



Generation 101: Review of Wholesale & Retail Markets

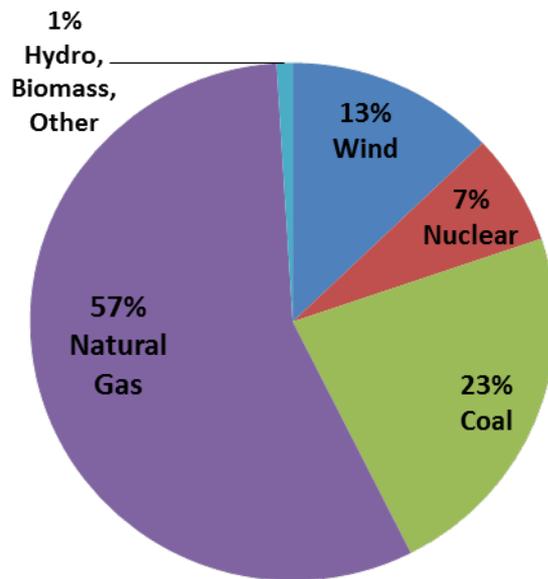
John Adams
Principal Engineer
Electric Reliability Council of Texas

April 17, 2012

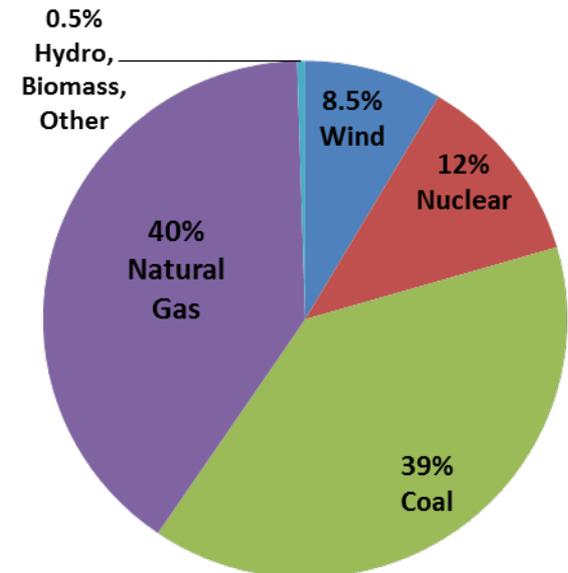
Wind Generation in the ERCOT Market

- 2011 Total ERCOT Generating Capacity: ~84,000 MW
- 2011 Installed Wind Power Capacity: 13%
- 2010 Wind Energy Produced: 8.5%

