

CONFIDENTIAL

**ERCOT: We Have a ~~Problem~~ Opportunity:  
Managing the Texas Electricity Market in  
Times of Uncertainty**

**BEG Center for Energy Economics  
December 8, 2011**



**Challenging Times Ahead in the ERCOT Market?**

"We are very concerned about the significant drop in the reserve margin. If we stay in the current cycle of hot and dry summers, we will be very tight on capacity next summer and have a repeat of this year's emergency procedures and conservation appeals."

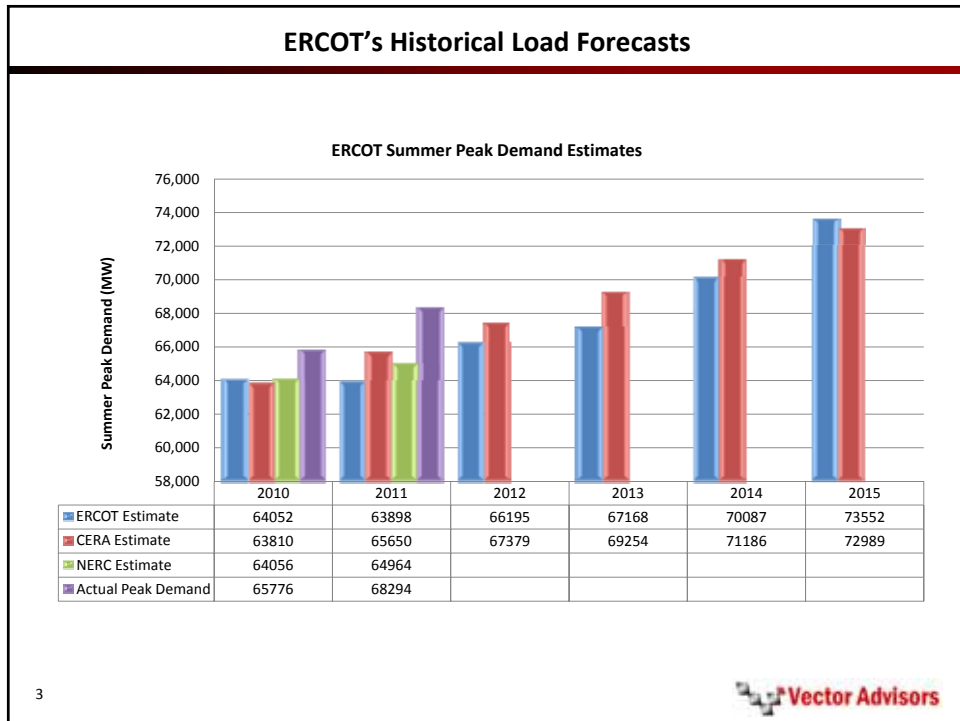
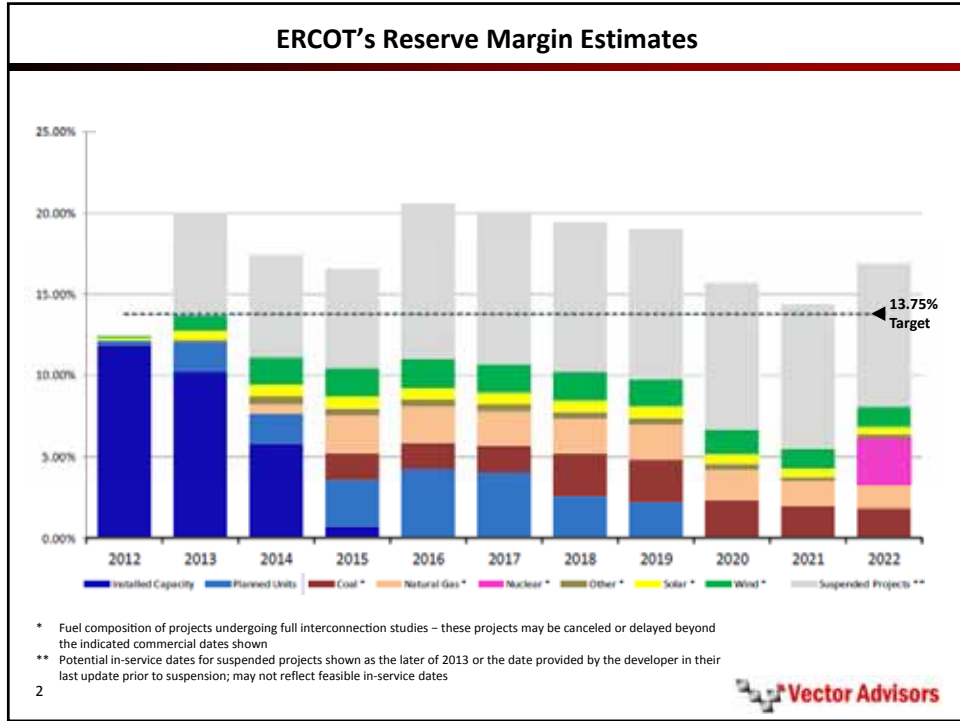
– Trip Doggett ERCOT CEO, December 2

