



# **ERCOT Demand Response Overview & Status Report**

## **AMIT-DSWG Workshop 'AMI's Next Frontier: Demand Response'**

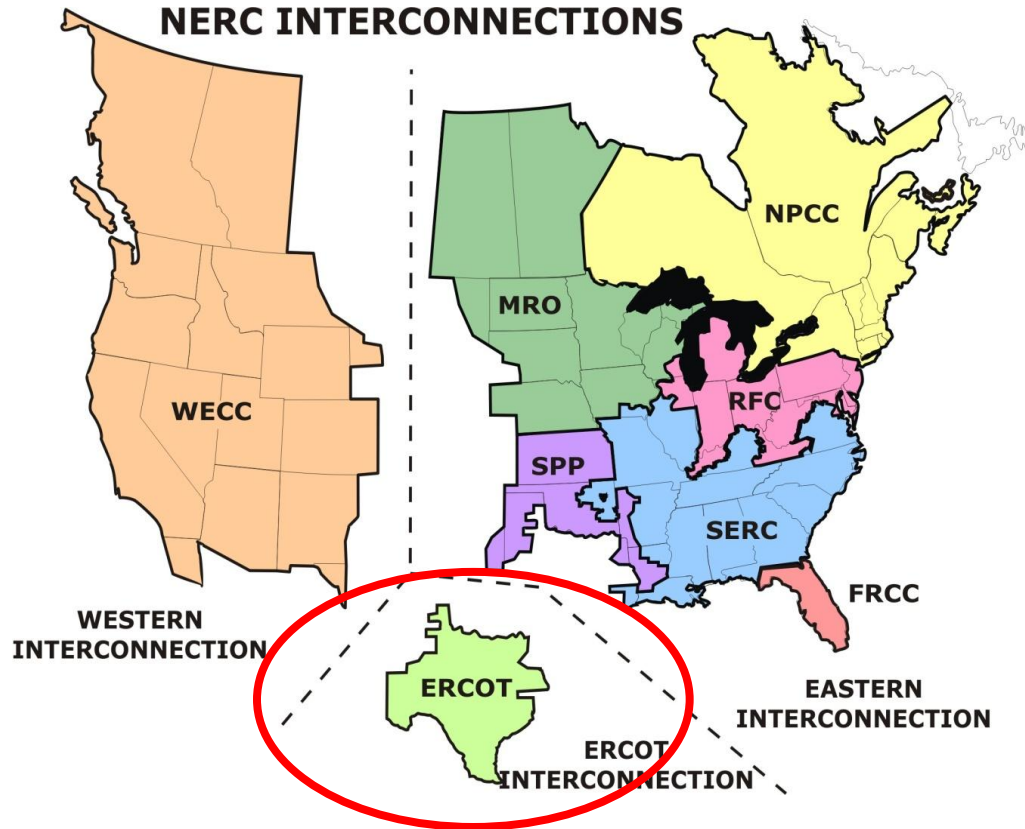
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August 30, 2011