**2011
Installed
Capacity***



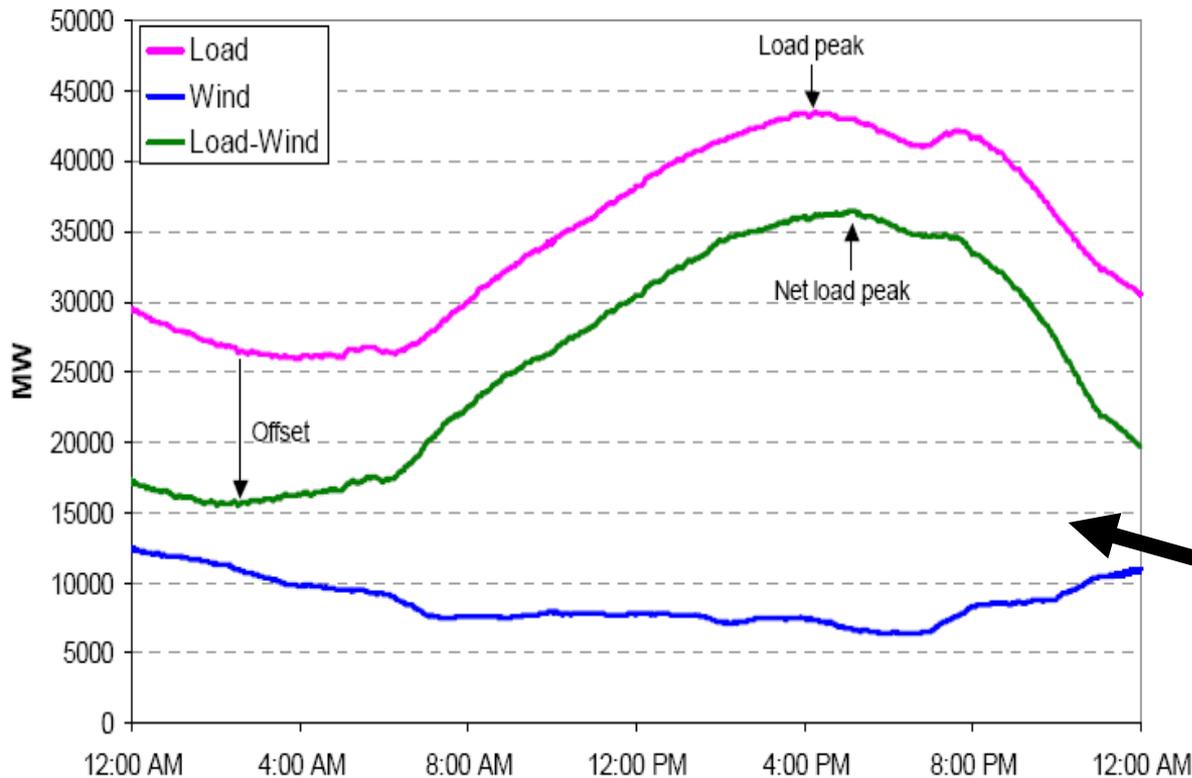
**2011
Energy
Produced***



*Source, ERCOT Quick Facts, January 2012

Forecasting Wind Generation

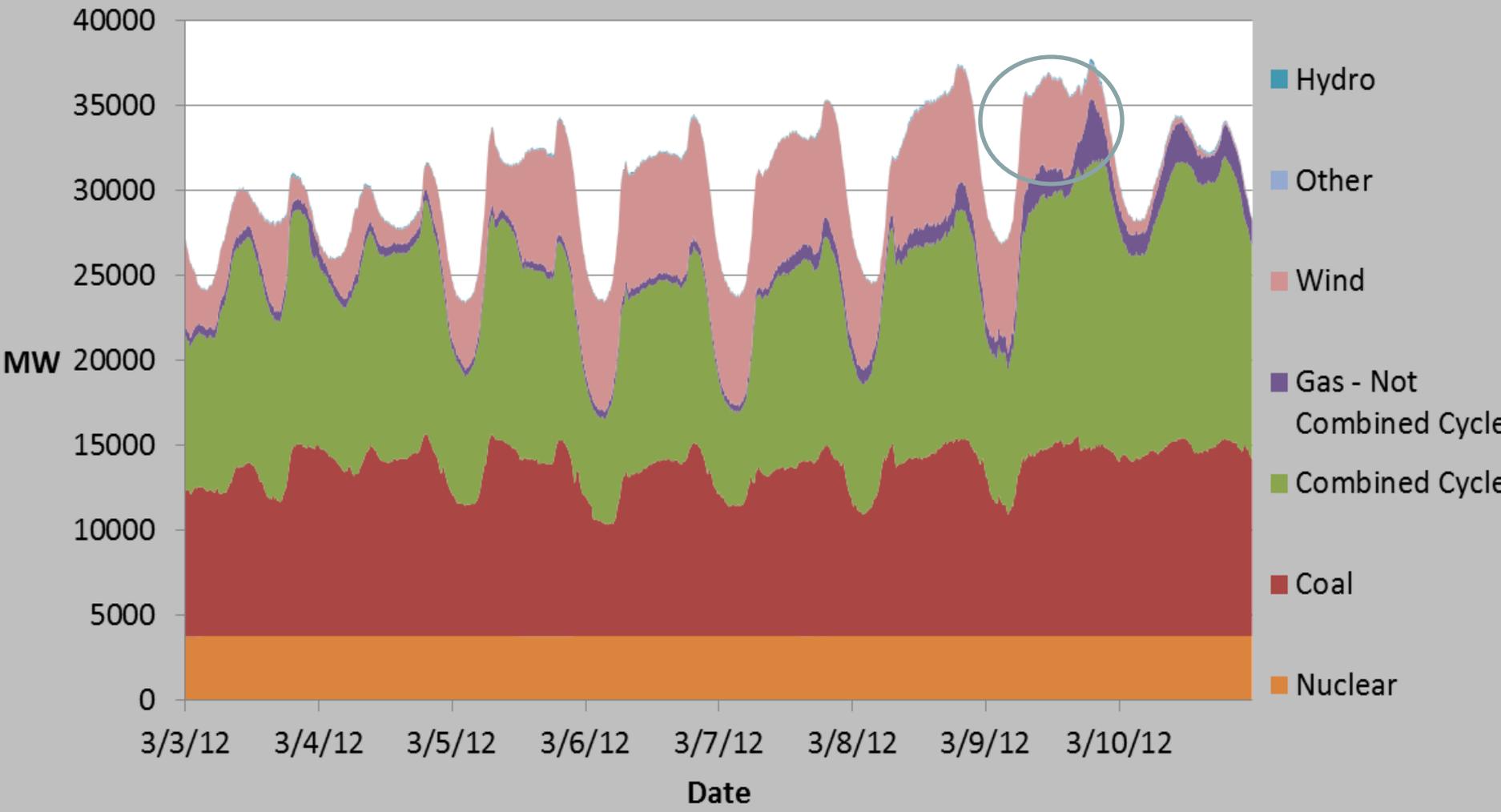
- “Net Load” is derived from Wind Generation & Load forecast



Controllable
Generation must
follow Net Load

IRR increase = Natural gas swing impact

Power Output in ERCOT by Fuel Type for a Week in March



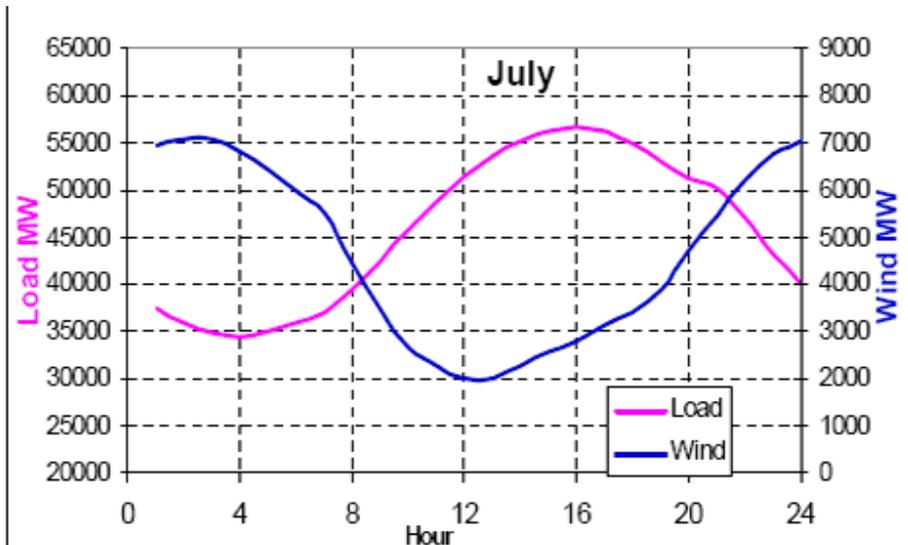
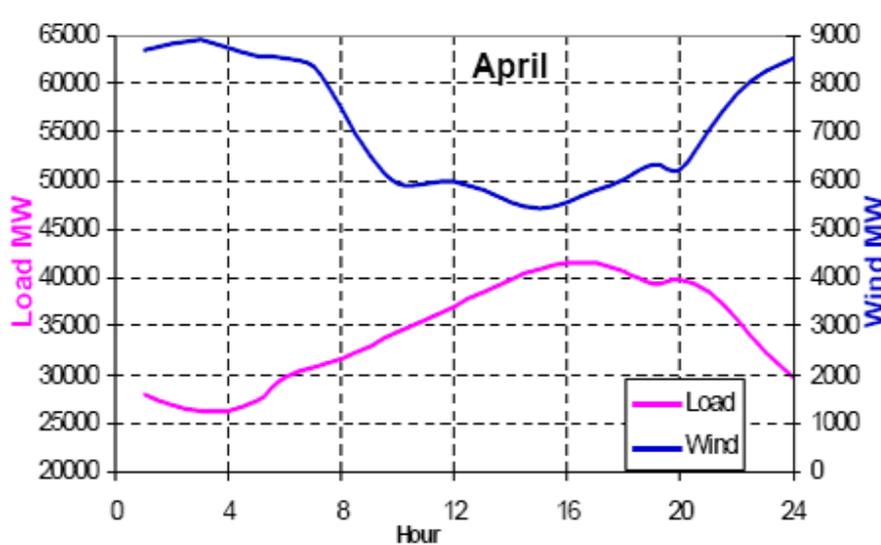
Wind Generation Challenges

