Center for the Commercialization of Electric Technologies

Polling Instructions for CCET Public Meeting/NI Week
Wednesday, August 6, 2014 1:00pm-5:00pm
Austin Convention Center, Austin, Texas

We are excited to use a polling technology that will allow us to sample your opinions during our presentations. We hope that by receiving real-time feedback, our presentations will be more tailored to your interests and will create an interactive discussion.

We are using PollEverywhere, a simple-to-use website. You have two options for casting votes: by texting votes on your mobile phone or through any internet enabled device (smartphone, laptop, tablet, etc.). When your presenter instructs you, simply cast your vote as shown. In the front of the room, we have a screen that will show the questions being asked, and the instant poll results. Web Ex Attendees will see questions on their devices.

Option 1- Respond using Text Messages *(Easiest)*

To join this session Enter 22333 as a recipient then send a message using the keyword CCET.
You will receive a response "You've joined Sarah Heintz (CCET)..."

The screen in the front of the room will list the number to text to cast your vote. WebEx attendees will see this on their monitors.

****PollEverywhere will only count one vote per question.** Standard texting rates may apply.

When the meeting is over at the end of the day, reply LEAVE to end the poll.

Option 2- Respond using the Internet

Connect to Austin Convention Center or NI in your available wireless networks on your computer and simply click on it to connect.
No Passwords Needed.
On your smart phone, tablet or laptop open a web browser (Safari, Explorer, Chrome, etc.) and go to

www.pollev.com/ccet

CCET Public Session Board Meeting

August 6, 2014 1:00 p.m. – 5:00 p.m.

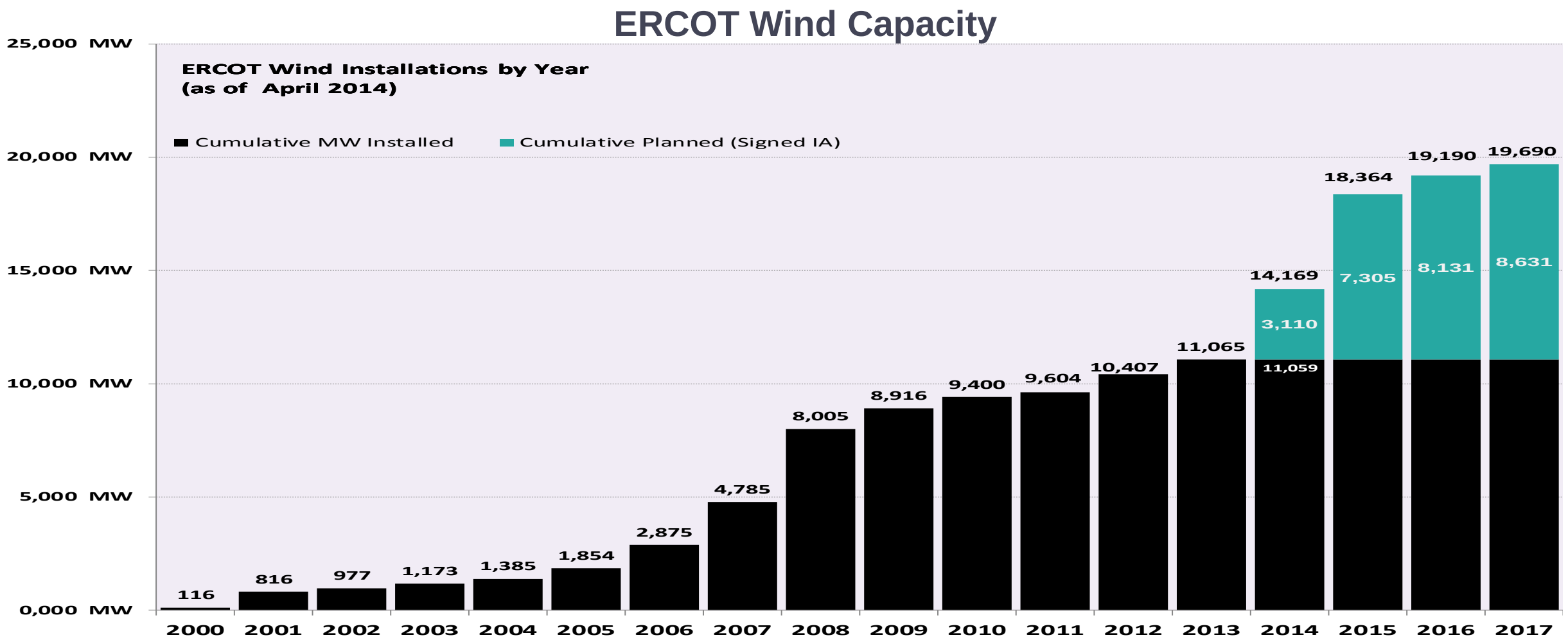
Austin Convention Center – NI Week

This material is based upon work supported by the Department of Energy under Award Number DE-OE0000194."

Milton Holloway, Ph.D.
President & COO
CCET
mholloway@electrictechnologycenter.com
electrictechnologycenter.com

Discovery Across Texas:
Project Panel Discussion

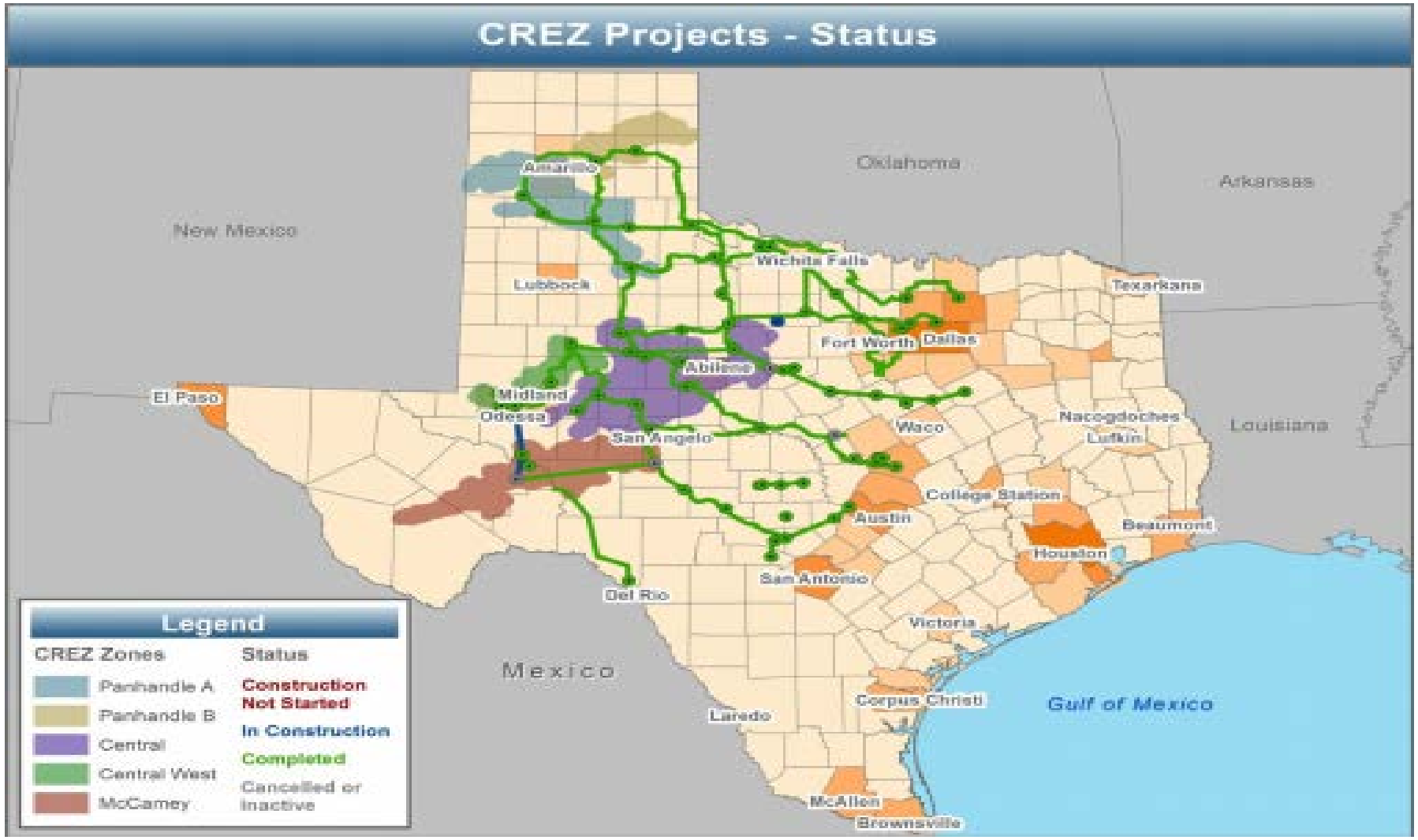
Context: Continuing Investment in Wind Generation



The data presented here is based upon the latest registration data provided to ERCOT by the resource owners and can change without notice. Any capacity changes will be reflected in current and subsequent years' totals. Scheduling delays will also be reflected in the planned projects as that information is received.

This chart reflects planned units in the calendar year of submission rather than installations by peak of year shown.

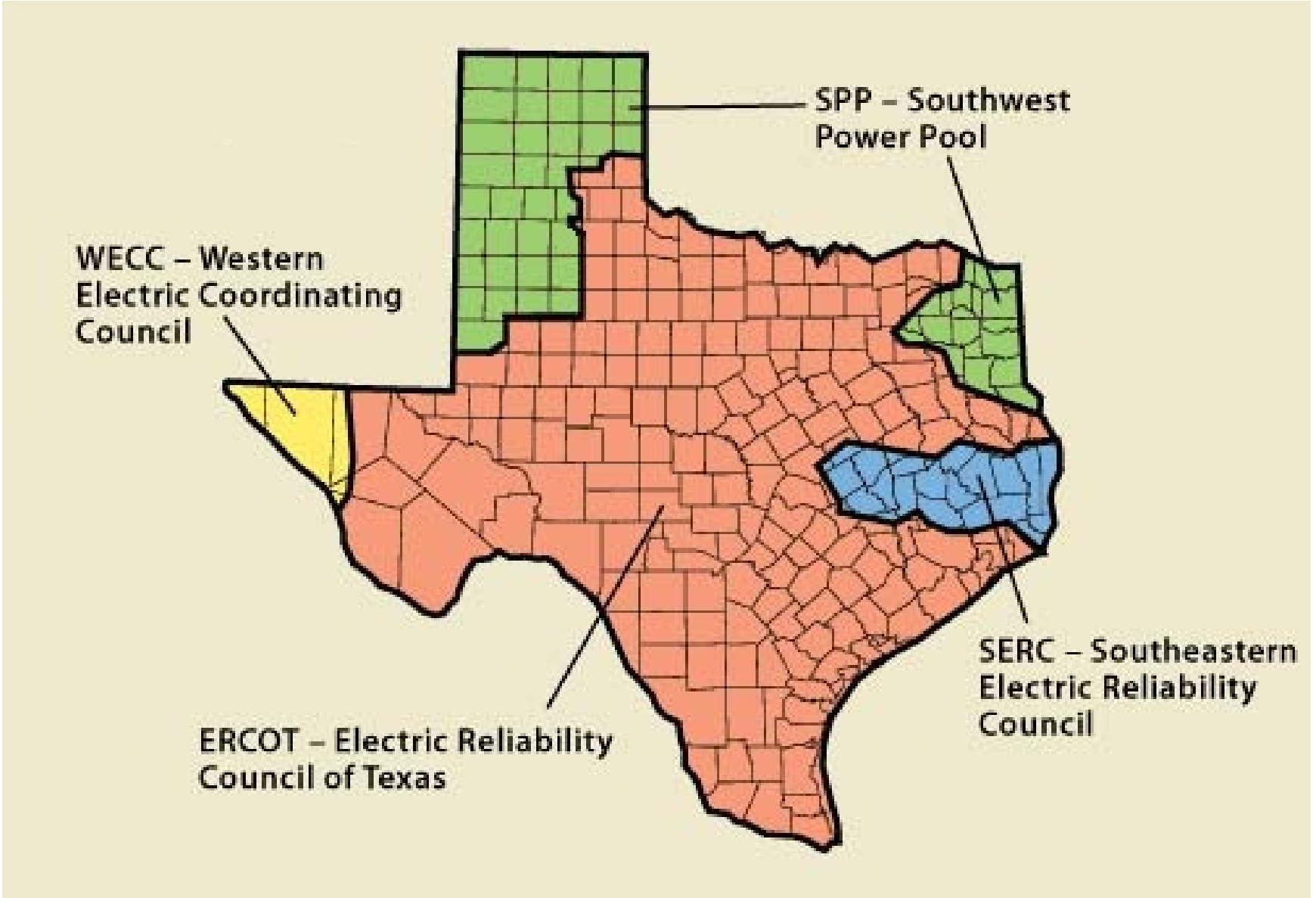
Context: CREZ* Build-out Completion



*Competitive Renewable Energy Zones

$7B cost, 3,589 miles of lines

Discovery Across Texas Project: ERCOT & Part of SPP



Discovery Across Texas - Project Team

Discovery Across Texas

Seven Project Components:

I. **Synchrophasor system with applications (ERCOT wide grid monitoring)**

II. **Security fabric demonstration for synchrophasor systems (demonstrated at Lubbock/TTU/RTC)**

III. **Utility-scale battery with companion wind farm (Lubbock/TTU/RTC)**

IV. **Pricing trials at Pecan Street (Austin)**

V. **Direct Load Control demonstration with dual communication paths (Dallas and Houston)**

VI. **Solar community monitoring (Harmony Community in Houston and Mueller Community in Austin)**

VII. **PEV fleet Fast Response Regulation Service demonstration (Fort Worth)**

CCET Demonstration Project: *Discovery Across Texas*

Agenda for the day

- Seven presenters this afternoon
- Audience Engagement Questions
- Q&A at the end
- Summary of Taskforce Efforts during August & September

Audience Engagement Question

Texas can reliably manage what % of transmission grade *generation* from wind & solar by year 2030

Answers:

a. **Twenty Percent**
b. **Thirty Percent**
c. **Forty Percent**
d. **Fifty Percent**
e. **Greater Than Fifty Percent**

Vikram Budhraja

President
Electric Power Group, LLC
budhraja@electricpowergroup.com

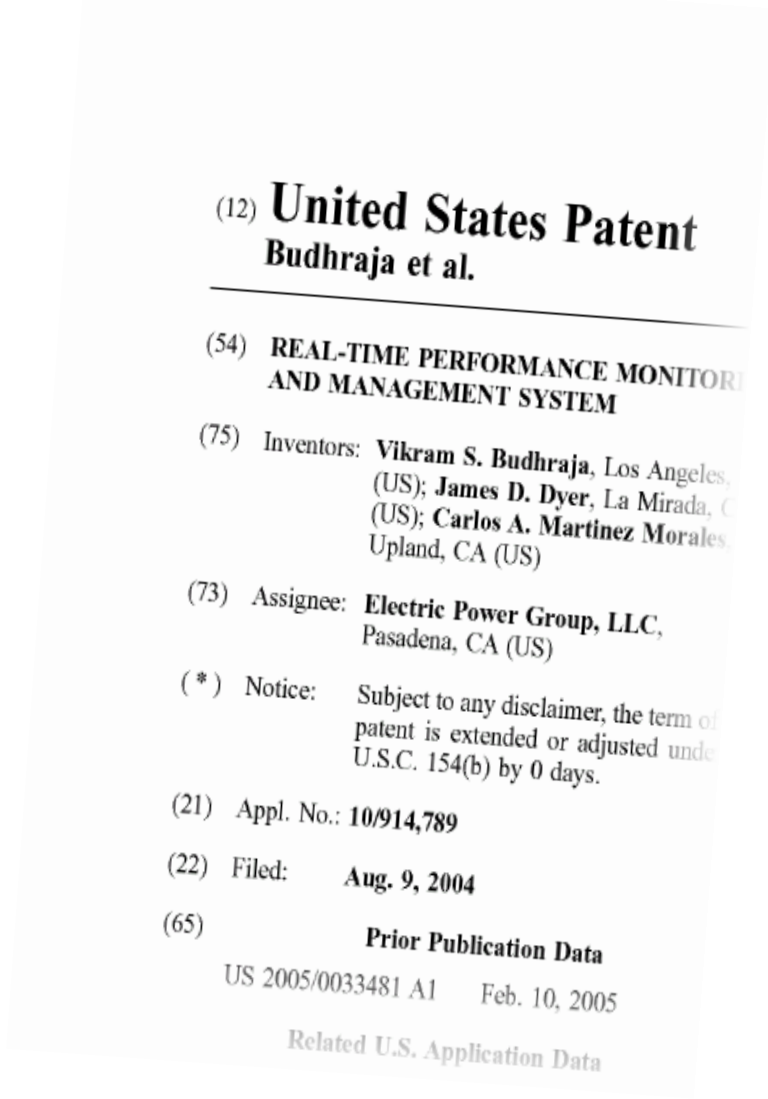
Electric Power Group

Synchrophasor Technology Adoption in Texas

CCET

About EPG

- Started in 2000 by experienced team of electric utility executives
- Focus area is **power grid technologies and solutions**
- Pioneered research and development in synchrophasor technology
- Leading phasor adoption - founding member of NASPI (EIPP), CERTS and phasor research for DOE/CEC
- Recognized as industry pioneer – granted 3 patents for Real Time Performance Monitoring, Wide-Area Real-Time Monitoring and Visualization System
- Customers include major utilities and ISO's in N. America, including AEP , Ameren, APS, BPA, CAISO, Consolidated Edison, Dominion Power, Duke Energy, SCE, ONCOR, LADWP, SRP, ***ERCOT***, NYISO, PJM, MISO, NYPA, Duke Energy, NASPI (DOE supported wide-area monitoring system)
- HQ in Pasadena, CA, USA



(12) **United States Patent**
Budhraja et al.

(54) **REAL-TIME PERFORMANCE MONITOR AND MANAGEMENT SYSTEM**

(75) Inventors: **Vikram S. Budhraja**, Los Angeles, (US); **James D. Dyer**, La Mirada, (US); **Carlos A. Martinez Morales**, Upland, CA (US)

(73) Assignee: **Electric Power Group, LLC**, Pasadena, CA (US)

(*) Notice: Subject to any disclaimer, the term of patent is extended or adjusted under U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/914,789**

(22) Filed: **Aug. 9, 2004**

(65) **Prior Publication Data**

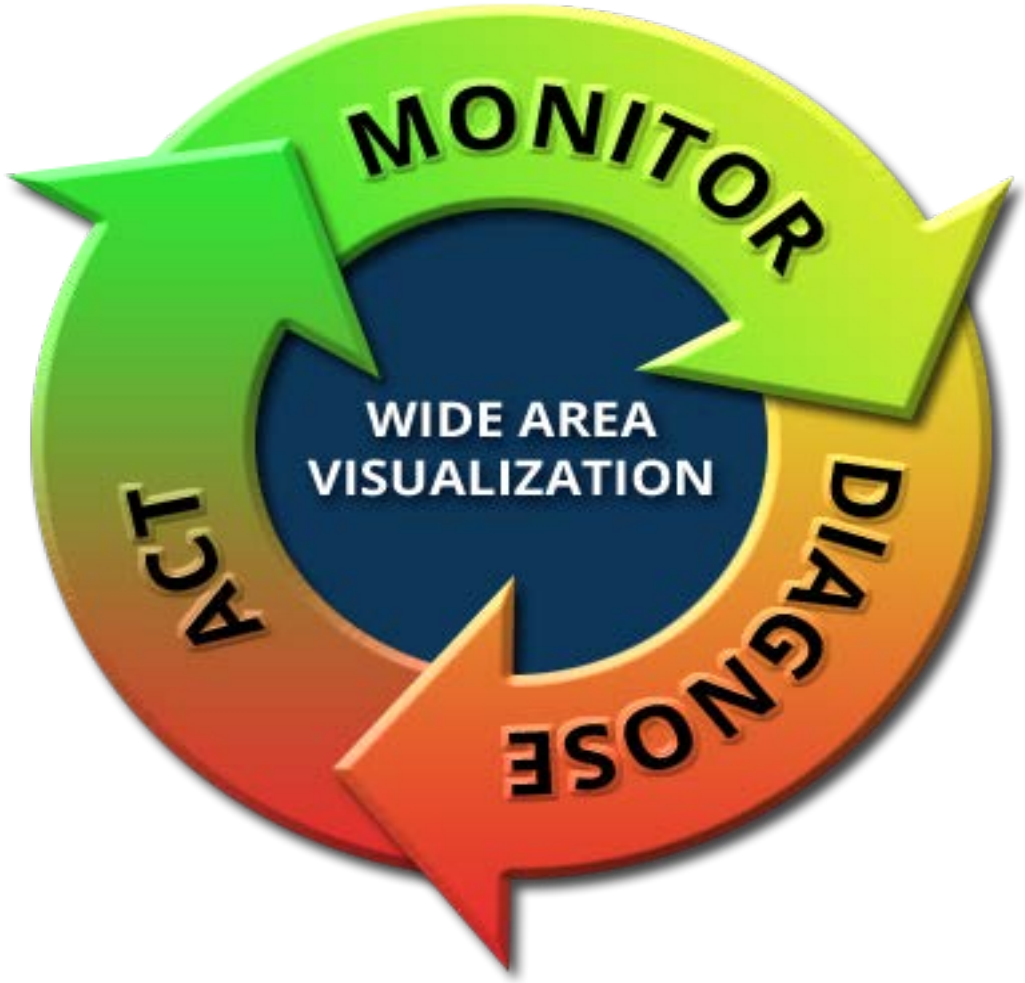
US 2005/0033481 A1 Feb. 10, 2005

Related U.S. Application Data

Synchrophasor Technology in Control Rooms

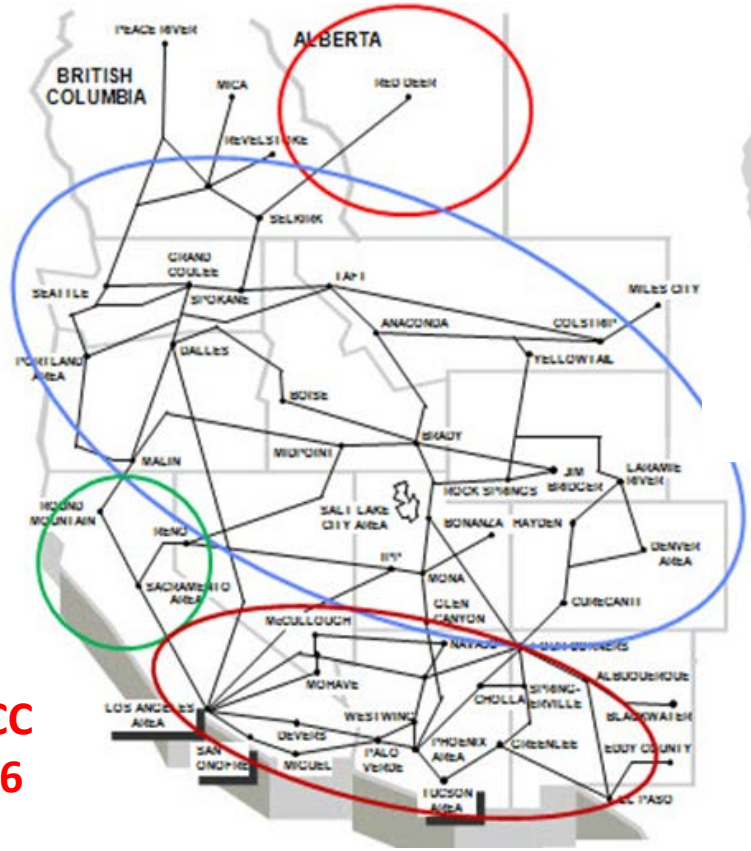
Monitor, Diagnose and Act

Operator's Mission: Keep the lights on!



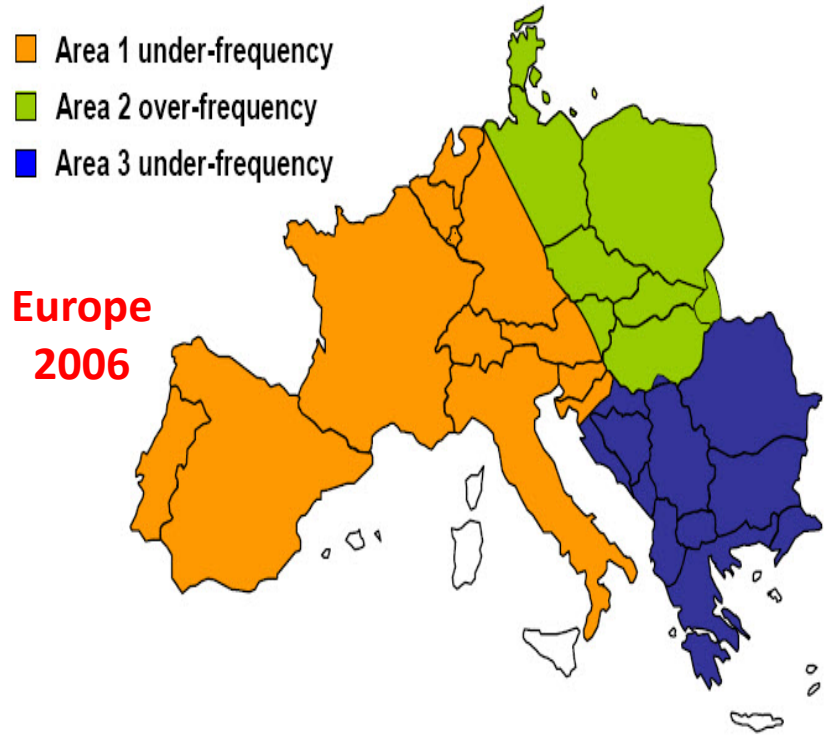
Major Blackouts

Millions without Power - Economic, Safety and Societal Impacts



WECC
1996

Northeast
2003



Europe
2006

Major Blackout Events – Why Do They Happen and Lessons Learned

- Lack of Wide-area Situational Awareness
- Lack of Time-synchronized Data
- Lack of Unified Displays and Monitoring Tools
- Inability to monitor grid dynamics
- Inaccurate models

RTDMS®, ePDC and other EPG applications provide operators and planners the tools and technologies for use in utility and ISO grid control centers

Phasor vs. SCADA Measurements

Phasor technology is NOT a replacement for SCADA,
rather it complements existing SCADA systems

ATTRIBUTE	SCADA	PMU
Resolution	1 sample every 2-4 seconds *(Steady State Observability)*	10-60 samples per second *(Dynamic/Transient Observability)*
Measured Quantities	Magnitude Only	Magnitude & Phase Angle
Time Synchronization	No	Yes
Total Input/Output Channels	100+ Analog & Digital/per station	~10 Phasors 16+ Digital 15+ Analog
Focus	Local utility monitoring & control	Wide area monitoring & control

CCET-DAT Synchrophasor Project Deliverables*

- A method for establishing and maintaining a reliable synchrophasor network to provide real-time dynamic information on large-scale wind resources and their impact on the transmission grid
- The use of synchrophasor measurements to identify precursor conditions to undesirable grid performance and behavior, or to grid interruptions
- Defining the value of the demonstration in replicating and transferring lessons learned for wind dynamics monitoring and management to other parts of the U.S.