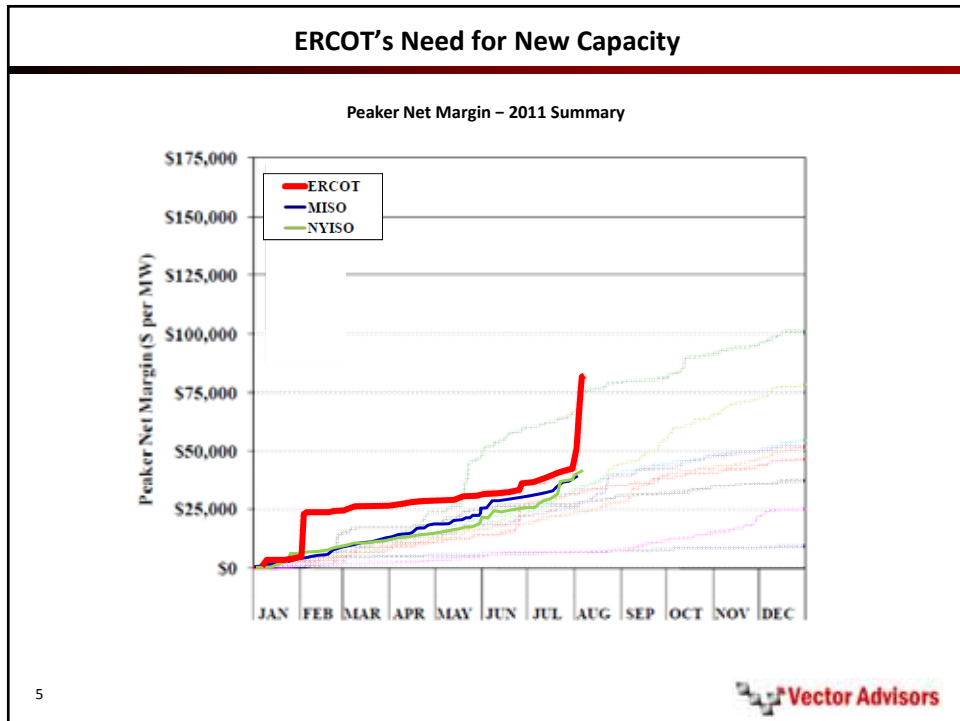
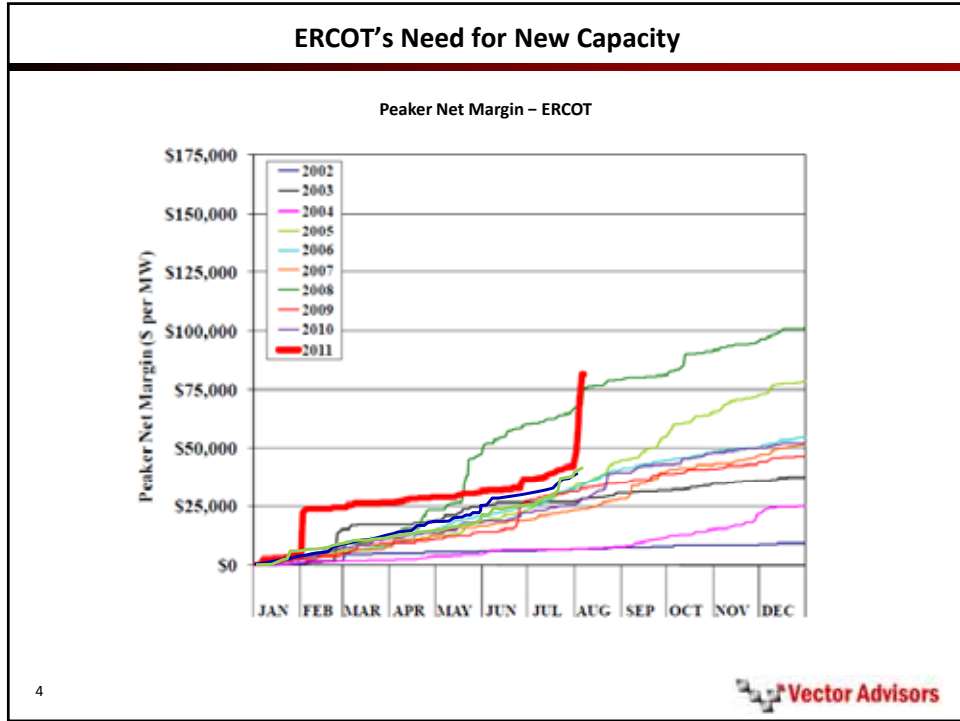
"I don't know that the state of Texas has a very clear and logical policy on why it's supporting renewables,"