Wind & Load Patterns

Spring and Summer*

- Sharper wind decreases
- Steeper load increases

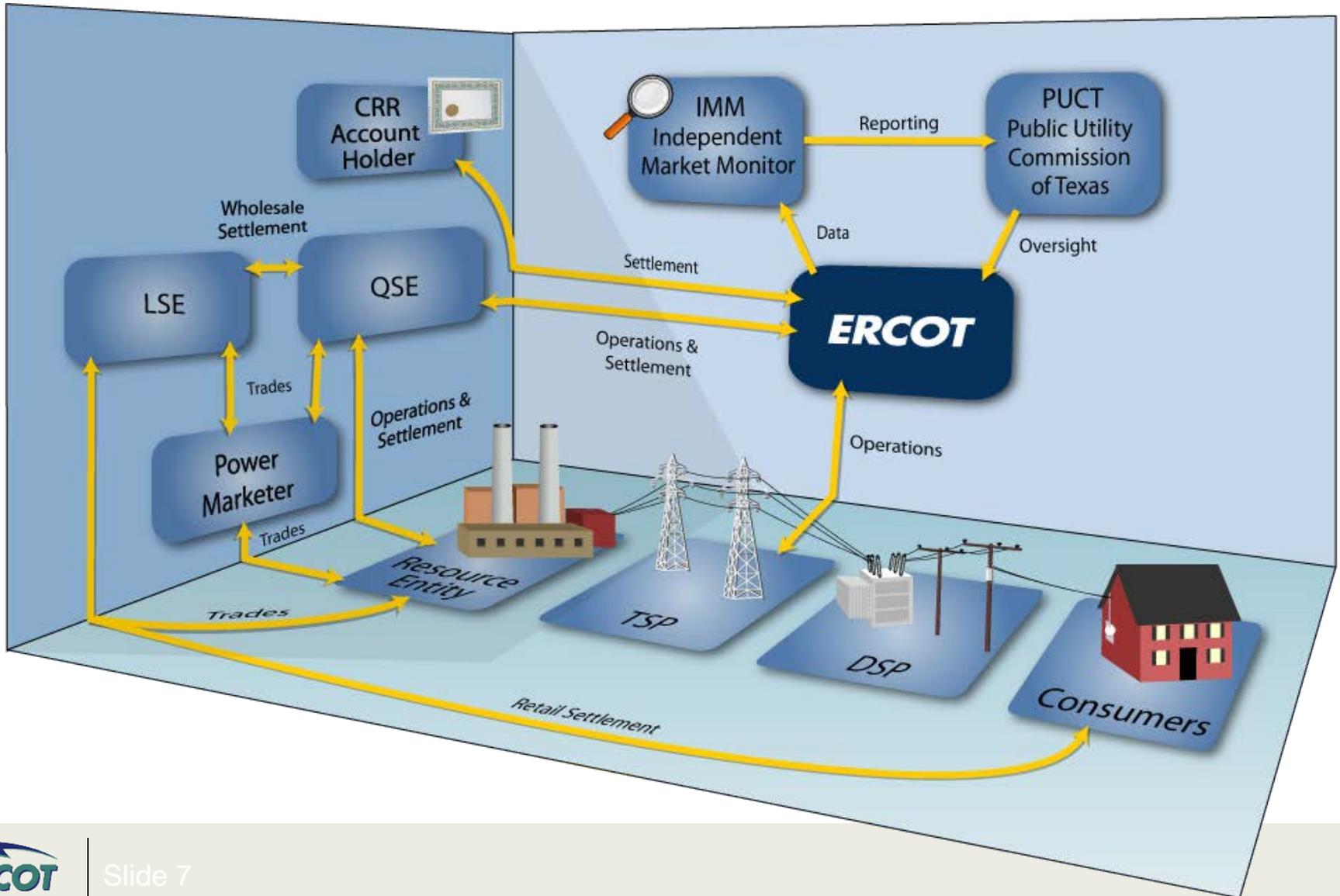
* Coastal wind more aligned with load - strong in the summer



Wind generation penetration has Increased significantly



Market Relationships



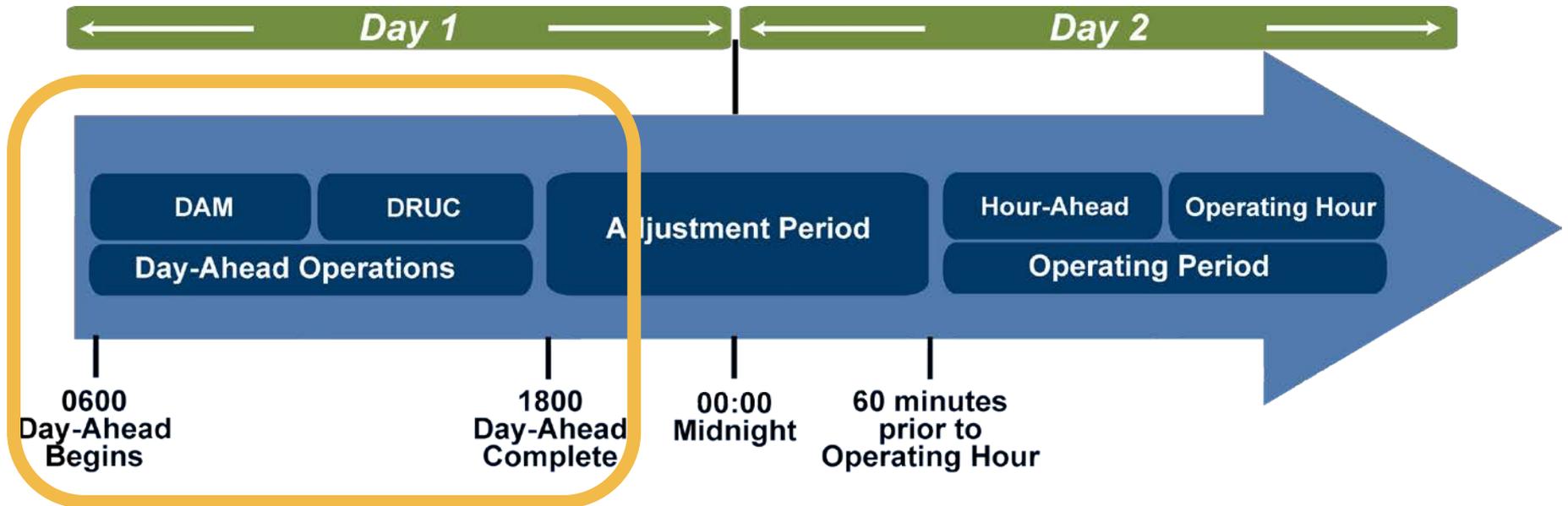
The Day-Ahead Market (DAM)

- Centralized Forward Market
- Buy and sell Energy
- Sell Ancillary Services to ERCOT
- Forward market provides price certainty

