



Demand Response in the ERCOT Markets

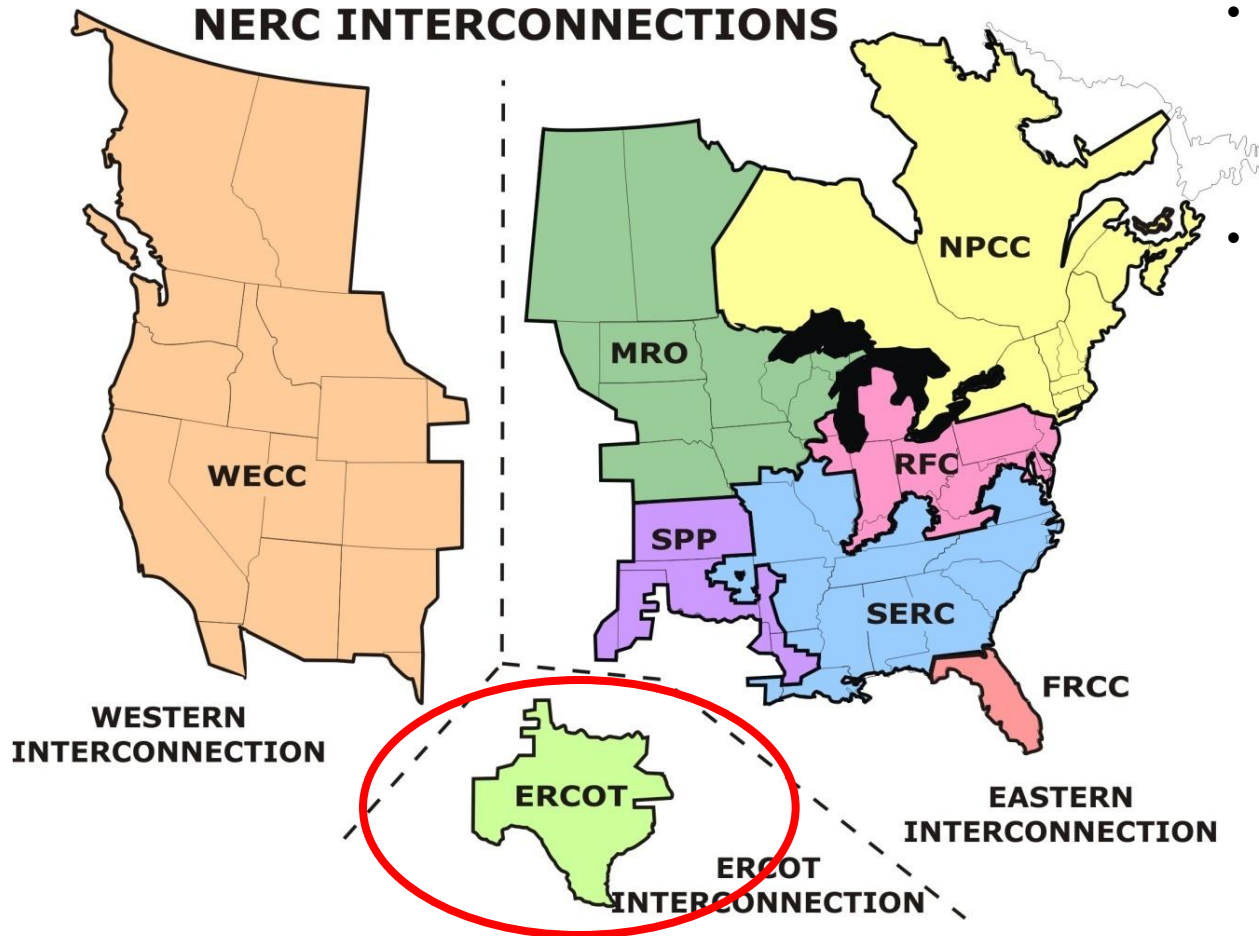
DOE Workshop—Washington, DC

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NERC INTERCONNECTIONS



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
 - 68,294 MWs – peak set 08/03/2011

Demand Response in ERCOT Today

Resource Type	Service	Requirements	Participants
Voluntary Load Response (VLR)	Load reduction in response to Market Price or other factors	<ul style="list-style-type: none"> • Metering • Load reduction technology • Retail contract with price response incentives 	<ul style="list-style-type: none"> • Commercial & industrial Loads with few exceptions
Load Resources (LRs)	Responsive Reserves Non-Spinning Reserve Service	<ul style="list-style-type: none"> • Interval metering • Telemetry • Under-Frequency Relay • Load reduction technology • ERCOT Qualification 	<ul style="list-style-type: none"> • Industrial Loads
Controllable Load Resources (CLRs)	Regulation Service Responsive Reserves Non-Spinning Reserve Service	<ul style="list-style-type: none"> • Interval metering • Telemetry • Ability to receive AGC-type signals • Governor-type frequency response • ERCOT Qualification 	<ul style="list-style-type: none"> • Industrial Loads
Emergency Interruptible Load Service (EILS)	10-minute special emergency DR service	<ul style="list-style-type: none"> • Interval metering • Load reduction technology • ERCOT Qualification 	<ul style="list-style-type: none"> • Mid- to large commercial & industrial Loads