Focus: Visualization, Tools, Analysis

* Source: Project Narrative

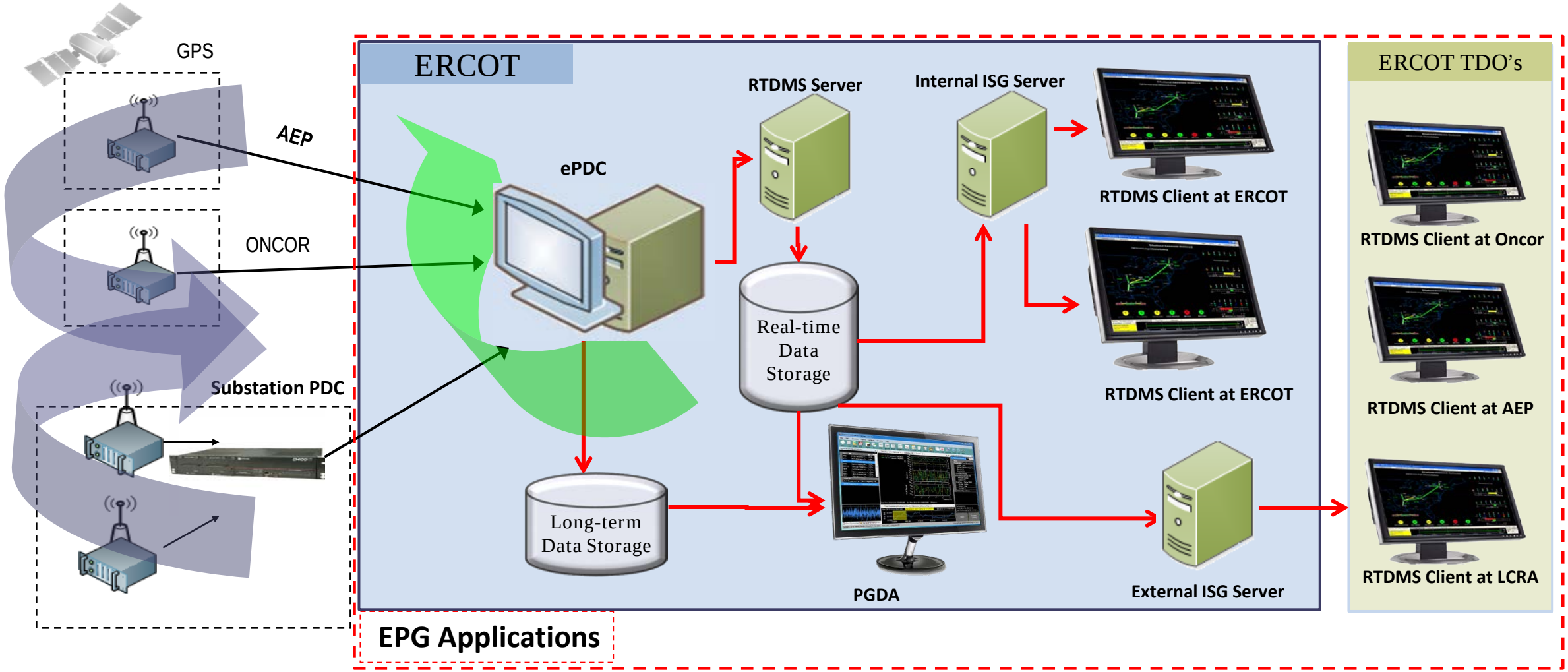
EPG Synchrophasor Activities in Texas

- **Visualization and Situational Awareness in ERCOT Control Room**
  - Establish a Robust Synchrophasor Network – RTDMS® 2012, ePDC Deployments
  - Validate and Manage the Synchrophasor Data – Data Quality, Communications, PMU Performance Analysis
  - Deployments and Integration Support for AEP, ONCOR, Sharyland, LCRA
  - Established Data Stream to EPG – Data Analysis & Support ERCOT
- **Off-line Tools**
  - Phasor Grid Dynamics Analyzer (PGDA™) Deployment
  - Generator Parameter Validator (GPV) Development
- **Analysis – Wind Integration, Dynamics and Grid Performance**
  - Events
  - Oscillation Data Mining – Baseline ERCOT Modes
  - Inertial Frequency Response
  - Baselining & Establish Alarm Limits for Use in Operations
- **Cyber Security - Demonstration of Security Fabric for Data Transport and Visualization**
  - Deployment at TTU
  - EPG - Intel/McAfee Collaboration to Integrate and Demonstrate Security Connected for Critical Infrastructure Technology (SC4CI)
- **Project Coordination, Knowledge Sharing, Training, Reporting**

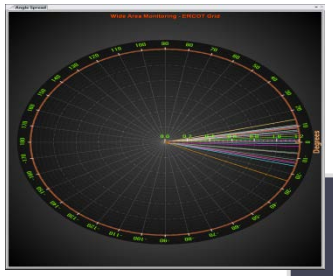
Uses of Synchrophasor Technology at ERCOT

- Wide-Area Visualization and Monitoring
- Oscillation Detection and Monitoring
- Event Analysis – Identify Uninformed Grid Changes
- Voltage Sensitivity
- Renewables Integration
- Increase Transmission Utilization
- Model Validation & Improve State Estimation
- Monitoring and Alarming Based on Dynamic Metrics (such as phase angles, damping sensitivities, which are indicators of grid stress and vulnerability)
- Unified Displays & Common Visualization

ERCOT Synchrophasor System Deployment



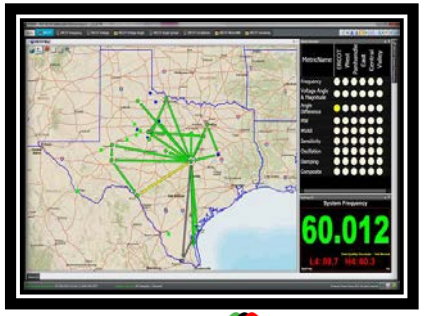
RTDMS at ERCOT for Wide Area Situational Awareness and Grid Metrics Monitoring



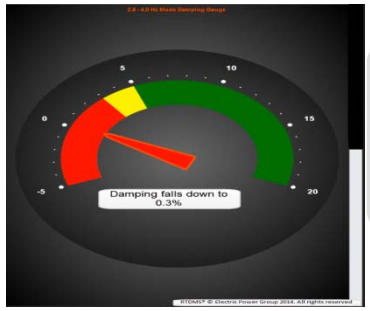
Phase Angle Monitoring
Grid Stress

Voltage Stability
Voltage Sensitivities

Wide Area View

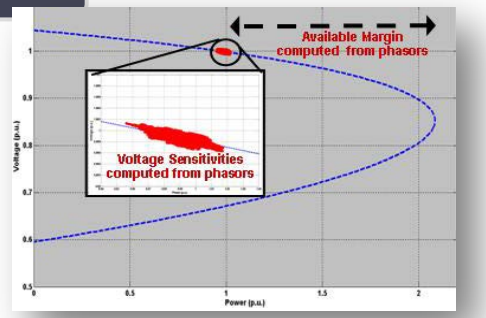


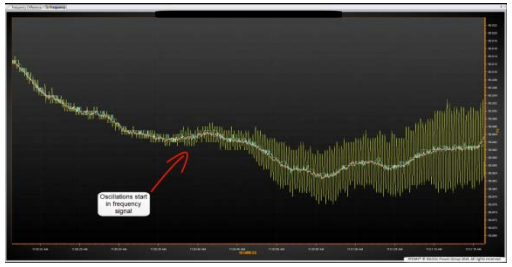
PHASOR RTDMS®



Dangerous Oscillations
Modal Damping & Energy

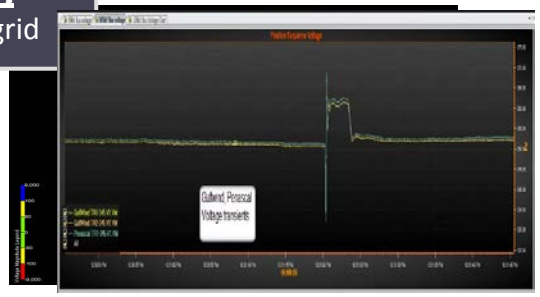
Margin
"How far are we from the edge?"





Frequency Instability
Frequency variations across grid

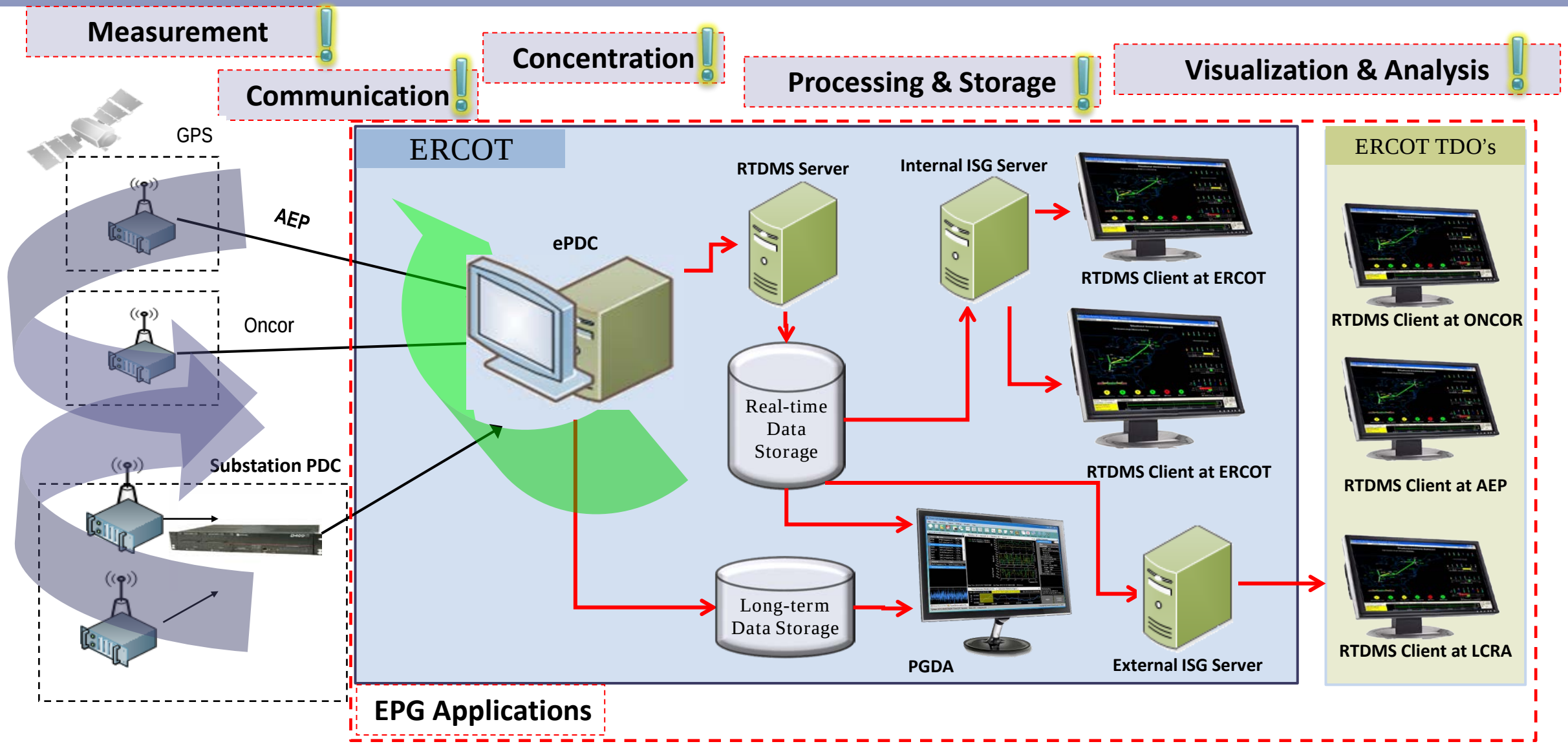
Voltage Monitoring
Transients across grid



Monitoring with RTDMS

- Wide Area Situational Awareness – flows, frequency, voltages
- Grid Stress - phase angle measurements
- Grid Robustness – damping status and trend
- Dangerous Growing Oscillations – low damping
- Frequency Instability – Frequency variation across interconnection
- Voltage Instability – Low voltage zones and areas approaching nose of the Power-Voltage curves
- Reliability Margin –“How far are we from the edge?” –sensitivity metrics

Security Challenge
Breach Can Happen Anywhere in the Application Chain

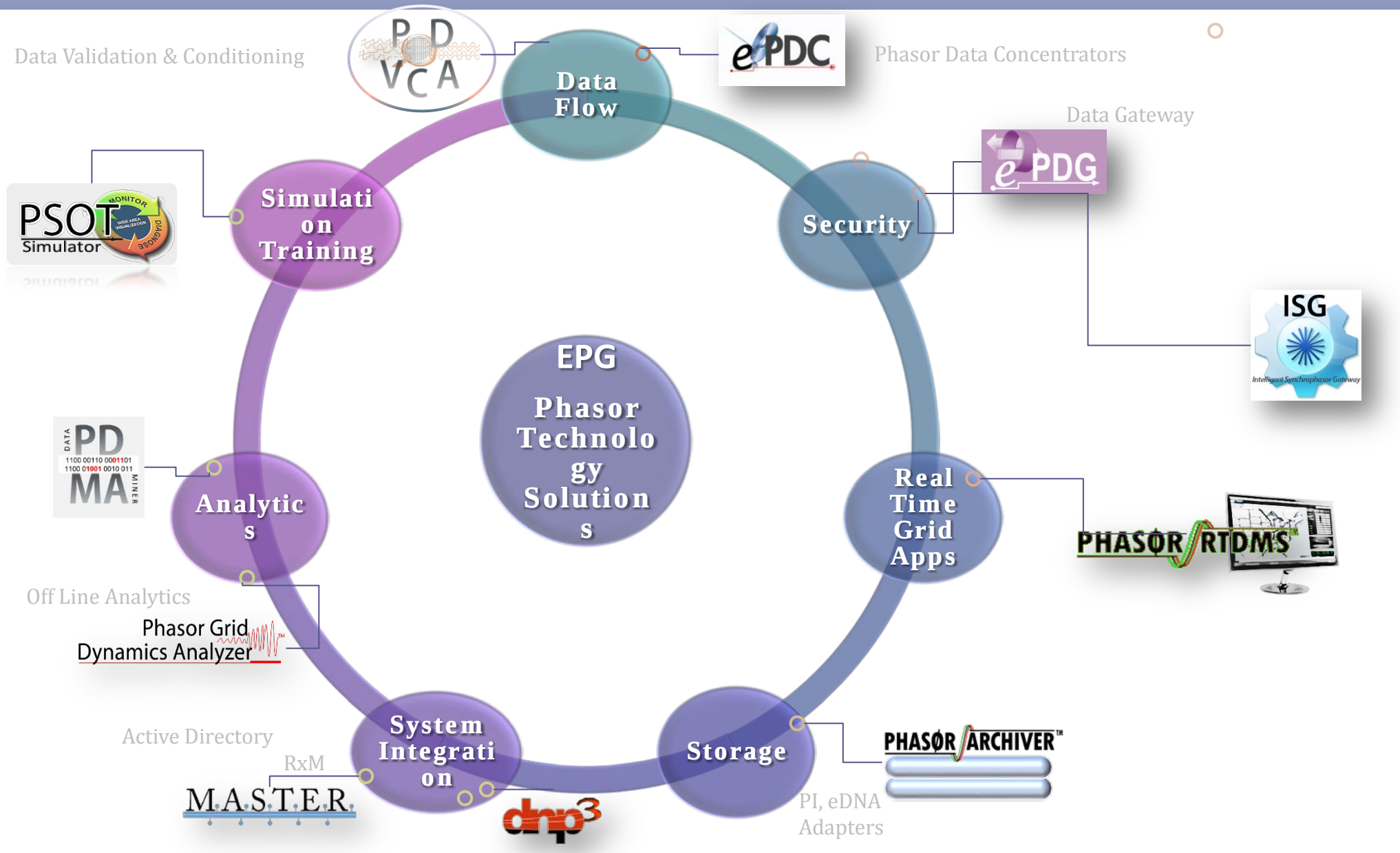


Basic Synchrophasor System

Security Fabric Demonstration

- CCET Sponsored Project - Discovery Across Texas (DAT) for Research and Demonstrate New Technologies for Wind Integration in ERCOT
- EPG - Synchrophasor Solutions Provider with deployment of Synchrophasor Applications for Data Concentration (*e*PDC) and Visualization (RTDMS)
- Intel and EPG Collaborated on design, development, deployment and demonstration of Security Fabric with EPG applications
- Texas Tech University - Host site for demonstration
  - TTU Synchrophasor Network monitors wind generation at Reese Technology Center and at nearby locations on utility grid
  - Data collection and wide-area visualization software (*e*PDC and RTDMS) secured with Security Fabric at TTU

EPG's End-to-End Synchrophasor Technology Solutions



Audience Engagement Question

The best contribution of Synchrophasor Technology for grid monitoring, management and analysis is that it…?

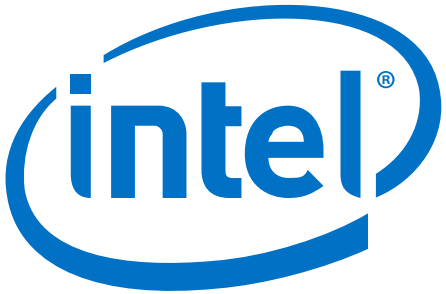
Answers:

A. **Enables increased use of transmission.**
B. **Provides real-time wide-area grid visualization and situational awareness.**
C. **Can serve as back up to EMS/SCADA system.**
D. **Facilitates integration of renewables and distributed technologies.**
E. **Enables operators to identify grid vulnerabilities and take timely corrective action to prevent or mitigate blackouts.**

Lorie Wigle

Vice President, General Manager IOT Security Solutions
McAfee a Division of Intel Security
Lorie_Wigle@McAfee.com

Security Fabric Field Trial



Security

Delivering a Next Generation Security Architecture

- Defining innovative industry approaches for collaborative and adaptive security
- Introducing security integrations which are sustainable and broadly reaching
- Developing capabilities for new security paradigms in areas such as Software Defined Datacenter, Cloud, and IoT

History
Arcl

- Inventor of the
computing arch
- Defining countl
lives ranging fr
- Top 10 Most In

licated
ovider

coverage in the

upon security

8 Gartner Security

Securing Critical Infrastructure

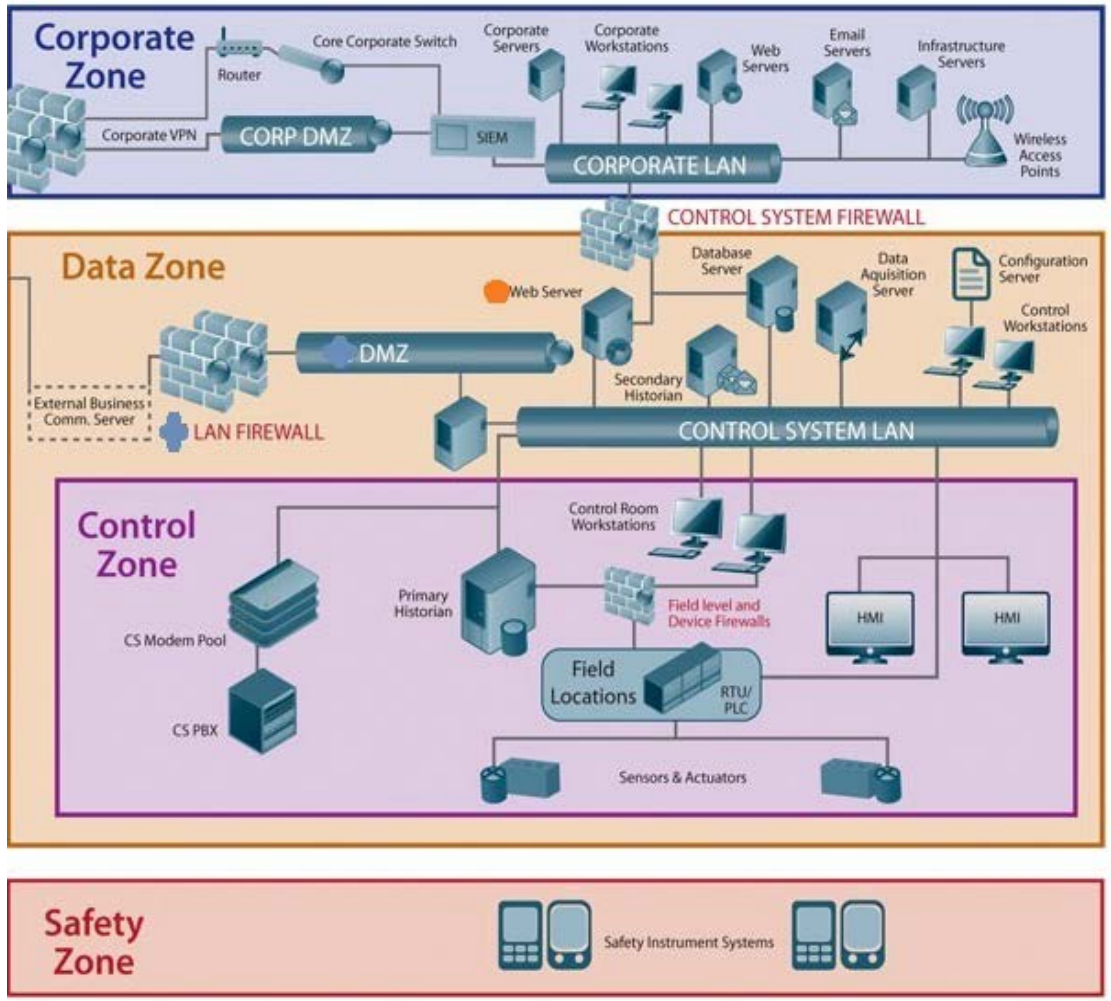
Harden the Device

Secure the Comms

Manage the security

Hardware-enhanced security + software & services key to achieve mission

Securing the Industrial Network- Architecture and IT/OT differences



Challenges	Enterprise IT Security	Industrial Systems/OT
Anti-virus	Common widely used	Updates can cause unacceptable network delays
Patch Deployment	Regular Scheduled	Slow to deploy/test, Unable to reboot
Network Communication	Standard protocols (IP/UDP)	Proprietary protocols (DNP/ICCP/Modbus)
Security Monitoring	Logs gathered, but reactive requires based on issues	Logging Only/Monitoring for performance/ availability
Vulnerability Management	“Find-fix” modus operandi for vulnerabilities	VM scans can destroy machines

Audience Engagement Question

Critical infrastructure, including the electricity grid, in the U.S. today is…

Answers:

a. **At far greater risk from physical attack than cyber attack**
b. **Is very well protected from cyber attack**
c. **Is somewhat vulnerable given that attacks and attackers are constantly becoming more sophisticated**
d. **Is at grave risk because security is not a priority**

Recent Study of 600 IT & IT Security Execs Globally

- **Two thirds** said their infrastructure had been compromised in the preceding 12 months,

  but just over a quarter said that security is a top priority.

- Nearly **60 percent** acknowledged that the threat to ICS and SCADA networks is increasing,

  but just five percent have a dedicated ICS and SCADA security dept.

- **Fifty-five percent** of those responding said that there is just one person at their organization responsible for the security of those systems, and a quarter have no dedicated personnel at all.

Operators of infrastructure, particularly energy infrastructure, often believe that their need to operate the infrastructure trumps the need to keep others from mis-operating it.

The report was conducted by the Ponemon Institute and sponsored byUnisys.

Why Security Fabric?

