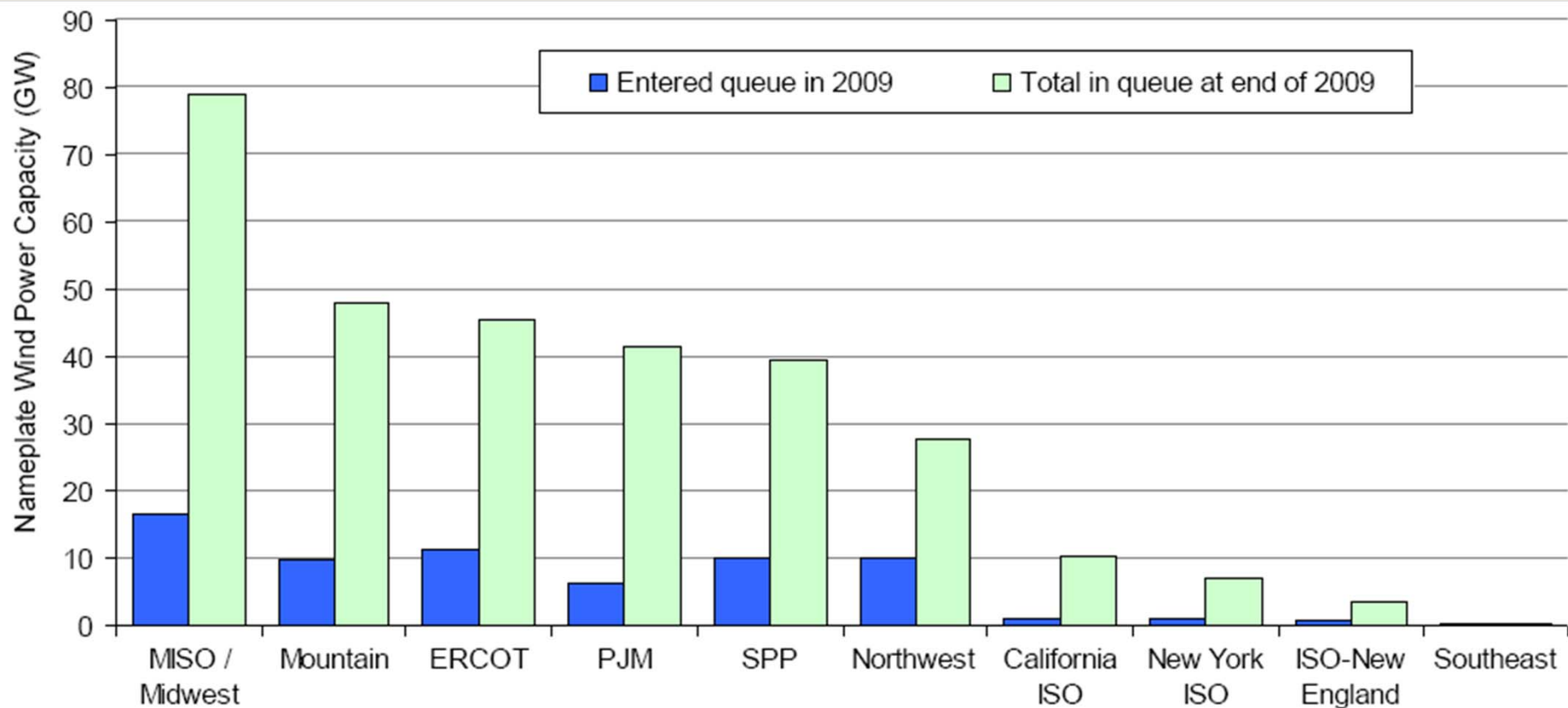


In transmission queue



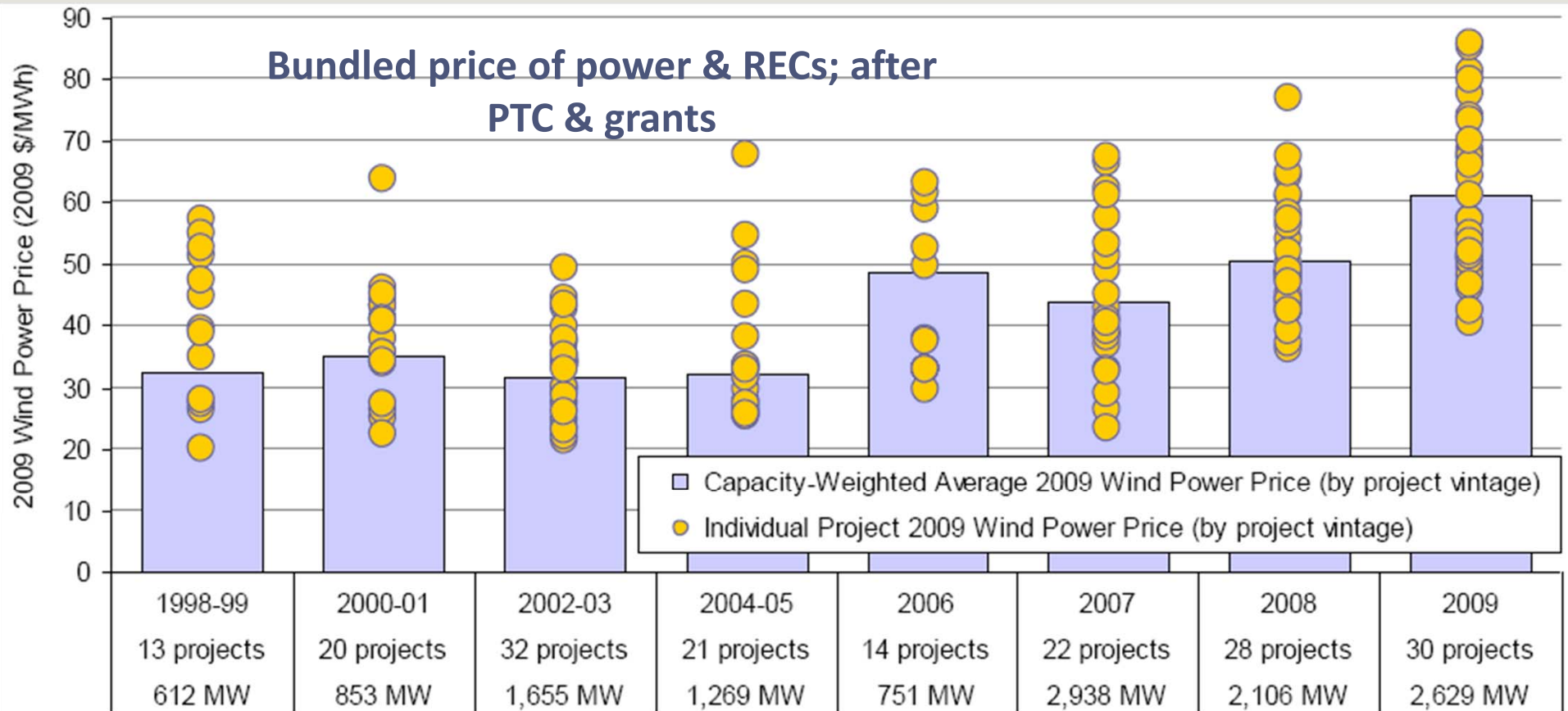
Source: 2009 Wind Technologies Market Report, Energy Efficiency and Renewable Energy, DOE, August 2010. Main authors are Ryan Wiser and Mark Bolinger from Lawrence Berkeley National Laboratory.

