



CEE CENTER FOR ENERGY ECONOMICS



CEE Analytics – Power & Gas

CEE Annual Meeting, December 6, 2012



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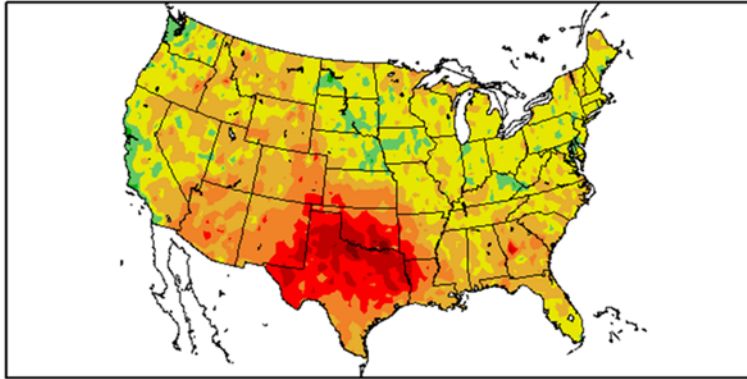
Resource Adequacy in Texas

- ERCOT is an energy-only market
- There is a reserve margin **target** of 13.75% (was 12.5%)
 - ERCOT's interpretation of "1 load-shed event in 10 years" is more stringent than "1 day of outage in 10 years"
- After the summer of 2011, a concern has emerged that generation capacity expansion would not keep up with demand growth in the future
- System-wide offer cap (price cap) was raised to \$4,500 (from \$3,000) on August 1, 2012; and will increase to \$9,000 by 2015.
- We tested impacts of these price caps (AURORAxmp)



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Departure from normal temperature (F) 8/2/2011 – 8/31/2011



Generated 9/1/2011 at HPRCC using provisional data.

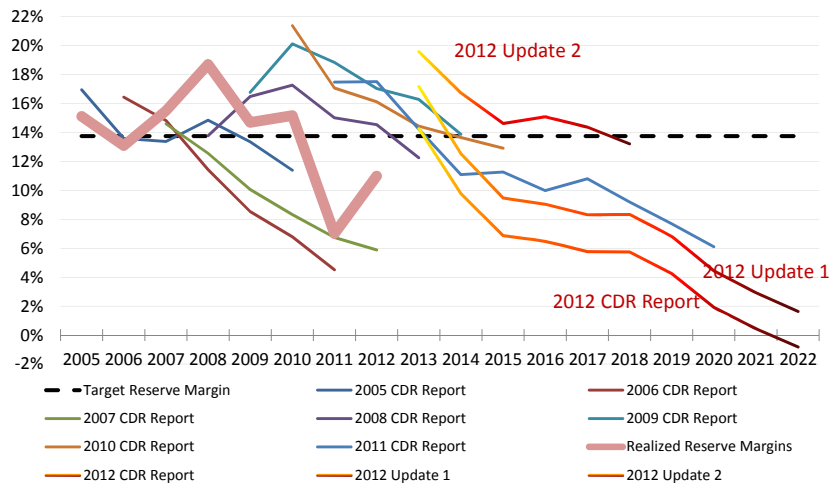
Regional Climate Centers

Was this a "once in 100 years" event or more of a new normal?



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ERCOT Forecasts of Reserve Margin