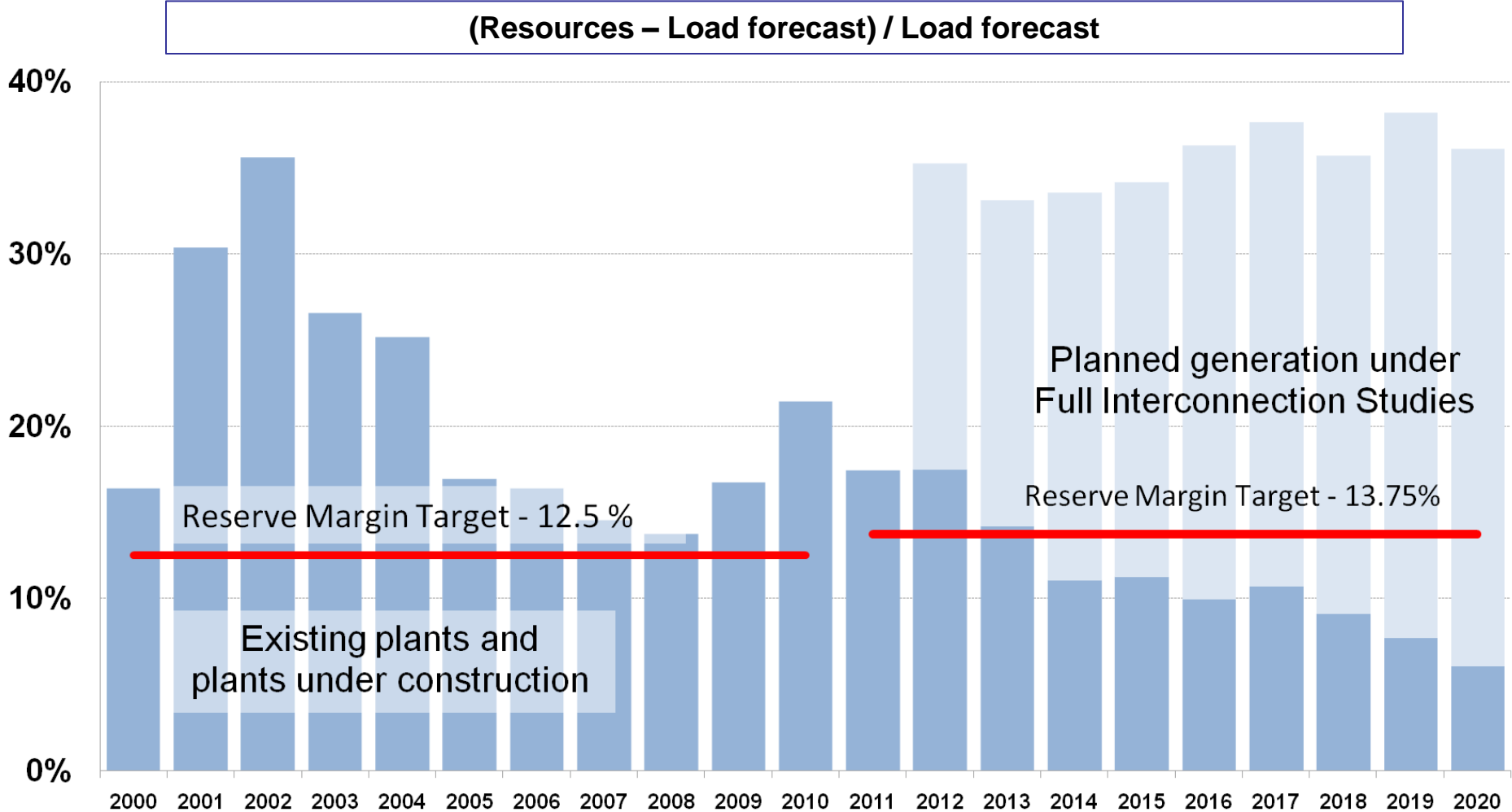
# North American Interconnected Grids



*ERCOT connections to other grids are limited to direct current (DC) ties, which allow control over flow of electricity*

- The ERCOT Region is one of 3 North American grid interconnections
- The ERCOT grid:
  - Covers 75% of Texas land
  - Serves 85% of Texas load
  - >40,000 miles of transmission lines
  - >550 generation units
  - Physical assets are owned by transmission providers and generators, including municipal utilities and cooperatives