– Ross Baldick  
Dallas Morning News, December 6

If I were in charge of Texas right now, I would make sure that we initiated the load management [i.e., demand response] program immediately. ... I would do on-bill [energy] efficiency. And I would pick up the phone and call First Solar or one of these major solar companies and say, "I got a bunch of land in West Texas, near substations. How many megawatts can you put in between now and June?" This is Texas. It's not California. We give permits here. We build shit. You can buy this stuff for \$1 a watt. What kind of deal can you make me? And I'd put in a bunch of solar between now and next summer.

– S. David Freeman  
Texas Tribune, December 6





### Overview

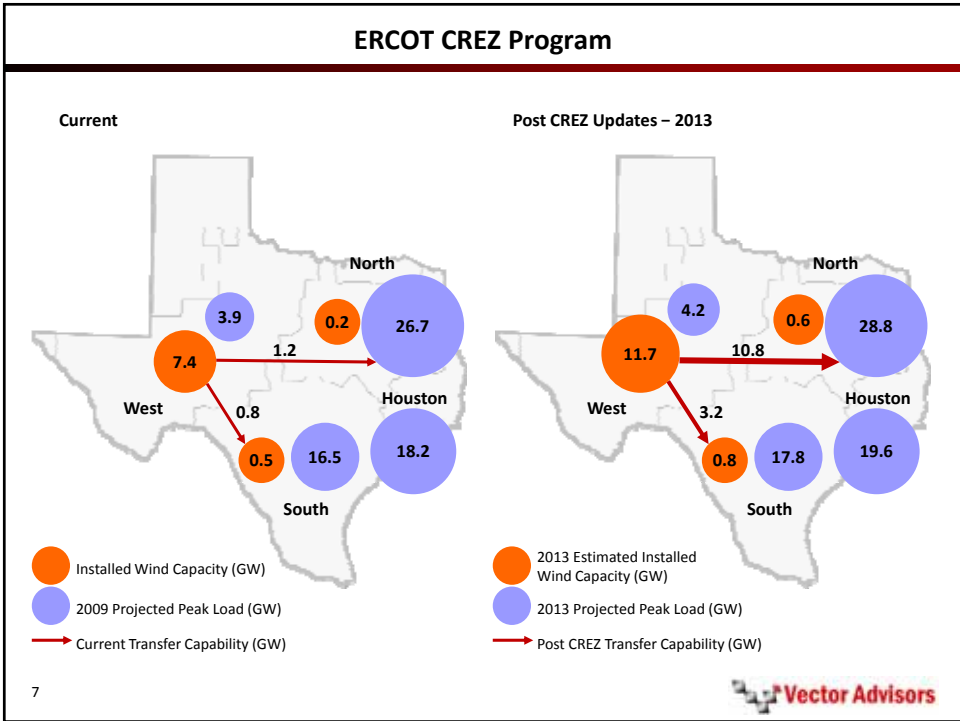
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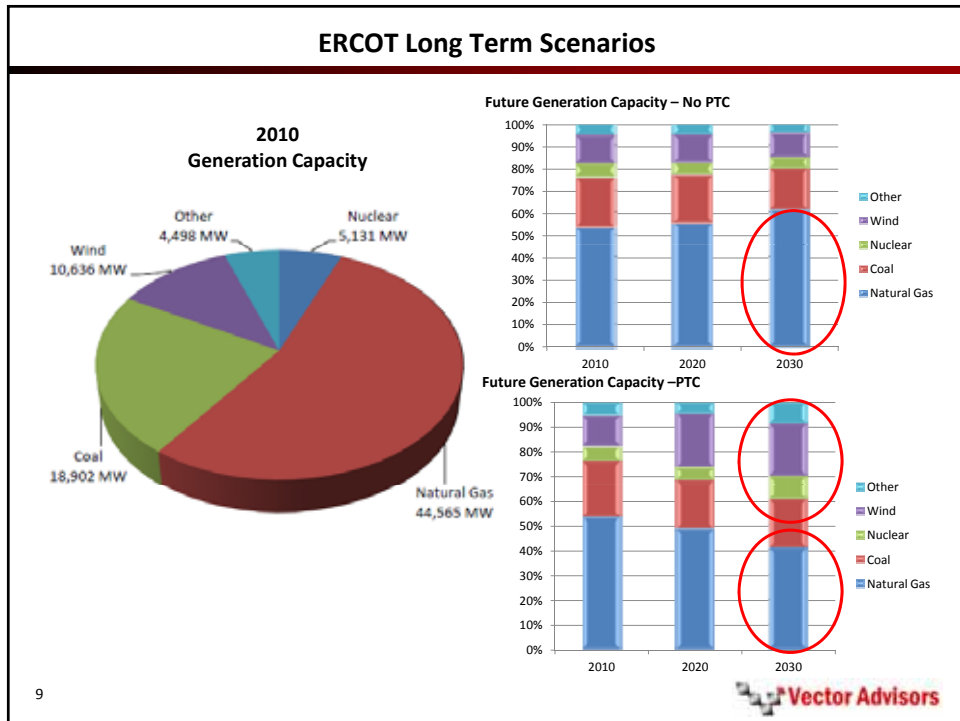