Regional differences in transmission queues



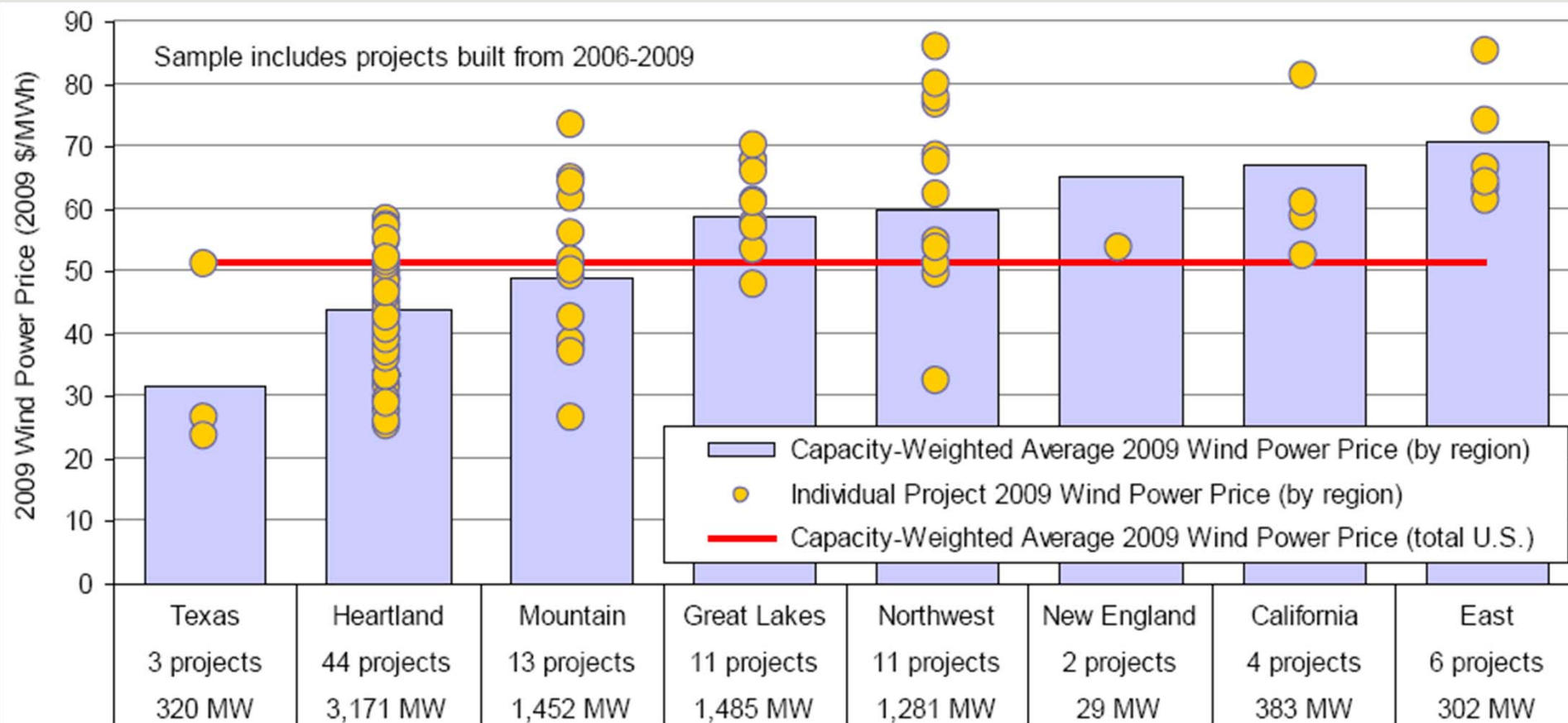
Source: *2009 Wind Technologies Market Report*, Energy Efficiency and Renewable Energy, DOE, August 2010. Main authors are Ryan Wiser and Mark Bolinger from Lawrence Berkeley National Laboratory.

Increasing price of wind



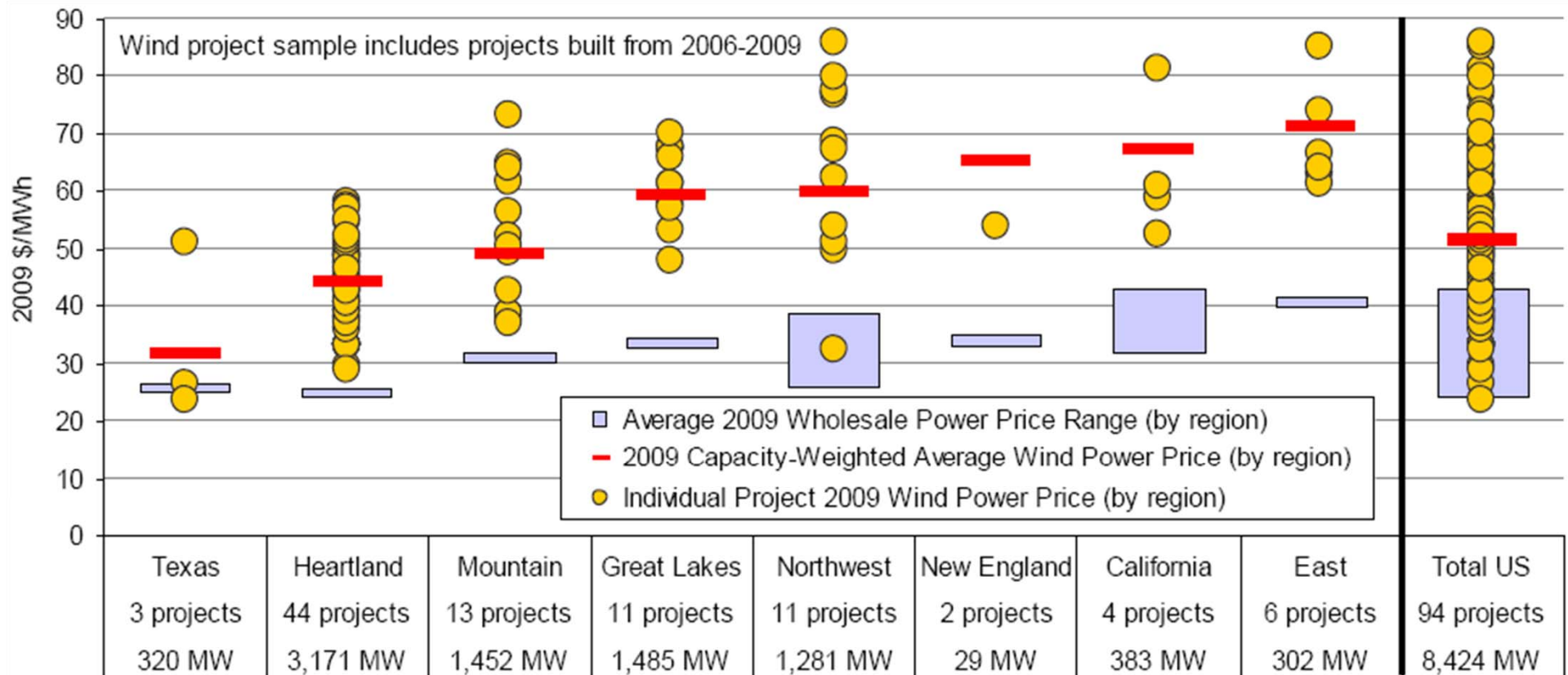
Source: *2009 Wind Technologies Market Report*, Energy Efficiency and Renewable Energy, DOE, August 2010. Main authors are Ryan Wiser and Mark Bolinger from Lawrence Berkeley National Laboratory.