# Reserve margins 2000-2020



# We're using more energy than ever

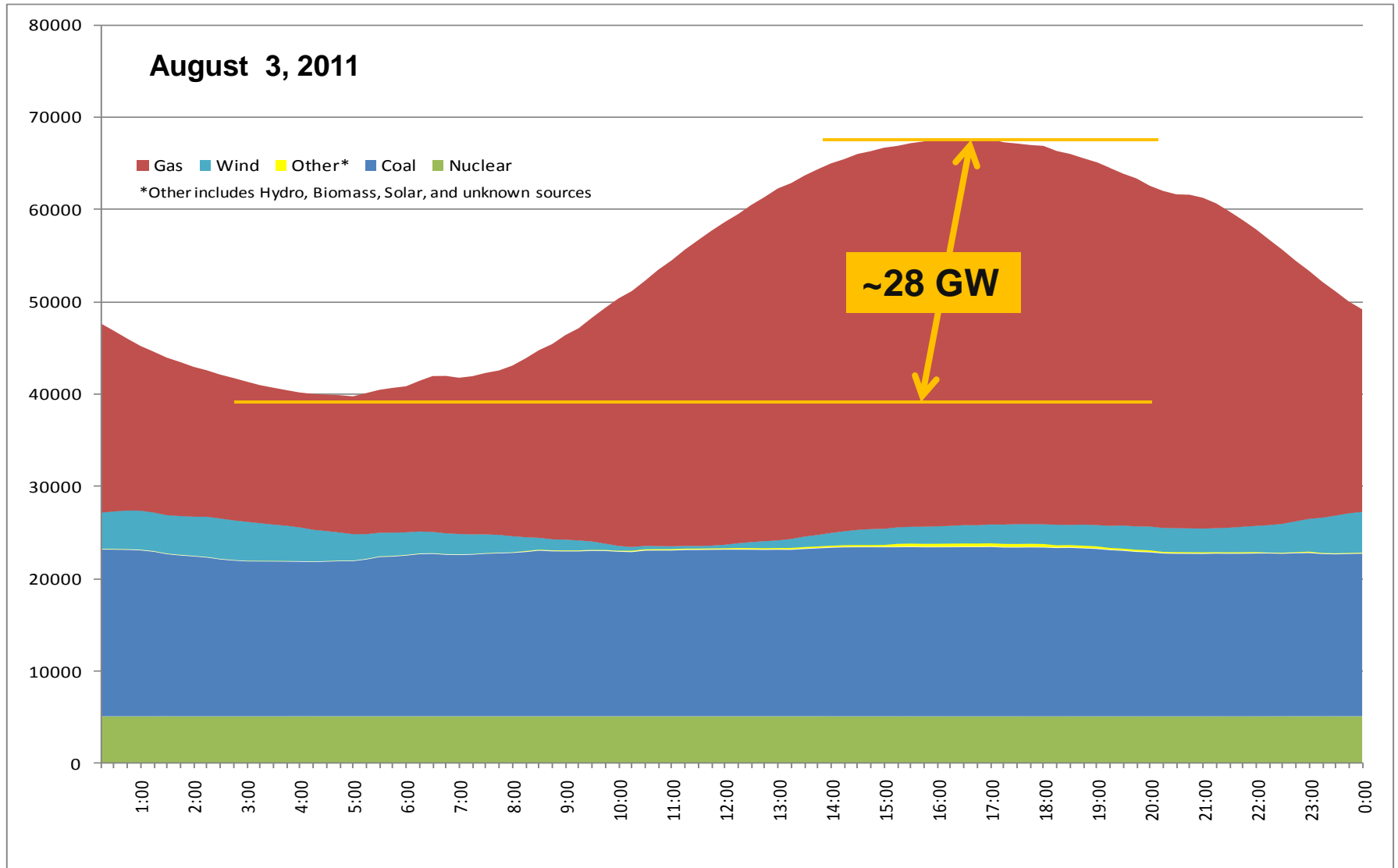
## Winter peak demand

- **New record – 57,282 MW (February 10, 2011)**
- **Beats previous 2007 record by ~ 8,300 MW**

## Summer peak demand

- **New record – 68,294 MW (August 3, 2011)**
- **Beats previous 2010 record by >2,500 MW**

# ERCOT's record load day with fuel mix



# Demand Response potential in ERCOT

- **FERC estimates >18 GW of DR potential in Texas by 2019**
  - Attributed to high peak demand
  - This would represent 20-25% of total ERCOT peak