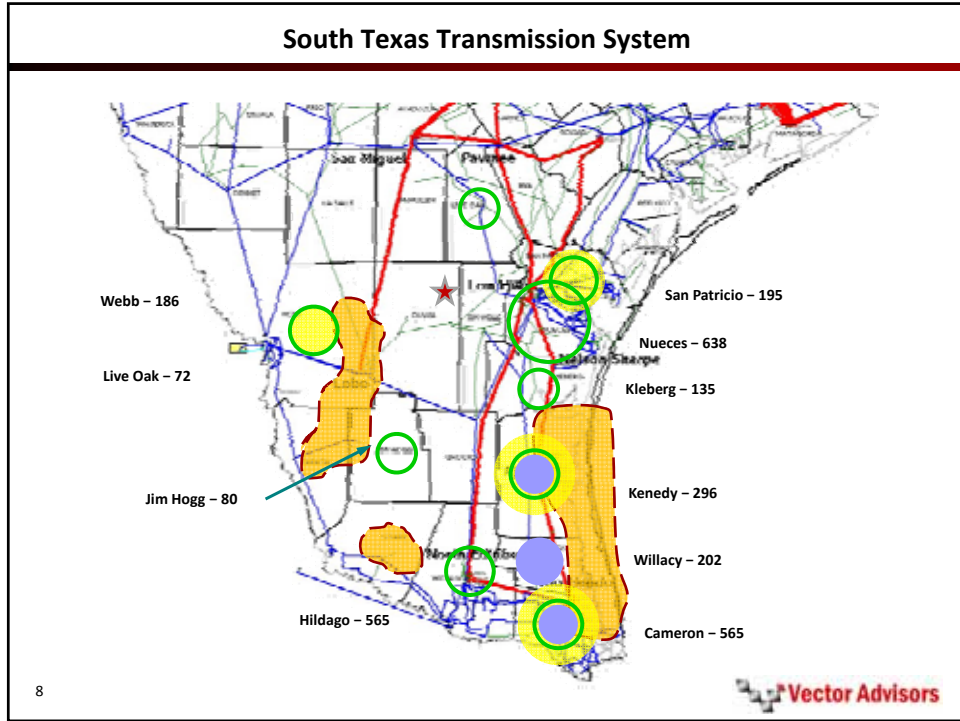
#### Elements of Texas Long Term Energy Future

**Wind– Meeting the Challenge of Managing Intermittent Resources**

- Utility Scale Solar – Capturing the Sun and Declining Costs
- Smart Grid and Demand Response – Getting Customers involved
- Energy Efficiency – Under-appreciated “Fifth Fuel”

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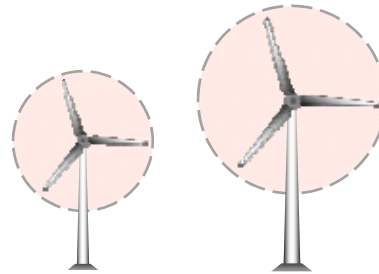


### ...And Efficiency Improvements

#### What's Missing?

- Grid Parity

	Older Turbine	New Turbine
Blade size and control	77 mm	100 mm
Nameplate capacity	1.5 MW	1.6 MW
Net capacity factors	35%	46%
Turbine cost reductions	\$1,600/kW	\$1,300/kW
LCOE	\$100/MWh	\$55/MWh



Sources: Photon, Hudson Analysis

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### Challenges in Managing Wind on the ERCOT Grid