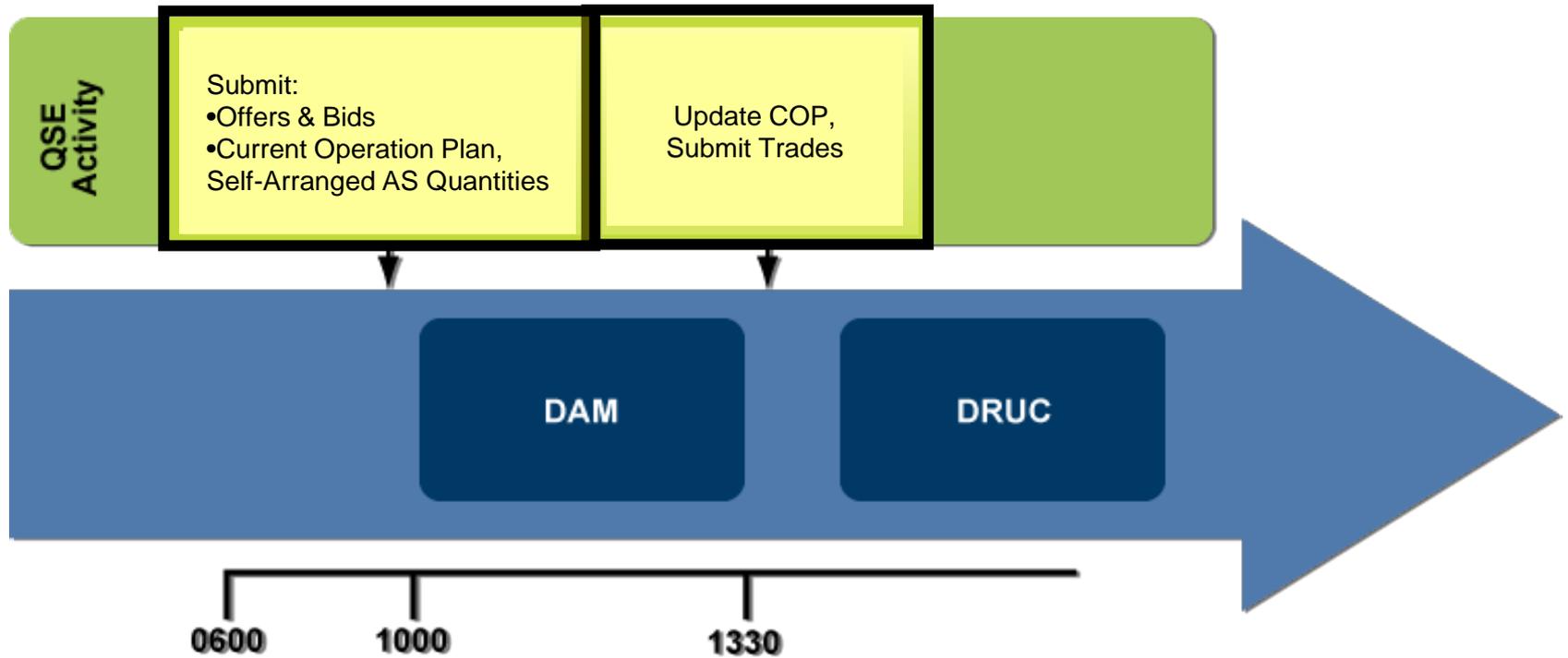


When do Day-Ahead Operations occur?

- Between 0600 and 1800



QSE Activities after DAM



Day-Ahead Reliability Unit Commitment (DRUC)

DRUC

- Occurs once a day
- Ensures enough capacity committed for next Operating Day



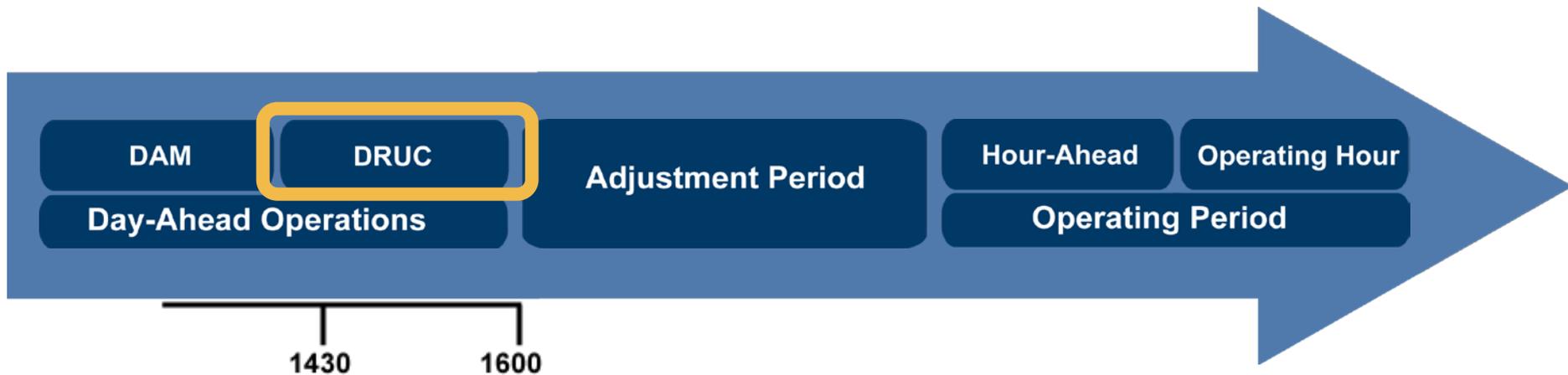
DRUC studies all hours of Day 2



1430
DRUC runs

Day-Ahead Reliability Unit Commitment (DRUC)

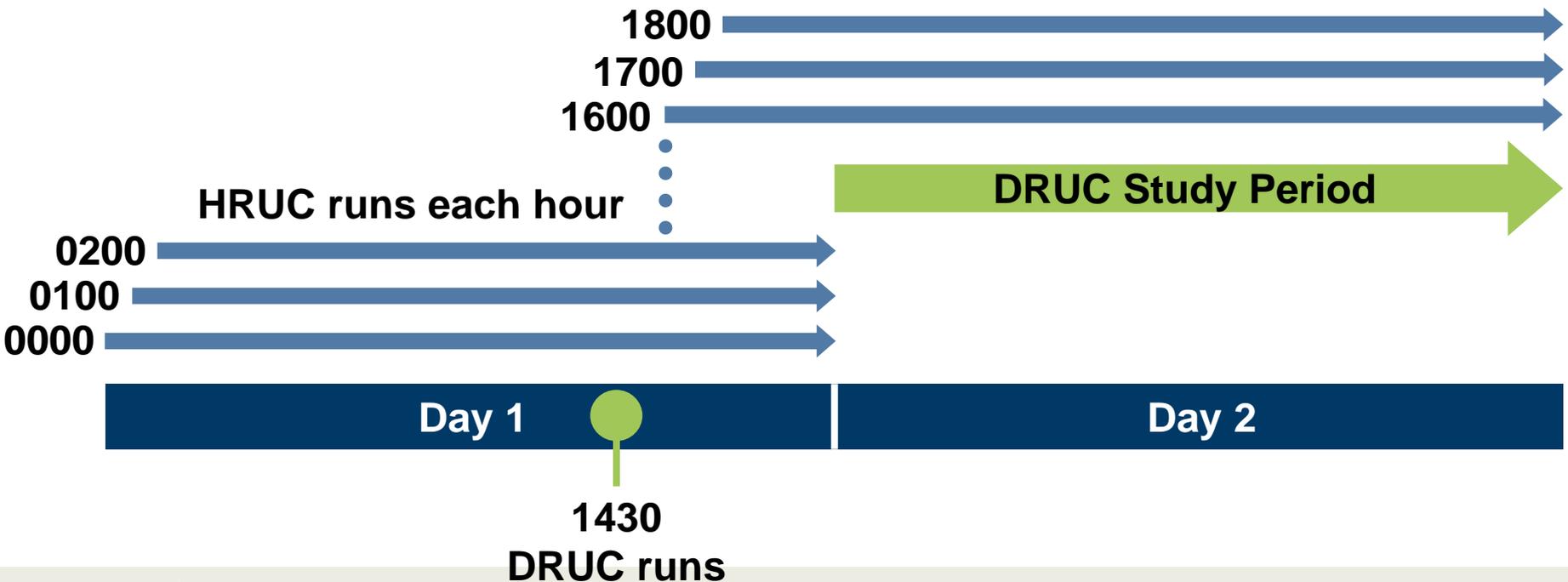
DRUC occurs after the Day-Ahead Market and before the Adjustment Period.