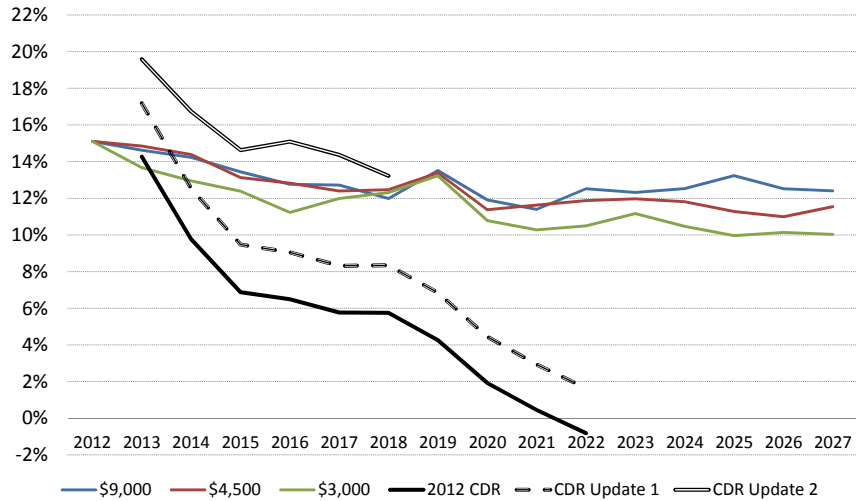
2012 Update 1: de-mothballed units

2012 Update 2: de-mothballed units, lower demand growth, new resources

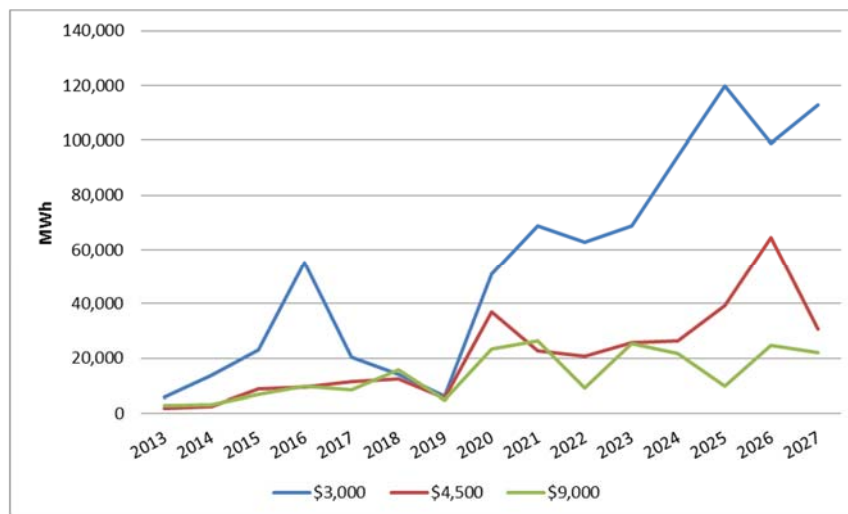


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Resource Adequacy in TX – Reserve Margin under Price Caps



Resource Adequacy – Demand Curtailment under Price Caps



Resource Adequacy – Average Wholesale Price of Electricity (nominal)

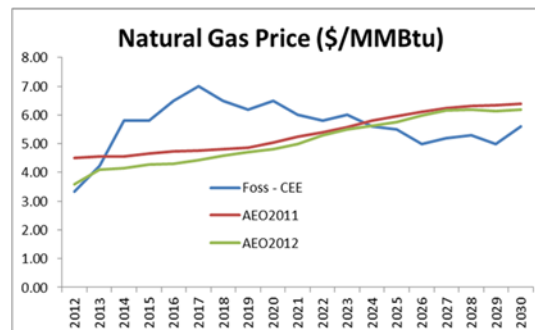


Conclusions

- On average, the reserve margin will be highest under the \$9,000 price cap
 - 12.8%, 12.4%, 11.4% for \$9,000, \$4,500 and \$3,000, respectively (but lower than 13.75% target RM).
- The 15-year (2013-2027) average nominal price is roughly the same for all 3 scenarios
 - In real terms, prices > average prices since 2009 but similar to prices seen before 2009 because they reflect an increase in natural gas price from its lows in 2009-2012.
- Curtailment is highest with \$3,000 cap & increases over time while it is low and fairly stable with \$9,000 cap.