- **Grid reliability issues** caused by the intermittent, unpredictable nature of the resources increase ERCOT's need to acquire additional operating reserves
- **Pricing issues** caused by the location of the Texas wind resource results in price volatility and heat rate compression
- **Generation operational issues** caused by the amount of renewables planned for the ERCOT market and the amount of baseload generation at minimum load conditions has an impact on base load generation operations and pricing


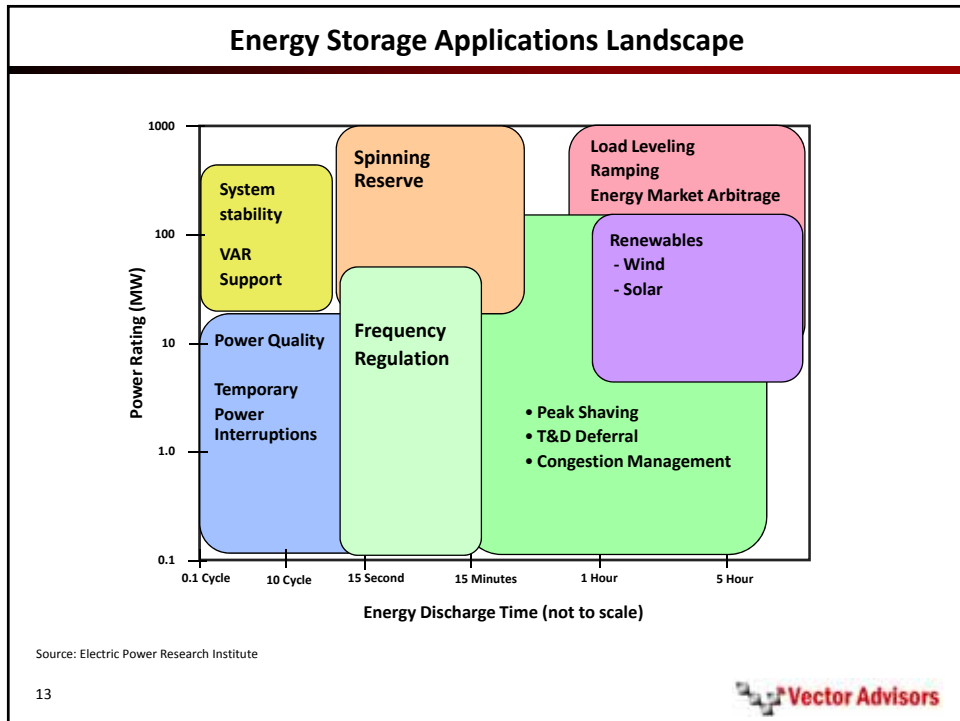
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## Energy Storage Technologies

Technology Class	Energy Storage Examples
<b>Chemical Storage</b>	<p><b>Sodium Sulfur Battery</b></p> <ul style="list-style-type: none"> <li>Electrical energy is stored for later use in chemical form. Existing battery technologies are being improved and new battery technologies are becoming available.</li> <li>Example: 34 MW Sodium Sulfur Battery – 51 MW wind farm, Japan (NGK)</li> </ul> 
<b>Thermal Storage</b>	<p><b>Ice Storage</b></p> <ul style="list-style-type: none"> <li>Air conditioners create ice at night, when power rates are low. This stored ice then runs a cooling system during the afternoon, when power costs are highest and the power grid is most stressed.</li> <li>Example: 12 kW Thermal Storage – Napa Community College (Ice Energy)</li> </ul> 
<b>Mechanical Storage</b>	<p><b>High Speed Flywheel</b></p> <ul style="list-style-type: none"> <li>Flywheels convert electrical energy to kinetic energy, then back again very rapidly. Flywheels are ideal for power conditioning and short-term storage</li> <li>Example: 3 MW Mechanical Storage for Ancillary Services – NE ISO (Beacon Power)</li> </ul> 
<b>Bulk Mechanical Storage</b>	<p><b>Below Ground Compressed Air</b></p> <ul style="list-style-type: none"> <li>Electricity is used to compress air into small or large modular storage tanks or a large underground cavern. The compressed air is used to spin turbines when electricity is needed.</li> <li>Example: 115 MW Compressed Air Energy Storage – McIntosh, Alabama</li> </ul> 
<b>Bulk Gravitational Storage</b>	<p><b>Pumped Hydro</b></p> <ul style="list-style-type: none"> <li>Excess electricity is used to pump water uphill into a reservoir. When power is needed, the water can run down through turbines, much like a traditional hydroelectric dam.</li> <li>Example: 1,532 MW Pumped Hydro – TVA's Raccoon Mountain</li> </ul> 