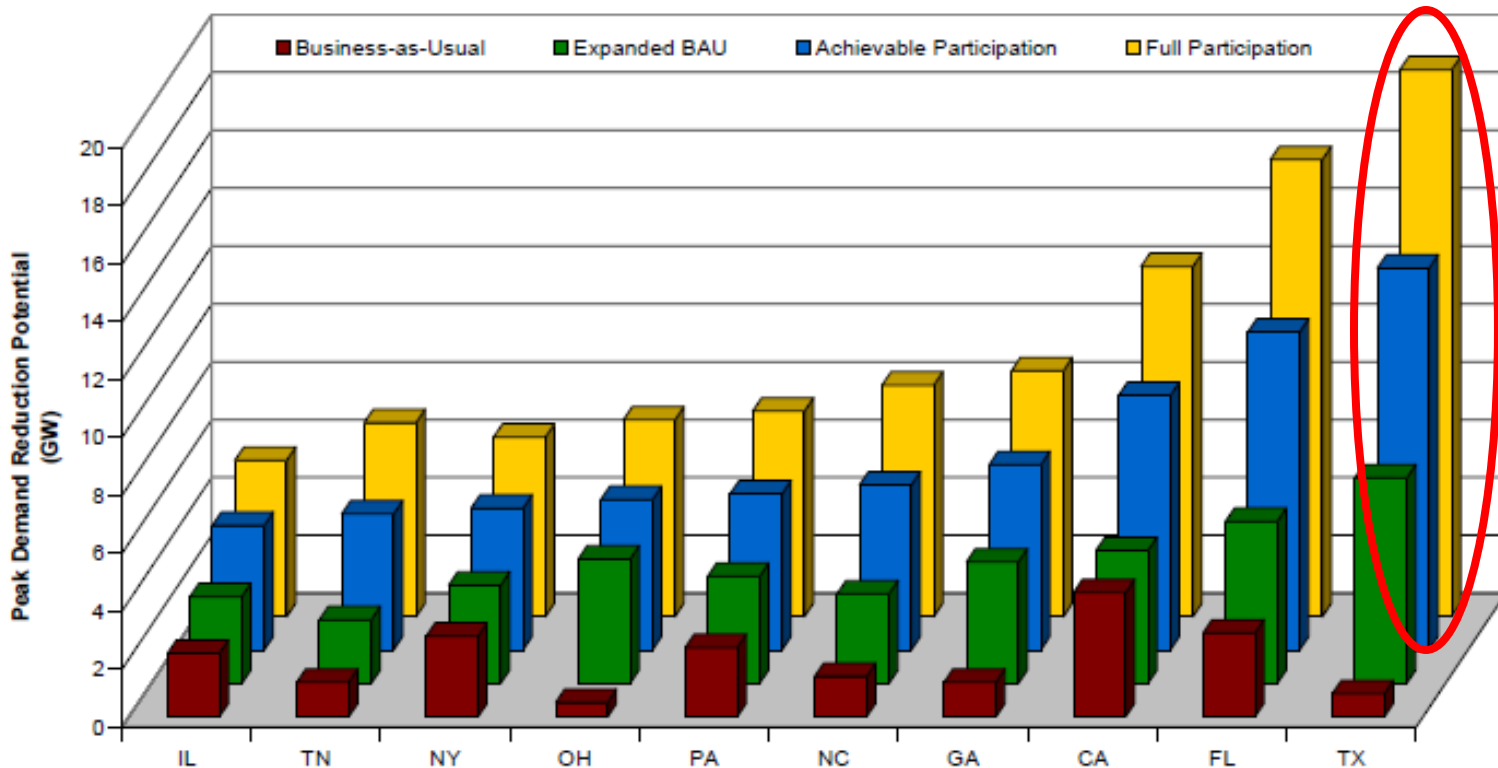
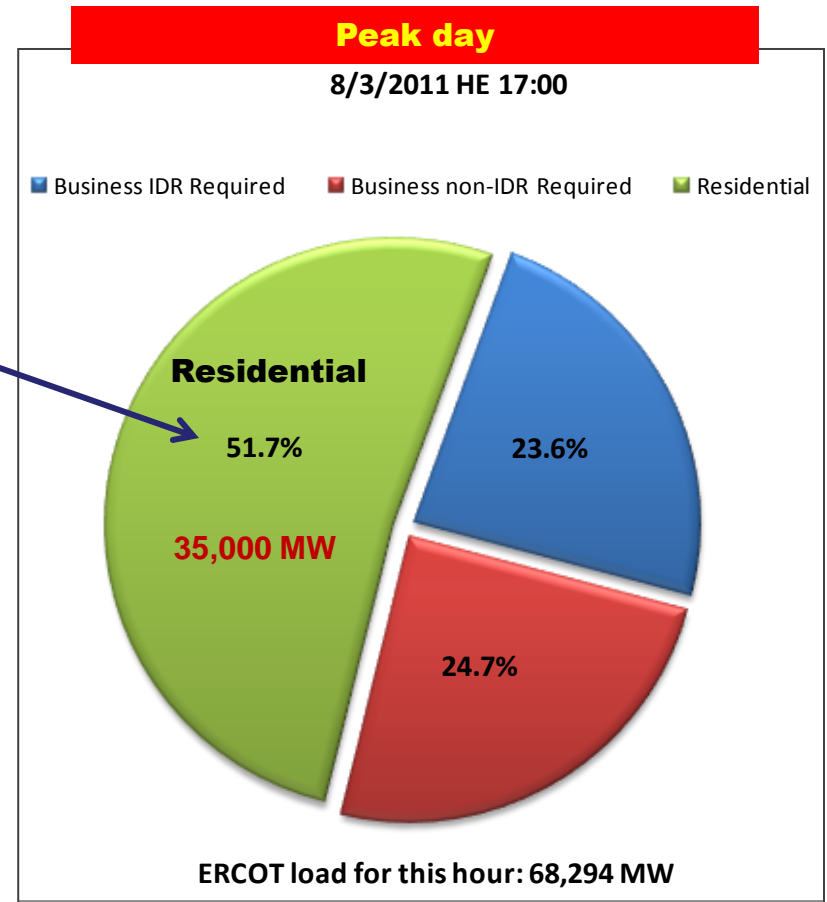
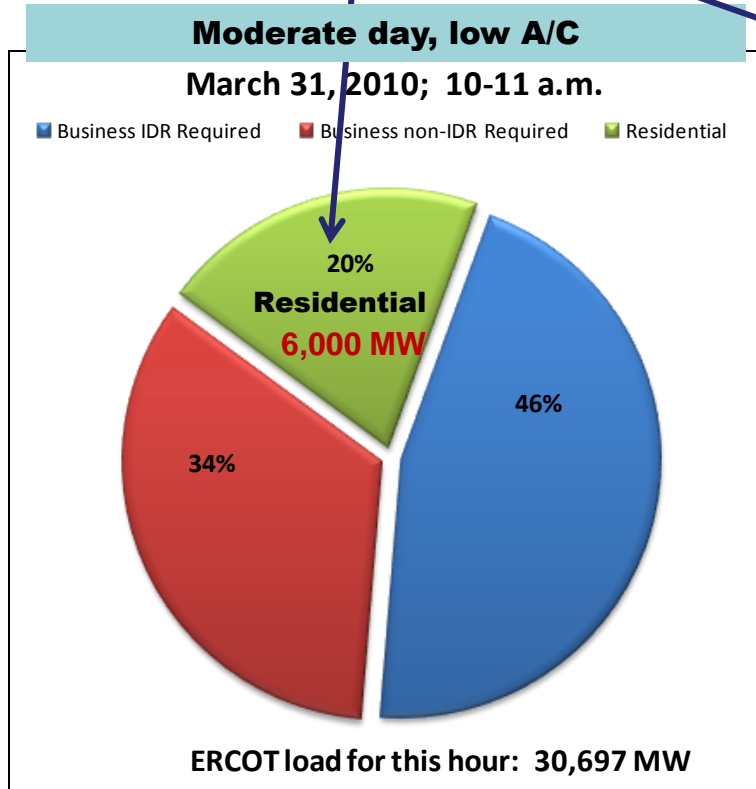