Hourly Reliability Unit Commitment (HRUC)

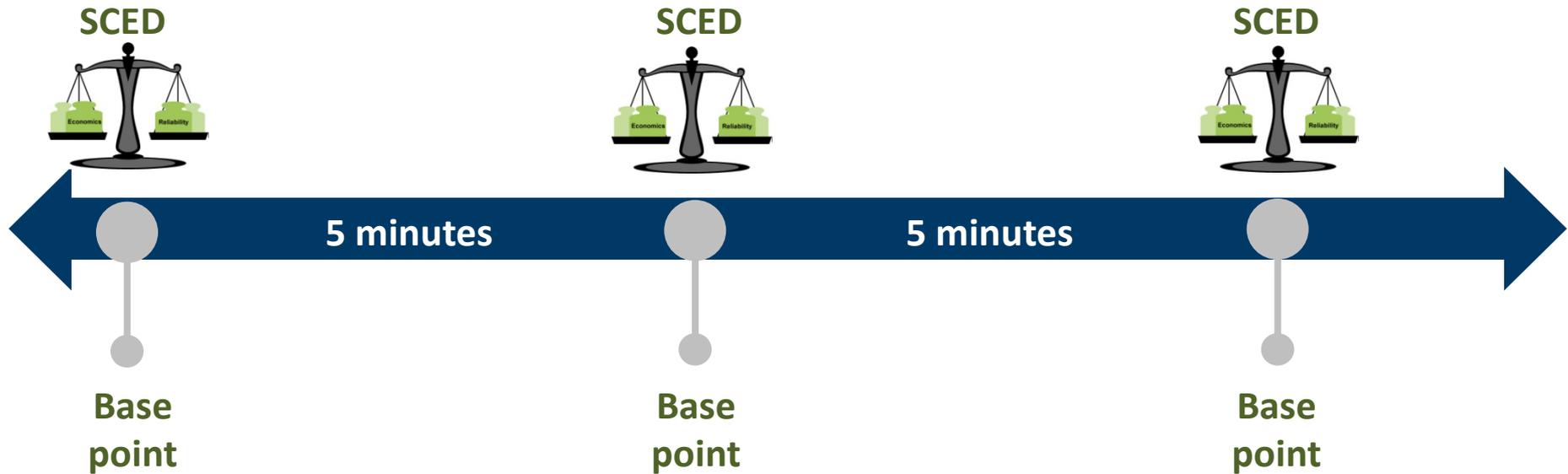
HRUC fine tunes DRUC commitments

- Reviews all hours already studied by DRUC
- Occurs hourly



SCED Dispatch Instructions

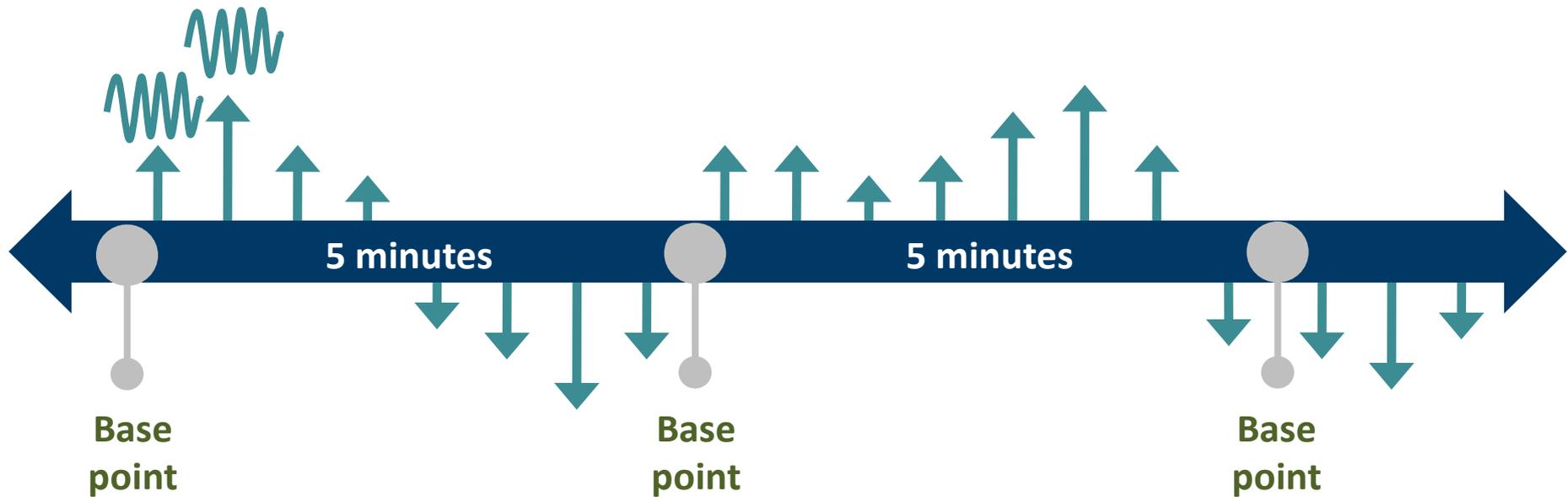
- At least every 5 minutes
- Based on economics



Load Frequency Control (LFC)

- Matches generation with demand
- Responds to frequency deviations
- Deploys Regulation Reserve Service

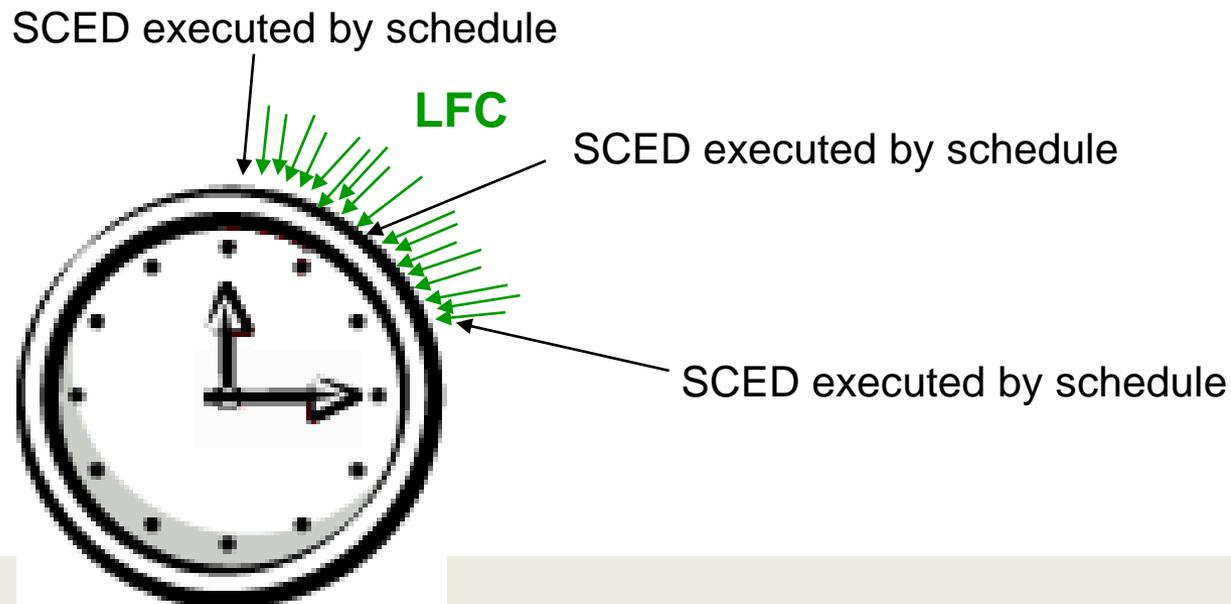
60.0000
Frequency (Hz)



Load Frequency Control Overview

In a 15 Minute Interval, SCED is executed a minimum of 3 times.