Conclusions – Sensitivity to NG Price

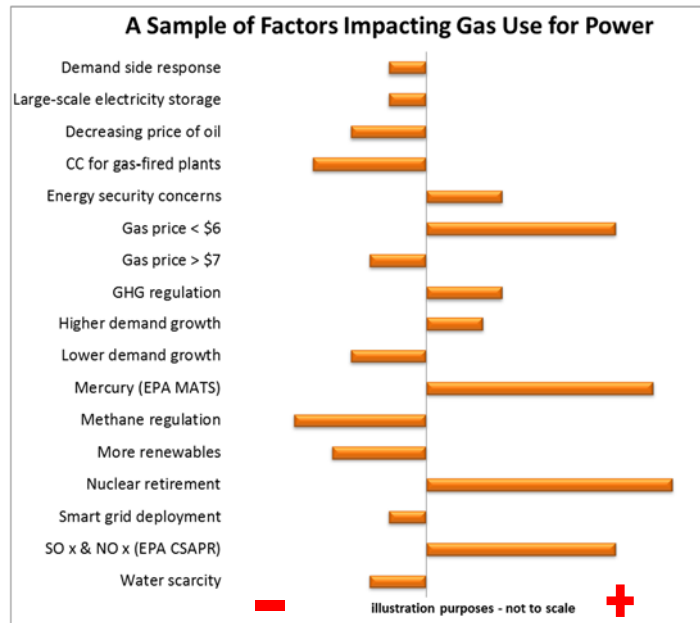
- Reserve margins slightly higher
 - 12.9%, 11.8% for \$9,000 and \$3,000, respectively.
- Average nominal prices are slightly higher
- Slightly more new builds earlier but less overall (also less retirements); lot more wind gets built earlier.



Open Questions

- What is the right price cap?
- What is the optimal reserve margin?
- What role can demand response play?
- What impact external factors will have on resource adequacy in Texas?

Gas/Power Linkages



Gas/Power Linkages

- **Impact on power sector gas use** of EPA regs (CSAPR, MATS), CO₂ penalty, subsidies for renewables, CREZ lines in Texas, alternative ng price scenario (AURORAxmp) →
- **Impact on the economy** of electricity & ng prices, and new builds (REMI PI+)
- To be updated for publication: stay of CSAPR, new costs for renewables, plant-level compliance costs, comparison w similar analyses

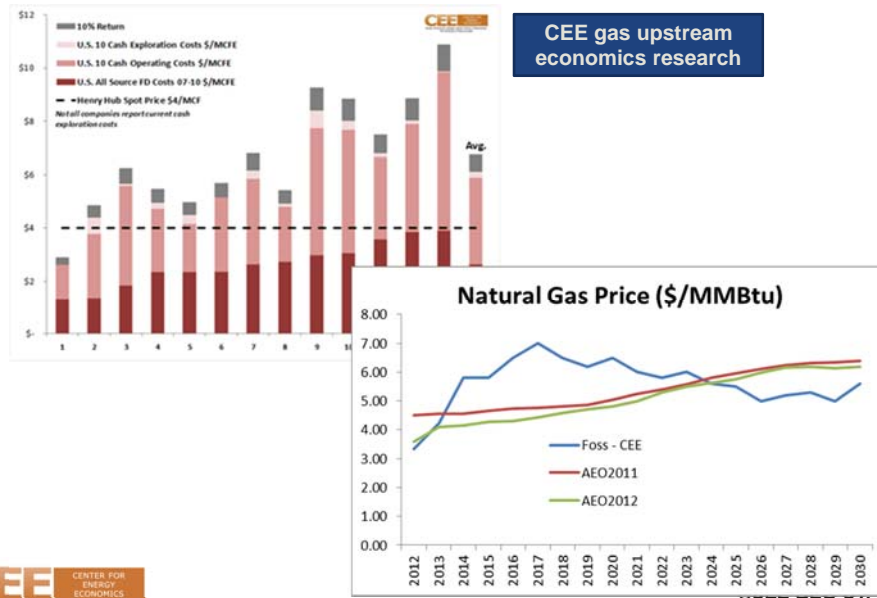
Gas/Power Linkages

- Joint modeling of multiple factors with AURORAxmp
 - EPA CSAPR for NO_x and SO₂
 - EPA MACT/MATS for mercury & other hazardous pollutants
 - CO₂ (\$14/t in 2018 to \$40/t in 2030)
 - Renewable incentives (\$15/MWh to \$30/MWh)
 - Natural gas price cycle
 - CREZ transmission addition in ERCOT