Regional price differences



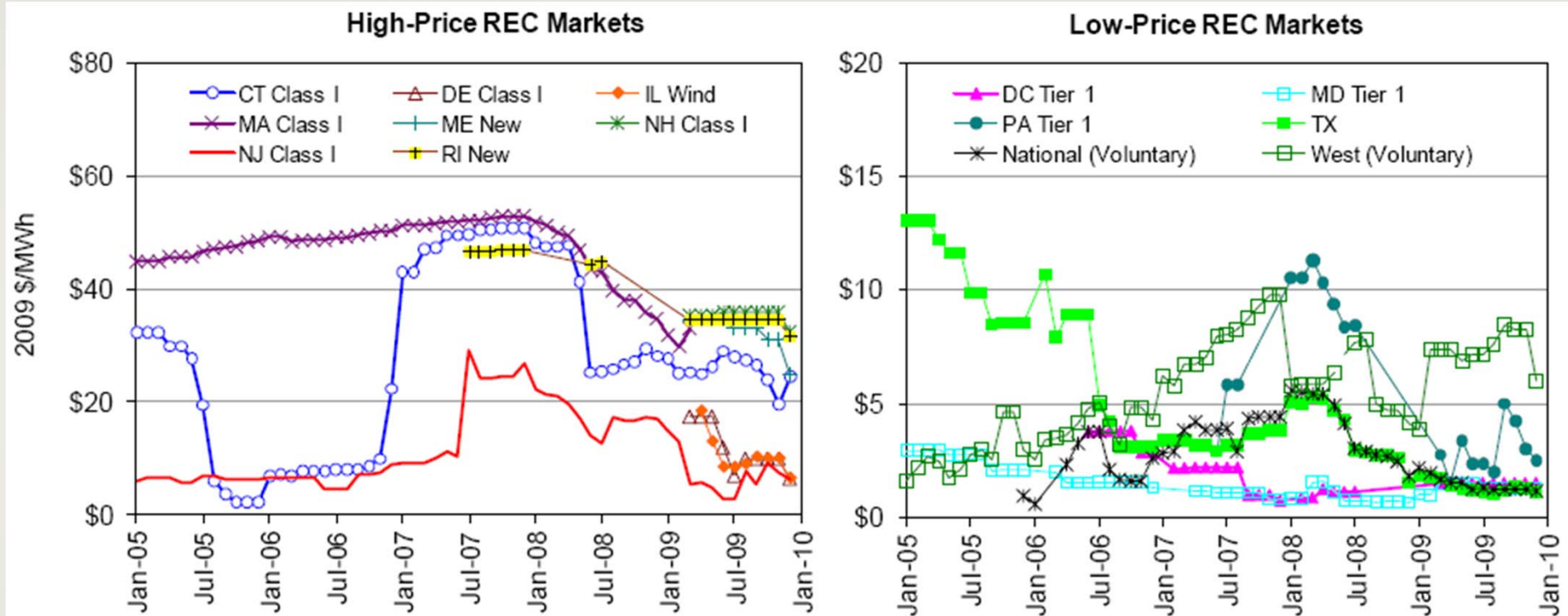
Source: *2009 Wind Technologies Market Report*, Energy Efficiency and Renewable Energy, DOE, August 2010. Main authors are Ryan Wiser and Mark Bolinger from Lawrence Berkeley National Laboratory.

Reduced competitiveness in most markets



Source: 2009 Wind Technologies Market Report, Energy Efficiency and Renewable Energy, DOE, August 2010. Main authors are Ryan Wiser and Mark Bolinger from Lawrence Berkeley National Laboratory.