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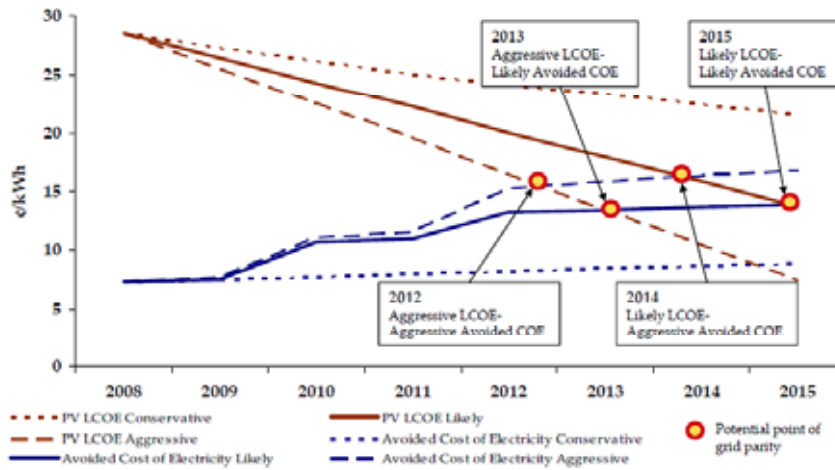
- Storage – Managing Intermittent Resources
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### When will Solar Reach “Grid Parity”?

PV Levelized Cost of Electricity (LCOE) vs. Avoided Cost of Electricity for a Utility (Real Terms)



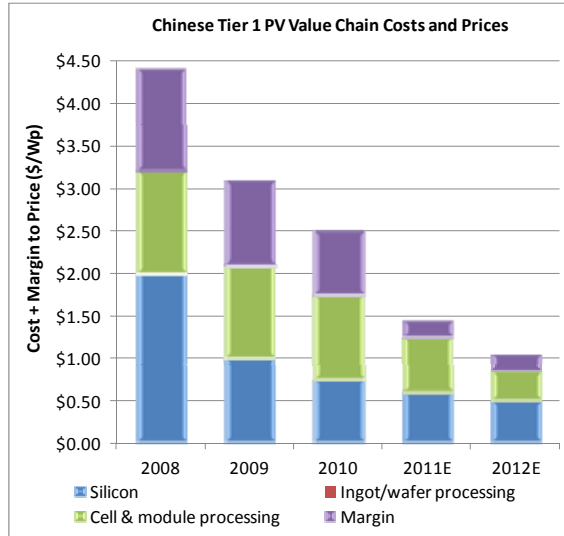
Source: Navigant Consulting

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### Solar Manufacturing Costs Have Declined Dramatically



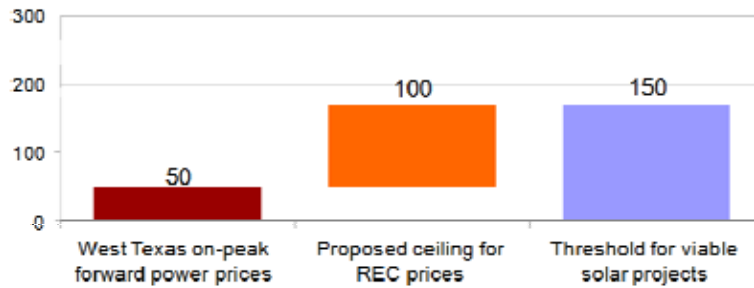
Sources: Photon  
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### Texas Solar Economics

Utility scale solar projects in Texas can achieve sufficient returns under \$150/MWh, which implies a \$100/MWh REC. Based on declining panel prices, solar costs in West Texas are likely to be in the \$120-140/MWh range (with \$70-90/MWh RECs)

Cost of solar in Texas = Average peak power price + REC price



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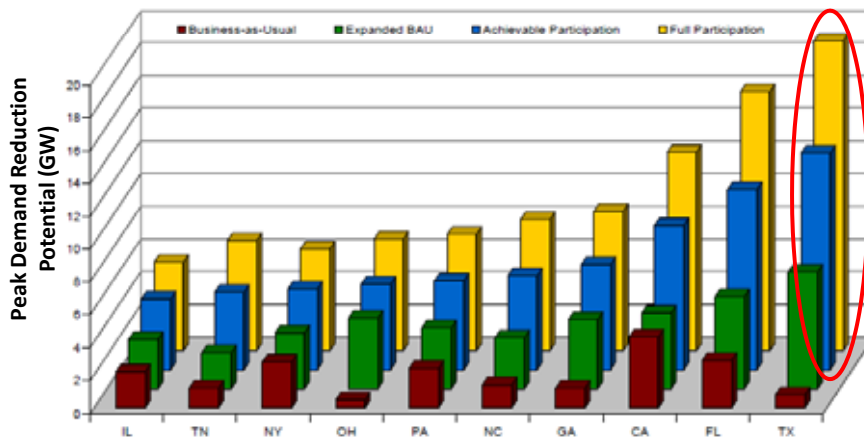
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### Demand Response Potential in ERCOT