- Addresses Critical Infrastructure cyber intrusion concerns for Power Grid Networks
- Intel/McAfee's Cyber Security technology integrated with EPG's RTDMS, *e*PDC, and Security Fabric Gateway (SFG)
- Secures entire business processes
- Integrates with existing applications without requiring any changes
- Provides predictive security capabilities via contextual awareness and global visibility (McAfee SIEM)
- Provides enhanced security management features
  - Monitors dynamic operational security states based on risk
  - Provides security and trust visualization tools
  - Enables enhanced security configurability to provide a better user experience and to minimize risk of human error

Security Fabric:
End-to-End Situational Awareness and Management

Integrated Embedded Security…

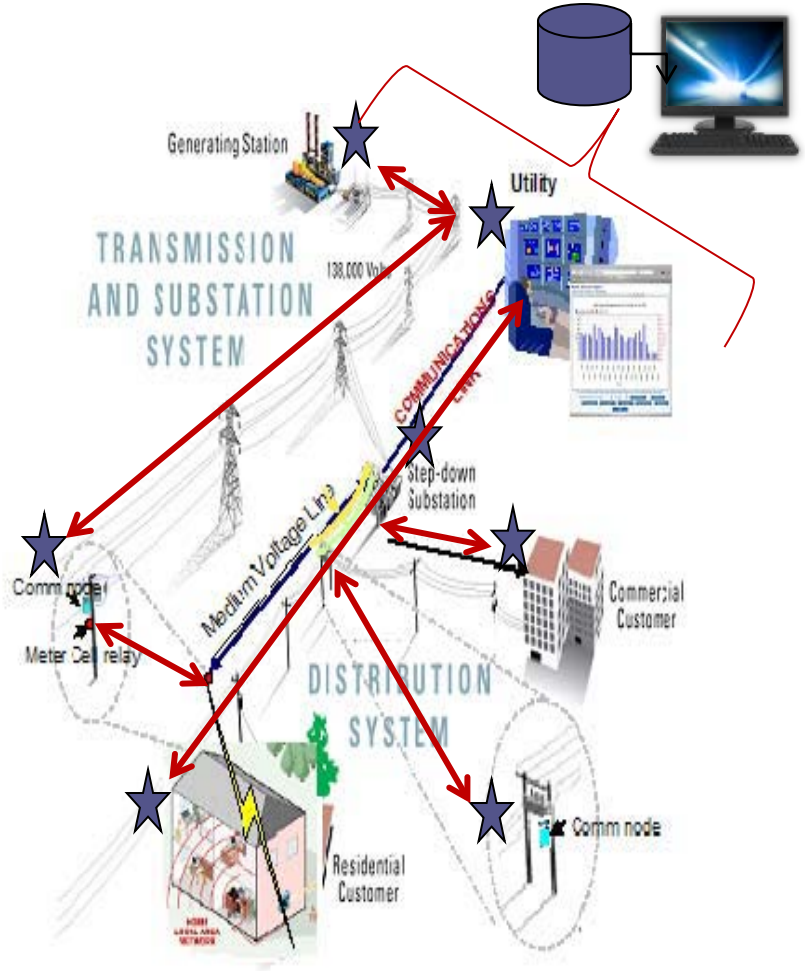
- McAfee Deep Command, Application/Change Control/Whitelisting, encryption
- Wind River OS/Hypervisor/IDP security/encryption
- Intel HW-assisted security/encryption

with Secure Intelligence and Connectivity…

- Intel Intelligent Gateways
- IPS/Firewalls/TLS
- 3rd Party SIA Firewalls & Protocol Filters

Comprehensively Monitored & Managed

- McAfee ePolicy Orchestrator (ePO)
- McAfee Enterprise Security Management (ESM/Nitro/SIEM)



SF is Designed to Address the NIST IR 7628 Guidelines

1. **Identity Management**
   - Ensures the device identity is established genuinely
2. **Mutual Authentication**
   - Allows both the Device Node and the Controller to verify the trustworthiness their identity to each other.
3. **Authorization**
   - Manages permission to proceed with specific operations.
4. **Audit**
   - Records noteworthy events for later analysis
5. **Confidentiality**
   - Encrypts sensitive data for matters of privacy.
6. **Integrity**
   - Ensures that messages have not been altered and that they are non-reputable.
7. **Availability**
   - Prevents denial of service attacks

These are the seven tenets of security as described in the NIST-IR 7628 Guidelines.

Applying Security Fabric to CI

Texas Synchrophasor Field Trial

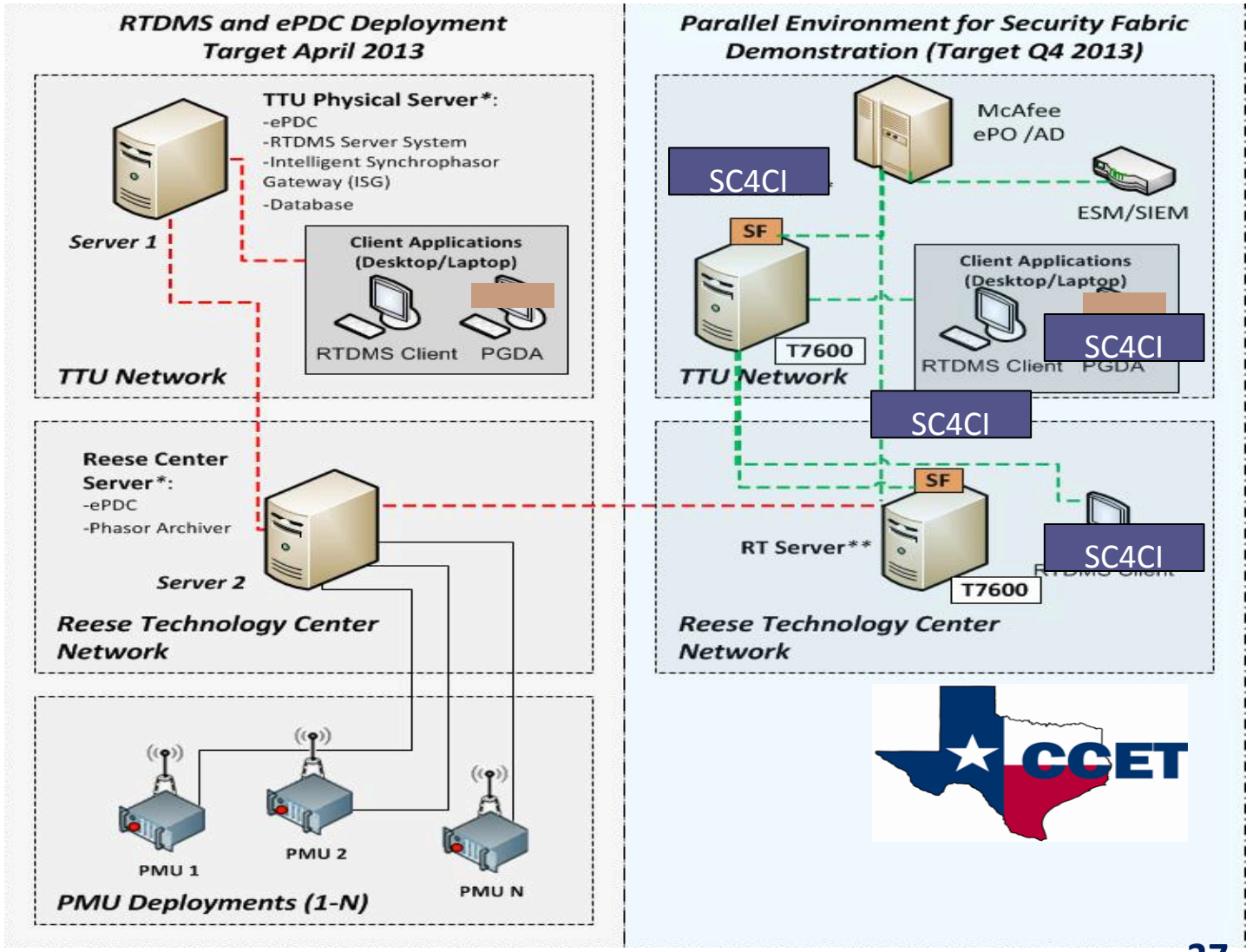
Electric Power Group (EPG) is adding the security fabric to their synchrophasor products and deploying them at TTU

Texas Tech University (TTU) is the site of the field trial.

Synchrophasor deployment already in place at TTU under the CCET project

Stand up parallel security-enhanced system

Conduct testing



Security Fabric Texas Synchrophasor Field Trial Platform Details

McAfee ePolicy Orchestrator & Enterprise Security Manager (SIEM)

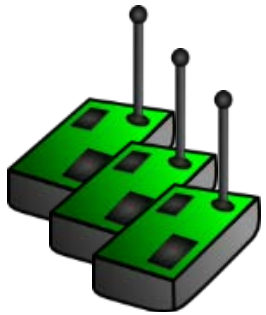
AAA: Kerberos/AD

Intelligent Synchrophasor Gateway ISG

EPG RTDMS Client

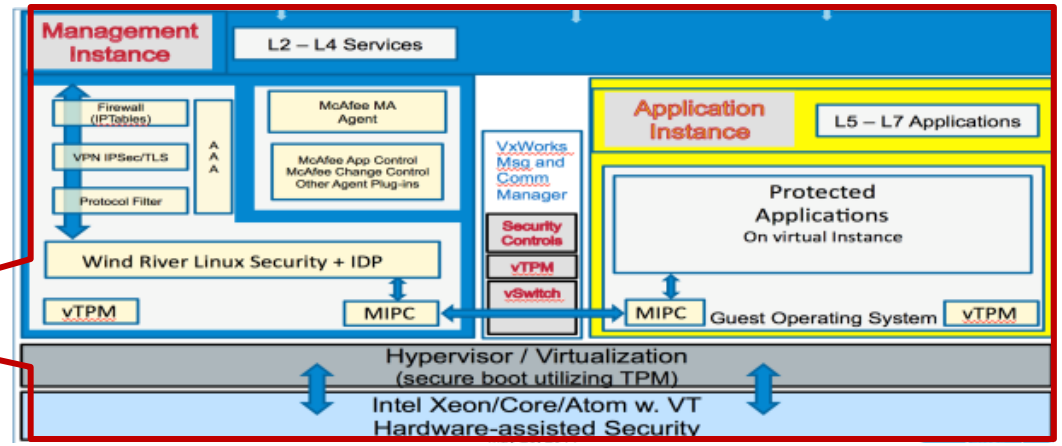
McAfee Integrity Control

C37.118 Data



PMUs

C37.118 Data



Electric Power Group

Visualizing Security

Key:
- Operational
- Warning
- Under Attack
- Optimization
- Remediation

Key
- - Operating
- - Authenticated but no flow
- - On but not authenticated
- - Not reachable

Security Fabric Operational State

Service Node	Mode	Session	Auth Flow
TTU ISG		TTU ISG – TTU Archiver	
		TTU ISG – Management	
TTU Archiver		TTU Archiver – TTU RTDMS	
		TTU Archiver – Management	
TTU RTDMS		TTU RTDMS – TTU ePDC	
		TTU RTDMS – Management	
TTU ePDC		TTU ePDC – Reese ePDC	
		TTU ePDC– Management	
Reese ePDC		Reese ePDC– Management	

Synchrophasor Security Fabric Testing

Dr. Phongphun Kijsanayothin and Dr. Rattikorn Hewett

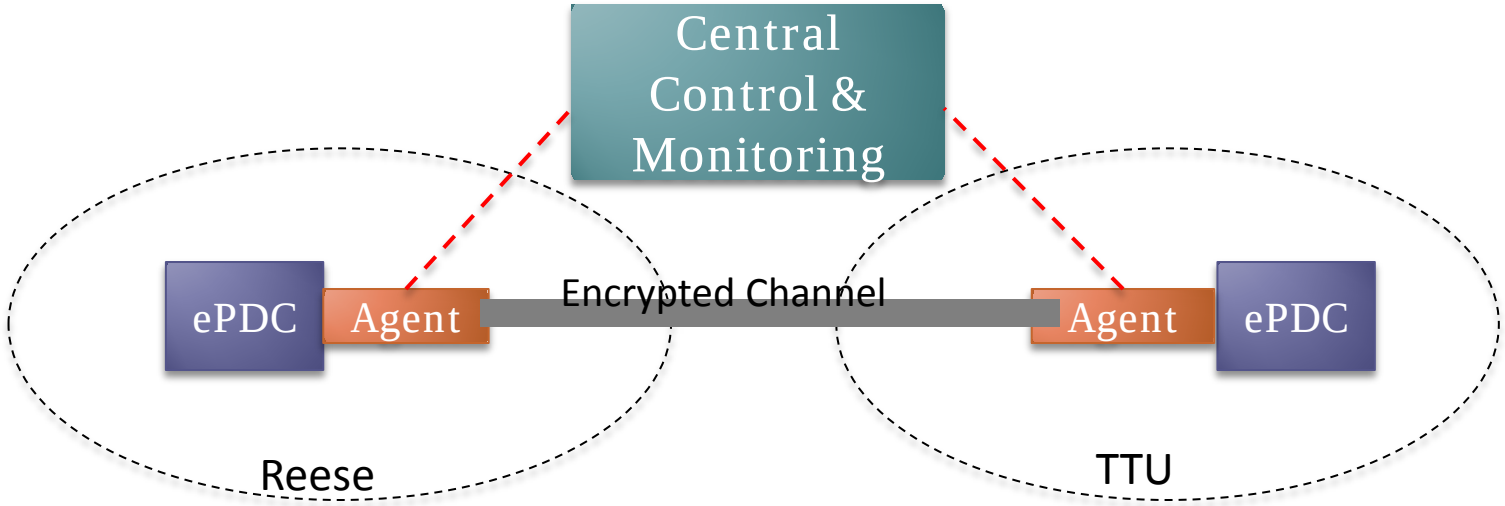
Shad Holt, P.E.
supporting the initial hardware install and connection to PMU network

TASK

Task: Carry out the testing and evaluate the effectiveness of the proposed security fabric

- **Phase 1:** Intel provides the security fabric materials along with a list of test cases that will be used in testing
- **Phase 2:** Obtain a systematic methodology for security testing in practice

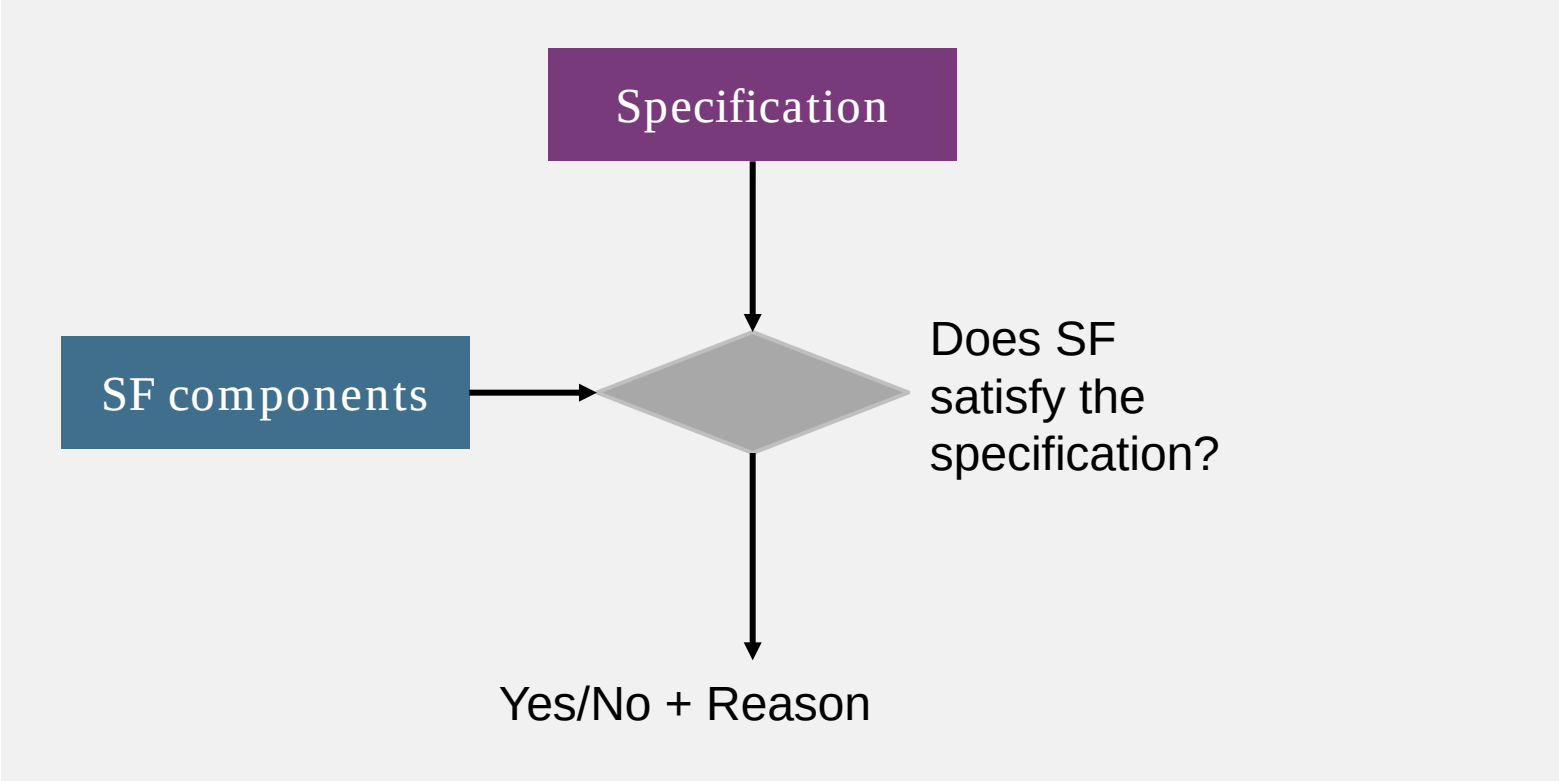
NIST-IR 7268 Requirements vs Specification Written by McAfee



Verification

Verify whether SF satisfies given specifications.
If it does (i.e., passes the test), SF meets the requirements

NIST-IR 7268
Requirement

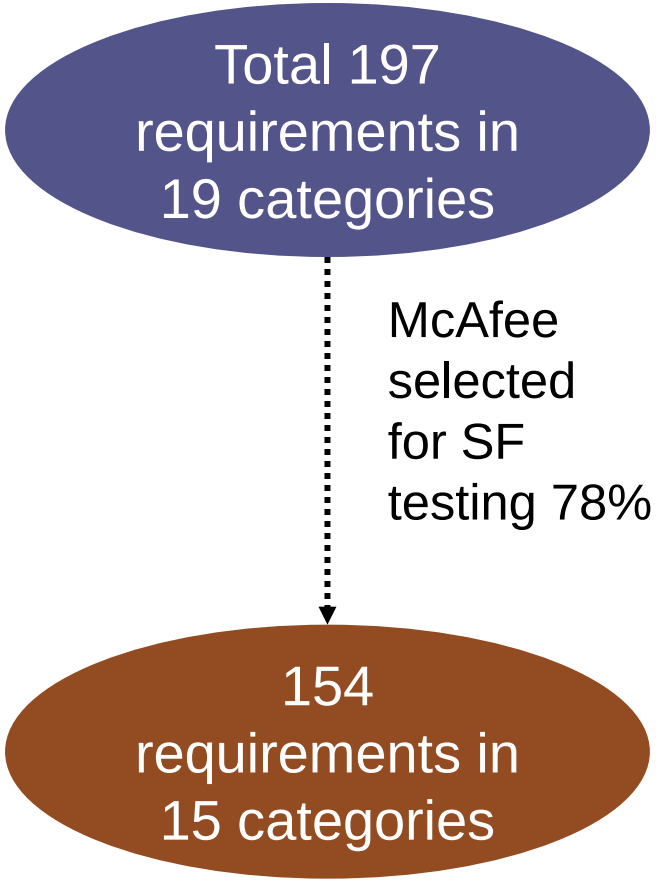


Selected Requirements

– NIST IR-7268 Guidelines for Smart Grid Cyber Security contains the **recommended security requirements** for the smart grid

Categories of Requirements	#Req.	Selected
Access Control	21	20
Awareness and Training	7	7
Audit and Accountability	16	16
Security Assessment and Authorization	6	6
Configuration Management	11	11
Continuity of Operations	11	11
Identification and Authentication	6	6
Information and Document Management	5	5
Incident Response (Not selected)	11	-
Smart Grid Information System Development and Maintenance	7	7
Media Protection	6	6
Physical and Environmental Security	12	12
Planning (Not selected)	5	-
Security Program Management	8	8
Personnel Security (Not selected)	9	-
Risk Management and Assessment (Not selected)	6	-
Smart Grid Information System and Services Acquisition	11	1
Smart Grid Information System and Communication Protection	30	29
Smart Grid Information System and Information Integrity	9	9

Recommended Security Requirements



Conclusion

- Required revision of requirement and specification for SF is in process
- No security breach based on testing to date

Bridging IT and OT Protection

Proven Security Adapted for New Intelligent Operations

Integrated Embedded Security…

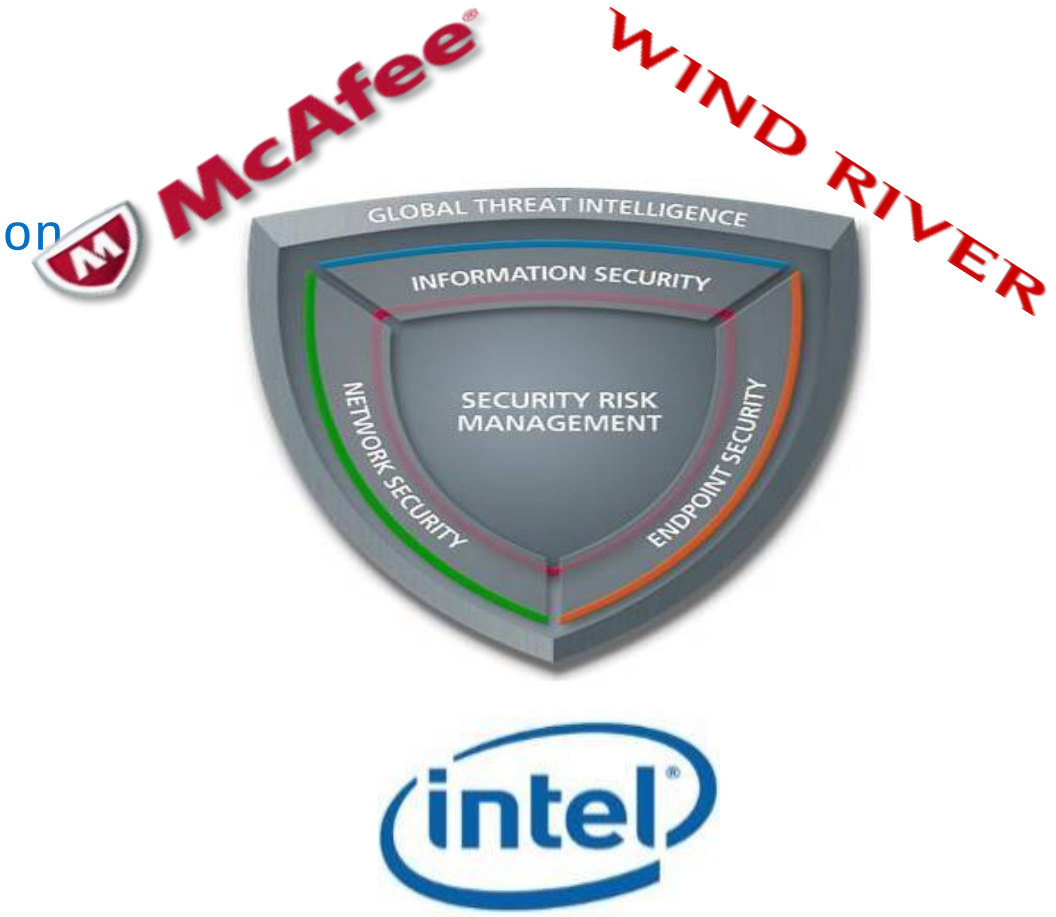
- McAfee Deep Command, Application/Change Control/Whitelisting, encryption
- Wind River OS/Hypervisor/IDP security/encryption
- Intel HW-assisted security/encryption

with Secure Communication…

- Intel Intelligent Gateways
- IPS/Firewalls/TLS/AAA
- 3rd Party SIA Firewalls & Protocol Filters

Comprehensively Monitored & Managed

- McAfee ePolicy Orchestrator (ePO)
- McAfee Enterprise Security Management (ESM/Analytics)



Zach Taylor

Manager of Engineering

South Plains Electric Cooperative, Inc.