Figure 16: Top Ten States by Achievable Potential in 2019 (GW)

Source: FERC 2009 National Assessment of DR, page 42

# Off-peak vs. on-peak load by customer type

29,000 MW of residential summer peak load



- Both days were weekdays
- Customer class breakdown is for competitive choice areas only
- IDR meters are required at >700kW

# One more way of looking at ERCOT

## Competitive Choice vs. Muni/Co-op Load

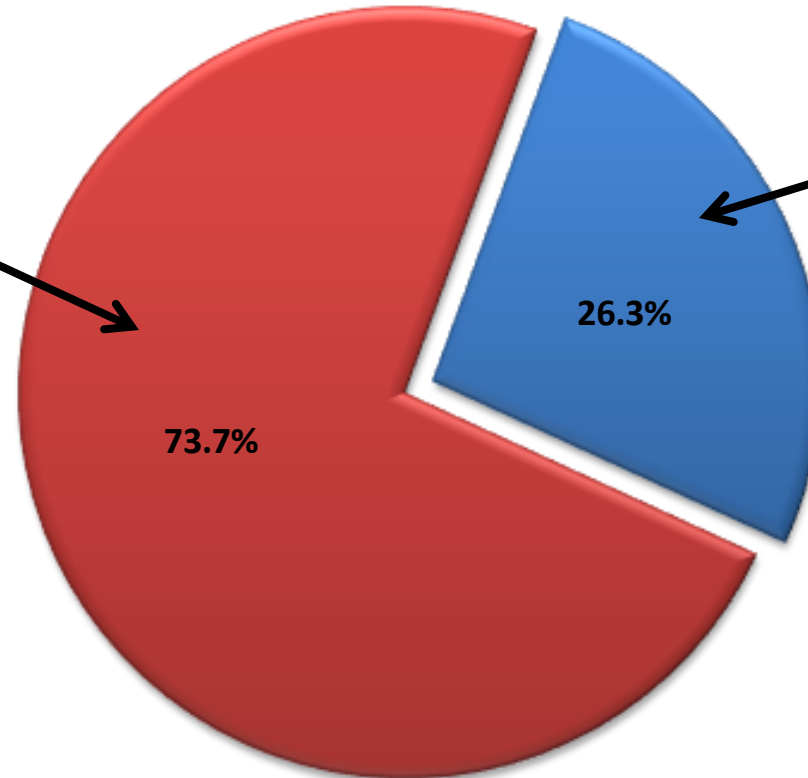
■ NOIE      ■ Retail Choice

Dozens of REPs competing for residential and small commercial accounts

Mostly flat-price options including pre-paid, renewables

AMI deployment underway

'Utility' in the traditional sense in no longer a valid term



Muni's and co-ops are still vertically integrated

Many have existing and developing smart grid initiatives:  
-- AMI  
-- Smart thermostats  
-- Other DLC

Possible triggers:  
Real-time prices, congestion management, 4CP response

MWh 12/1/10 thru 8/11/11



# Definitions of Demand Response

- **‘The short-term adjustment of energy use by consumers in response to price changes or incentives.’ (FERC)**
- **‘Changes in electric use by demand-side resources from their normal consumption patterns in response to changes in the price of electricity, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.’ (NERC)**
- **‘A temporary change in electricity consumption by a Demand Resource in response to market or reliability conditions.’ (NAESB)**

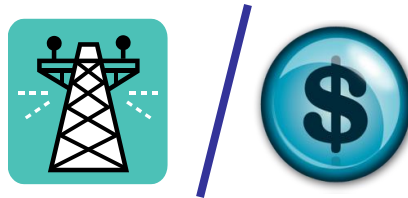
# Definitions of Demand Response

- **The common threads:**
  - Change in Load
  - In response to a signal (economic or operational)
- **Key questions relative to DR:**