- FERC estimates >18 GW of DR potential in Texas by 2019
  - Attributed to high peak demand; would represent 20-25% of ERCOT peak
  - ‘Full participation’ scenario assumes **default dynamic pricing tariff**

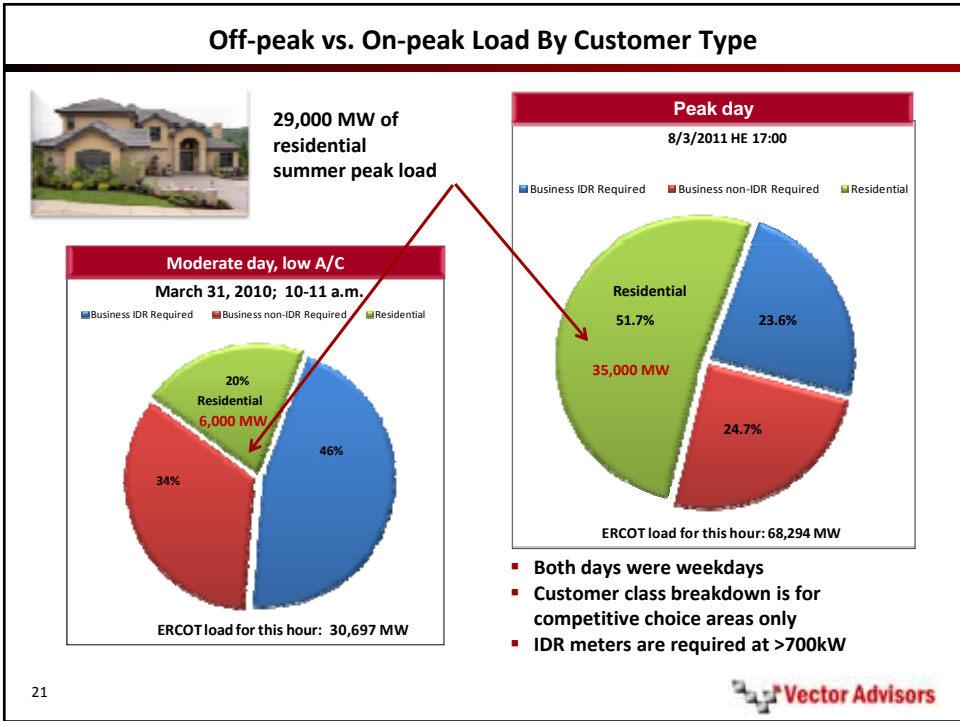
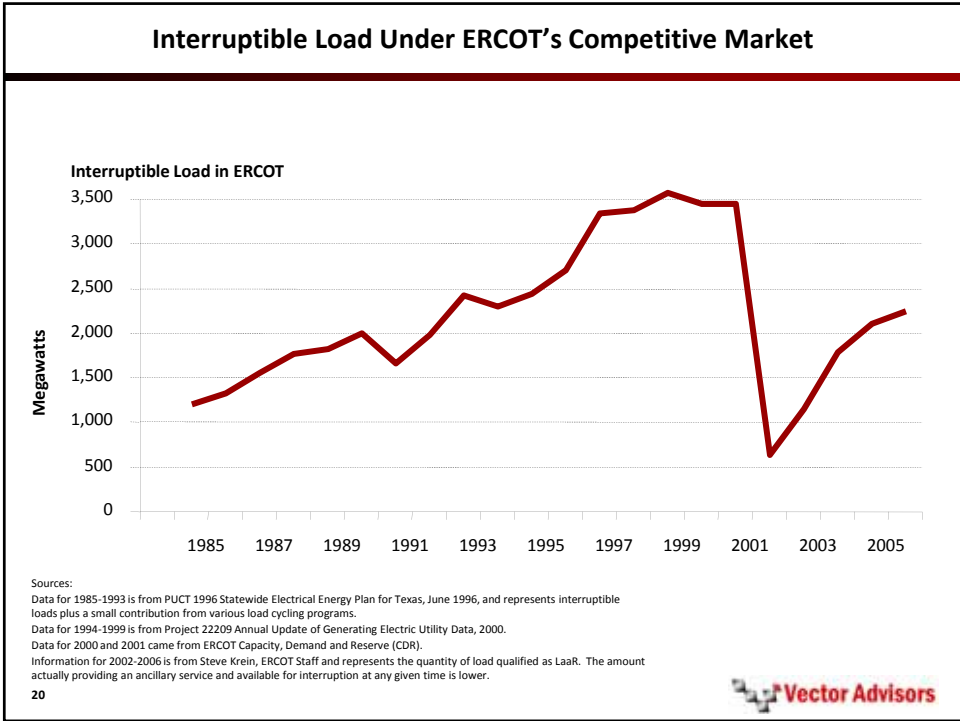
Top Ten States By Achievable Potential In 2019 (GW)