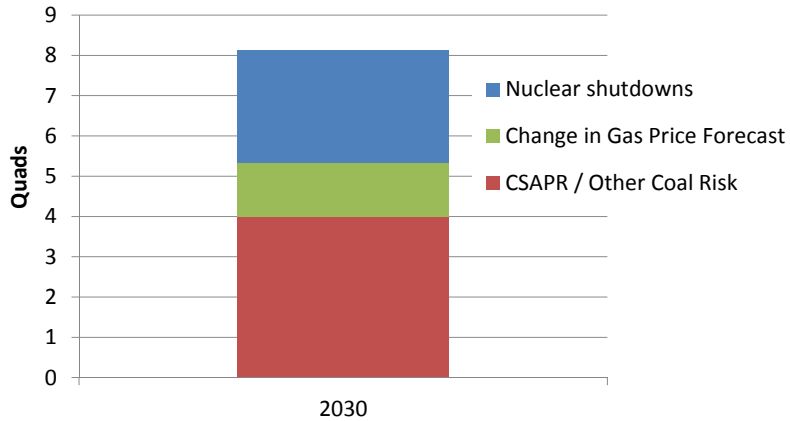


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Natural Gas Price Inputs



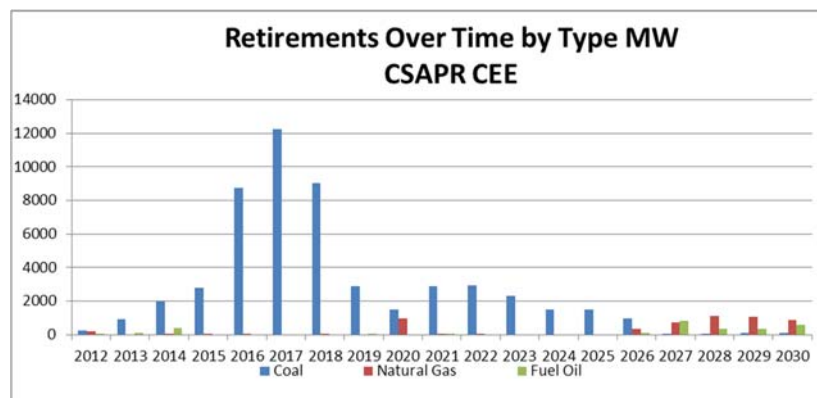
Increase in Gas Use for Power - Results from A Modeling Exercise*



*See *U.S. Gas-Power Linkages: Building Future Views* for details:

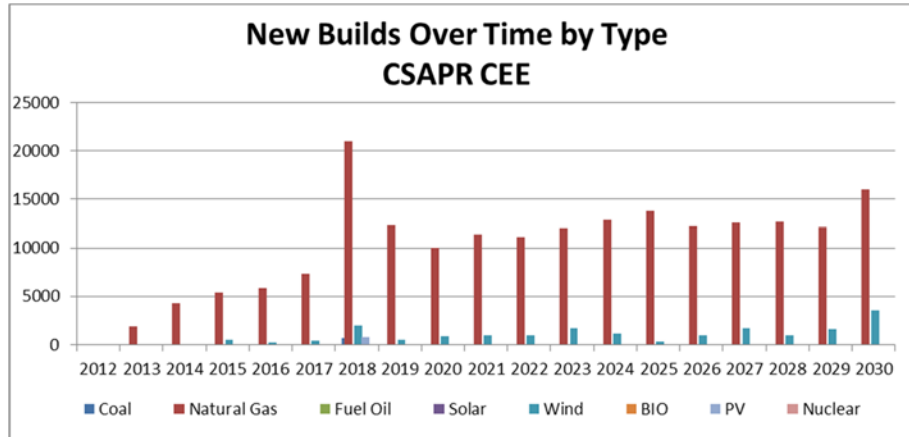
<http://www.beg.utexas.edu/energyecon/thinkcorner/Think%20Corner%20Gas-Power%20Linkages.pdf>

Emission Regulations Force Coal Retirements

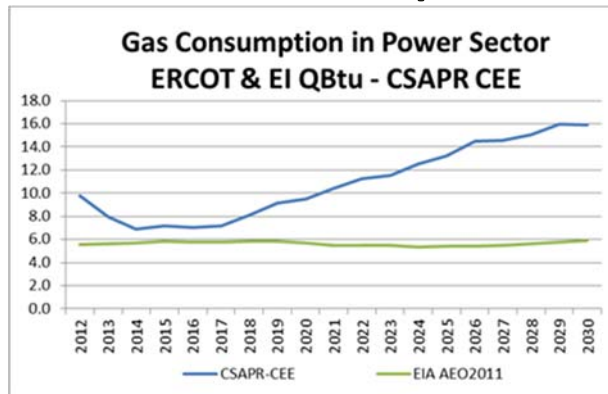


- Over 50 GW retire by 2030. Most occur before 2020 - ~40GW (consistent with current predictions).