1. What's the incentive?



2. What is the signal?



3. Who pushes the button?



# Demand Response in ERCOT

Today



Resource Type	Service	Requirements
<b>Voluntary Load Response (VLR)</b>	Curtailement or reduction in response to Market Price or other factors	<ul style="list-style-type: none"> <li>• Metering</li> <li>• Curtailement technology</li> <li>• Retail contract with price response incentives</li> </ul>
<b>Load Resources (LRs)</b>	Responsive Reserves	<ul style="list-style-type: none"> <li>• Interval metering</li> <li>• Telemetry</li> <li>• Under-Frequency Relay</li> <li>• Curtailement technology</li> <li>• ERCOT Qualification</li> </ul>
<b>Controllable Load Resources (CLRs)</b>	Regulation Service Responsive Reserves	<ul style="list-style-type: none"> <li>• Interval metering</li> <li>• Telemetry</li> <li>• Ability to receive AGC-type signals</li> <li>• Governor-type frequency response</li> <li>• ERCOT Qualification</li> </ul>
<b>Emergency Interruptible Load Service (EILS)</b>	Curtailement in response to ERCOT Verbal Dispatch (10 minutes)	<ul style="list-style-type: none"> <li>• Interval metering</li> <li>• Curtailement technology</li> <li>• ERCOT Qualification</li> </ul>

Future?



All of the above PLUS :		
<b>Load Participation in Security-Constrained Economic Dispatch</b>	Real-Time Energy Market and all Ancillary Services	<ul style="list-style-type: none"> <li>• To be determined</li> <li>• Loads would submit DR energy offer curves to compete with generation in the energy market</li> </ul>

- **Economic DR:**
  - Continuously evolving group of Loads and MWs
  - ERCOT has no dispatch control and limited knowledge
  - 2007 ERCOT survey of LSEs indicated >1000 MW:
    - Curtailing to 4CP signals (summer peak intervals)
      - 11,000+ IDR-metered Loads + NOIEs subject to tariffs
      - Several predictor products available in the market
      - Behavior is baked into ERCOT load forecasting
    - Curtailing based on real-time price exposure
    - Curtailed by LSE through direct load control

- **187 Load Resources with 2391 MW of registered DR capacity**
  - Participation in Responsive Reserves capped at 1150 MW and is fully subscribed for most hours
  - LRs are single sites associated with electrical bus on Network Model
  - 2-second telemetry to ERCOT required
- **2 CLRs with about 35 MW of registered capacity**
  - Sophisticated Loads capable of moving in both directions in response to automated signals and grid frequency
  - Much discussion in ERCOT and other ISOs today about the potential for aggregations of residential customers to provide Regulation Service (frequency response)

- **Up to 491 MW of EILS provided by ~120 individual Loads and aggregations (>550 individual meters)**
- **EILS has a 1,000 MW cap, so we're halfway there after 3.5 years**
- **Open to customers of any size with interval metering**
  - Aggregations allowed, but no participation to date by residential customers
- **Frequently cited limitations to growth:**
  - 10-minute dispatch requirement not suitable for all Loads
  - Lack of ability to contract for a long term
  - Financial incentives diluted for large aggregations

# ERCOT DR: Load Resource deployments since April 2006

	Day	Date	Time	Type of Deployment	Season	EILS TP
1	Mon	4/17/2006	15:34	EECP Step 2 Systemwide VDI	Spring	BH2
2	Tue	10/3/2006	17:37	Systemwide VDI for frequency restoration	Fall	BH3
3	Fri	12/22/2006	2:54	UF Event followed by VDI for frequency restoration	Winter	NBH
4	Mon	7/2/2007	19:38	Systemwide VDI for frequency restoration	Summer	BH3
5	Wed	9/5/2007	7:57	Systemwide VDI for frequency restoration	Summer	NBH
6	Wed	12/12/2007	1:56	Systemwide VDI for frequency restoration	Winter	NBH
7	Tue	2/26/2008	18:49	EECP Step 2 Systemwide VDI	Winter	BH3
8	Sun	3/16/2008	11:37	UF Event, frequency < 59.7 Hz	Spring	NBH
9	Mon	8/11/2008	17:14	Systemwide VDI for frequency restoration	Summer	BH3
10	Tue	12/16/2008	15:49	Systemwide VDI for frequency restoration	Winter	BH2
11	Sat	1/9/2010	10:32	Systemwide VDI for frequency restoration	Winter	NBH
12	Sat	5/15/2010	16:14	UF Event, frequency < 59.7 Hz	Spring	NBH
13	Wed	6/23/2010	15:20	UF Event followed by VDI to selected QSEs for frequency restoration	Summer	BH2
14	Fri	8/20/2010	15:28	Systemwide VDI for frequency restoration	Summer	BH2
15	Wed	11/3/2010	10:21	UF Event followed by VDI to selected QSEs for frequency restoration	Fall	BH1
16	Wed	2/2/2011	5:20	EEA Level 2A Systemwide VDI	Winter	NBH
17	Wed	3/23/2011	14:47	UF Event (partial), frequency dropped to near 59.7 Hz	Spring	BH3
18	Tue	4/5/2011	22:02	UF Event (partial), frequency dropped to near 59.7 Hz	Spring	NBH
19	Wed	5/19/2011	14:08	UF Event (partial), frequency dropped to near 59.7 Hz	Spring	BH2
20	Tue	8/4/2011	14:32	EEA Level 2A Systemwide VDI	Summer	BH2