Load Resource Characterization

- **Total Load Resource Capacity – 2400 MW Registered**
- **Most capacity comes from large industrial electro-chemical process loads – 10 Load Resources account for about 1030 MW of capacity**
- **Next group is made up of medium size industrial facilities 10 to 50 MW in size – 40 Load Resources account for the next 820 MW of capacity**
- **Balance is made up of small industrial and commercial facilities that are 10 MW of capacity or less –139 Load Resources account for the balance of 550 MW of capacity**
- **Facilities include electro-chemical processing, oil field equipment, cement plants, manufacturing, compression, pumping, data centers, and other industrial loads.**

ERCOT Load Resource Deployments (21 since April '06)

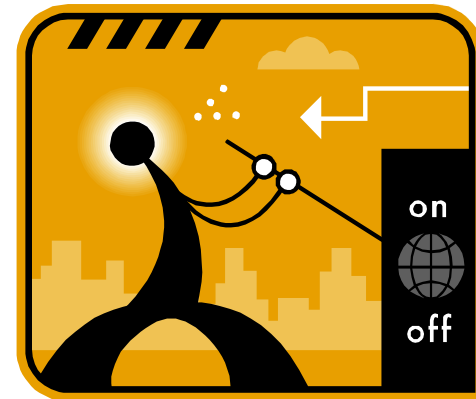
Day	Date	Time	Type of Deployment	Season	EILS TP
Mon	4/17/2006	15:34	EECP Step 2 Systemwide VDI	Spring	BH2
Tue	10/3/2006	17:37	Systemwide VDI for frequency restoration	Fall	BH3
Fri	12/22/2006	2:54	UF Event followed by VDI for frequency restoration	Winter	NBH
Mon	7/2/2007	19:38	Systemwide VDI for frequency restoration	Summer	BH3
Wed	9/5/2007	7:57	Systemwide VDI for frequency restoration	Summer	NBH
Wed	12/12/2007	1:56	Systemwide VDI for frequency restoration	Winter	NBH
Tue	2/26/2008	18:49	EECP Step 2 Systemwide VDI	Winter	BH3
Sun	3/16/2008	11:37	UF Event, frequency < 59.7 Hz	Spring	NBH
Mon	8/11/2008	17:14	Systemwide VDI for frequency restoration	Summer	BH3
Tue	12/16/2008	15:49	Systemwide VDI for frequency restoration	Winter	BH2
Sat	1/9/2010	10:32	Systemwide VDI for frequency restoration	Winter	NBH
Sat	5/15/2010	16:14	UF Event, frequency < 59.7 Hz	Spring	NBH
Wed	6/23/2010	15:20	UF Event followed by VDI to selected QSEs for frequency restoration	Summer	BH2
Fri	8/20/2010	15:28	Systemwide VDI for frequency restoration	Summer	BH2
Wed	11/3/2010	10:21	UF Event followed by VDI to selected QSEs for frequency restoration	Fall	BH1
Wed	2/2/2011	5:20	EEA Level 2A Systemwide VDI	Winter	NBH
Wed	3/23/2011	14:47	UF Event (partial), frequency dropped to near 59.7 Hz	Spring	BH3
Tue	4/5/2011	22:02	UF Event (partial), frequency dropped to near 59.7 Hz	Spring	NBH
Wed	5/19/2011	14:08	UF Event (partial), frequency dropped to near 59.7 Hz	Spring	BH2
Thu	8/4/2011	14:32	EEA Level 2A Systemwide VDI	Summer	BH2
Wed	8/24/2011	15:11	EEA Level 2A Systemwide VDI	Summer	BH2

- Six of 21 deployments have occurred during summer peak hours
- Eight of 21 deployments occurred during non-business hours
- ERCOT needs operational DR any time (not just on peak)

Requirements for Load Resources:

- Registration as a Load Resource under a Resource Entity with an existing relationship to a Qualified Scheduling Entity
- Interval Data Recording (IDR) Meter Installed
- Real Time Telemetry provided to ERCOT thru QSE
 - Net Power Consumption (MW)
 - Reactive Power (MVars) for CLRs
 - Low Power Consumption (LPC) (MW)
 - Max Power Consumption (MPC)(MW)
 - Load Resource Breaker status (CB, etc.)
 - Ancillary service Schedule (in MWs)
 - Ancillary Service Resource Responsibility (in MWs)
 - Status of UF Relay (Non-Controllable Load Resources)
 - Resource Status (ONRL, Offline)
- One Line Drawing submitted with all applicable data
- Relay Test Reports Submitted (Non-Controllable Load Resources)
- Complete Qualification Test for the Ancillary Service(s) to be provided

- **Today's triggers (ERCOT):**
 - Operations/reliability
 - Energy Emergency Alert
 - Grid frequency drop (UFR trip)
 - Frequency recovery (NERC Disturbance Control Standard)
 - Local congestion management (not used since 2003)



New Frontiers in Load Participation at ERCOT

- **Look Ahead SCED**
- **Load Resources in SCED**
- **Storage Resources**
- **Small Load Participation**

- **Under zonal systems Loads had 7-8 minutes to respond to energy price that would be in effect for the following 15 minutes**
- **Under nodal systems, settlement prices are not known until after the 15 minute interval is over**
- **Market Participants are looking at potential ways to “look ahead” and post informational prices based on best information known**
- **Concept is based on Market Designs in several other ISOs in which SCED looks at the Generation to be Dispatched**



Load Resource Participation in SCED

- **In current market design most non-Controllable Load Resources can only participate in Non-Spin and Responsive Reserve Markets**
- **Dispatched by verbal instruction from ISO Operator**
- **Few LR are willing to participate in Non-Spin since they have no control over the energy price at which they are deployed**
- **Change the paradigm to have LRs economically dispatched by SCED and let them set the price at which they would be willing to be dispatched**
- **Some settlement issues need to be resolved**

Challenges to Integrate Energy Storage

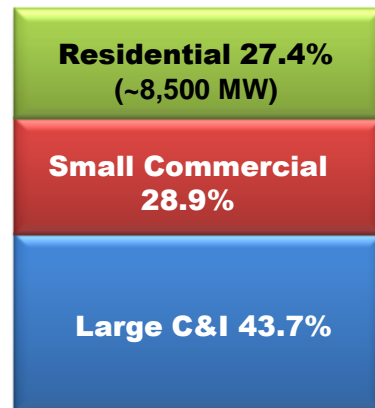
- 1. Current ERCOT systems built to recognize only Generation and Load Resources, Energy Storage is in some way similar to both and in some ways neither.**
- 2. Ancillary Services are purchased in hourly increments and therefore Energy Storage technologies that are Energy Limited may have issues providing services at maximum output capability under current protocol requirements.**
- 3. ERCOT systems not designed to recognize State-of-Charge and therefore current systems not able to dispatch Energy Storage Resources efficiently.**

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

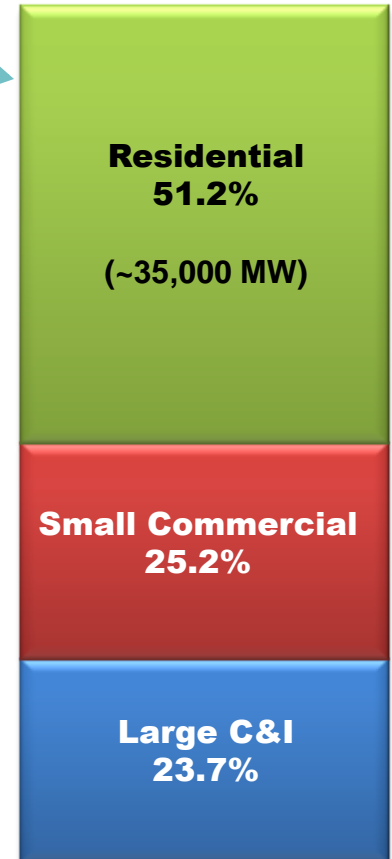


Wed., Aug. 3, 2011
5:00 PM
ERCOT Load: 68,416 MW
Temperature in Dallas: 109°

Wed., March 9, 2011
5:15 PM
ERCOT Load: 31,262 MW
Temperature in Dallas: 64°



3/9/2011 IE 17:15



8/3/2011 IE 17:00

- Customer class breakdown is for competitive choice areas; percentages are extrapolated for NOIEs to achieve region-wide estimate
- Large C&I are IDR Meter Required (>700kW)

- **Current market activities for most part preclude participation by Residential and Small Commercial Load**
- **With new AMI infrastructure, low cost communication and advanced control capabilities there are opportunities for these Loads to be aggregated and provide service to ISO AS Markets**
- **Some issues or barriers that need to be resolved:**
 - Real time telemetry
 - How to model in the ISO network
 - Primary Frequency Response
- **Possibly move to Pilot by next Summer**