In a 15 Minute Interval, LFC is executed at least 225 times.



The Public Utility Regulatory Act (PURA) of 1999 includes in the list of customer rights the right to on-site distributed generation. The Public Utility Commission of Texas (PUCT) has adopted Substantive Rules Â§25.211 and Â§25.212 to address the technical and procedural aspects of interconnecting distributed generation. The PUCT has also developed a manual that includes information on the operational aspects and environmental treatment of distributed resources.

- **25.211**
- **25.212**
- **25.213**
- **25.217**
- **25.242**
- **25.173**

Small DG

- ~ 2000 sites in the competitive portion of ERCOT
- Predominately Solar
- Couple of hundred wind
- ~1500 residential
- Treated as negative load

Registered DG

- Typically > 1 MW
- ~ 20 sites in competitive ERCOT
- Paid load zone price

- ✓ Limits to wind DG growth
- ✓ Accelerating solar DG growth
- ✓ Steady UPS systems growth
- ✓ Need to keep track of the magnitude of impact upon “net load” to be prepared for the impacts of cloud cover/etc.

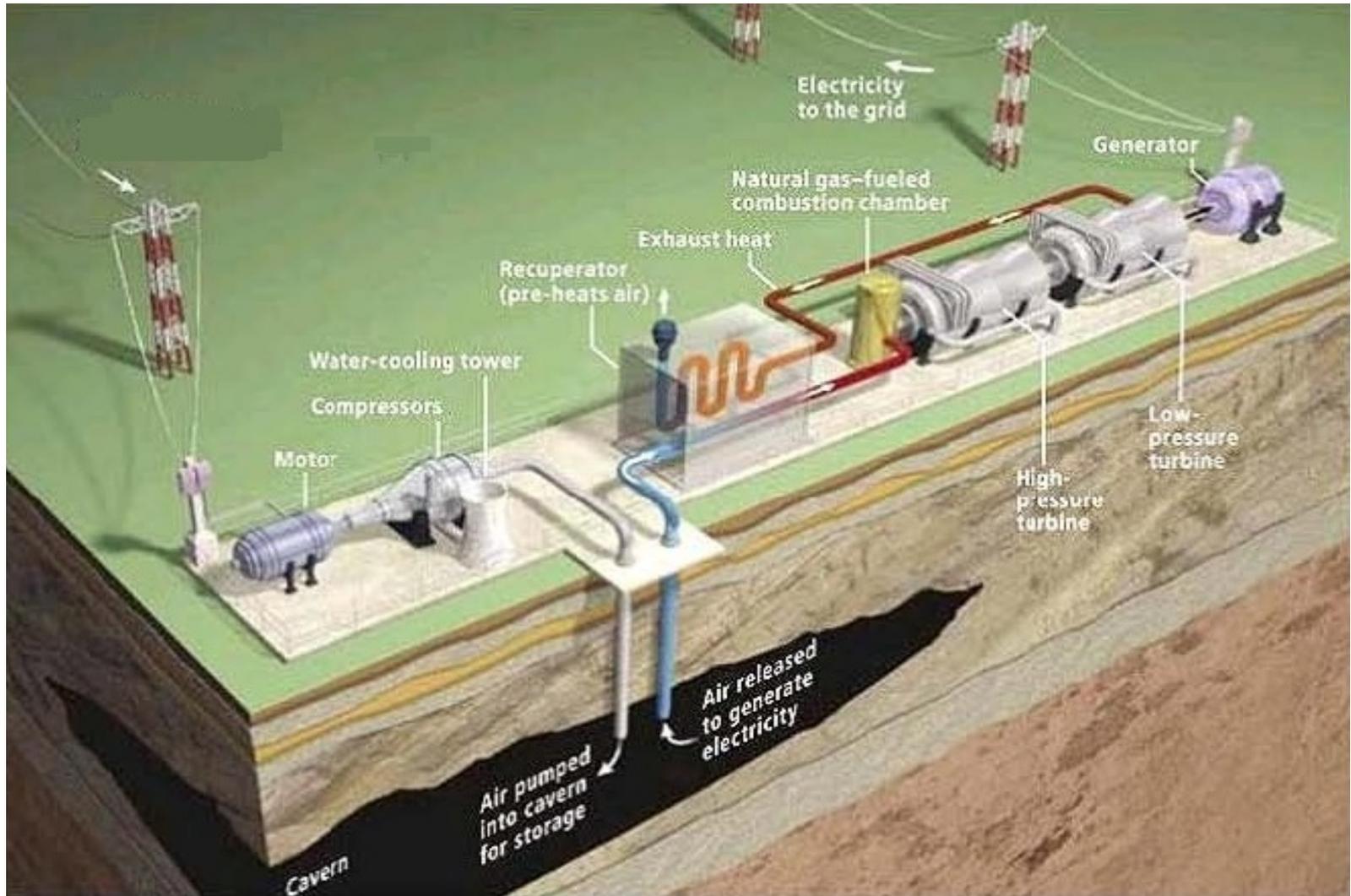
Wind: limits to DG wind growth

- ✓ Land use / zoning
- ✓ Scale / capacity factor
- ✓ Geography / wind profile
- ✓ Cost to benefit ratio
- ✓ Technology limitations relative to others

- ✓ Various battery types
- ✓ Applications range from tens of MW to small kW capacities.
- ✓ Typically of limited duration
- ✓ Typically have need to cycle to some significant depth of discharge