REC prices matter in few markets



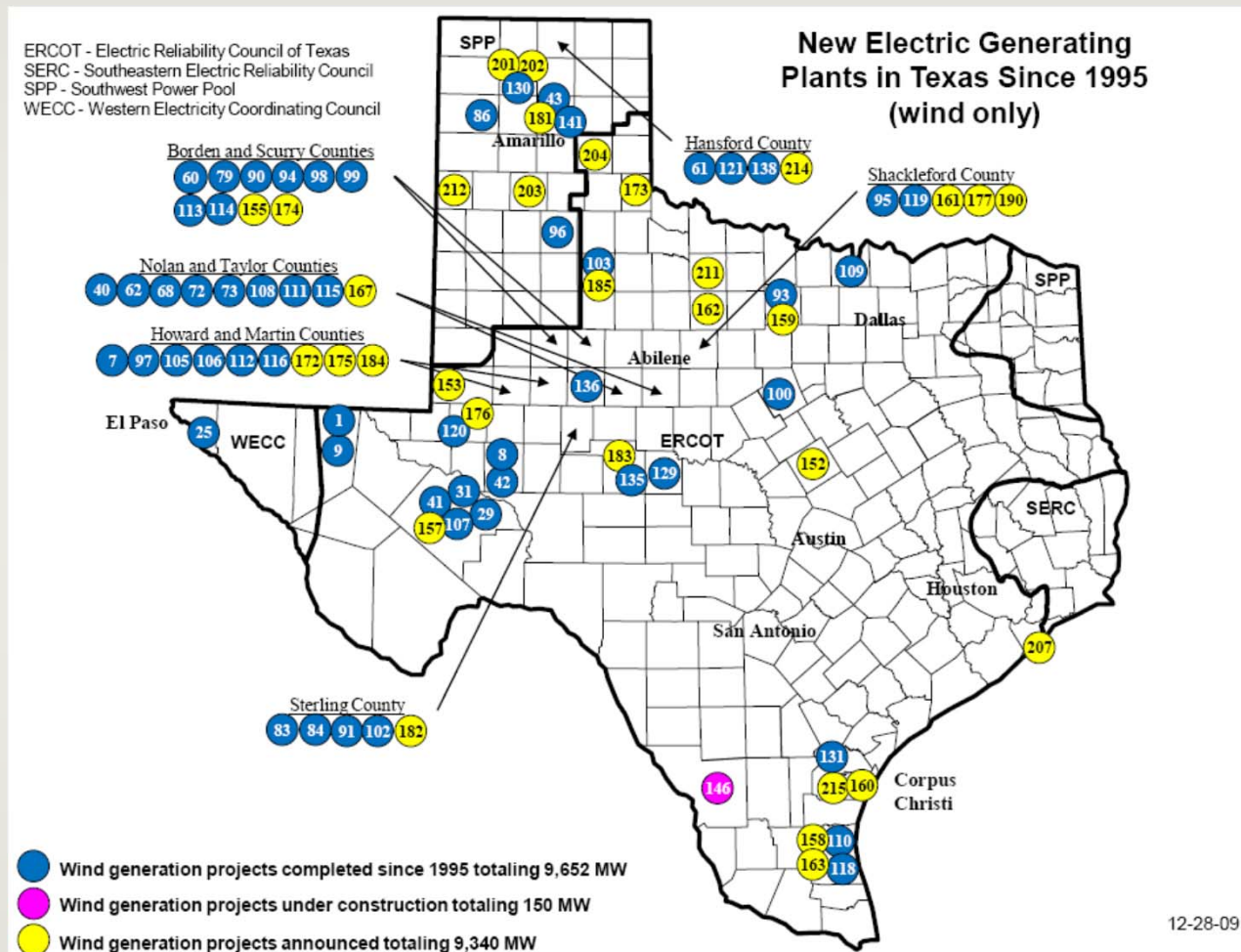
Source: *2009 Wind Technologies Market Report*, Energy Efficiency and Renewable Energy, DOE, August 2010. Main authors are Ryan Wiser and Mark Bolinger from Lawrence Berkeley National Laboratory.

Texas added a lot of wind

- ~9 GW of new renewables capacity since 2000 – much greater than RPS targets
- Top reasons for rapid expansion
 - Federal PTC
 - Availability of high quality wind resources
 - Competitive market design:
 - REC tracking easy due to ERCOT metering for settlement
 - Ease of transmission siting & interconnection, and cost uplift
 - Non-discriminatory access to the grid
 - Natural gas on the margin
 - State's tax abatement policies implemented by host municipalities.

Source: Lessons Learned from REC Trading in Texas, CEE-UT, December 2009,
http://www.beg.utexas.edu/energyecon/transmission_forum/tf.php

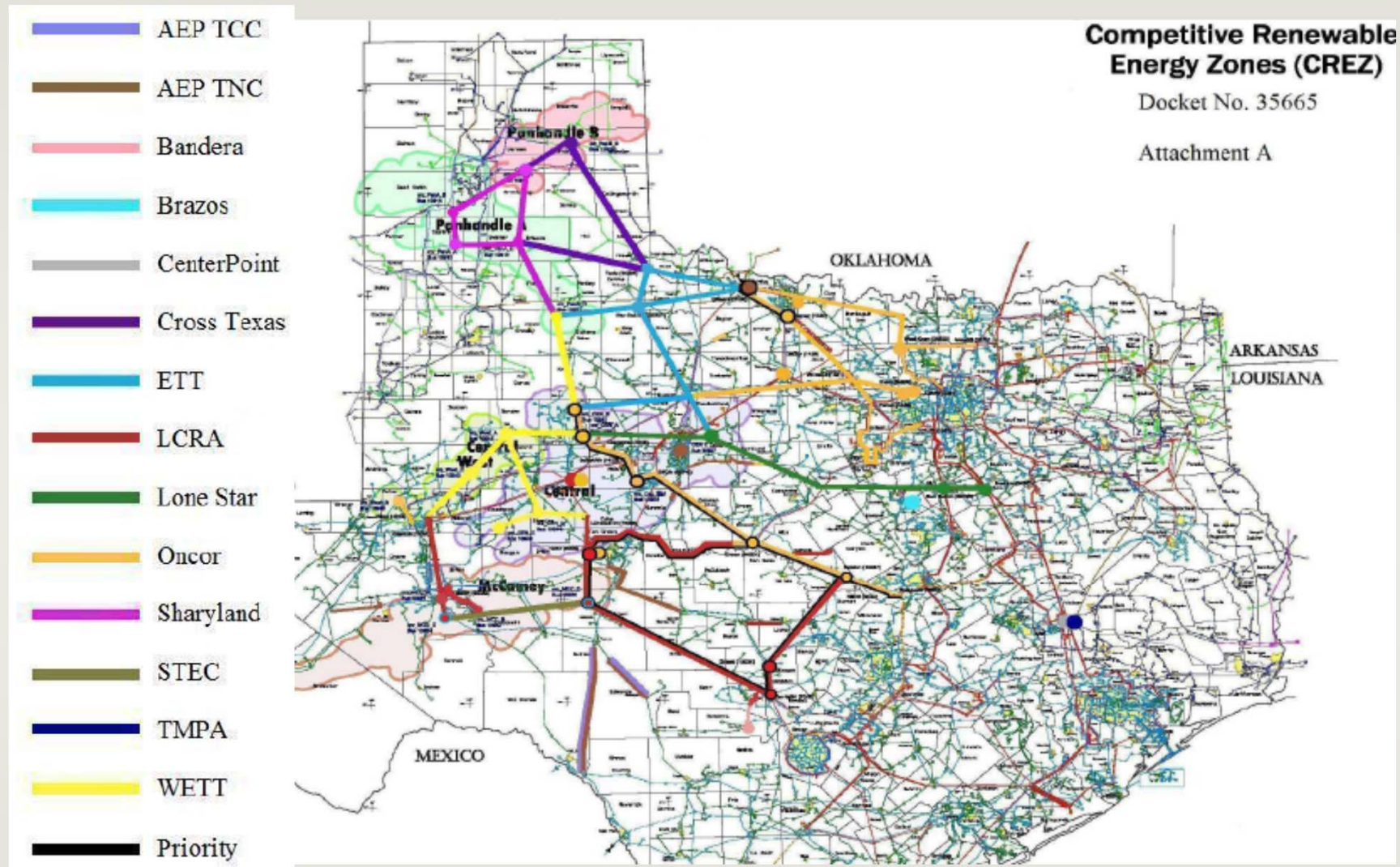
Mostly away from load centers



Considerations Going Forward

- Expansion of transmission
 - Negative zonal bidding: $-(PTC+REC)$ lowest bid
 - Cost of CREZ projects
 - Delays in CREZ development → private lines
 - Priority dispatch not consistent with open access
 - Capacity conversion factor calculation
- Reliable integration of more wind into the grid and its impact on other fuels
- Diversifying renewables (solar, biomass, etc.)
- Federal RPS (could create new markets for excess RECs in Texas)