# LR deployment analysis since April 2006

- **By type:**
  - 4 of 20 have been emergency condition dispatches
  - 8 of 20 have been under-frequency relay trips (full or partial)
  - 8 of 20 have been dispatches for frequency restoration
- **By time period:**
  - 8 of 20 have occurred during non-business hours (overnights and weekends)
- **By season:**
  - 6 in the summer
    - 5 of the 6 during afternoon peak hours
  - 6 in the winter
  - 6 in the spring
  - 2 in the fall
- **The lesson: Summer's important, but ERCOT can need DR at any time**



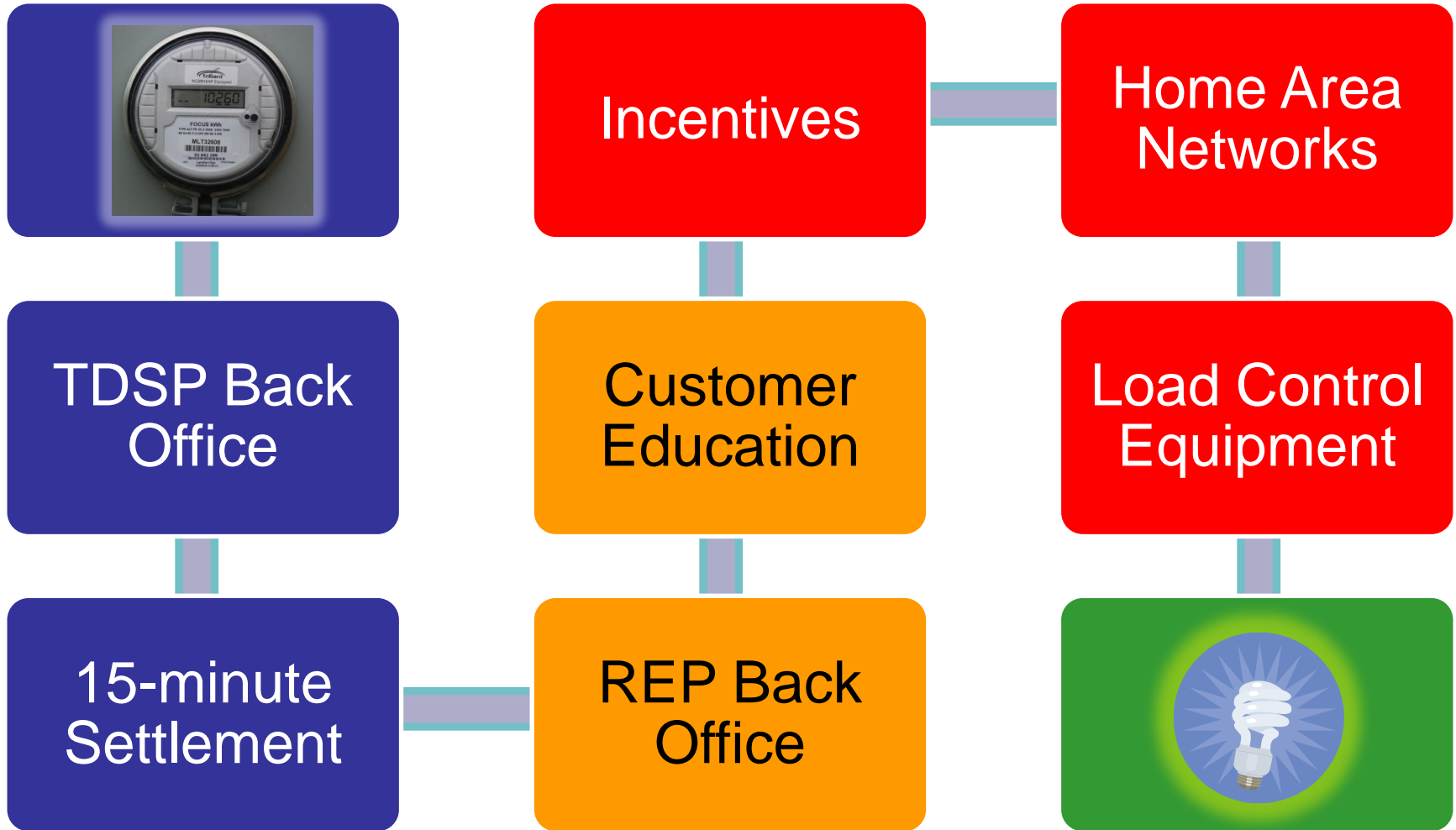
# DR in the ERCOT real-time energy market