Source: FERC 2009 National Assessment of DR, page 42

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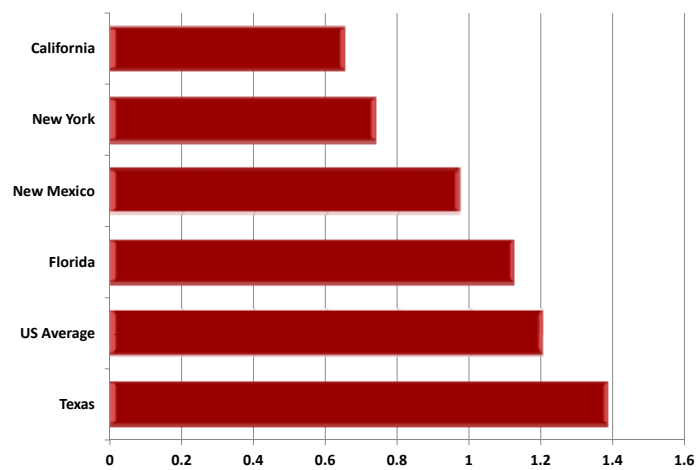
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## Energy Consumption By State

MWh/100 people



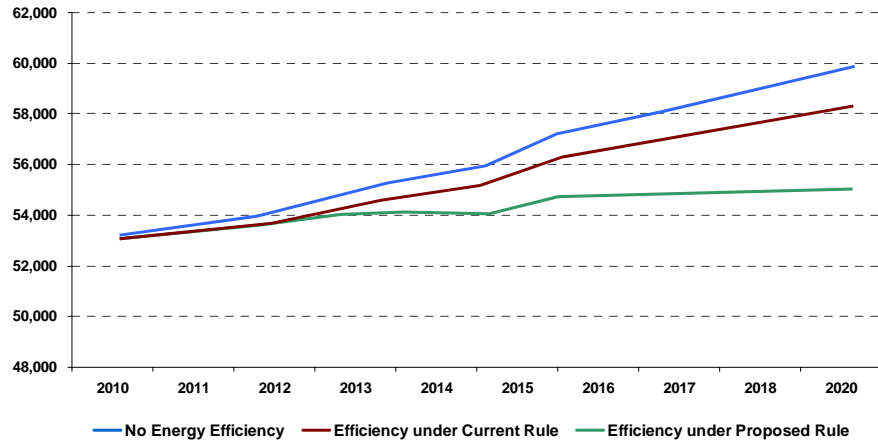
Source: [http://www.statemaster.com/graph/ene\\_tot\\_ele\\_con\\_percap-total-electricity-consumption-per-capita](http://www.statemaster.com/graph/ene_tot_ele_con_percap-total-electricity-consumption-per-capita)

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## Growth in Energy Demand

**“Texans have always been far better at making energy than saving it. But if a proposal before the Public Utility Commission gets approved this year, buildings and appliances in Texas would need to become much more energy efficient” Texas Tribute March 22, 2010**



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## Can Texas Become the “Clean Energy” Capital of the World?

- Texas has the unique combination of a self-contained electricity grid, a modern wholesale electricity market and a dynamic competitive retail market that could easily bring new clean energy technologies to market
- Texas utilities making large investments in building the electric grid of the future with “Smart Meters” and “Smart Grid” technology
- Universities undertaking significant energy research activities
- Many large companies with deep industry energy expertise are headquartered or have a major presence in Texas
- Many entities (Pecan Street Project, CCET, Surge Accelerator) focused on commercializing “start-up” energy technology companies

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## Can We Meet The Challenge?



“I think that Texas is up to the task (of meeting the reliability challenge). I believe that ERCOT has the full array of tools, as well as the state PUC, to step up to that challenge and deal with it.”

Jon Wellinghoff  
Chair, Federal Energy Regulatory  
Commission

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