ZTaylor@spec.coop

South Plains Electric Cooperative
Your Touchstone Energy® Cooperative

Utility Scale Battery System

CCET

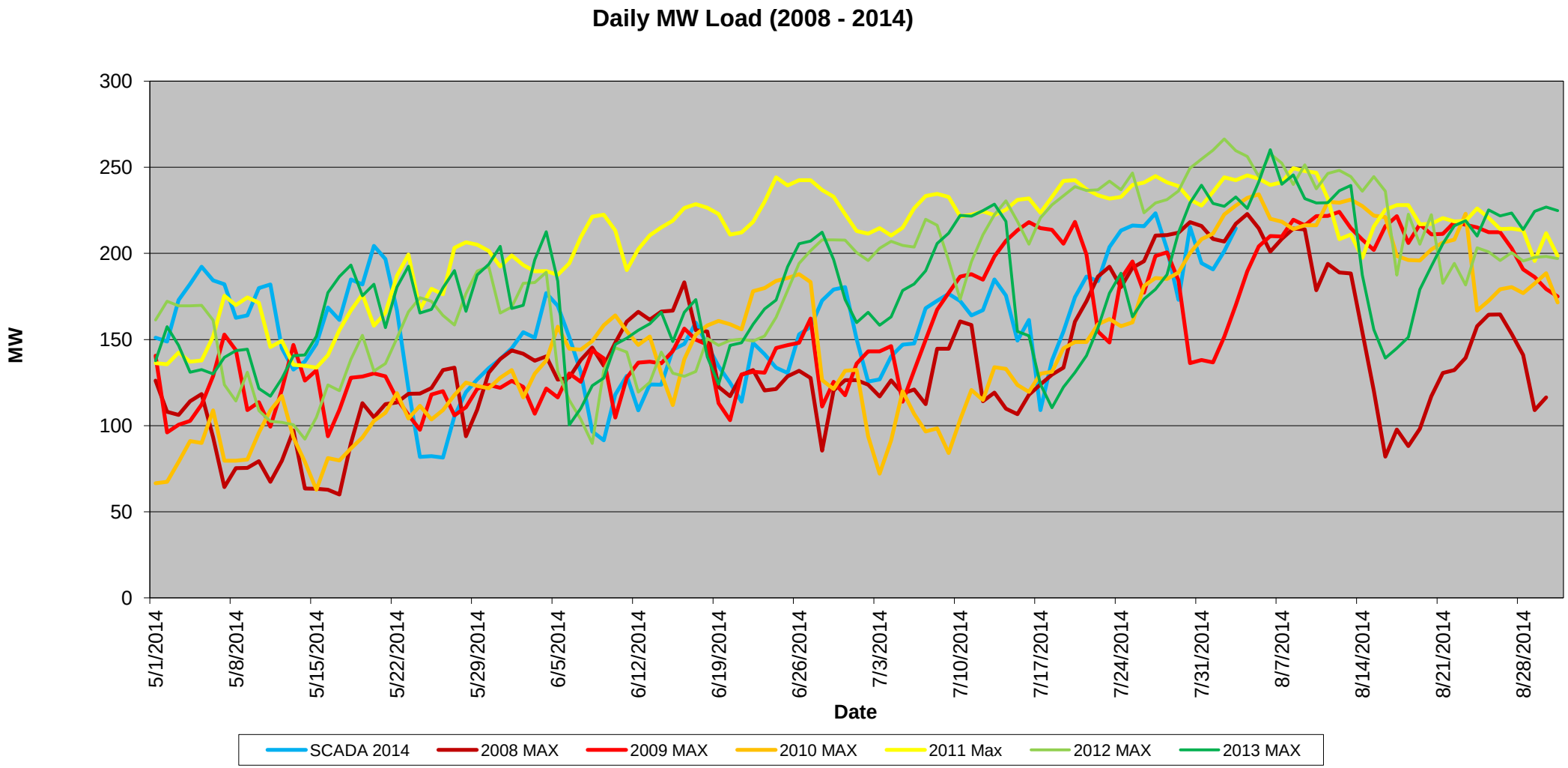
Introduction

- South Plains Electric Cooperative, Inc.
- Why Batteries?
- Battery System
- Testing & Future Tests
- Summary

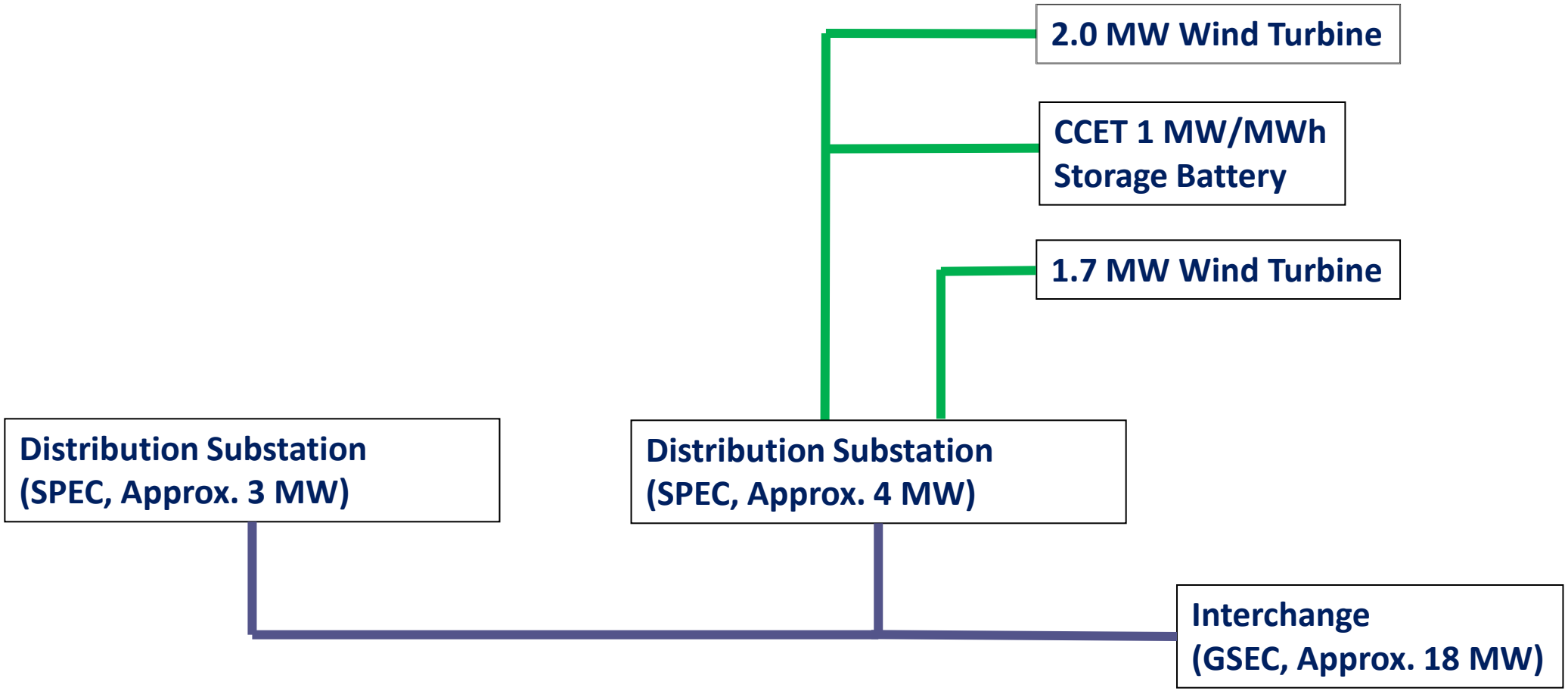
South Plains Electric Cooperative, Inc.

- Approx. 51,000+ Meters
- 9,783 Miles of Distribution
- 110 Miles of Transmission
- Power Suppliers
  - Golden Spread Electric Cooperative (SPP)
  - Brazos Electric Power Cooperative (ERCOT)

South Plains Electric Cooperative, Inc.



South Plains Electric Cooperative, Inc.



Battery Storage & Wind Integration: Batteries Provide

- Resource for Frequency Control
  - Increasing wind generation requires increased resources for frequency control
- Resource to balance load with Gen
  - Batteries can be both a load and generation
  - Ramp-Up / Ramp-Down with changes in Wind Pattern

Battery Storage & Wind Integration: Batteries Provide

- Resource to Improve Grid Efficiency through Peak Shaving
- Dispatchable Resource
- Assist with Power Quality (VAR Support)
- Storage of Wind Energy

Battery Selection & Integration

- RFP Specification Released Nov 2012

- Contract Awarded - February 2013

- Operational - October 2013

- SPEC Distribution Recloser

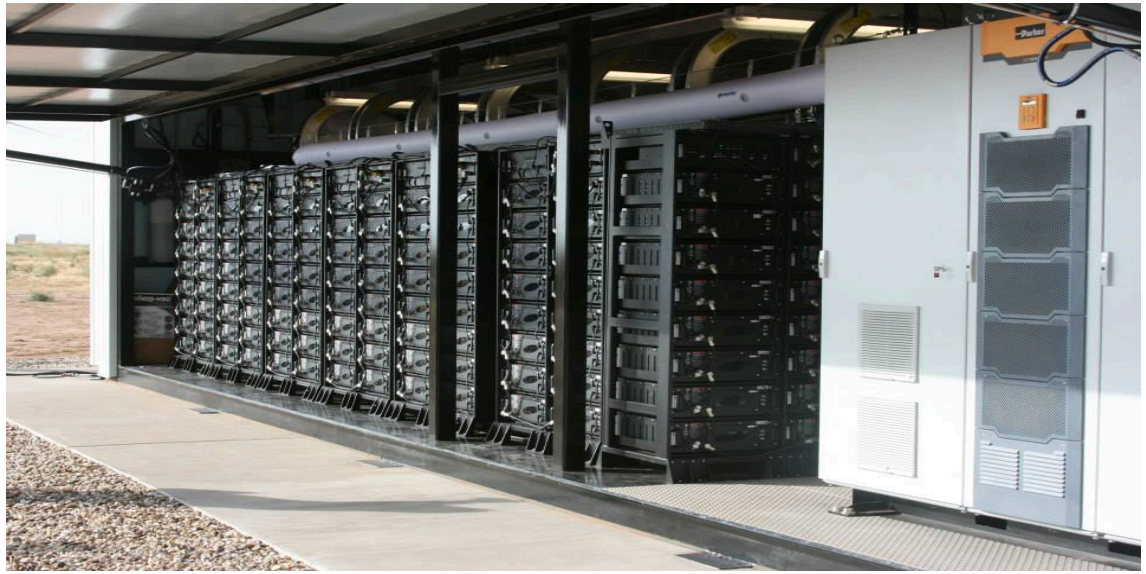
- 1500 KVA Pad-Mount (12.47kV – 480VAC)

- Battery System

Battery Specifications

- 1 MWh Battery System (50ms Response)
  - Lithium Manganese Oxide
    - Cell Capacity – 60 Ah
    - Nominal Voltage – 3.7V (Min – 2.7V, Max – 4.1V)
    - Power – 222 Wh
  - 8 Cells = Module (1.8 kWh)
  - 2 Modules = Tray (3.6 kWh)
  - 8 Trays = Rack (56.8 kWh)
  - 20 Racks = BESS (1.0 MWh)
- 3-Phase Inverter (DC – AC)
- 24/7 Real-Time Monitoring

Battery on Location



Located at the Reese Technology Center 10 miles west of Lubbock

Demonstrating Performance in Actual Operation

- Evaluation of Performance
- Providing Data for TTU EE Department to Complete Simulation Models
  - Modeling Battery + Wind Turbines + Dist. System
  - Refine Model based on Test Results
- Providing the data to support an economic analysis of the benefits and cost of the BESS

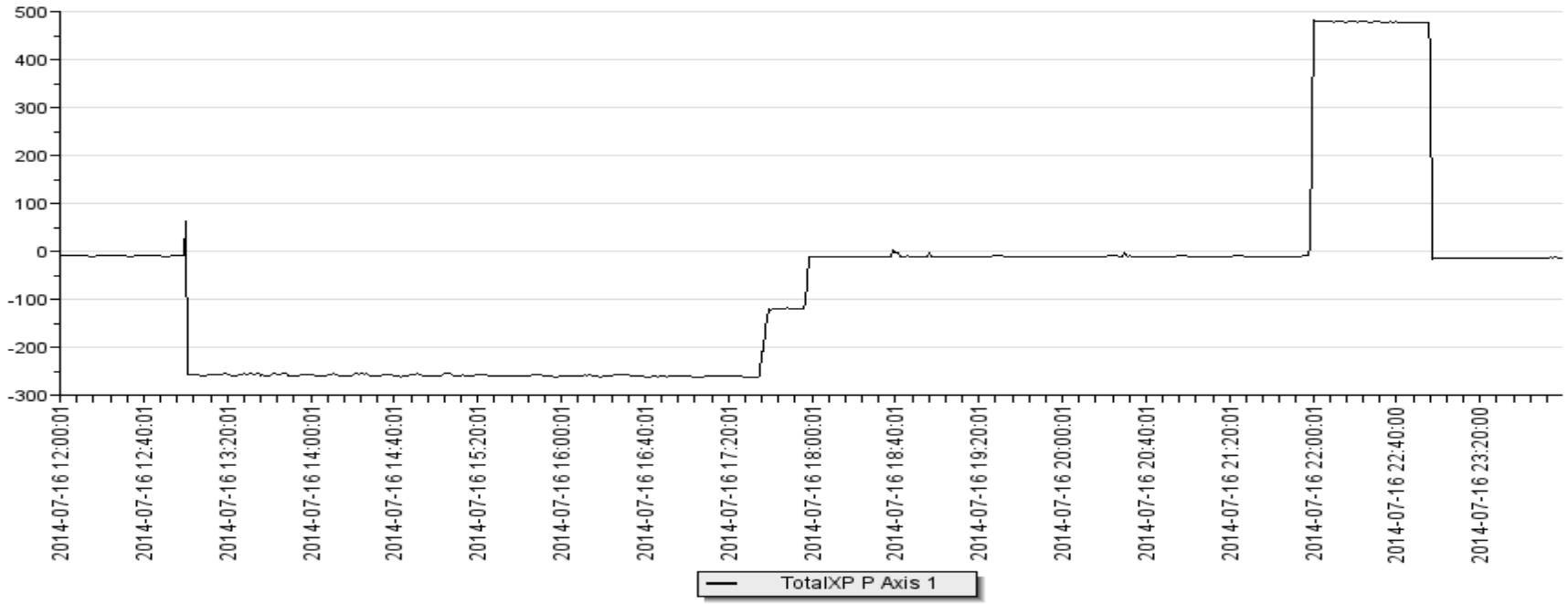
Tests Being Performed

- Demand Response
- Frequency Response
- Ramping Battery – Load Leveling
- Wind Speed Drop
- Fast Responding Frequency Response (FRRS)

- Will be combining these tests once they are completed independently

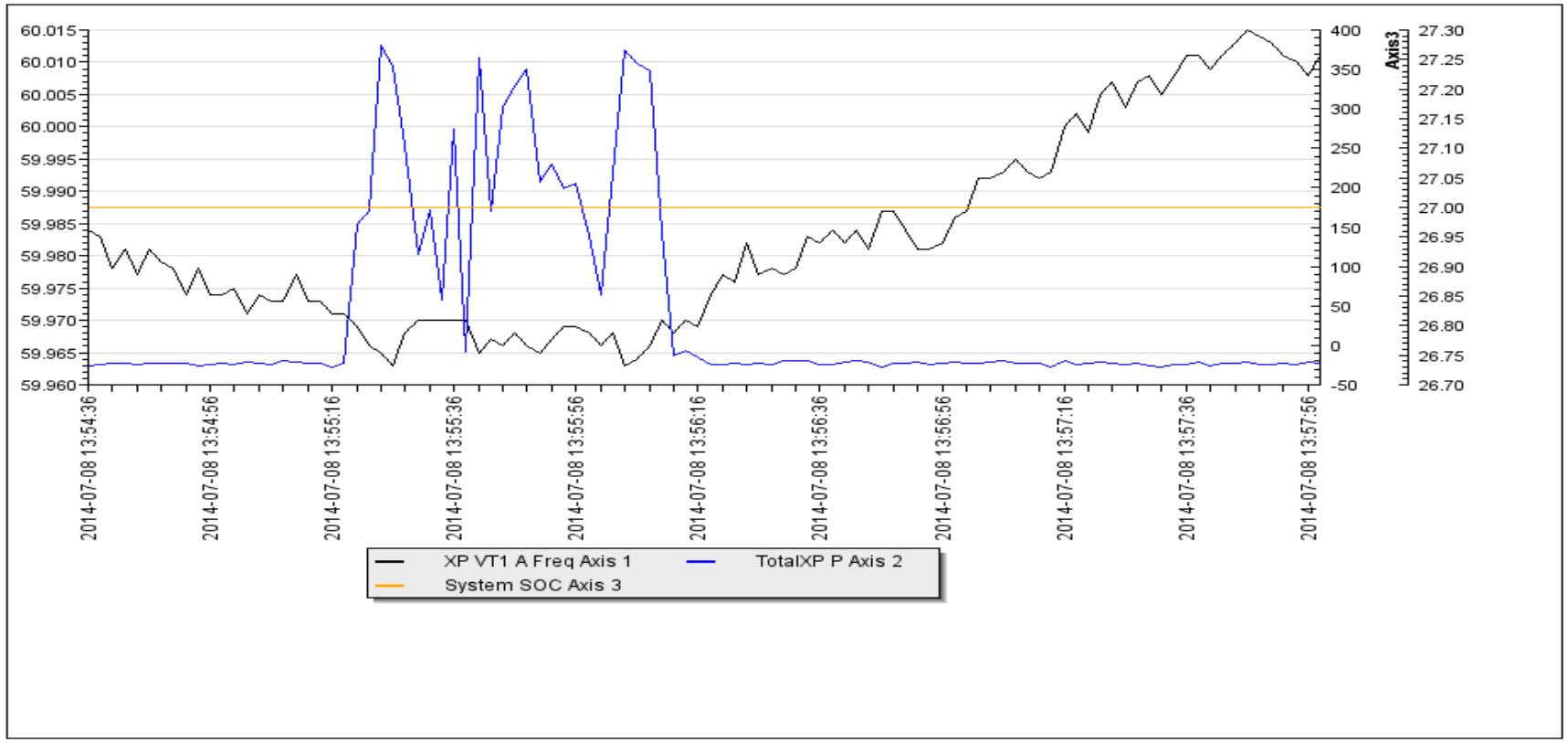
Demand Response

- SPEC is Summer Peak Driven
  - 100% Demand Rate Structure from GSEC
- GSEC Area Peak - 266 MW Demand (2012)
  - Peak as Early as July 27th (This Year)
  - Peak as Late as August 12th (2009)



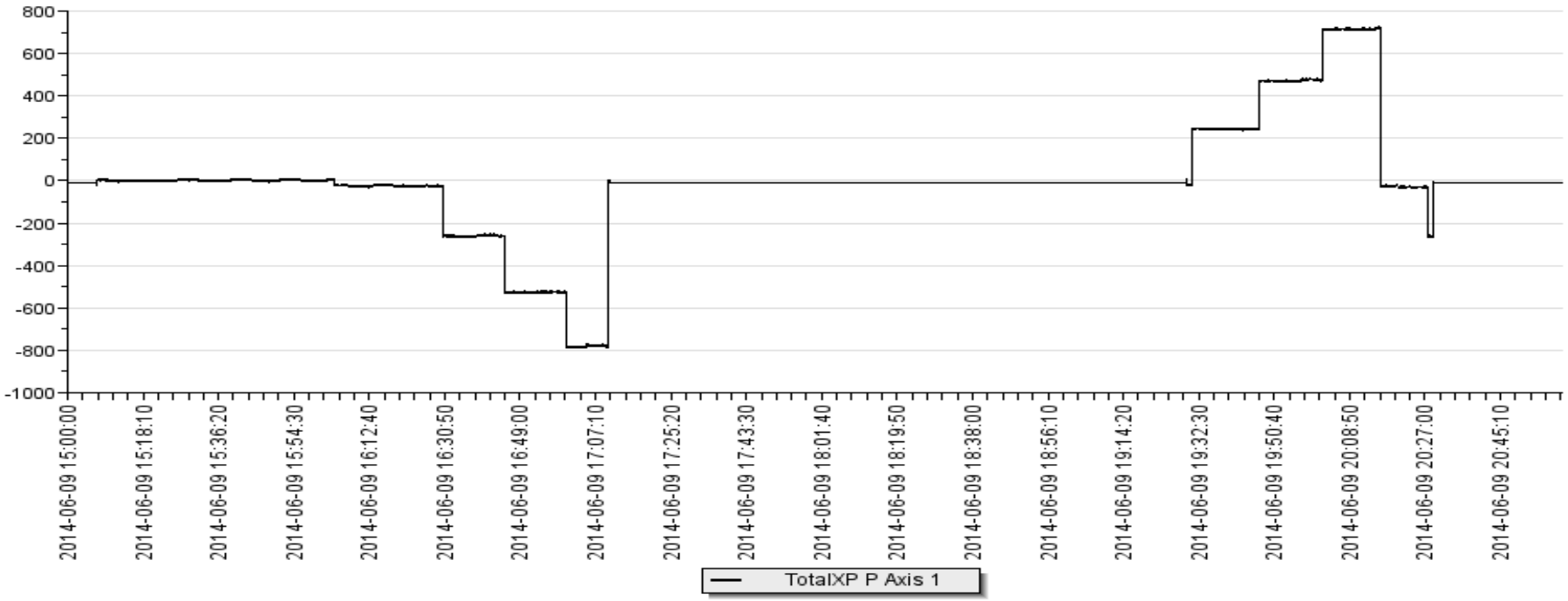
Frequency Response

- Dead Bands – 60.04 to 59.97
- Response Slope – 0.01%
- Max Output +/- 400 KW



Ramp Support

- Charge Batteries in 15-min Intervals
  - 250KW, 500KW, 1000KW (SOC-50%)
- Discharge in Same Manner



Testing Planned during August - December

- Ramping Battery – Load Leveling
- Wind Speed Drop
- Fast Responding Frequency Response (FRRS)
- Will be combining these tests once they are completed independently

Audience Engagement Question

The MAIN challenge to battery systems becoming significant contributors to a modern grid are:

Answers:

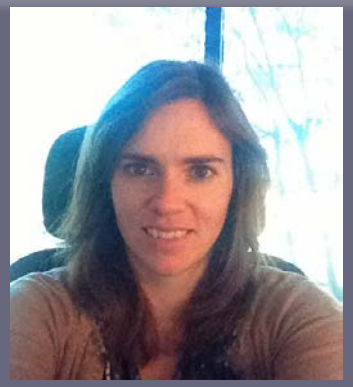
A. **Cost**
B. **Reliability**
C. **They are both generation and load complicating their treatment in the regulatory system**
D. **Other storage systems are more economical**
E. **An unproven new technology**

South Plains Electric Cooperative
Your Touchstone Energy® Cooperative

CCET

Summary

- Positive Results with Completed Battery Testing
- Continue Battery Testing (Stacking)



Holly Prosser

Energy Analyst II

Frontier Associates

hprosser@frontierassoc.com

Texas Future Community Project

What is the Texas Future Community Project?

- Texas Future Community (TFC) is a component of the CCET Discovery Across Texas project

- **TFC Objective:** Provide a blueprint for future residential developments that can harness the capacity of available renewable electricity

“Enable the wind”

Dynamic Pricing for residential communities

1. Wind Pricing
2. Critical Peak Period Pricing

Wind Price

- Low price during hours of the year when wind energy production tends to be highest
  - Nighttime during the 5 windiest months

- A surcharge on the baseline price during daytime hours of the 5 windiest months

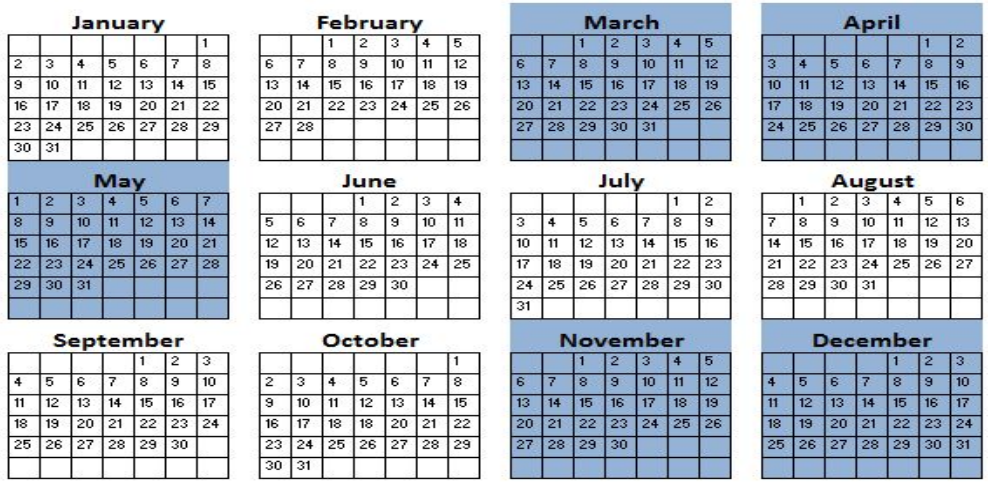
Critical Peak Period Price

- A very high price during hours when electric system is likely to be most stressed
  - Summer afternoons, up to 15 days per year
- A discount on the baseline price during all other summer hours

Experimental Wind Pricing

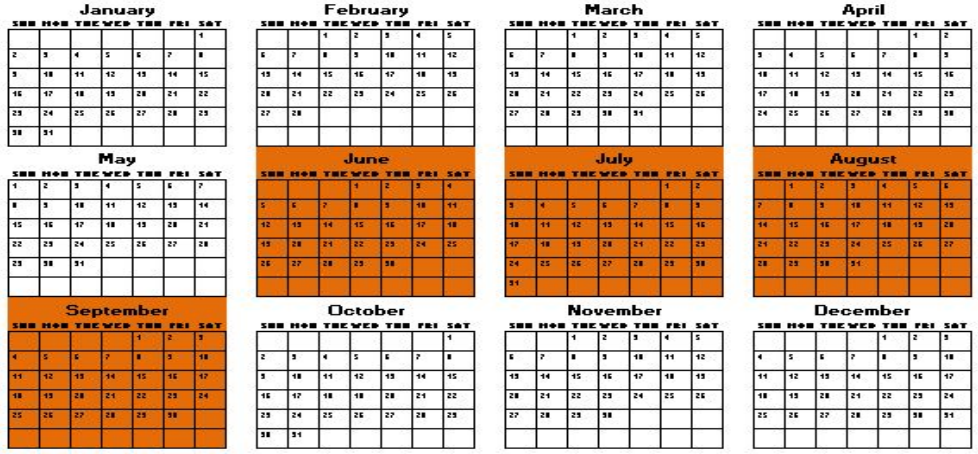
- **Wind hours**
  - Low wind price applied daily to consumption from 10pm-6am, $0.0265/kWh
- **Non-wind hours**
  - $0.02/kWh surcharge applied during all other hours

- **Wind Pricing applies only during:**
  - March
  - April
  - May
  - November
  - December

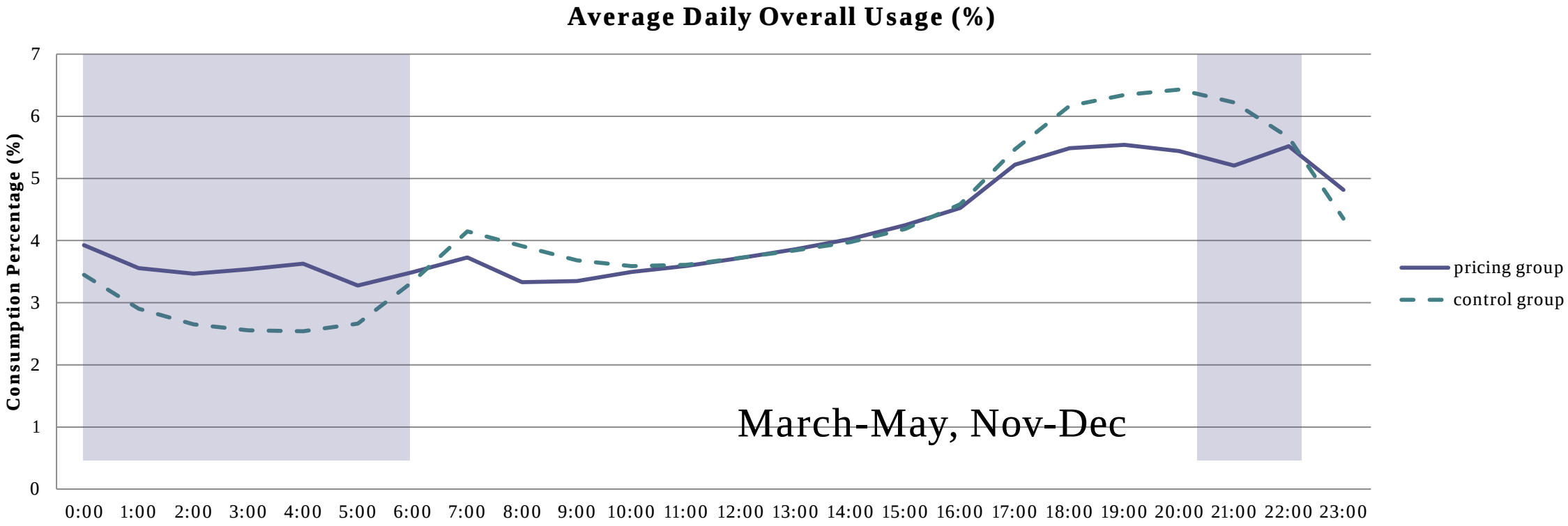


Experimental Critical Peak Pricing

- **Critical Peak Hours**
  - High critical peak price is applied up to 15 days per year to consumption from 4pm-7pm, $0.64/kWh
  - Critical Peak events called a day-ahead by Frontier, based on weather forecasts
- **Non-Critical Peak Hours**
  - Discount is applied to consumption during all other hours
- **Critical Peak Pricing applies only during:**
  - June
  - July
  - August
  - September