Source: Lessons Learned from REC Trading in Texas, CEE-UT, December 2009,
http://www.beg.utexas.edu/energyecon/transmission_forum/tf.php

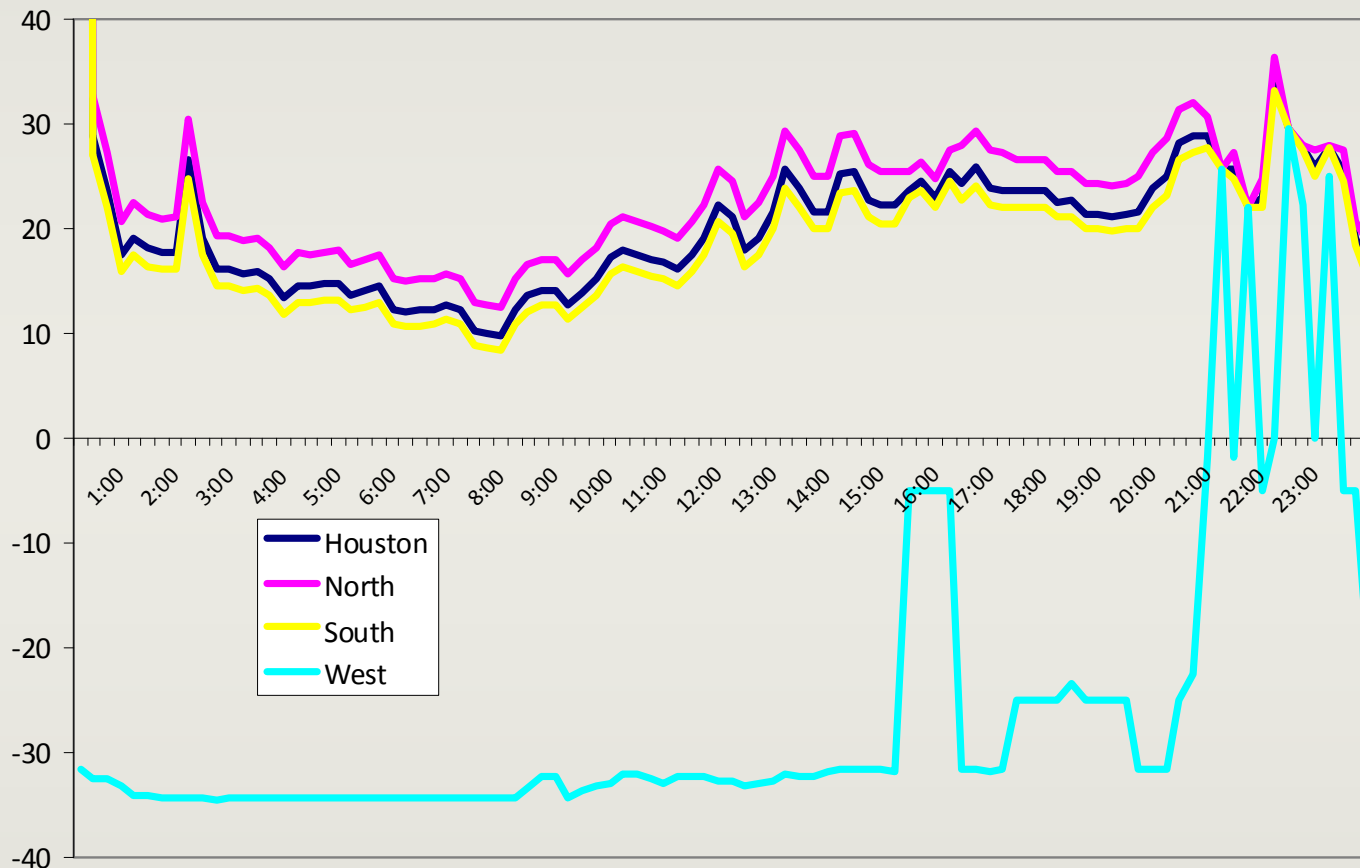


Source: PUCT (http://www.puc.state.tx.us/electric/maps/CREZ_Map_Attach_A.pdf)

Balancing Market Prices

April 26, 2009

MCPE (\$/MWh)