New Builds Mostly Gas and some Wind

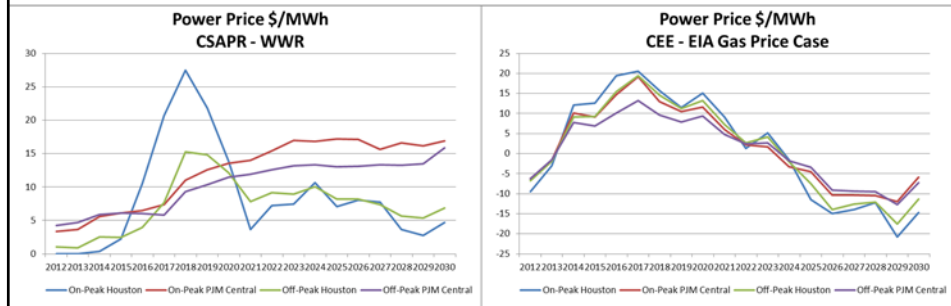


Gas Consumption



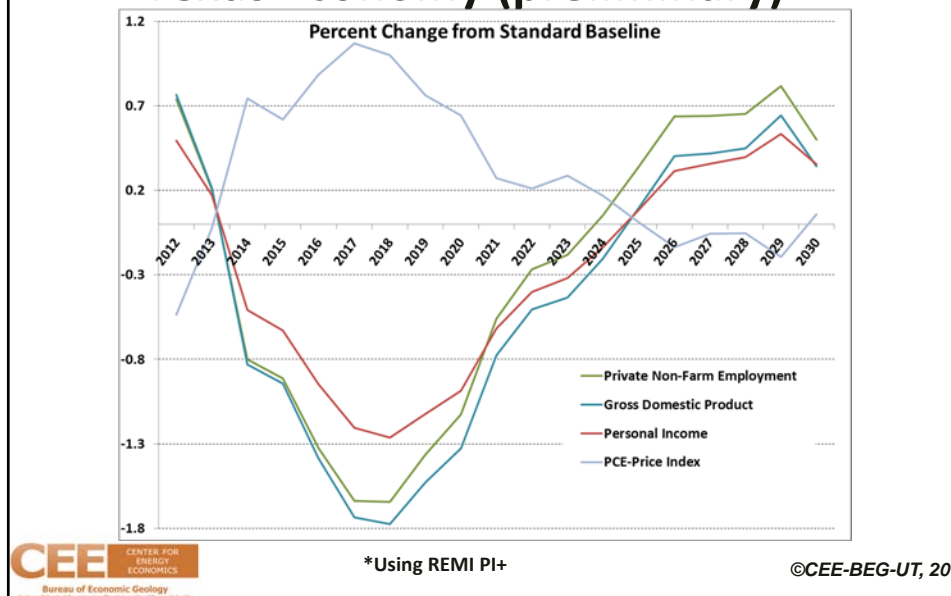
- Outer years, greater gas consumption than CSAPR.
- Coal declines by only 7% (as opposed to 20% w EIA forecast).

Power Price Changes



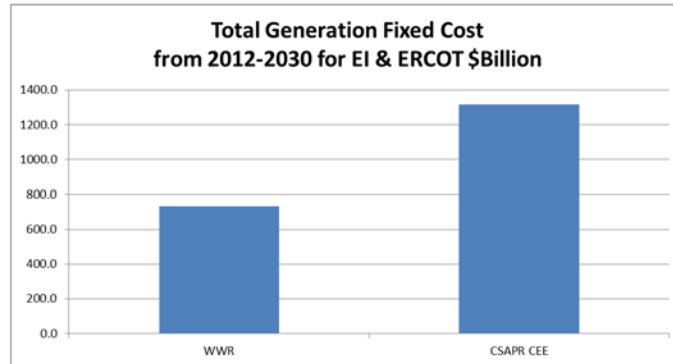
- CSAPR will increase power prices as retirements take time for the market to adjust.
- However a gas price change of a dollar can result in much more prolonged changes in power prices.