- ✓ CAES
- ✓ Batteries
- ✓ Flywheels
- ✓ Pumped hydro
- ✓ Thermal mass

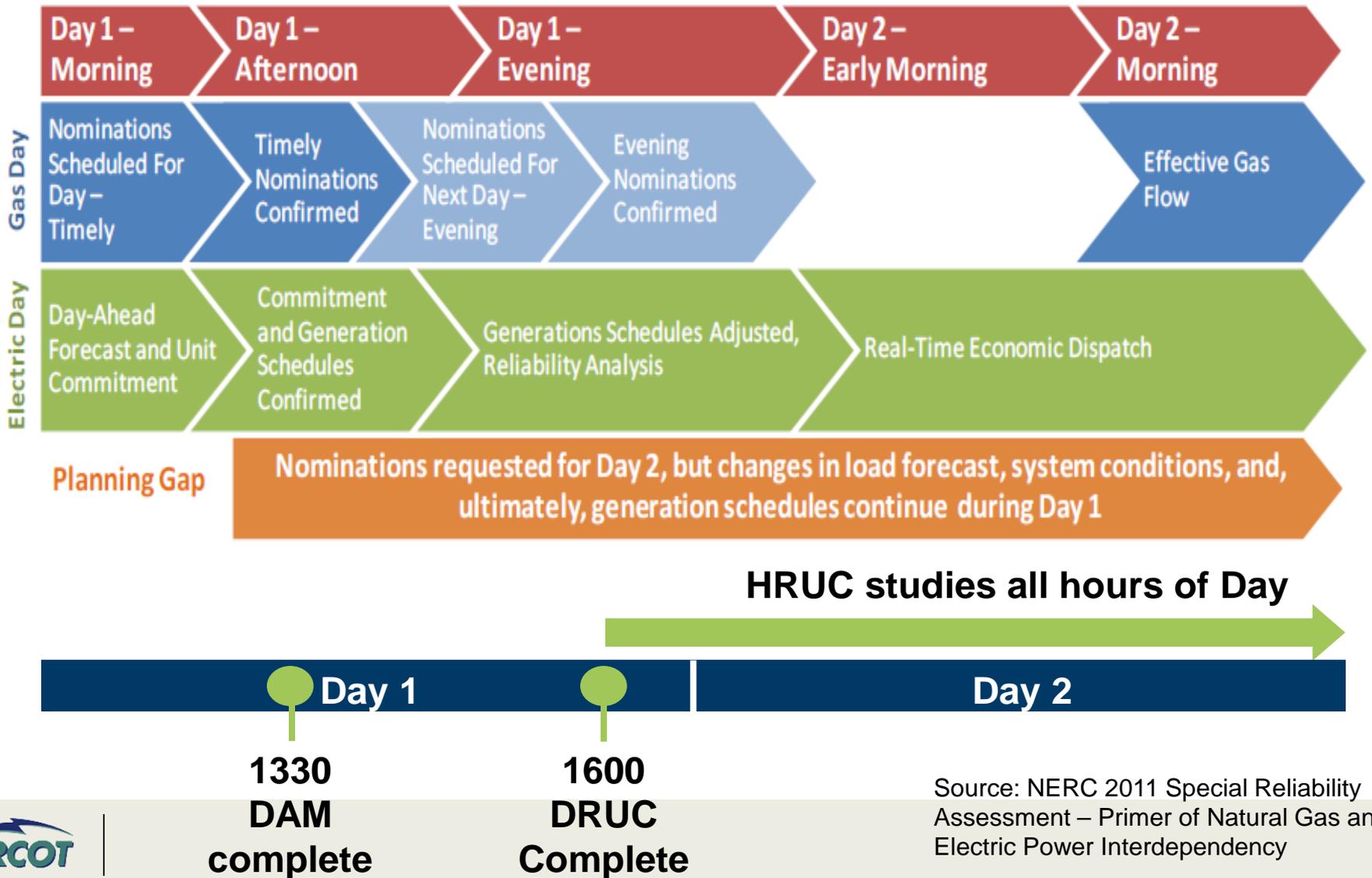
Energy Storage: CAES



- ✓ Very different technologies have very different capabilities as generation resources and as load resources
- ✓ Likely to have very different roles in the market and, therefore, in system operations