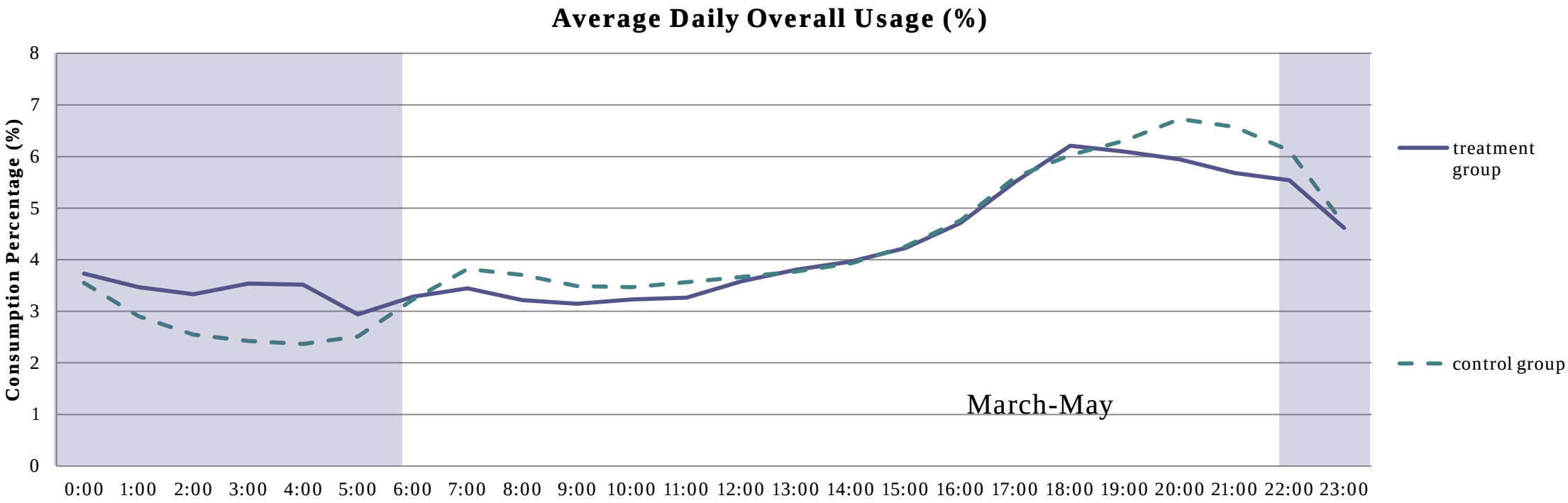


Average Usage Profile 2013 Wind Months



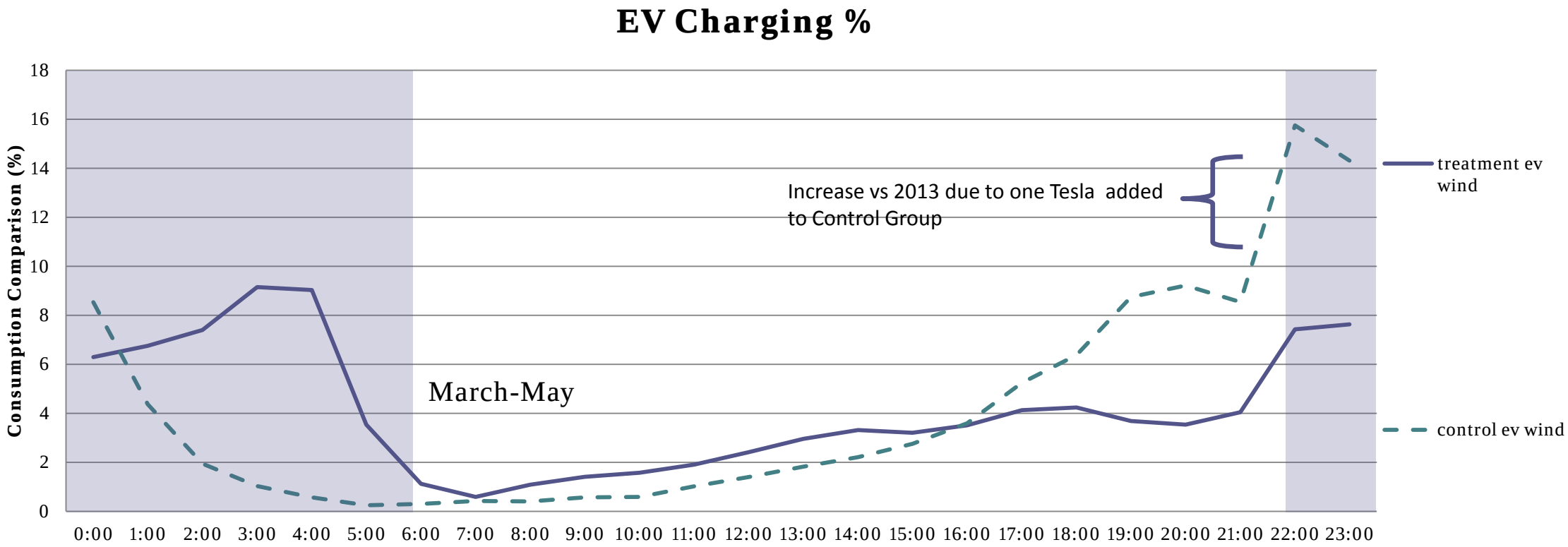
- This graph shows overall energy usage for all energy consuming devices (air conditioning, appliances, electric vehicles, dryers, etc.)
- In 2013 wind months, participants shifted their load from evening to overnight, mainly attributable to electric vehicle charging

Average Usage Profile 2014 Wind Months



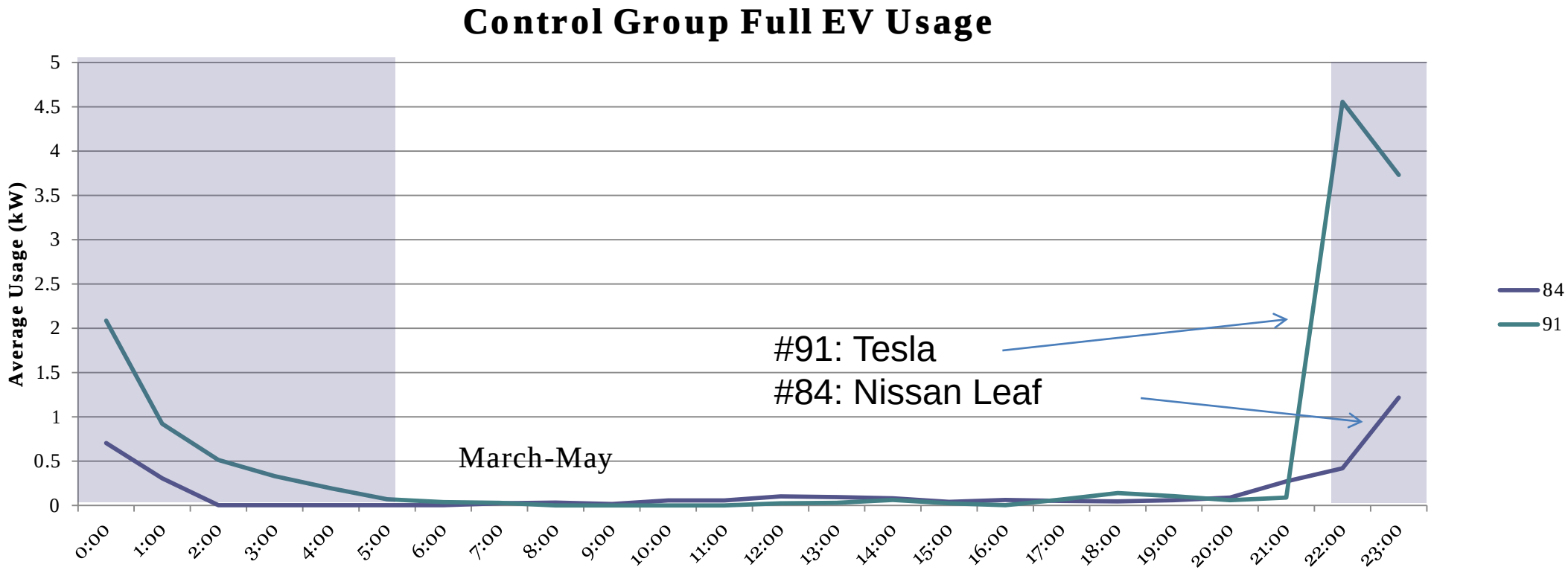
- **This graph shows overall energy usage for all energy consuming devices (air conditioning, appliances, electric vehicles, dryers, etc.)**
- **Participant response to wind prices in 2014 has been similar to 2013. Much load shifting is attributable to electric vehicles.**

Average EV Charging Profile 2014 Wind Months



- This graph includes both hybrids and full EVs
- 2014 wind month shift in EV charging is almost identical to 2013, except that the 2:00-5:00AM peak is more pronounced, indicated scheduled use of charge scheduling.

EV Charging Profiles – Full Electric

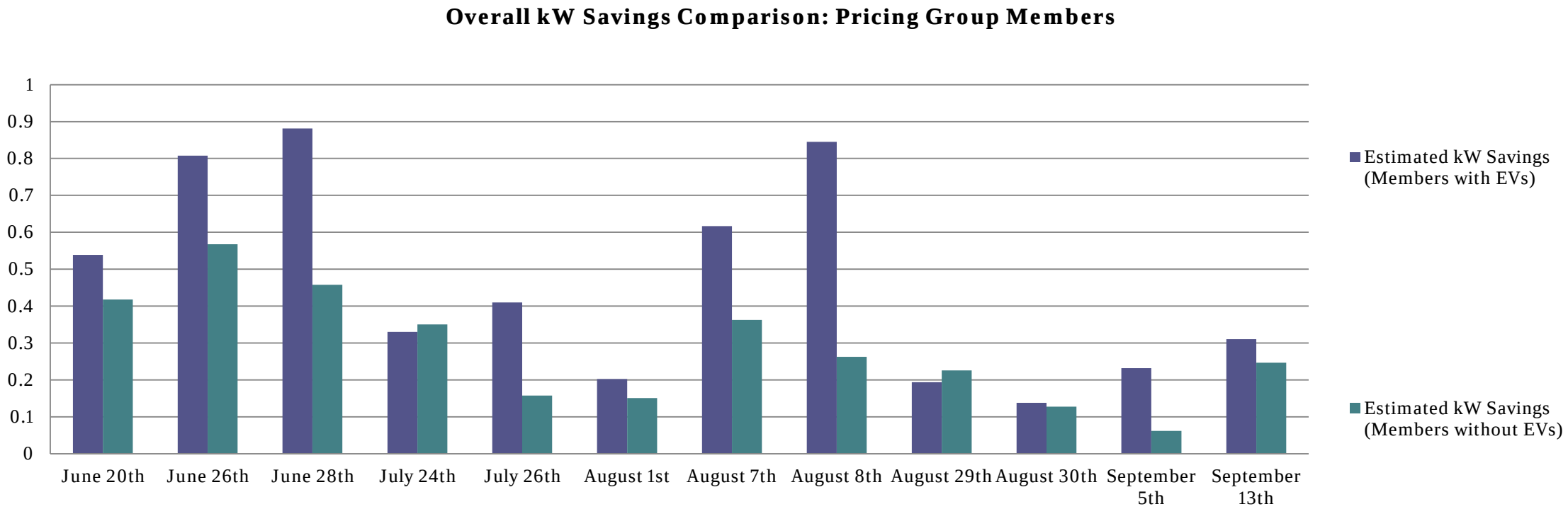


- **Interesting finding: Two full electric vehicles in the Control Group that charge after 10pm**
  - **Implies that full electric vehicles already may be more friendly towards charging off-peak**
  - **Wind pricing scheme may have its greatest impact on hybrids, which are more inclined to charge on-peak**

Wind Enhancement Pricing Findings

- Participants who are shifting the most load are mainly owners of electric vehicles (EVs). These participants shift their EV charging from the afternoon to overnight.
- In the experiment, ratio of 3:1 hybrids to full electric vehicles
  - Two full EVs in the control group are already charging at night
  - Hybrid owners can be trained to shift their charging to the nighttime, with this pricing scheme

Critical Peak Pricing in 2013



- Pricing group members with EVs save more energy during critical peak pricing periods.
- By the end of the summer, the response to critical peak pricing events had declined.

Critical Peak Pricing in 2014

- In progress.
- Critical peak events are being called.
- The cooler summer is presenting a challenge.

Critical Peak Pricing Findings

- **Participants with electric vehicles**
  - **0.459 kW savings on average per participant**
- **Participants without electric vehicles**
  - **0.282 kW savings on average per participant**
- **Response to critical peak pricing events is significant, but does decline over time.**

Audience Engagement Question

Does the wider adoption of electric vehicles (EVs) hurt the system peak?

Answers:

A. Yes
B. No
C. Both of the Above

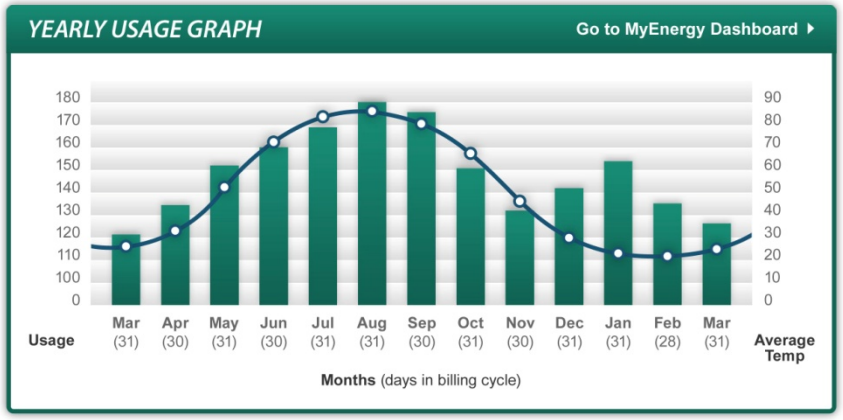
FRONTIER ASSOCIATES

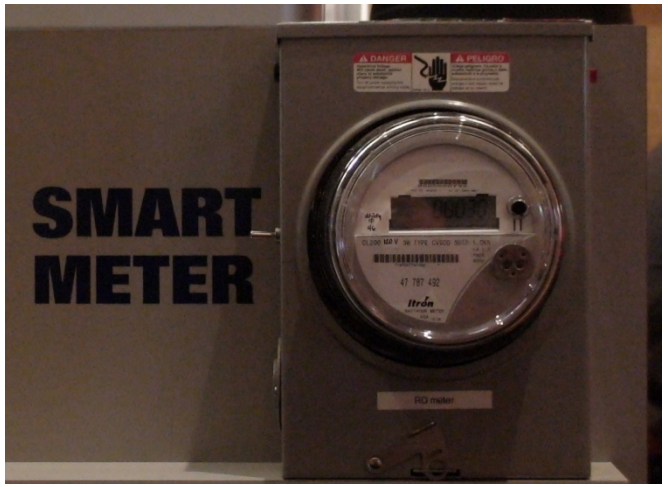
Pecan Street Inc.

CCET

Conclusions

- Customers with electric vehicles can be trained to shift their energy consumption towards times with high wind generation
  - This dynamic pricing scheme could encourage electric vehicle transportation powered by wind generation
  - Particularly for hybrids, which are more inclined to charge on-peak, presumably due to evening plans
- Participants respond to critical peak prices, although the effect does decline over time
- These results are transferable to future residential developments
  - Particularly future communities with electric vehicles, Time of Use rates, and Advanced Metering Infrastructure





Jennifer Pulliam

Director, Products & Innovation

TXU Energy

Jennifer.Pulliam@txu.com

Smart Meter Texas Portal Integration for Demand Response

Project Objective

In August of 2012 TXUE began a project to achieve the following objectives

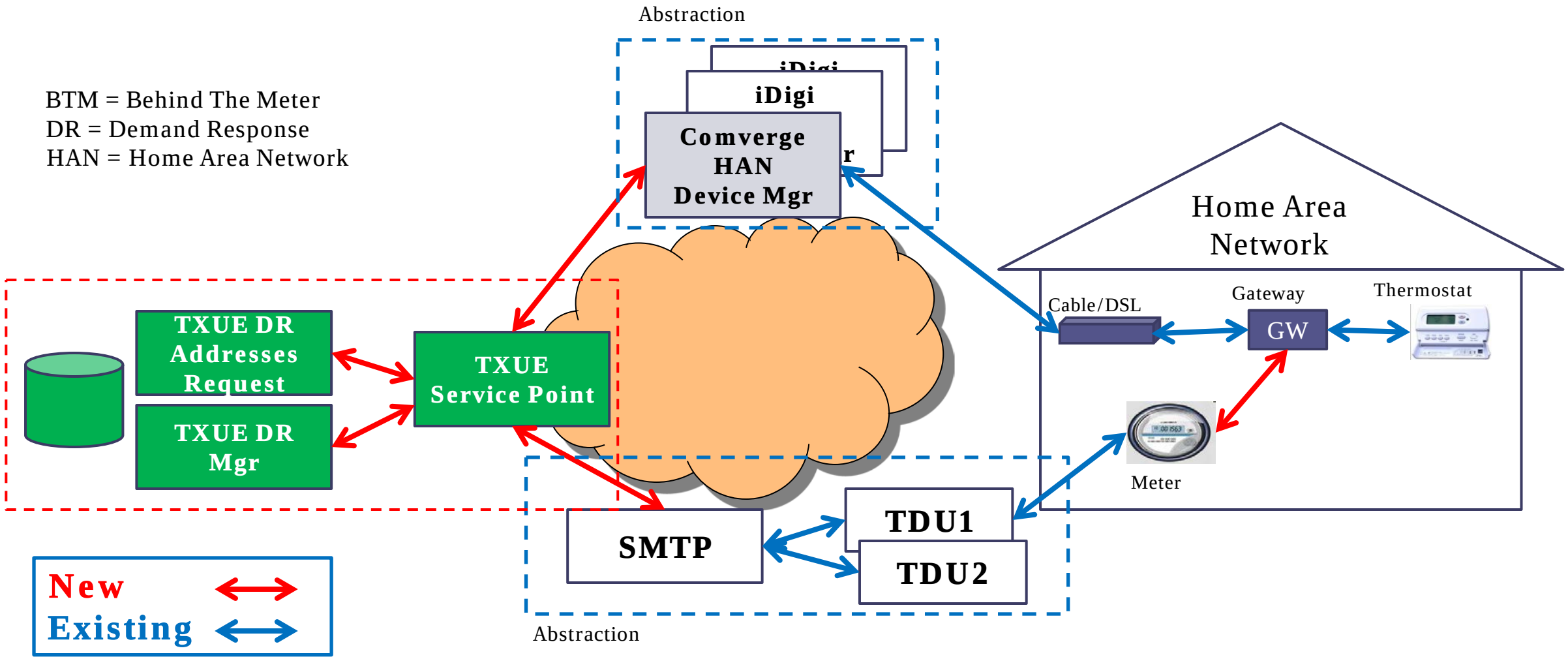
- **Demonstrate the potential for execution of demand response capability through the SMT portal and respective TDU Advanced Meter Systems (AMS)**

- **Design and build APIs that integrate demand response capabilities currently in place with the TXU Energy iThermostat program with the SMT portal**

- **Conduct a demonstration employing the SMT portal to execute actual demand response activities, and thereby informing future efforts to reduce strain on the ERCOT grid through demand response**

Conceptualization of BTM & DR Functionality

BTM = Behind The Meter
DR = Demand Response
HAN = Home Area Network



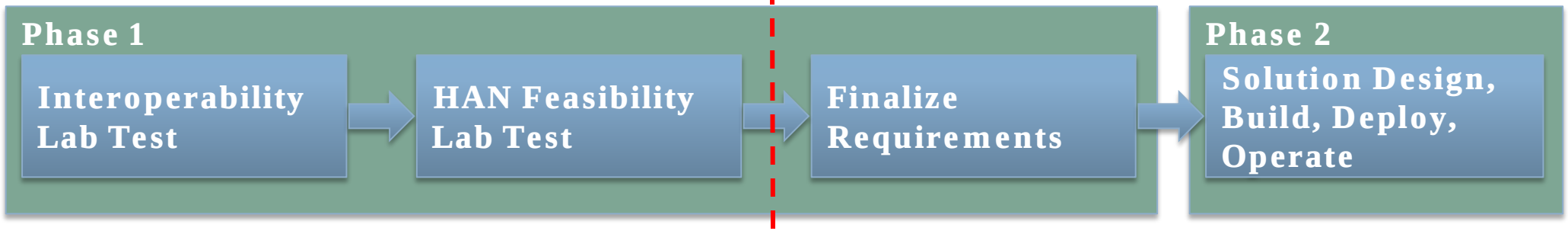
Project Success Criteria

- Remote provisioning, to the extent possible, the installed base of TXU Energy customers' thermostats to TDU AMS Meter (as coordinator)
- Remote and/or onsite provisioning of future customers at the time of installation to TDU AMS Meter (as coordinator)
- Maintain the existing connection to iDigi Gateway (as coordinator), ensuring no loss of connectivity to internet, while also adding connection to the TDU AMS Meter (as 2nd coordinator)
- Ensure thermostat behaves as expected if it receives a DR signal from both coordinators
- Timely transmission of load control signal to installed base of thermostats via the SMT portal
- Measurement & Verification of impact on consumption resulting from cycling events
- Leverage lessons learned to influence SMT, REP, and product vendor DR capabilities

Approach and Findings

Findings:

- Initial configuration focused on those devices widely deployed
- Testing revealed that our initial configuration will not support SEP protocols and is not upgradable over the air
- Not economically feasible to roll a truck



- Existing TDU Interoperability test
- Pre-req before initiating HAN Feasibility Test
- Oncor & CNP Smart Meter labs

- Test HAN with TXU iDigi Gateway plus TDU Smart Meter
- Oncor & CNP Smart Meter labs

- Based on learning's from lab tests, finalize requirements

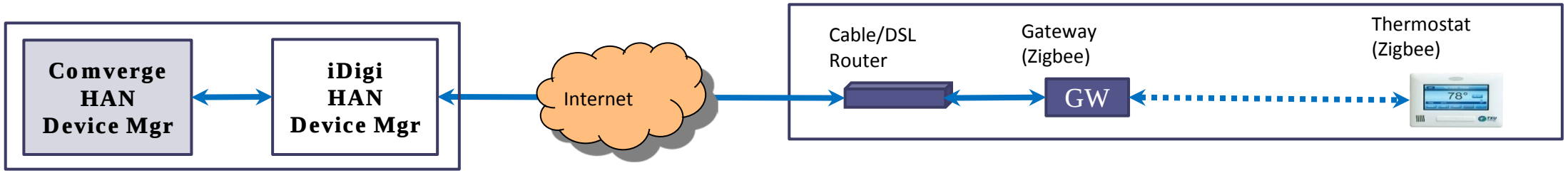
- Lock in a development and deployment timeline

Received 'no-go' recommendation from Comverge

Explored Connectivity / Device Recovery Options

Continued to explore alternatives to recover and maintain device connectivity to achieve DR results with or without connectivity through SMT.

Multiple points of failure required comprehensive strategy to identify and recover stranded devices.



- **Concluded proactive device monitoring and recovery required to identify offline devices and implement remote recovery processes**
- **Reached out to offline customer base – deployed comprehensive communication strategy to trigger customer initiated recovery**
- **Conducted customer surveys to identify customer characteristics for future targeting**
- **Determined that alternative hardware/network solutions are required (e.g. WiFi, Cellular, etc.)**

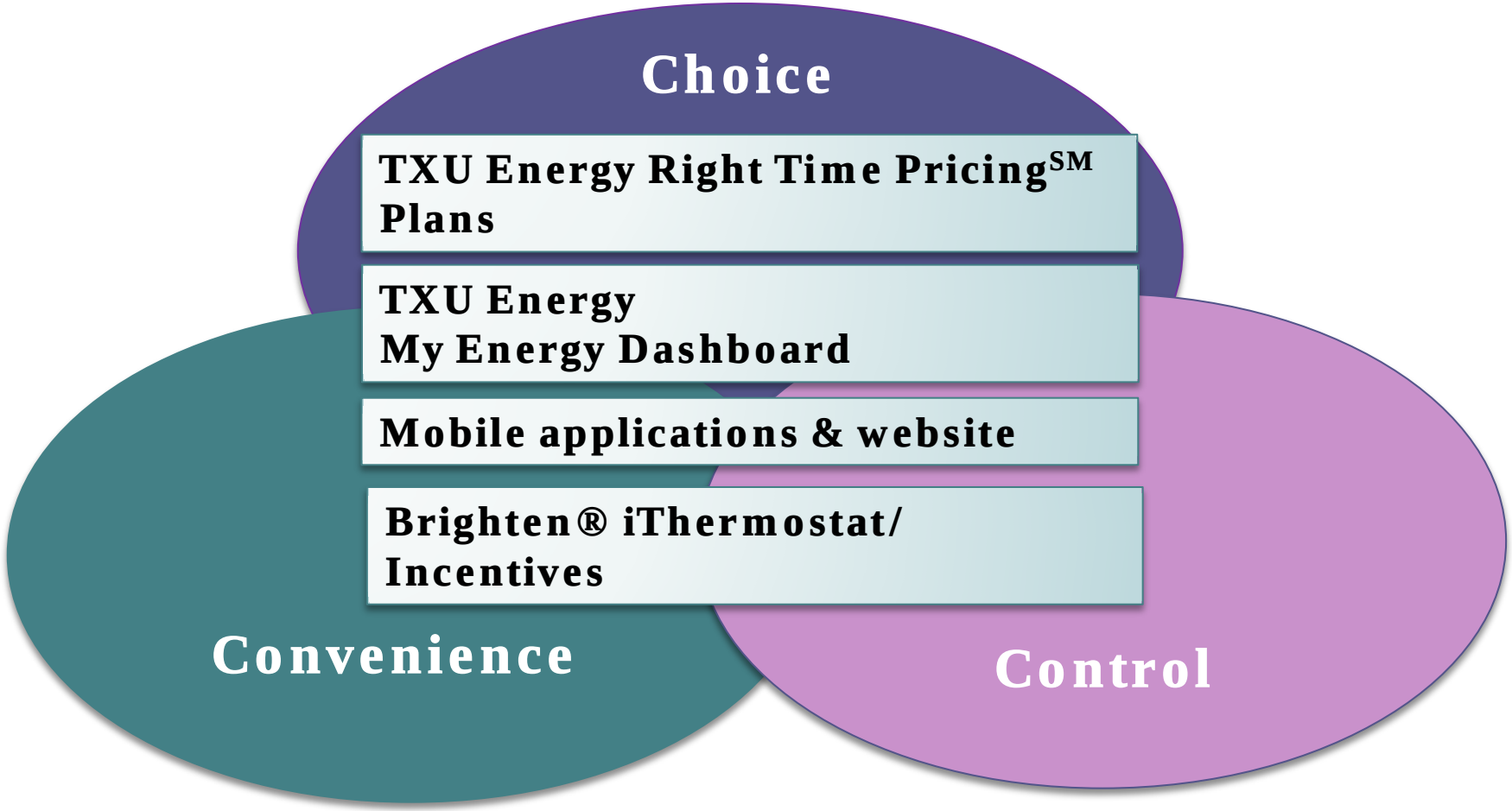
Project Results

- **Older thermostats in market (White Rodgers) could not communicate with smart meters**
  - Could be reconfigured to support SEP protocol but requires costly truck roll
- **Newer Carrier thermostat can communicate with smart meters**
  - Successfully established communication path to the thermostat via SMT
- **Developing a dual path network requires in-market gateway to be reconfigured**
  - Convert gateway from the HAN coordinator to a Router
  - Smart meter becomes the new HAN coordinator
- **Successfully established limited dual path communications in lab and in-home production testing**
  - **Bonded thermostats to meter**
  - Executed DR through SMT Portal
  - Limited thermostat controls via the Internet connection - vendor system not designed to fully support router configured gateway
- **Cost of system upgrade not feasible to support market trial**

2013 testing and results led us to identify alternative technology that will improve our residential customer experience.