Impact of Power Price Changes on Texas Economy (preliminary)*



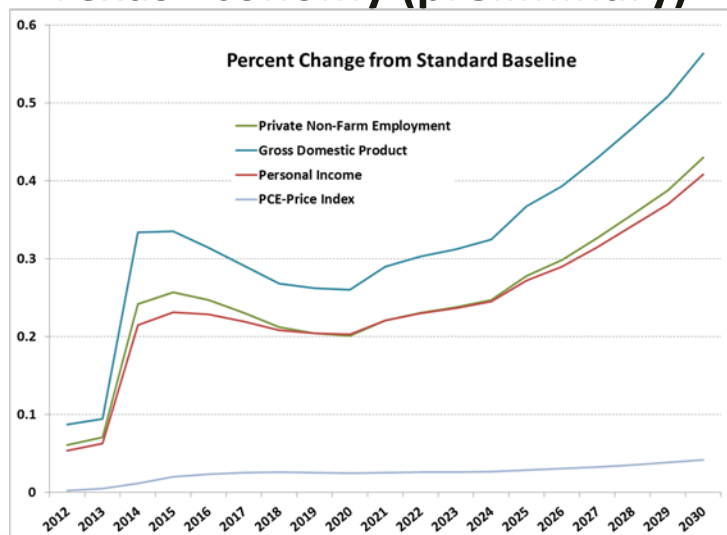
*Using REMI PI+

Fixed Investments in Generation

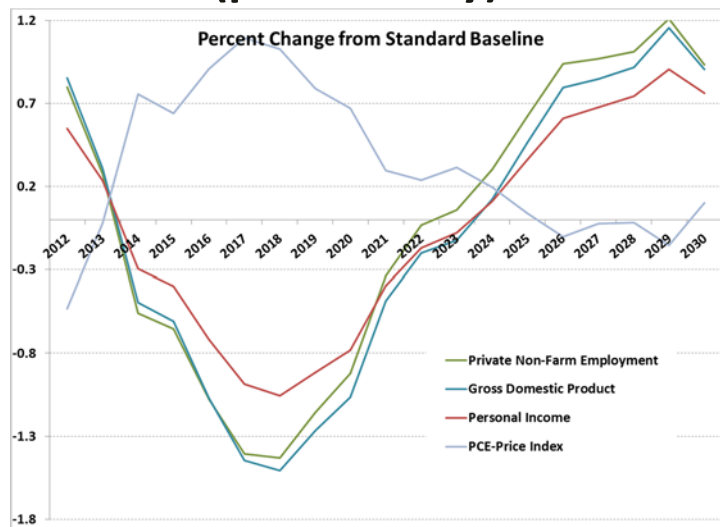


- Even without regulation ~\$750 billion (includes Control Equipment, New Builds, O&M) is needed.
- CSAPR case: \$1,300 billion – more than \$73 billion in ERCOT.

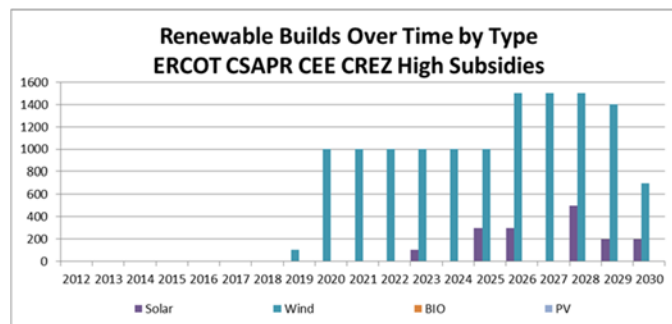
Impact of Generation Investments on Texas Economy (preliminary)*



Combined Economic Impact (preliminary)*



CREZ and Renewable Incentives



- CREZ by itself does not lead to new renewables capacity.
- CREZ with high subsidies will result in more renewables.
- Coincidentally, renewable builds start when CO₂ prices are introduced.