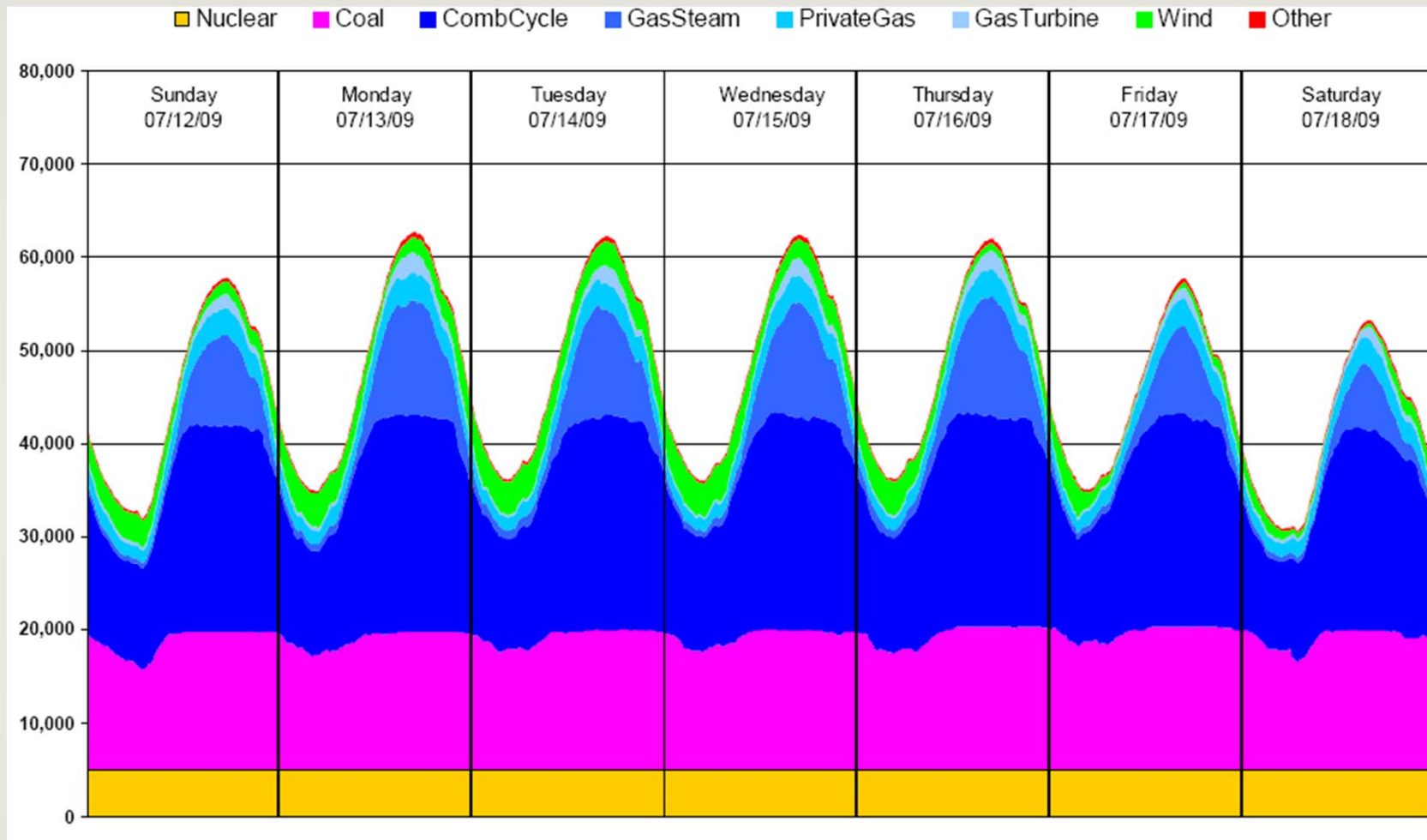


Negative price intervals (West)

2006	76
2007	338
2008	4894
2009	3069
2010	3477 (as of Oct 31)

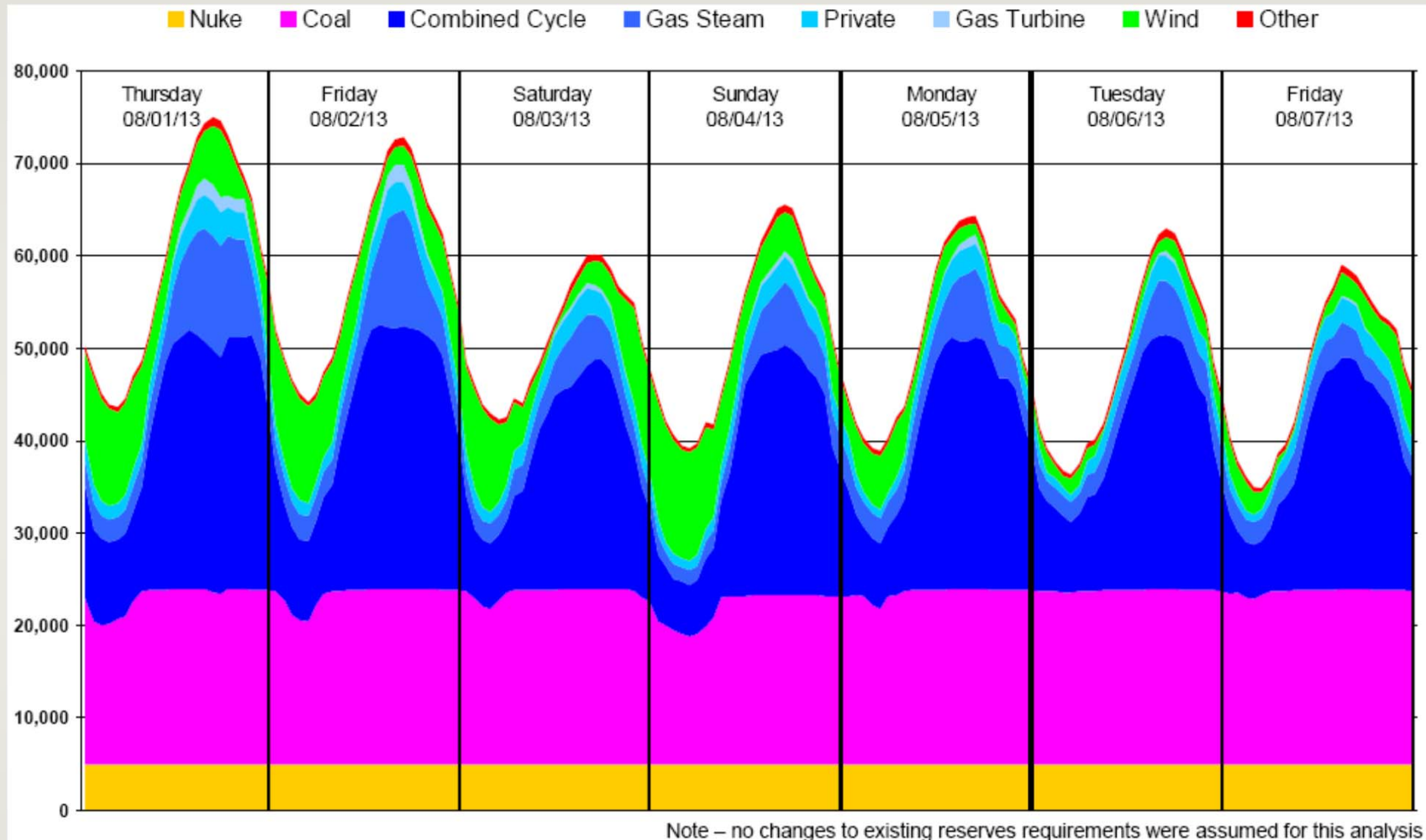
For a detailed discussion, see “Wind and Energy Markets: A Case Study of Texas” by Ross Baldick, *USAEE Dialogue*, Vol 18 No 2, dialogue.usaee.org