Future of Residential Demand Response

As technology changes and the DR market evolves, TXUE continues to evaluate a Demand Response strategy that achieves our customer engagement objectives.



Appendix

TDU Interoperability Tests

TDU Interoperability Test Status		
TDU	Device	
	Carrier PCT	White Rogers PCT
CenterPoint	Passed	Unable to Provision to Meter
Oncor	- 108 Conditions Passed - 22 Conditions Failed	Unable to Provision to Meter

Oncor - Carrier PCT Failed Test Condition Summary	
Test Condition Category	Count
Load Control Messages	7
Cancel Load Control Messages	8
Cancel All Load Control Messages	3
Text Messages	2
Cancel Text Messages	2
Total Failed Test Conditions	22

Appendix

Technology Feasibility Study

- The Test Messaging will consists of a standard series of tests per the list in the Table below:

ZIGBEE HAN TEST CASE	DEVICE TYPE	DESCRIPTION	DESIRED OUTCOME
PROVISIONING	ALL	Add a device to the AMS ESI	Device successfully joined to target ESI
DEPROVISIONING	ALL	Remove device from the AMS ESI	Device disassociated from ESI
TEXT MESSAGE	IHD PCT	Send a text message	Device displays the correct message
CANCEL TEXT MESSAGE	IHD PCT	Message cancelled	Message removed from the device
CANCEL FUTURE TEXT MESSAGE	IHD PCT	Message cancelled	Message removed from the device
PRICE MESSAGE	IHD PCT	Send a price signal	Price signal displayed
TIME SYNCRONIZATION	ALL	HAN device receives current time	Time is syncronized Time is displayed
SEND LOAD CONTROL MESSAGE - COOLING TEMPERATURE SETPOINT	PCT	Temperature setpoint change for COOLING for a prescribed period	Device adjusts setpoint at the requested time for requested duration

Audience Engagement Question

Direct Load Control can be a powerful resource to balance load with generation:

Answers:

A. During hot summer days
B. During the spring months
C. By leveraging competitive market programs
D. By choice of vertically integrated companies
E. All of the above

Jerry Harness

Reliability Engineering
Baytown & Humble Service Centers
CenterPoint Energy
Jerry.HarnessJr@centerpointenergy.com

Future Community – Houston Solar Community Update

What We Will Talk About Today

- Summary of URD Loop Monitoring
- Overall Observations and Next Steps

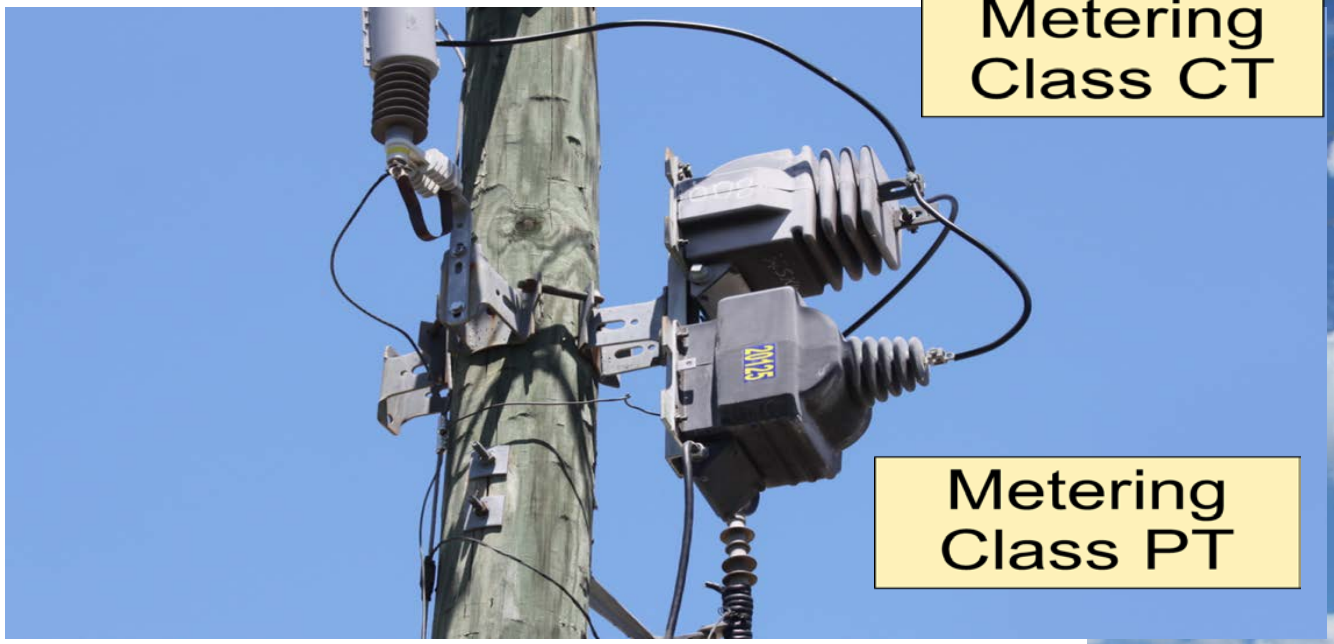
Communities Monitored

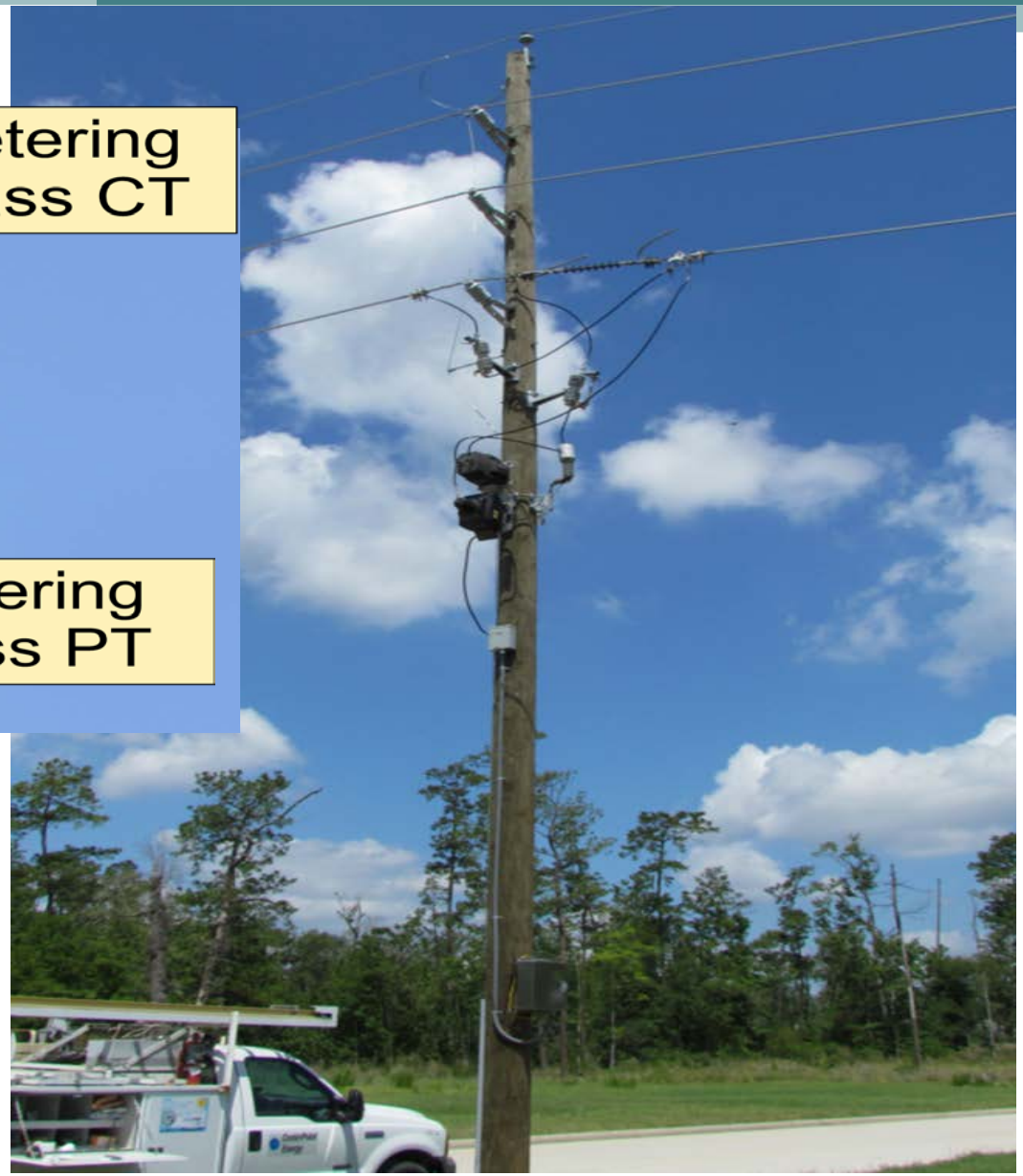
Monitoring 35 kV single phase URD (Underground Residential Distribution) loops in two communities in North Houston – Legends Ranch and Harmony – to observe and characterize any energy consumption impacts due to differing construction features (energy efficiency) and to observe any power quality impacts due to the presence of rooftop solar PV generation.

Engineering and Data Collection by CenterPoint Energy
Data Analysis by Frontier Associates LLC.


DISCOVERY
AT SPRING TRAILS
A CANYON GATE COMMUNITY
Section Lot Size Avail Lots
3 65' 30
3 75' 6
Section Lot Size Avail Lots
TBD TBD TBD
Section Lot Size Avail Lots
2B 55' 25
Section Lot Size Avail Lots
1B 65' 14
Section Lot Size Avail Lots
1b 75' 31
OPTIONAL SOLAR
Section Lot Size Avail Lots
55' 11
Section Lot Size Avail Lots
Swing1 55' 54
CONROE I.S.D.
YORK JUNIOR HIGH SCHOOL
TOM C[illegible] INTERMEDIATE SCHOOL
FUTURE DEV. ~12 ac.
FUTURE POD 9.6 ac.
FUTURE POD 13.7 ac.
FUTURE POD 4.3 ac.
COMMERCIAL
COMMERCIAL 4.6 ac.
COMMERCIAL
COMMERCIAL
COMMERCIAL
SWING TRACT 16.6 ac.
RAYFORD RD
DISCOVERY CREEK BOULEVARD
RILEY FUZZEL ROAD
Discovery Creek
Section Lot Size Avail Lots
4B 60' 36
Section Lot Size Avail Lots
POD Sale 60/70 5
Section Lot Size Avail Lots
POD Sale 50' 39
Section Lot Size Avail Lots
POD Sale 60' 80
C
F
H
W
CastleRock
First Texas
Highland
Westin
MODEL HOMES
CastleRock (281) 788-4141
First Texas (281) 651-1314
Highland (281) 350-1060
Westin (832) 813-0200
From Downtown:
Take I-45 North to Rayford Road and turn right. Proceed about 4.5 miles to The Discovery Center, which is across from Discovery Creek Blvd. on Riley Fuzzel.
THIS PLAN HAS NOT BEEN REVIEWED OR APPROVED BY ANY GOVERNMENTAL AGENCY. ADDITIONAL STREETS AND/OR DRAINAGE PROVISIONS MAY BE REQUIRED. THIS PLAN IS AN ARTISTS CONCEPTION AND IS PROVIDED FOR GENERAL INFORMATION PURPOSES ONLY. ALL PLANS FOR FACILITIES OR LAND USES ARE SUBJECT TO CHANGE WITHOUT NOTICE.


HARMONY
Sounds like home.
Model Homes
WESTIN HOMES
PERRY HOMES
HIGHLAND HOMES
CASTLE ROCK
FIRST TEXAS HOMES
ASHTON WOODS
(Coming Soon!)
VILLAGE BUILDERS
(Coming Soon!)
EXISTING LOTS
DEVELOPING LOTS
FUTURE LOTS
COMMERCIAL
SCHOOLS
Harmony-Tx.com





URD Loop Monitor

UCM
(Universal Circuit Monitor)

Parameters Recorded

- Power Factor (PF)
- Frequency
- Voltage
- Current
- THDv
- THDi
- Real Power
- Reactive Power
- Apparent Power

SATEC Model PM174 PQ Monitor

Remote display and logging of data at each UCM location via cellular communications.

URD Loops Monitored

	# homes	Avg Sq Ft	Solar kW
Harmony UCM2	60	3,361	66
Harmony UCM3	26	4,418	30
Harmony UCM7	40	2,739	46
Legends UCM4	43	3,272	-
Legends UCM5	44	3,740	-
Legends UCM6	94	1,156	-

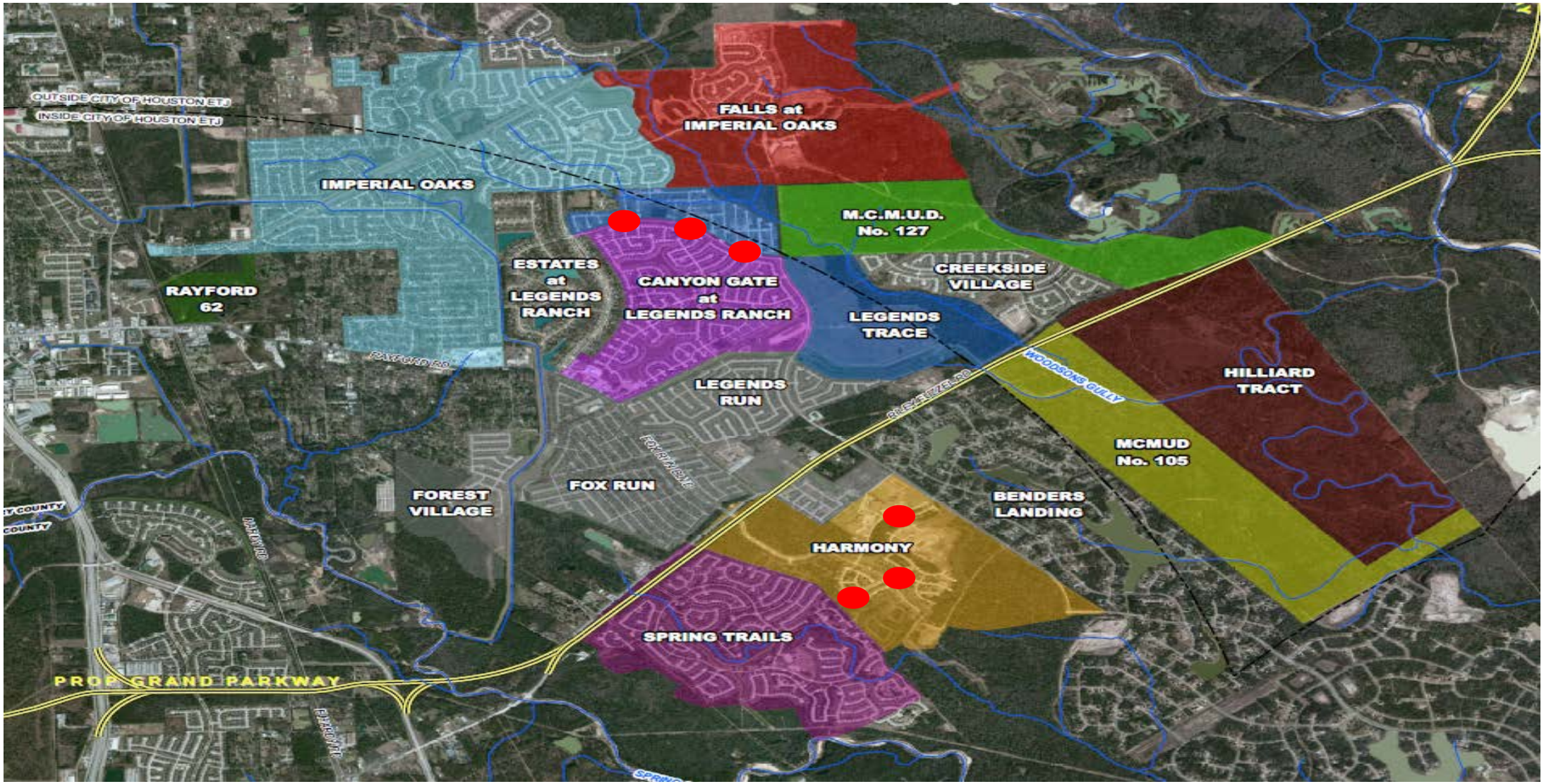
Communities Monitored

Objective: Differentiate the two neighborhoods based on energy consumption and power quality impacts from rooftop solar generation.

Question: Does the 'solar neighborhood' (Harmony, high efficiency homes) exhibit different power consumption and power quality as compared to the more standard construction and non-solar neighborhood (Legends Ranch)?

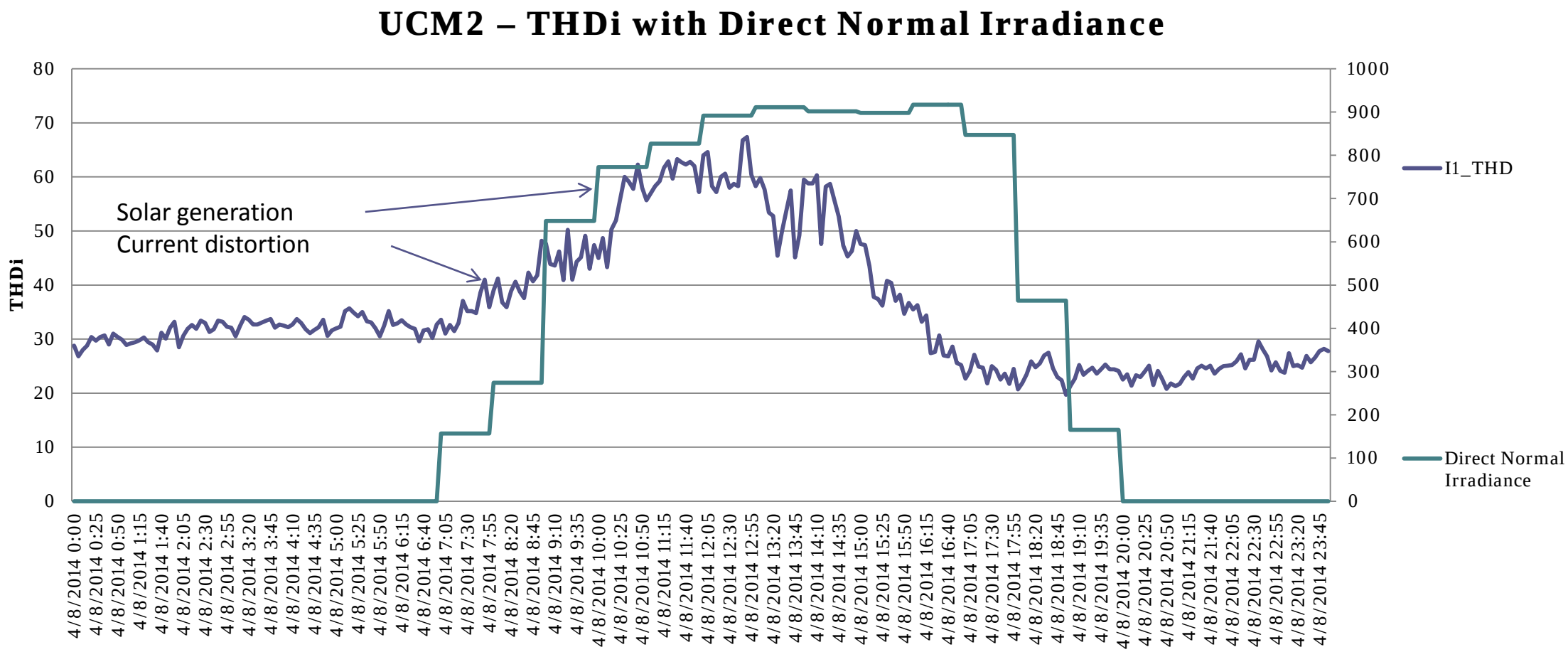
Method: Monitor three single phase URD loops in each subdivision; identify and explain any correlation of solar production profiles (Harmony only) to measured voltage, power factor, THDv, THDi; compare energy usage intensity of Harmony vs Legends Ranch homes.

Area Map of Control and Study Communities Showing Monitor Locations



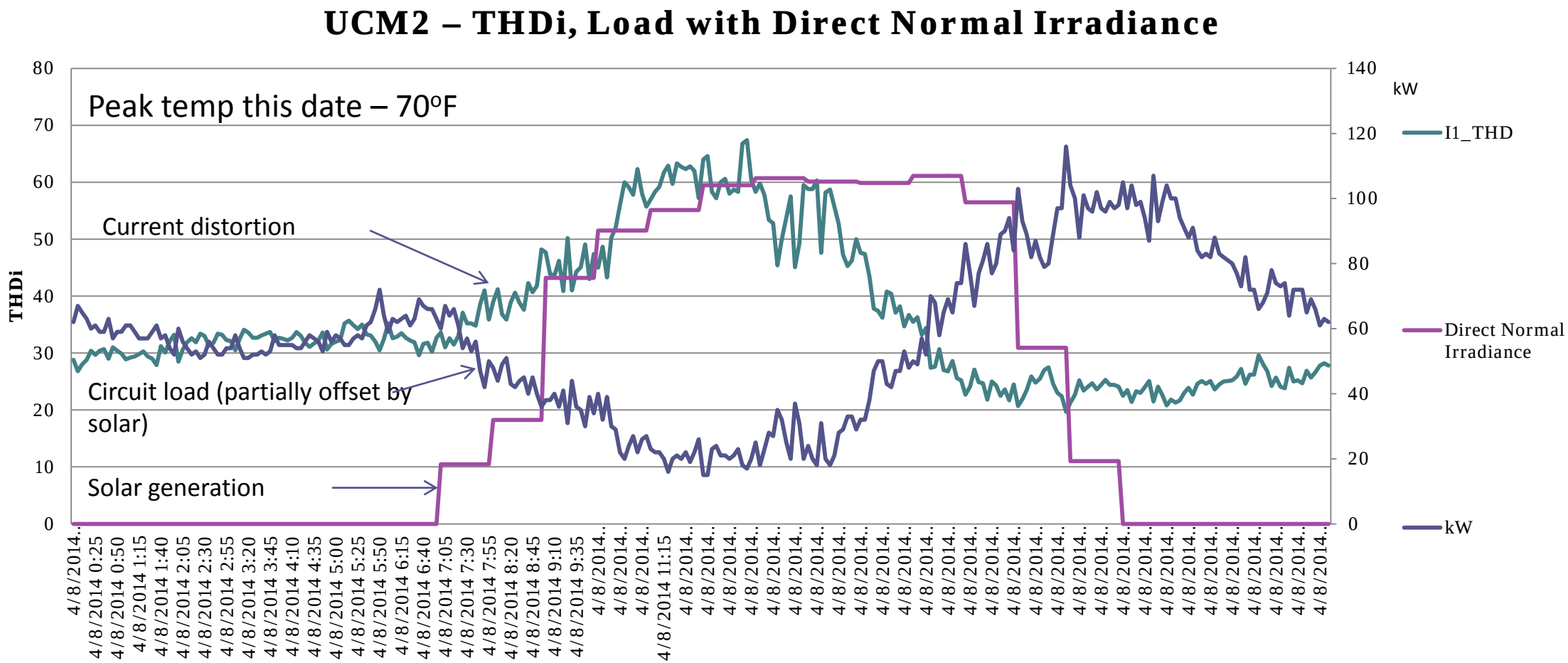
MONITOR LOCATIONS

Harmony Correlations to date



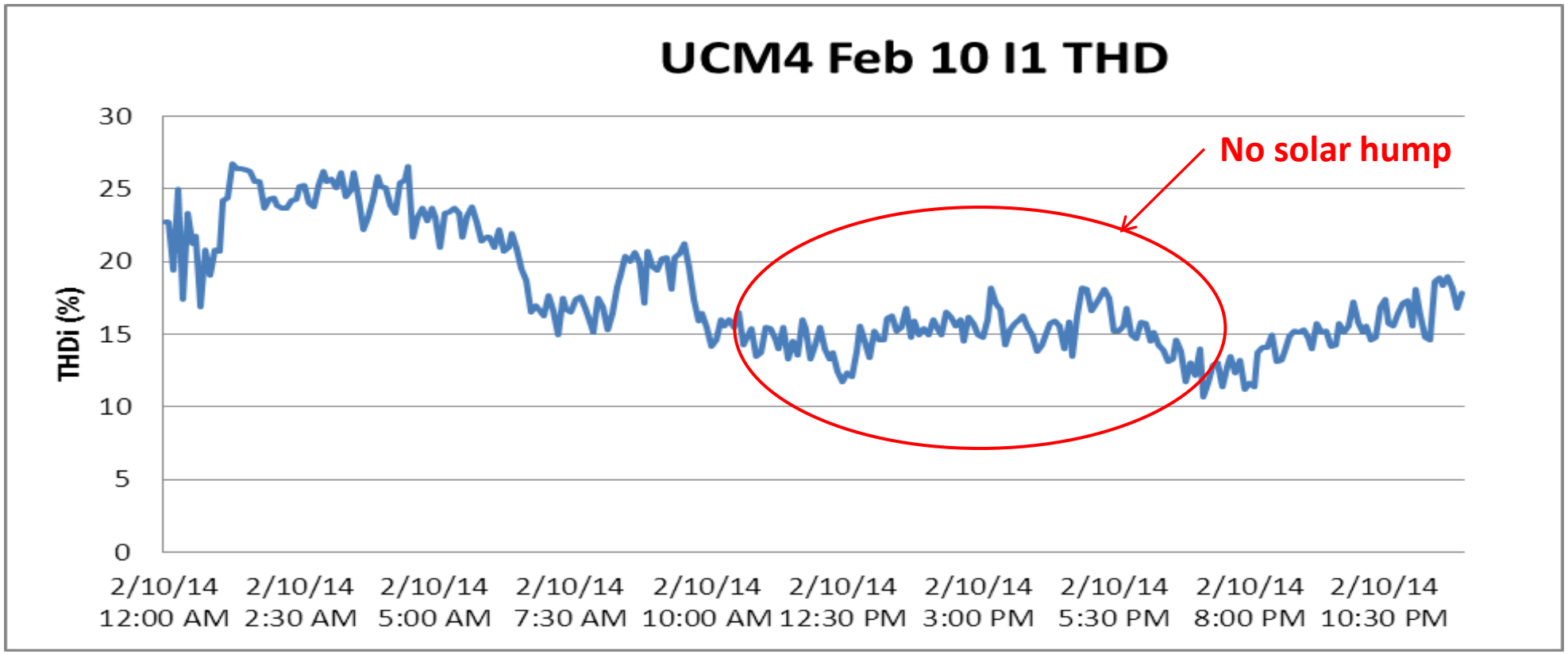
Strong THDi correlation to solar production. Note THDi starts to decline (before solar production declines) as load increases from residents returning home (next slide).