- **Security Constrained Economic Dispatch (SCED) sends dispatch instructions to generators in real time based on offer price and location (if necessary to avoid congestion)**
- **SCED currently cannot accept DR offers from Load Resources**
- **Internal project has kicked off at ERCOT, supported by stakeholder white paper**
- **Loads could set LMPs based on their opportunity cost**
- **Could open up Nonspin Reserves market to DR**
- **S.B. 1125 (2011 Legislature) requires PUC by rule to ensure that ERCOT:**
  - ‘...allows load participation in all energy markets for residential, commercial, and industrial customer classes, either directly or through aggregators of retail customers, to the extent that load participation by each of those customer classes complies with reasonable requirements adopted by the organization relating to the reliability and adequacy of the regional electric network and in a manner that will increase market efficiency, competition, and customer benefits.’

- **Intelligent load management enabled by:**
  - Advanced metering
  - Home Area Networks
  - Load control devices and tools
  - Dynamic price offerings and other incentives
- **‘Self-healing’ grid responding dynamically to shortages, disturbances or price signals**
- **‘Demand Response 2.0’**



# Path to AMI-enabled DR

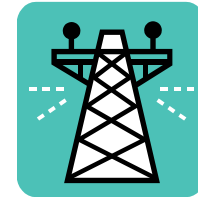




- **Contractual DR:**
  - ERCOT Ancillary Services or EILS
  - TDSP Load Management Standard Offer Programs
  - Subsidized HANs or controls in exchange for centralized dispatch (Direct Load Control) by a REP or third party to:
    - Manage load shape based on market positions
    - Respond to real-time price spikes
  - Critical peak pricing combined with REP DLC
- **Voluntary DR:**
  - Time of Use pricing (behavioral load-shifting)
  - Real-time pricing tied to wholesale market signals
- **Combinations of the above**
- **Others**

- **Operations/reliability**

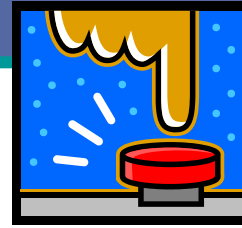
- Energy Emergency Alert
  - Two so far in 2011
- Grid frequency drop (Under-frequency relay trip)
- Frequency recovery (NERC Disturbance Control Standard)
- Congestion management



- **Economic**

- Energy price response (LMPs or Load Zone Settlement Price Points) – real-time pricing, critical peak pricing, etc.
- 4CP response – transmission tariff cost-avoidance by large customers and NOIE programs

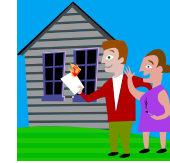




- **Who will push the button?**

- **Multiple candidates:**

- Customers may control their own load manually
- Customers may acquire automation tools to have load controlled automatically based on signals
- Appliances and other devices will begin incorporating Auto-DR
- REPs may offer products that allow them to control customers' load based on pre-determined conditions
- DR aggregators may enroll customers in DR products and control load remotely
- TDSPs via the AMI infrastructure may enroll customers in standard offer programs and control load remotely



- TDSPs may also use the infrastructure for shedding non-critical firm load during emergencies

## Does economic DR benefit grid reliability?

- **Yes -- price elasticity of demand has reliability value even though it is not dispatched by ERCOT**
- **In the Nodal market, prices and shortage conditions are aligning better than in the old Zonal market**
  - Example: \$3,000/MWh prices across the peak on Aug. 4
- **Some concerns remain: energy-only market design relies on scarcity pricing for incentives for future generation investment**
  - Market participants and PUC are working on concerns about effects of Nonspin deployments on real-time prices
- **In addition, interval metering provides a great data mine for assisting in mid- and long-term load forecasting**
  - As more customers enroll in DR products, ERCOT will need to adapt its load forecasting tools

## Questions we have

- **How much mass market DR potential is out there?**
- **How many REPs will build AMI DR portfolios?**
  - Does DR capability = smarter energy consumers = customer loyalty?
  - Can energy savings via load management tools help REPs acquire customers?
  - What about the back-office system requirements?
- **How fast will it develop?**
- **Who is most likely to push the button?**
- **What energy prices are needed to stimulate economic DR?**
- **Will residential DR aggregations enroll in EILS?**
- **If they could, would mass-market DR aggregations participate in:**
  - The real-time Nodal energy market?
  - Ancillary services (i.e., Nonspin Reserves)?



# Questions?