Impact of Wind – Peak Summer '09



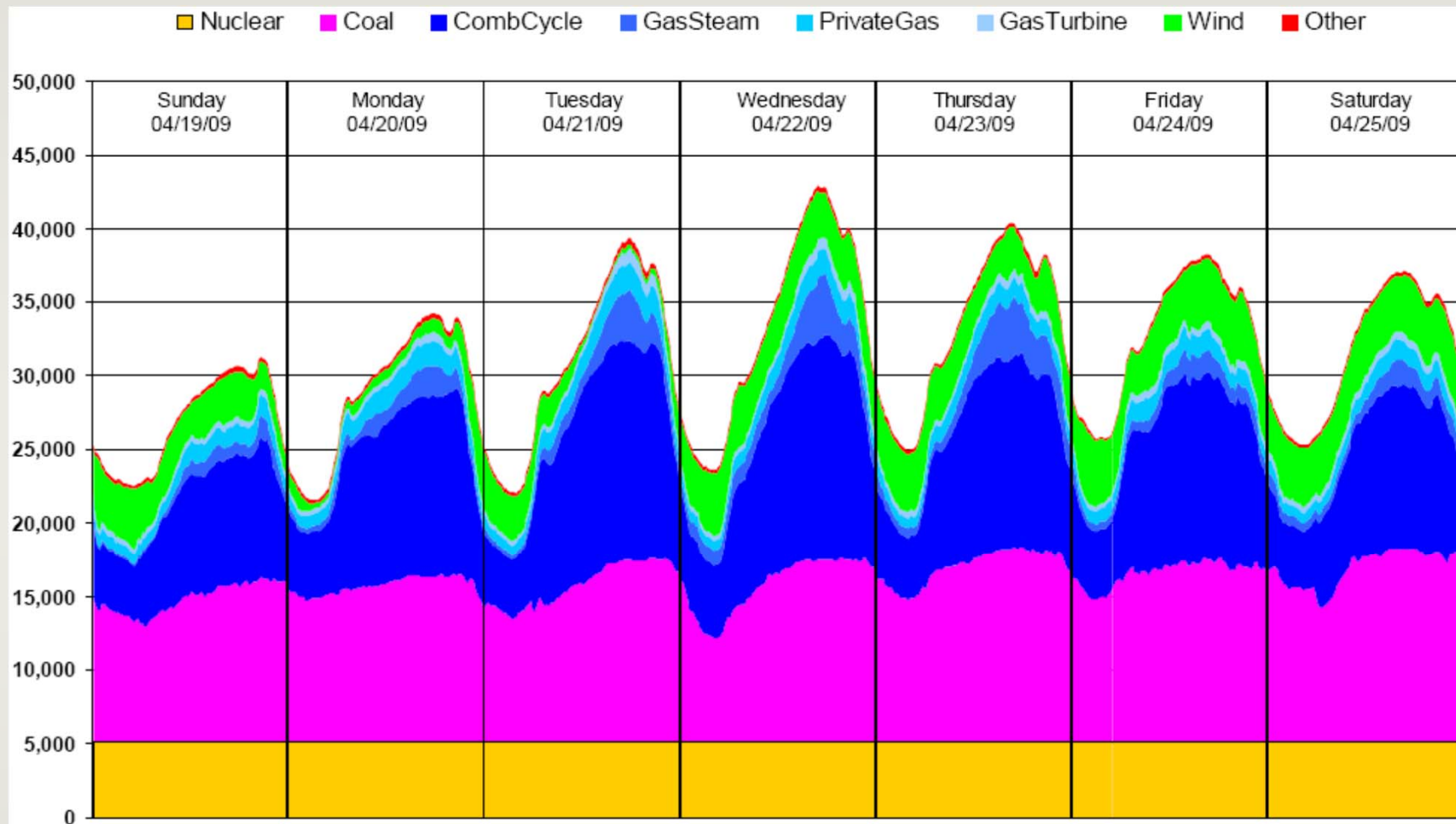
Source: ERCOT data as presented by PUCT Chairman Smitherman, "Public Priorities and the Role of Competition" (KEMA's 21st Executive Forum, March 30, 2010).

Impact of Wind – Peak Summer '13



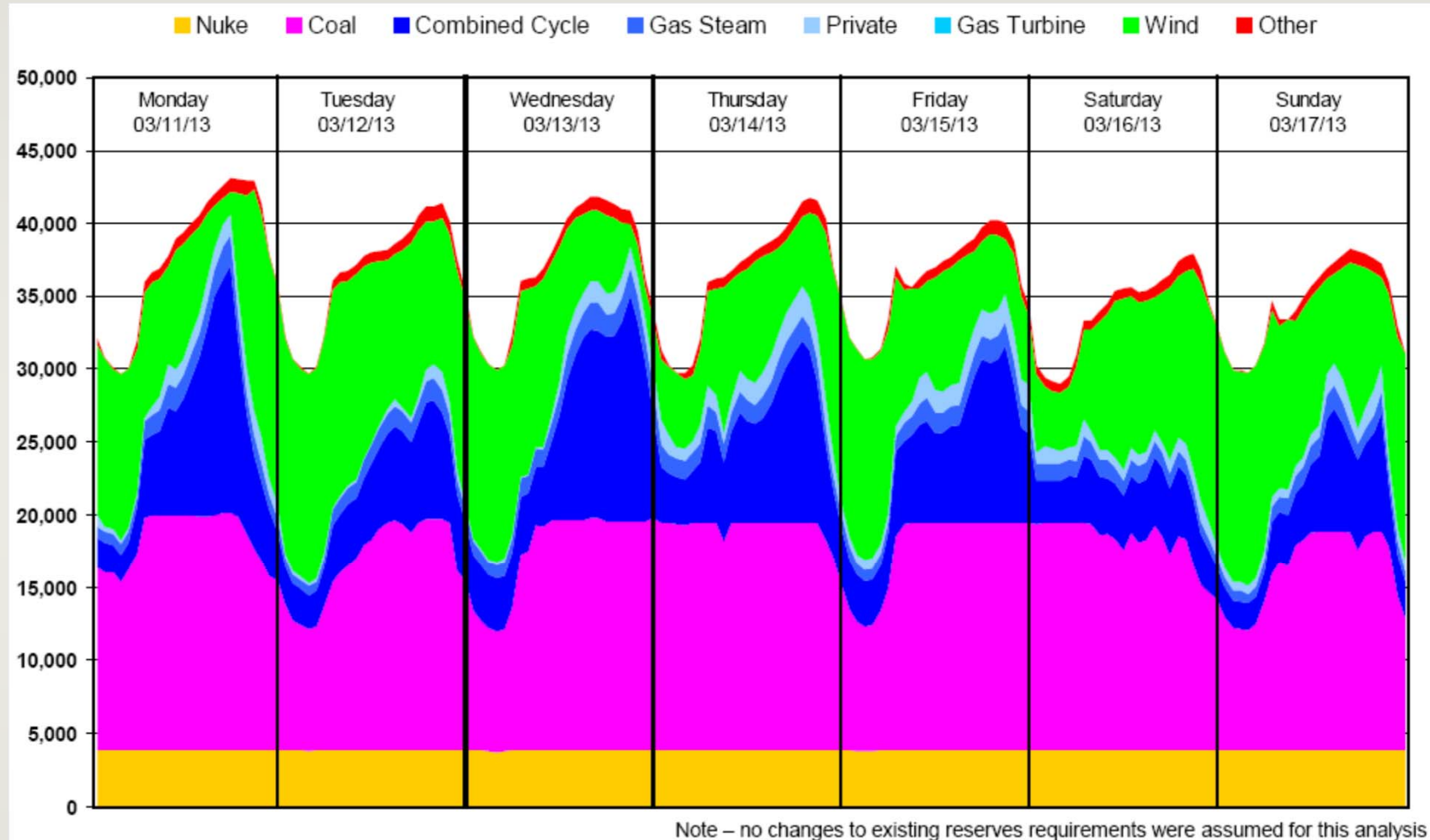
Source: ERCOT data as presented by PUCT Chairman Smitherman, “Public Priorities and the Role of Competition” (KEMA’s 21st Executive Forum, March 30, 2010).