Harmony Correlations to date



Strong THDi correlation to solar production; typical inverse THDi correlation to circuit load, which dips to 15kw for 60 homes, thanks to solar; note typical evening load.

Legends Comparison

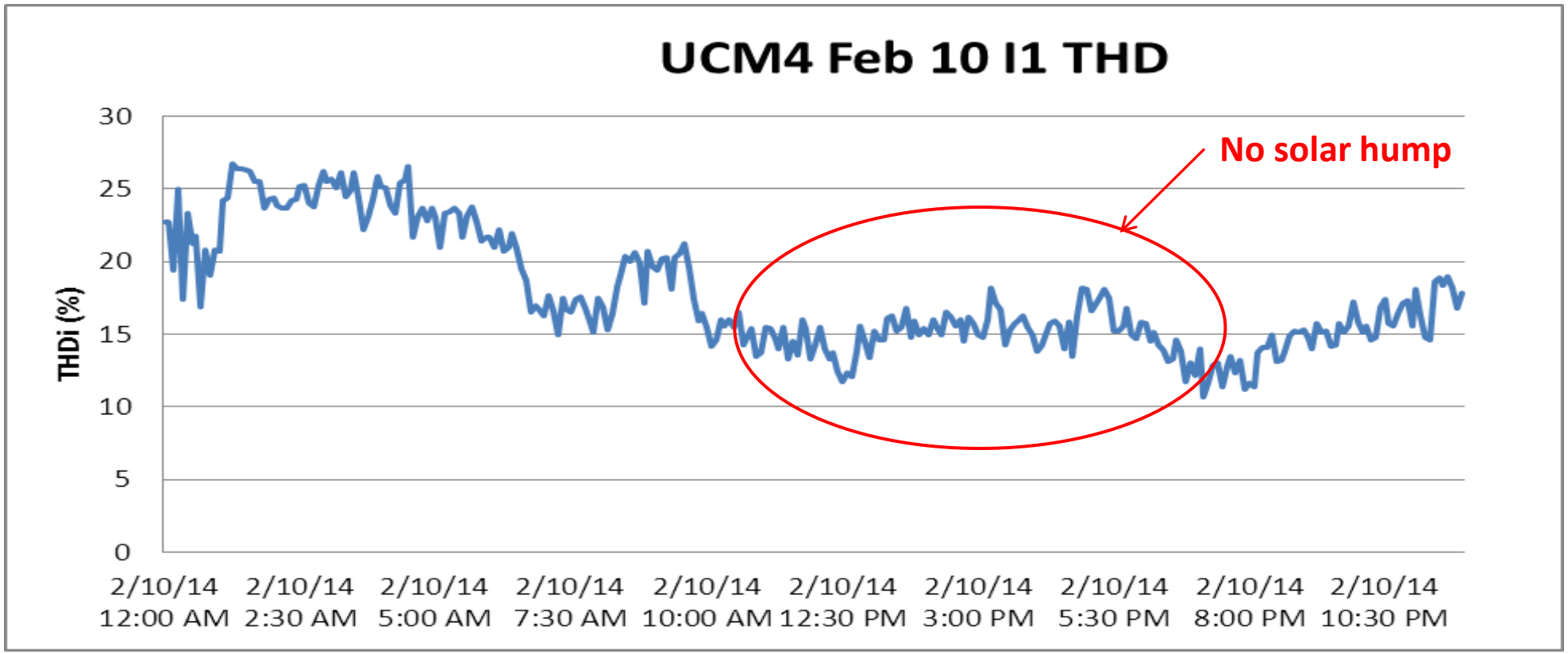


Legends – no solar; THDi peak during middle of night at low load

Harmony Correlations to date

- Voltage has a small correlation to solar production in Harmony.
- Power factor has a strong inverse correlation to solar production in Harmony.
- Voltage distortion has no correlation to solar production in Harmony.
  - Observed voltage distortion peaks in the evening on both Harmony and Legends.
- Current distortion has a very strong positive correlation to solar production in Harmony.
  - As load current reduced the current distortion rises.
  - See a pattern as load picks up in the evenings the current distortion drops.

Pecan Street Comparison



Legends – no solar; THDi peak during middle of night at low load

Circuit Monitoring – Next Steps

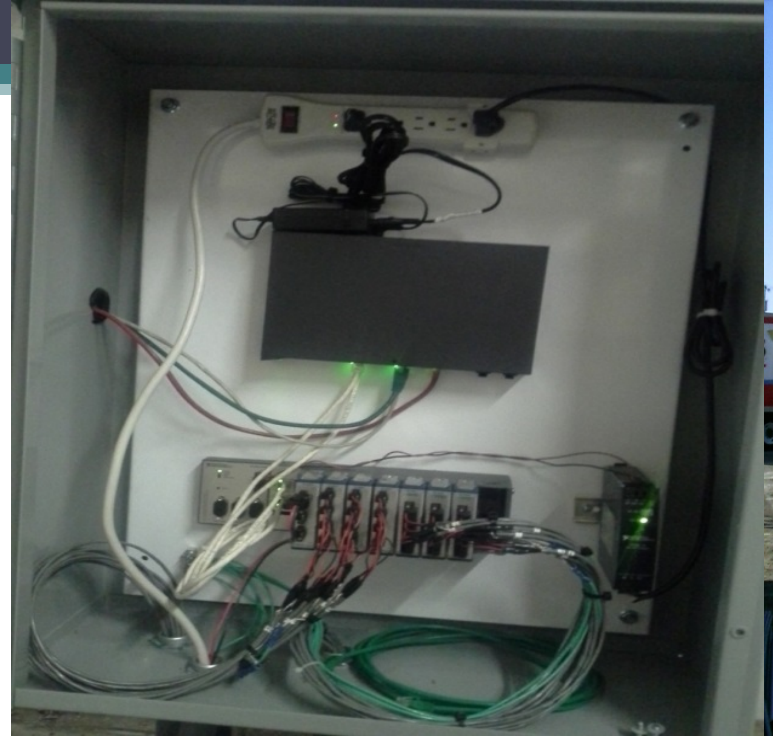
- Continue to monitor loops throughout the end the year.
- Compare /contrast findings through Spring, Summer, Fall weather patterns.
- Compare/contrast findings from Houston and Austin.
- Installed Pecan Street Monitor to one home in Harmony.
- Research PQ-solar impacts/studies by others.

Audience Engagement Question

A large penetration of rooftop solar will make the ERCOT grid with 30 percent wind generation?

Answers:

A. More of a challenge
B. Less of a challenge
C. It depends



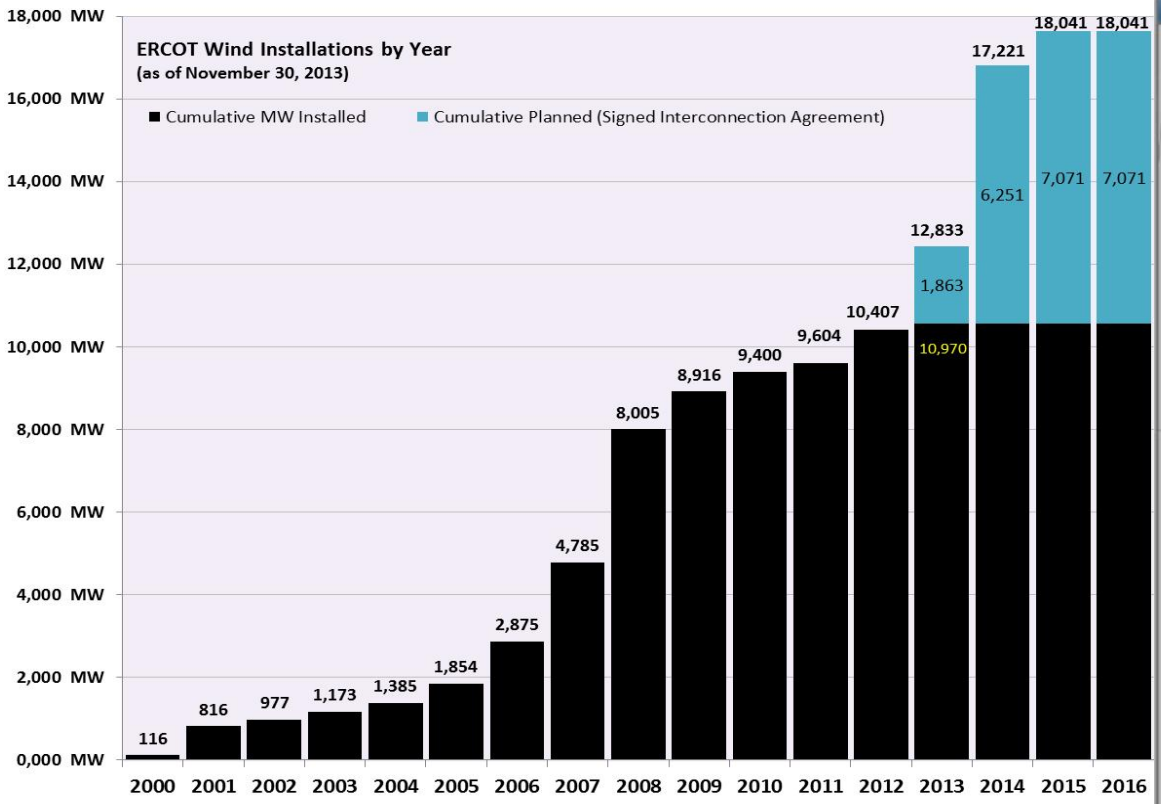
Sean C. Mitchem

Principal Analyst
Smart Energy Technologies
Southwest Research Institute (SwRI)
sean.mitchem@swri.org

Electric Vehicles for Managing Wind Integration

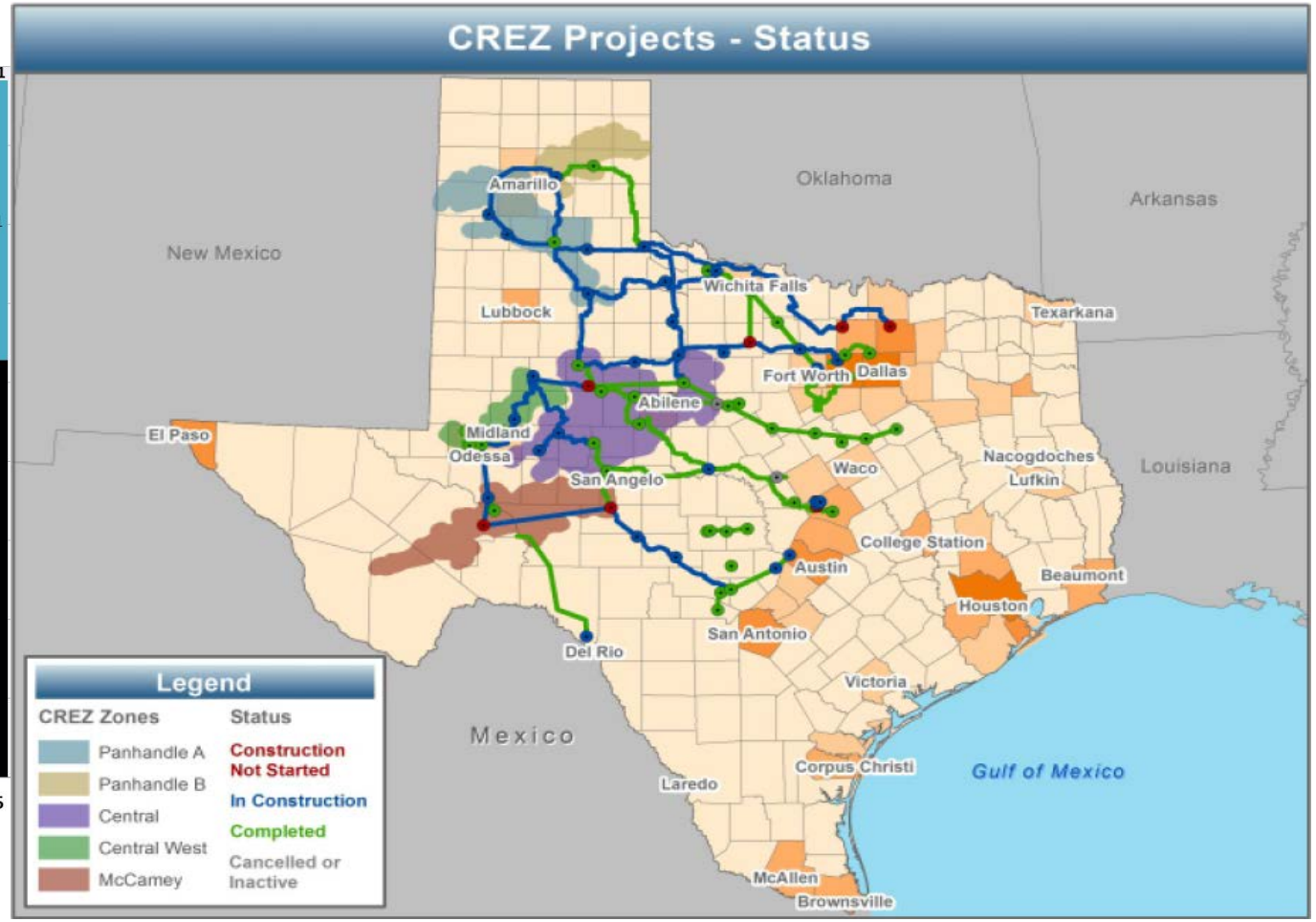
Team Partners

ERCOT Wind Capacity

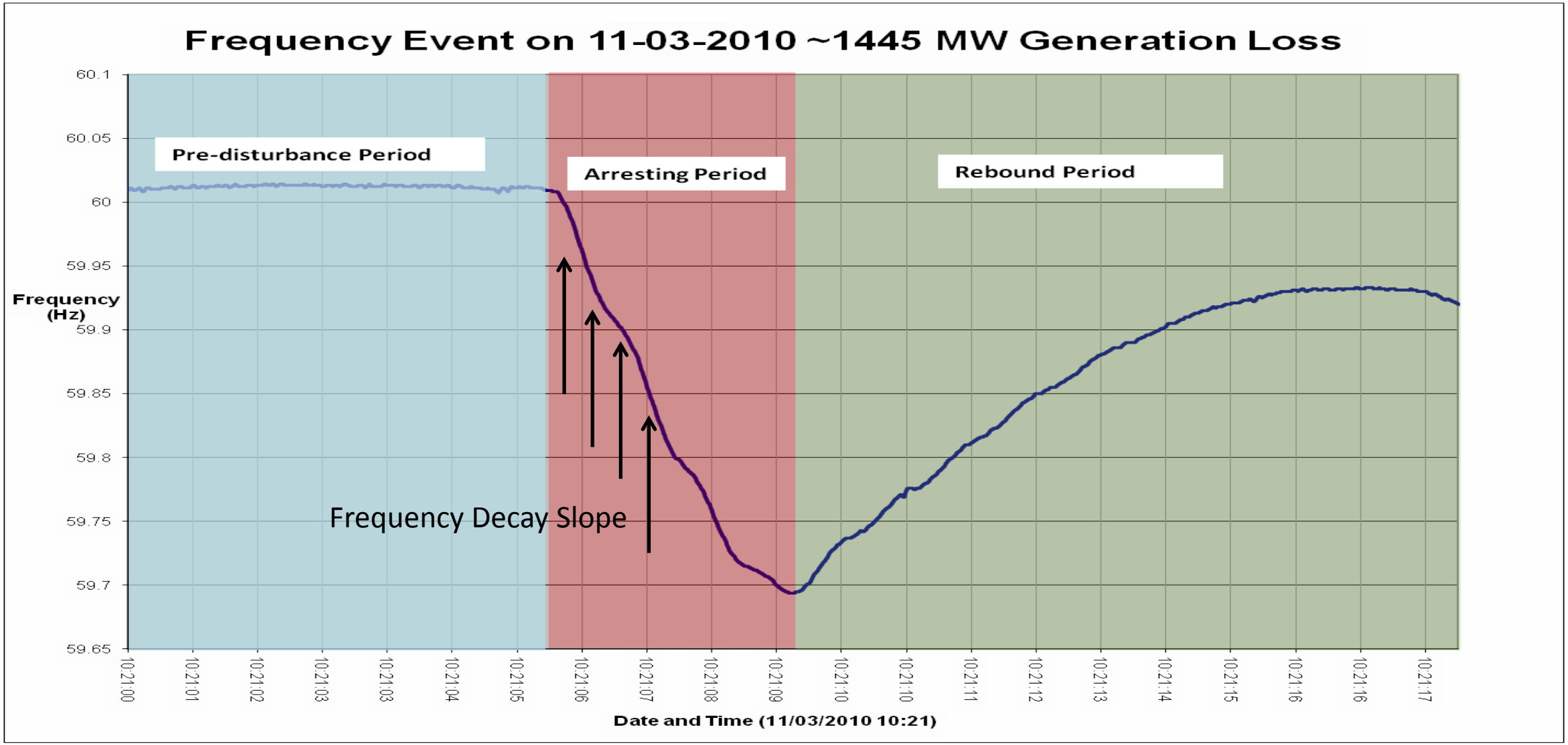


The data presented here is based upon the latest registration data provided to ERCOT by the resource owners and can change without notice. Any capacity changes will be reflected in current and subsequent years' totals. Scheduling delays will also be reflected in the planned projects as that information is received.

This chart reflects planned units in the calendar year of submission rather than installations by peak of year shown.



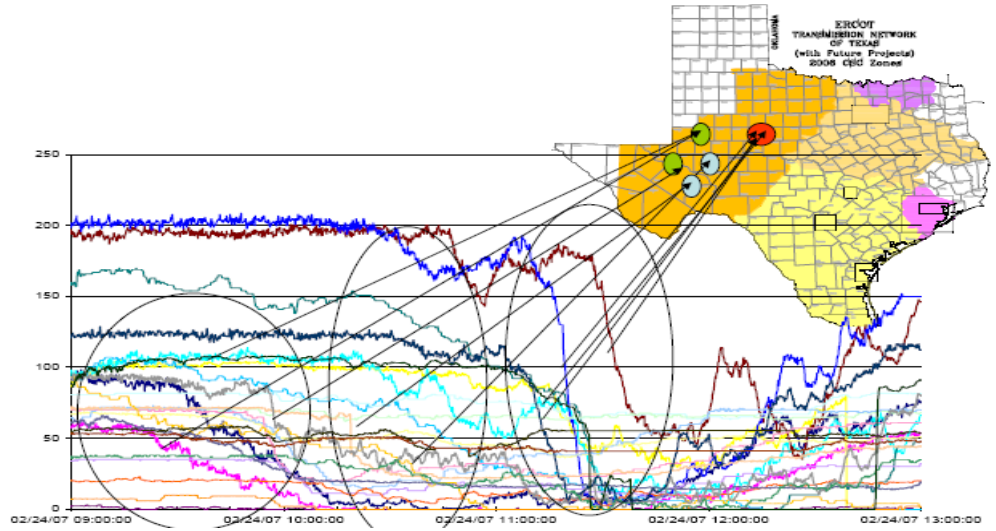
Frequency Decay Slope

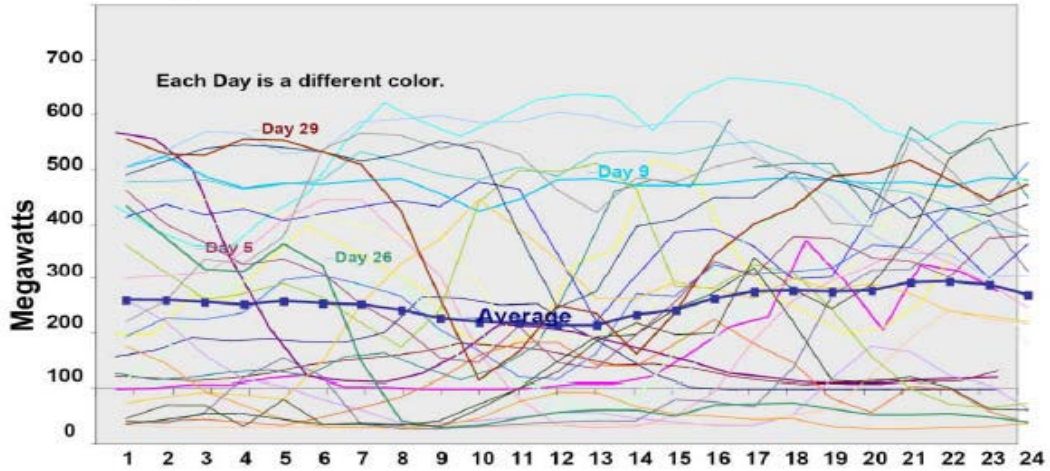


Source: ERCOT Fast Responding Regulation Service Pilot Presentation TAC 9-7-2012

PEV Fleet Charge Control - Utility/ISO Perspective

- How will an EV fleet benefit my grid?
- How to integrate with the fleet to be effective?
- What's the best service(s) for EVs to be involved in?
- Will this increase renewable penetrations?
- How will EVs affect reliability of the grid?





Fast Response Regulation

- Fast responding regulation
  - Use of fast-acting (less than 1 second to full response) resources to counter frequency variations
  - Enabled through FERC Orders 755 and 784
  - Demonstrated by ERCOT FRRS Pilot Feb 2013 to Feb 2014
- Use PEV delivery fleet to provide FRR Reg-Up service
  - Fast responding battery load
  - Demonstrate secondary use of EV for additional revenue
- Monitor grid frequency and automatically provide service
  - Greater than .03Hz deviation from 60Hz
  - Implement full bid capacity
  - Implement independent of ISO signal for faster response

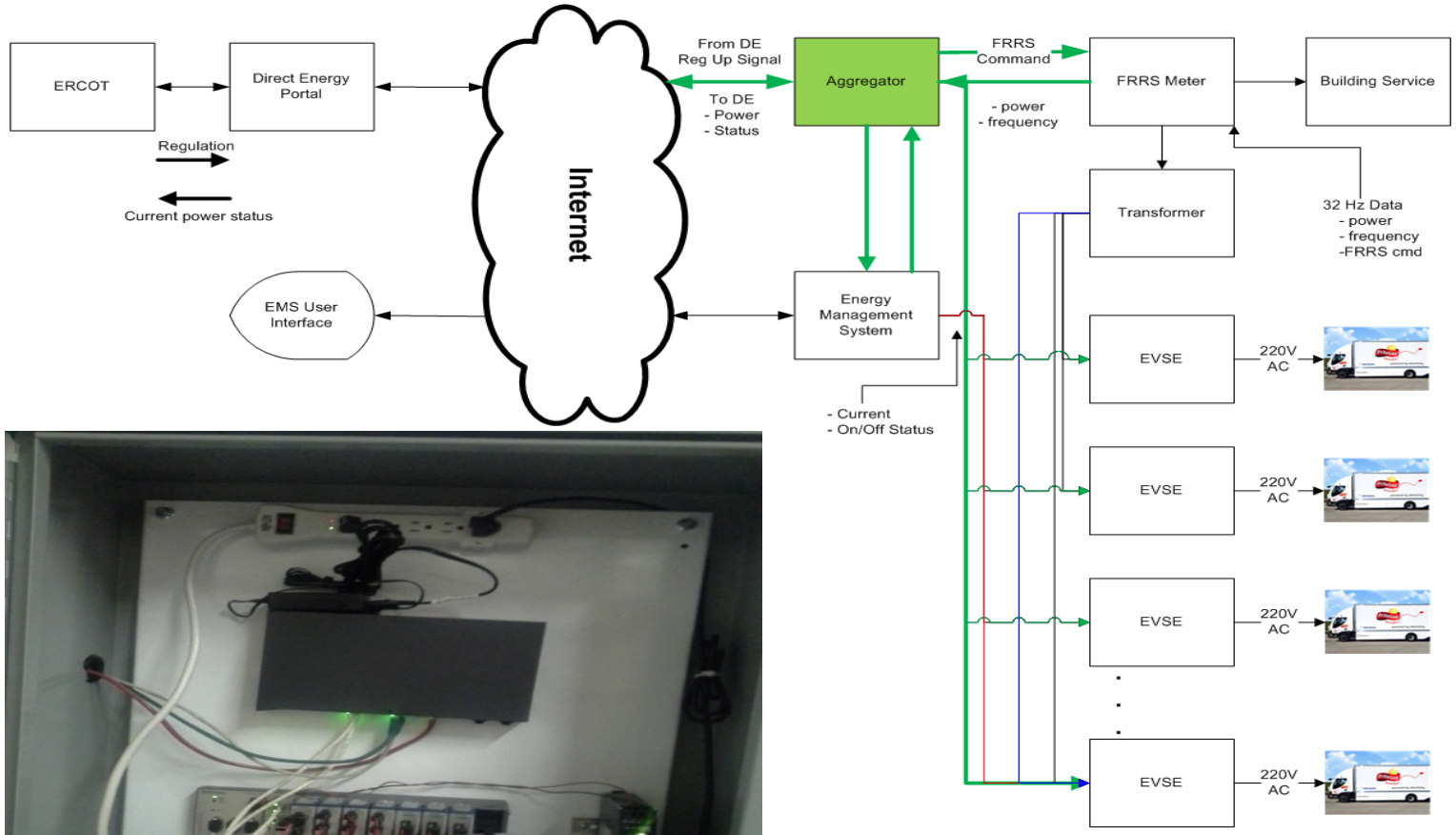
Fast Responding Regulation Service (FRRS) Pilot Project

- (Technology neutral) pilot project - 2-25-13 through 2-18-14. (Batteries, fly-wheels, Load Resources)
- FRRS is an Ancillary Service requiring participating resources to ramp to full output within 60 cycles of an instruction or triggering event.
- FRRS is intended to complement traditional regulation service.
- FRRS is intended to respond first and help slow down the frequency decay while other resources start to respond.
- FRRS is intended to respond to large frequency drops to promptly help arrest the frequency decay.
- Must past qualification test to participate ---- and in order to get paid for an hour in the pilot ---- must meet performance criteria.