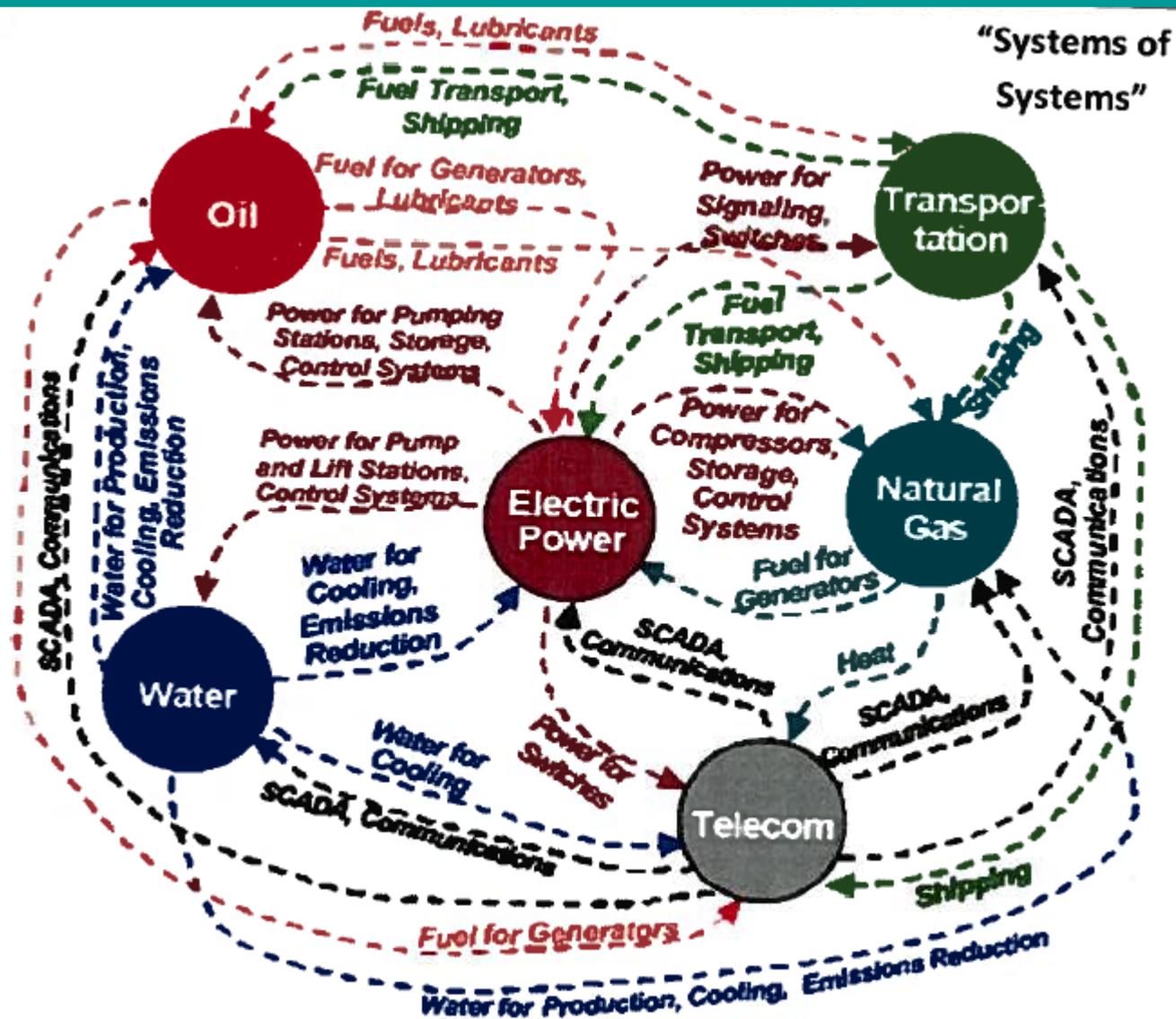
Interdependency Concerns

FIGURE 7-9: SIMPLIFIED GAS AND ELECTRIC PLANNING AND OPERATIONS DAYS

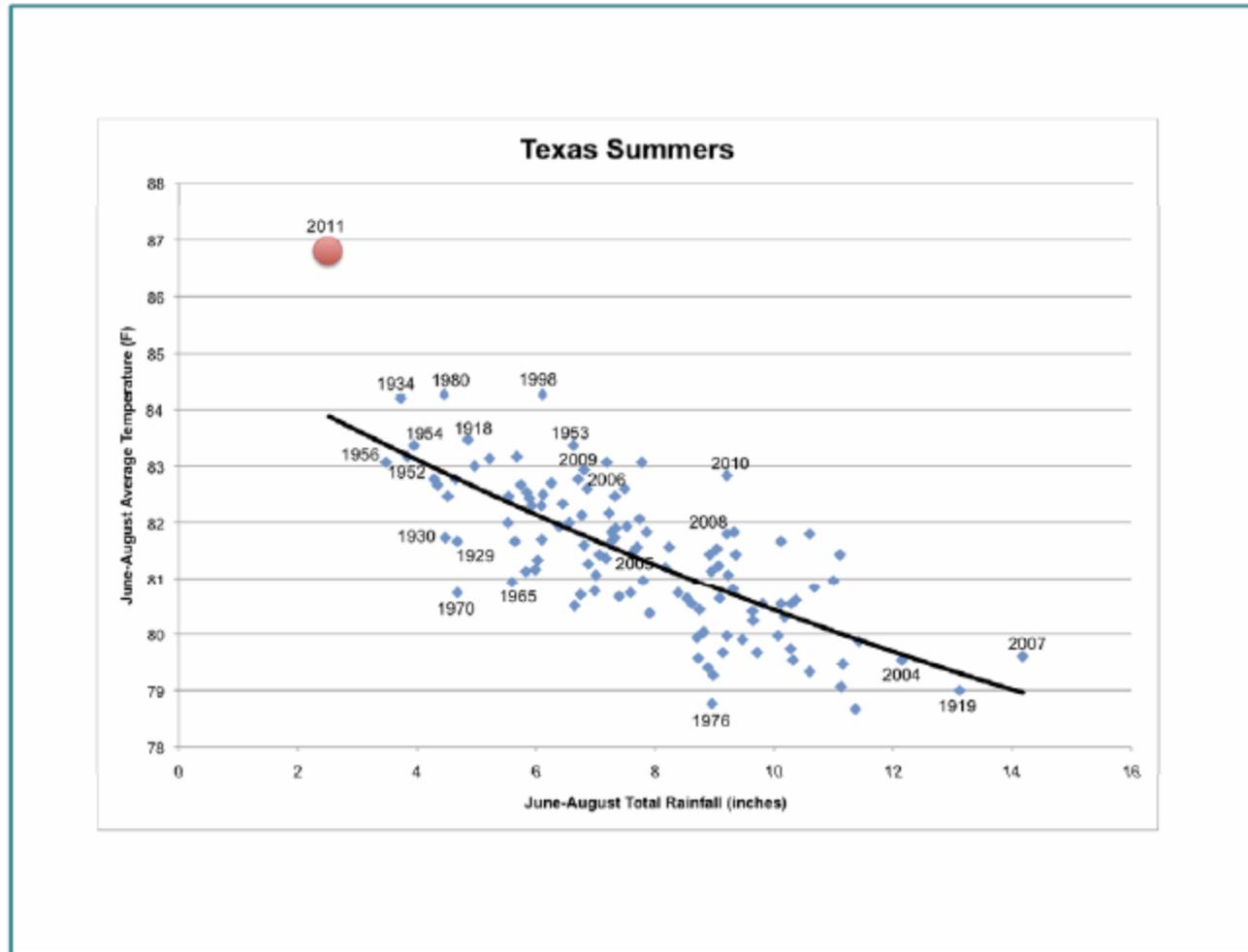


Source: NERC 2011 Special Reliability Assessment – Primer of Natural Gas and Electric Power Interdependency

Interdependency



TEXAS SUMMERS (1895 – 2011)



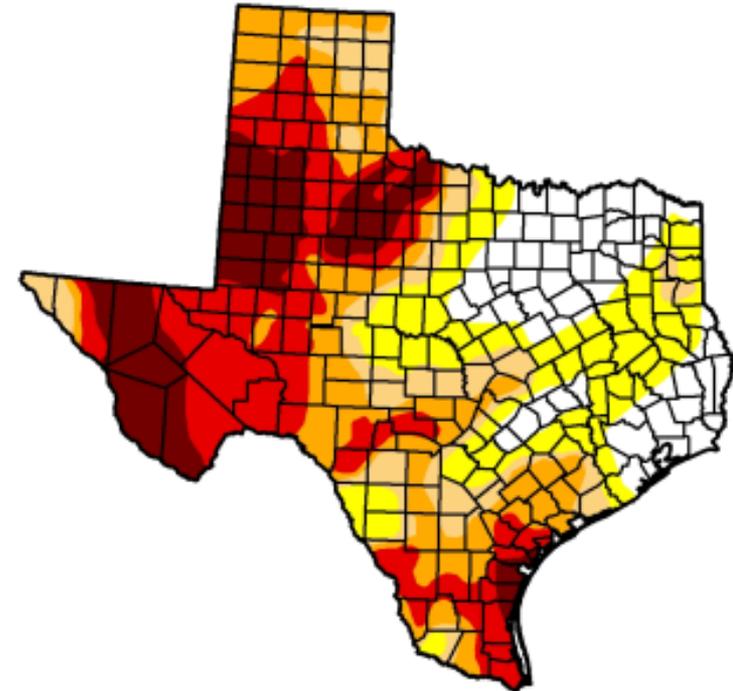
Source: John Nielsen-Gammon, Texas State Climatologist

U.S. Drought Monitor Texas

April 3, 2012
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	16.55	83.45	65.39	53.08	34.81	14.05
Last Week (03/27/2012 map)	12.67	87.33	67.07	55.37	36.38	17.92
3 Months Ago (01/03/2012 map)	0.01	99.99	97.83	84.81	67.32	32.40
Start of Calendar Year (12/27/2011 map)	0.01	99.99	97.83	84.81	67.32	32.36
Start of Water Year (09/27/2011 map)	0.00	100.00	100.00	99.16	96.65	85.75
One Year Ago (03/29/2011 map)	0.00	100.00	94.87	78.54	43.07	0.00



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://droughtmonitor.unl.edu>



Released Thursday, April 5, 2012
Brian Fuchs, National Drought Mitigation Center

<http://www.texastribune.org/library/data/texas-reservoir-levels/>