Impact of Wind – Typical Spring '09



Source: ERCOT data as presented by PUCT Chairman Smitherman, “Public Priorities and the Role of Competition” (KEMA’s 21st Executive Forum, March 30, 2010).

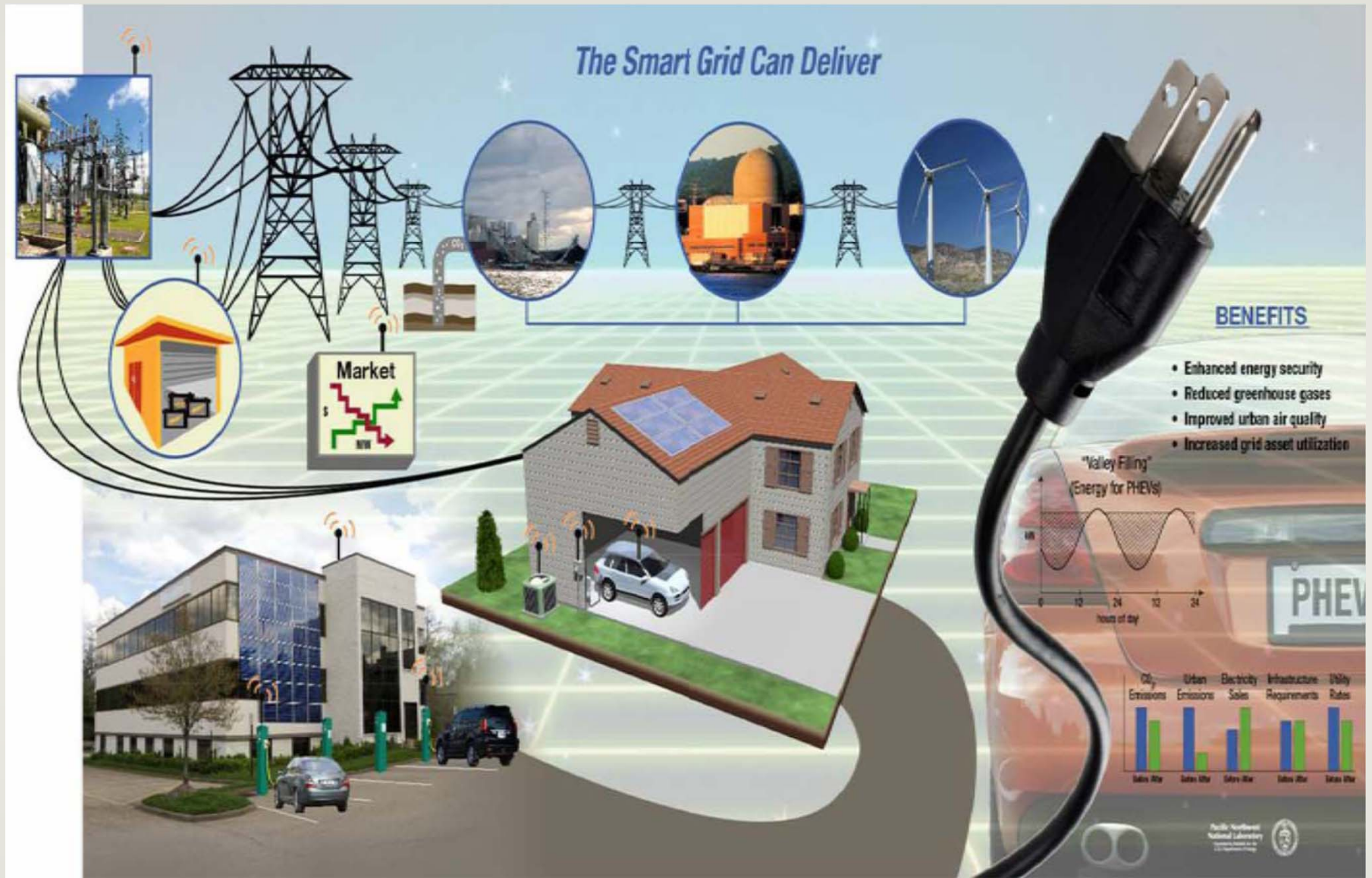
Impact of Wind – High Wind '13



Source: ERCOT data as presented by PUCT Chairman Smitherman, “Public Priorities and the Role of Competition” (KEMA’s 21st Executive Forum, March 30, 2010).

Few observations on load profiles

- Wind generation does not match peak load well
- Wind generation does not match seasonal demand well
- Wind is most available during “valleys” → opportunity for charging EVs (a convenient way to store electricity)
- But, will consumers charge at night?



Source: DOE

SG funding issues

- ARRA funding shortfalls
 - In August, \$3.4 billion worth of SG projects were at risk of not getting funding since they may not finalize their contracts with DOE, suppliers and utilities and/or filings with regulators by the fiscal year deadline.
 - only \$8 billion out of \$35 billion appropriated was spent by the Sep 31 deadline (although \$33 billion has been awarded).

Issues with SG projects

- PUCs review cost implications more closely (e.g., BG&E case)
- Some consumers took utilities to court for cost increases (e.g., PG&E)
- Xcel Energy's Smart Grid City ended up with higher costs than predicted
- Installed meters not standard within grids; do not communicate with all in-house devices

Which SG applications?

- To fully realize SG benefits from small consumers, need
 - Standards in smart meters and in-home devices (seamless communication)
 - Making it easier for consumers (phone apps?)
 - Time differentiated pricing
- Without these, we should probably leave small consumers alone (for now) and focus on T&D applications of SG.

In closing

- It will be difficult to build more wind until
 - CREZ lines are built
 - Credit market (economic) conditions improve
 - Reliability and other generators' concerns are addressed
- PTC will remain necessary, especially in a low natural gas price environment

In closing

- It will be difficult to build non-wind alternatives without additional incentives/mandates
 - All such bills failed at the 2009 TX legislature mostly due to high cost concerns
 - Many other states has solar and/or DG set-asides