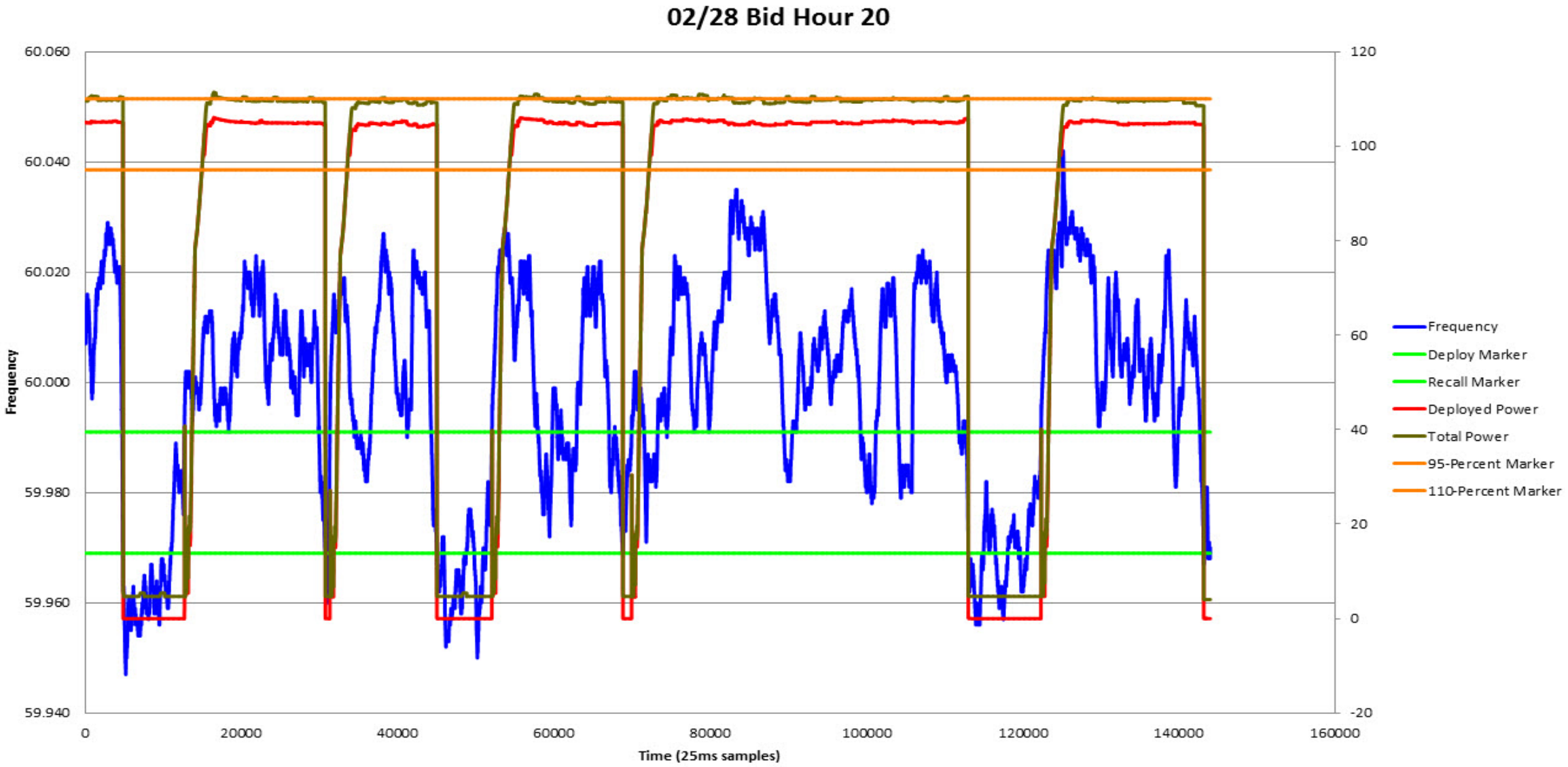
ERCOT FRRS Pilot Requirements

- Qualify as a resource within ERCOT
- Detect and record system frequency with an accuracy of at least 1 MHz
- Record frequency samples at 32 samples per second
- Record output MW at 32 samples per second
- Be able to receive and respond to an ERCOT FRRS signal dispatch through an ICCP/DNP3 signal
- Be able to automatically detect frequency deviation of +/- 0.03 Hz from 60 Hz
- Be able to commit 100% FRRS capacity within 60 cycles of frequency deviation
- Be able to commit requested % FRRS capacity within 60 cycles of ICCP signal
- Be able to provide FRRS telemetry to ERCOT every 2 seconds

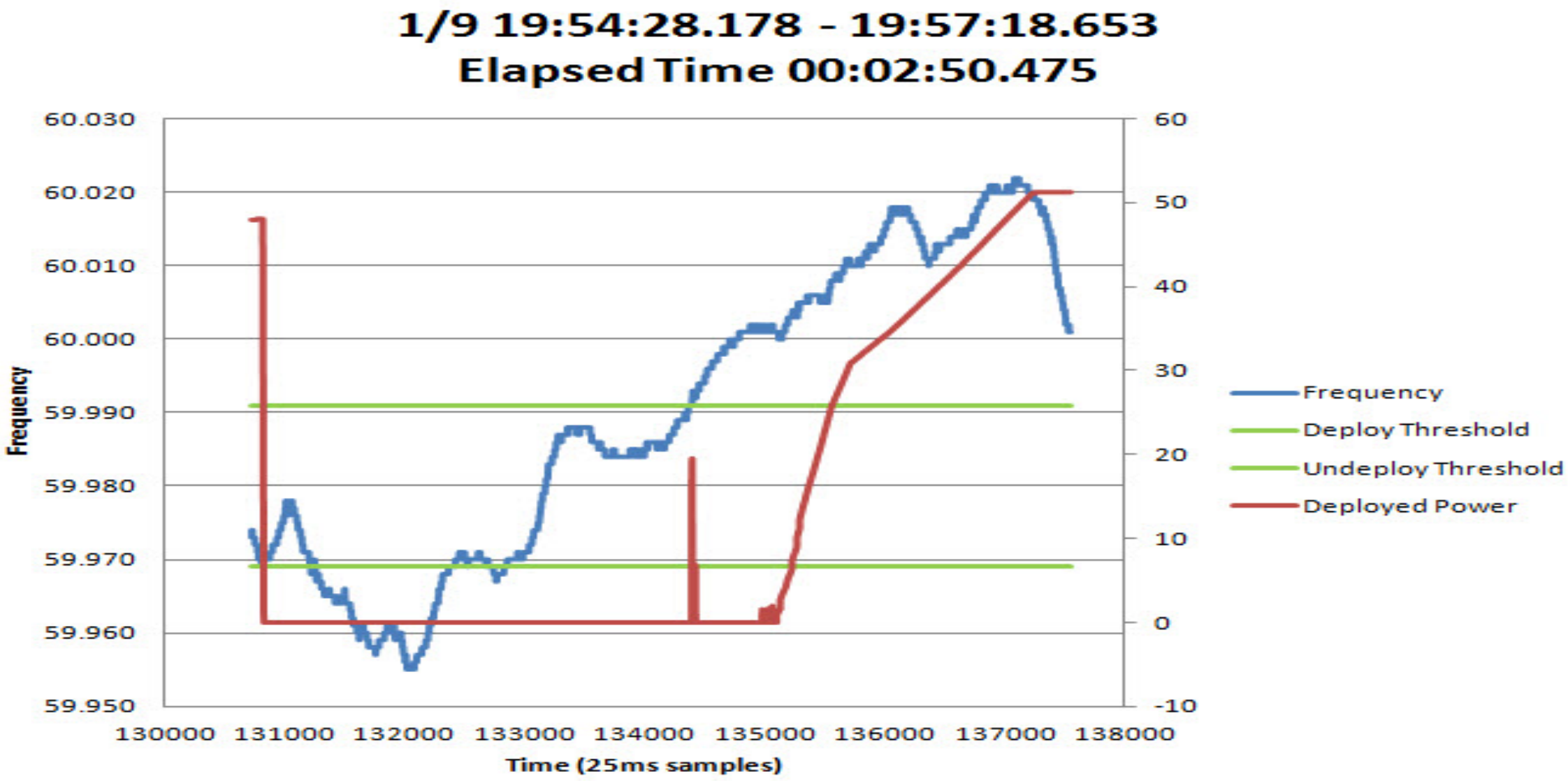
FAST Response Regulation Service (FRRS)



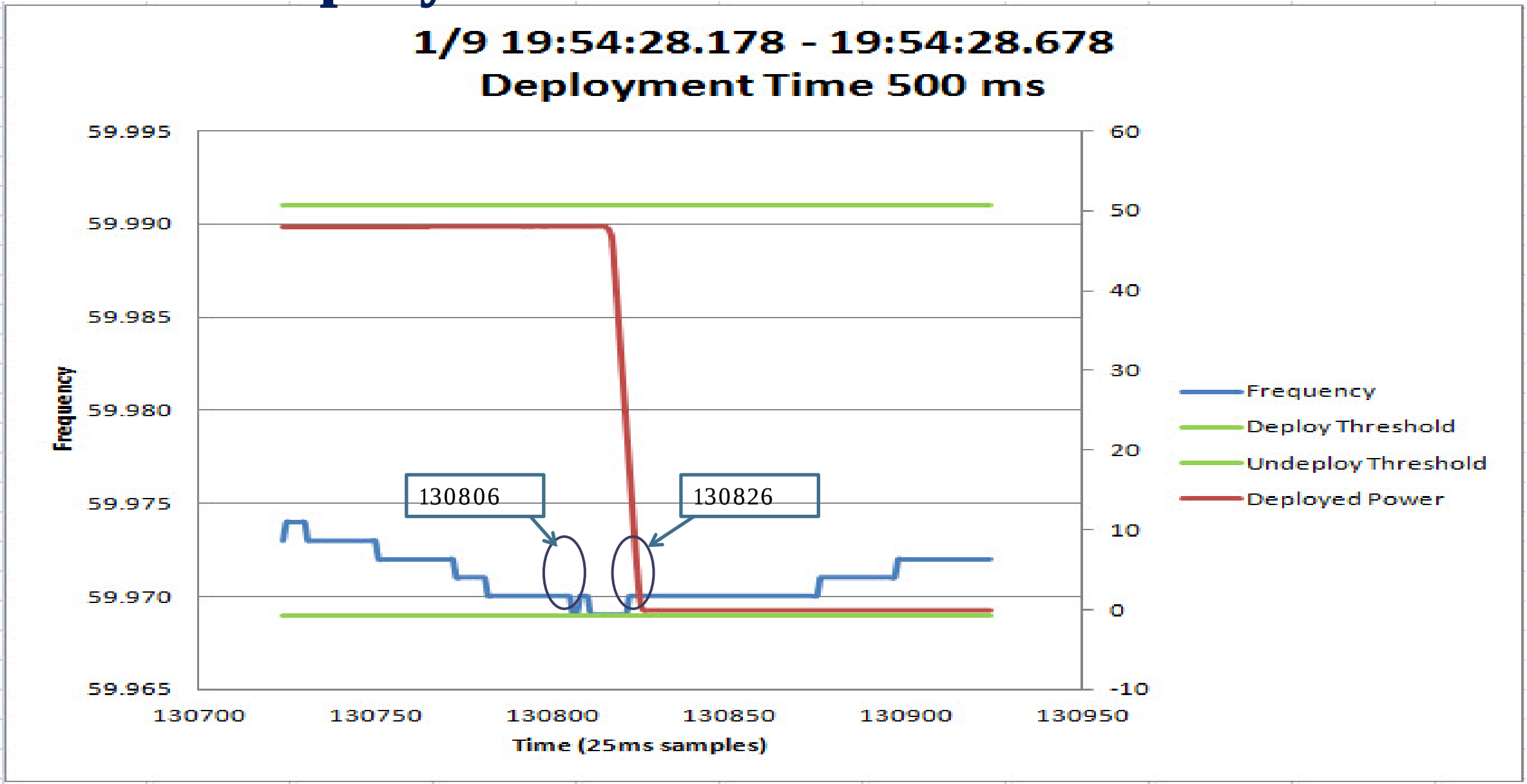
FRRS Deployment



FRRS Deployment



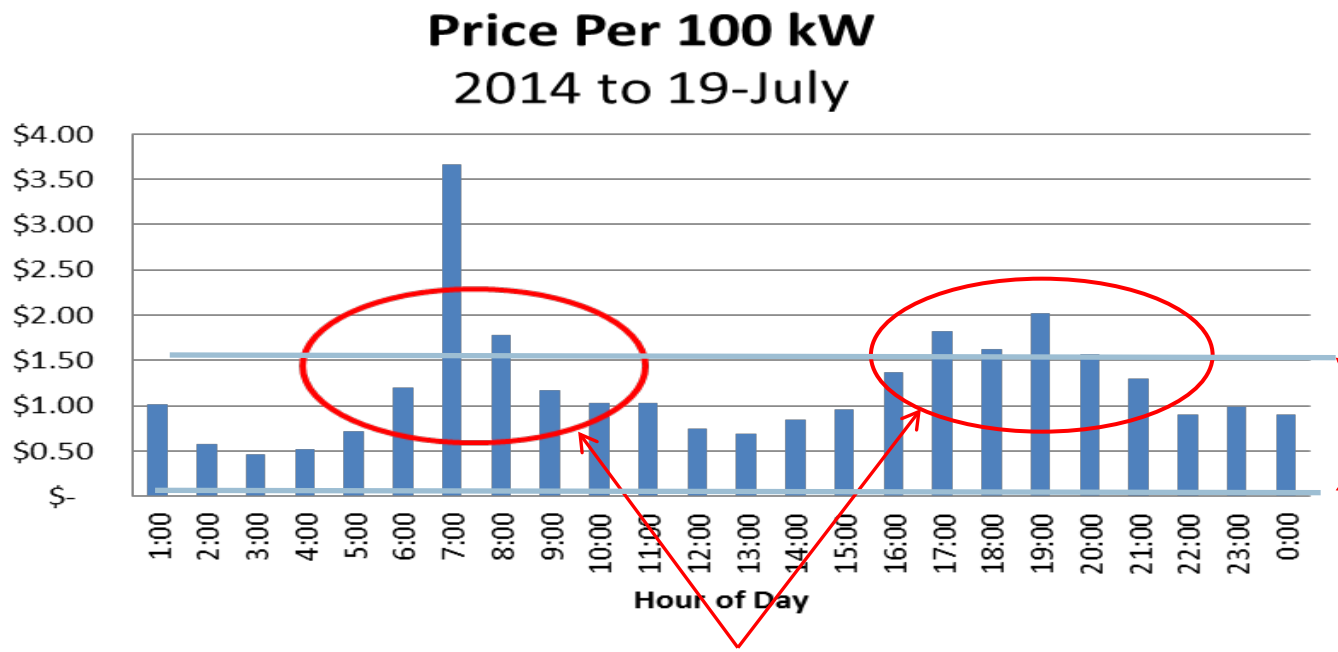
FRRS Deployment



FRRS Pilot Project - Results

- Passed ERCOT qualification test for 100 kW to participate in FRRS Pilot on 20-Dec 2013
- First EV fleet to successfully participate in ERCOT FR market.
- Prior to participating in market, were “simulating” participation – actually controlling PEV load – 100% success in meeting performance criteria
- Observations:
  - ~ 33 bid hours
  - 129 deployments
  - 3.8 average deployments per hour
  - 2:17 (mm.ss) average deployed time per deployment
    - 0:14 minimum deployment
    - 5:49 maximum deployment
  - 8:55 (mm.ss) average total time deployed per hour

Identification of Target Fleet Charge times to Maximize FR Payment



Nominal regulation up payment range from $.50 to $2 per 100 kW per bid hour

Average price points as target timeslots to participate in FR are 6-9 AM, 5-10 PM

PEV Fleet Reg-Up Revenue Example - ERCOT

- Assumptions
  - Fleet of 10 PEVs – 100 kW bid
  - 10 kW charging
  - One way charge control (on/off)
  - One delivery route/day (3 to 5 hours charge)
  - Extrapolate 2014 to-date Reg-up payments through end of year

- **Results - In Example – not enough revenue to justify CC program based on FR only. Could be a part of an overall CC program.**

Hr	Price per 100 kW	30 Days
19:00	$1.82	$54.65
20:00	$1.62	$48.61
21:00	$1.95	$58.41
22:00	$1.49	$44.71
	Total Monthly Revenue	$206.38
	Total Annual Revenue	$2,476.54

Strategies for Maximizing CC Fleet Revenue

- Individual fleet vehicle charge control (Aggregation)
  - Demand Charge (EV fleet) avoidance
  - AS sweet spot market participation (if participating)
  - Demand Charge (facility) avoidance
  - TOU, facility energy management , others
- Individual vehicle SOC management
  - Insures each vehicle has at least minimum SOC to complete route
  - Provides an enhancement to all of the above strategies
- Fleet CC strategies independent of unidirectional or bi-directional charging systems

Audience Engagement Question

Electric vehicles make a good resource for Fast Response Regulation Services because:

Answers:

A. Unused energy remains in the batteries at the end of the day
B. Batteries respond very quickly to being turned on and off
C. EVs are easily scheduled to meet FRRS bid commitments
D. They can move around to where energy is needed quickly

Summary

- Electric Vehicles can provide frequency regulation
  - PEV Frequency regulation being tested in PJM
  - Fleet DC/FC implemented in Colorado Springs
  - Fleet Fast FR being tested in ERCOT region
- Electric vehicles have the capability to participate in fast response frequency regulation services
- The Grid can benefit from increase in grid storage capabilities provided by electric vehicles
- Economics for connecting EVs points to more than Ancillary Service participation
- Fast responding resources like EVs can increase wind “usability” by managing variation

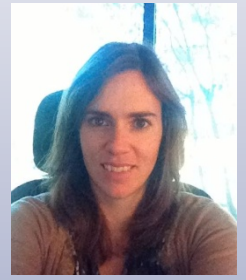
PRESENTERS INFORMATION

Milton Holloway, Ph.D.
President & COO
CCET
512.472.3800
Mholloway @electrictechnologycenter.com

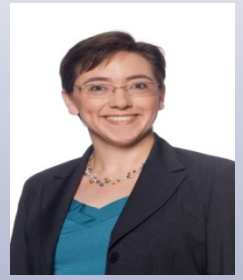
Vikram Budhraja
President
Electric Power Group, LLC
626.685.2071
budhraja@electricpowergroup.com

Lorie Wigle
Vice President, General Manager IOT Security Solutions
McAfee a Division of Intel Security
503 466-4405
Lorie_Wigle@McAfee.com

Zach Taylor
Manager of Engineering
South Plains Electric Cooperative, Inc.
806.775.7755
ZTaylor@spec.coop



Holly Prosser
Energy Analyst II
Frontier Associates
512.372.8778 , ext. 107
hprosser@frontierassoc.com

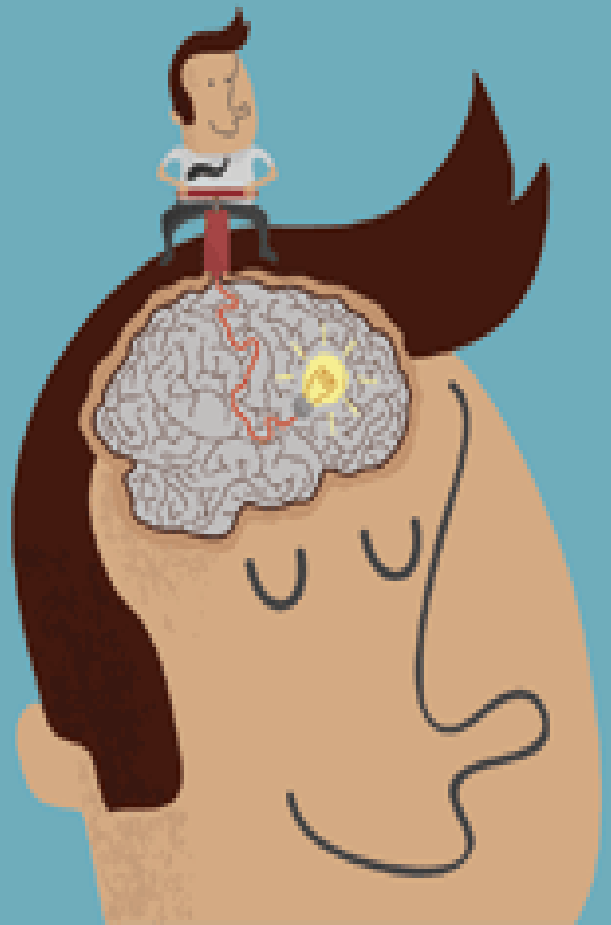


Jennifer Pulliam
Director, Products & Innovation
TXU Energy
972.868.8432
Jennifer.Pulliam@txu.com

Jerry Harness
Reliability Engineering
Baytown & Humble Service Centers
CenterPoint Energy
281.425.7331
Jerry.harnessjr@centerpointenergy.com

Sean C. Mitchem
Principal Analyst
Smart Energy Technologies
Southwest Research Institute (SwRI)
210.522.2698
sean.mitchem@swri.org

Creative Process Q&A



A Renewed Organization for a New Challenge: Visibility into the Distribution System

Vision & Mission

- Our Vision is a fully integrated distribution system of the future that adapts to consumer preferences and behavior, is interoperable and open to market entrants, fully visible to the utility and the grid operator and operates as a partner with the rest of the stakeholders to improve grid reliability, security and efficiency

- Our Mission is to enhance the development of technology and market opportunities that more fully integrate distribution system assets and market participants into the ERCOT electric grid

Taskforce on Distribution Modeling Systems

Taskforce Activities

(WebEx #1) August 12 Agenda
- Adopt **statement of objectives**
- Develop a **summary of the "State of the Art"** of distribution system simulation modeling
- Review of the two distribution modeling systems that are in the public domain (**OpenDSS and GridLAB-D**)

(WebEx #2) August 26 Agenda
- Develop a **priority list of challenges and opportunities** that lend themselves to a research and/or a demonstration project
- Determine what resources (companies, institutions and/or devices and software) are available inside and outside the ERCOT market to support the priorities

(WebEx #3) September 9 Agenda
- Develop a **White Paper** that can be used to solicit interest in CCET^2 and for exploring potential funding sources (define the scope of work, explore funding options and recommend a modeling system)

Current members (others to be added as interest determines)

CenterPoint, Electric Power Group, Austin Energy, SwRI, IBM, Intel, ERCOT

Taskforce on Sensor Systems for Real Time Distribution System Monitoring

Taskforce Activities

(WebEx #1) August 13 Agenda

- Adopt statement of objectives
- Develop a summary of the "State of the Art" of distribution system monitoring capabilities, including a review of existing sensors on the distribution systems in the Texas market
- Define the requirements for real time monitoring from both ERCOT and TDU perspectives

(WebEx #2) August 27 Agenda

- Determine what resources (companies, institutions and/or devices and software) are available inside and outside the ERCOT market to support the priorities
- Develop a priority list of challenges and opportunities that lend themselves to a research and/or a demonstration project

(WebEx #3) September 10 Agenda

- Develop a White Paper that can be used to solicit interest in CCET^2 and for exploring potential funding sources (define the scope of work, explore funding options and recommend a demonstration project to test the viability of real time monitoring systems)

Current members (others to be added as interest determines)

CenterPoint, National Instruments, Frontier Associates, IBM, Intel, ERCOT, Austin Energy, Younicos, DVI

Taskforce on Challenges for and from Devices on the Edge

Taskforce Activities

(WebEx #1) August 14 Agenda
- Adopt **statement of objectives**
- Develop a **summary of the "State of the Art"** of the Internet of Things and Emerging Technologies
- Review the professional literature on the Rate of Technology Adoption in the electric sector around the end use points

(WebEx #2) August 28 Agenda
- Adopt a **methodology for assessing the rate of technology adoption**
- Define the **requirements for successful integration of devices**
- Identify priority technology adoption assessments

(WebEx #3) September 11 Agenda
- Develop a **White Paper** that can be used to solicit interest in CCET^2 and for exploring potential funding sources (define the scope of work, explore funding options and recommend a project to assess priority technology penetration of priority technologies in the ERCOT market)

Current members (others to be added as interest determines)

CenterPoint, National Instruments, TXUE, IBM, Intel, ERCOT, Austin Energy, Younicos, DVI, Sharyland, LocalGRID

Open invitation to join the Taskforce effort…

www.ElectricTechnologyCenter.com

Questions?

- **Milton L. Holloway: Mholloway@ElectricTechnologyCenter.com; (512) 472-3800**