ACEEE From Grid Response to Grid Interactive: An Evolving Perspective

GridBallast

Autonomous Load Control For Resilient Reserves

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PV Market and Policy Drivers

PV Price & Penetration

Texas Renewable Energy Resource Assessment

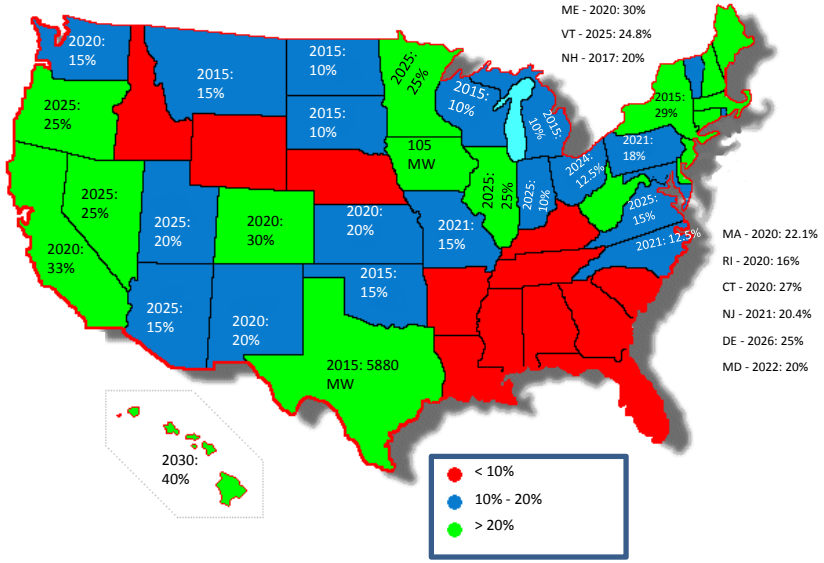
Note: Data for solar only
http://www.seco.cpa.state.tx.us/publications/renewenergy/

"inflection point"

- Economic / social benefits prevail (< $0.10/kWh)
- Renewable penetration exceeds 5% (point of stability problems)

Legislated Renewable Standards Policies and Goals

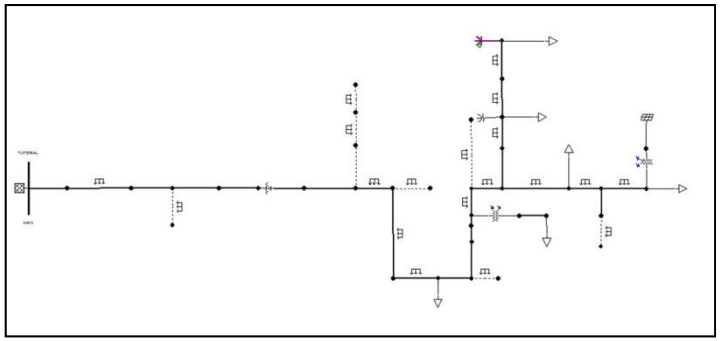
IREC North Carolina Energy Center

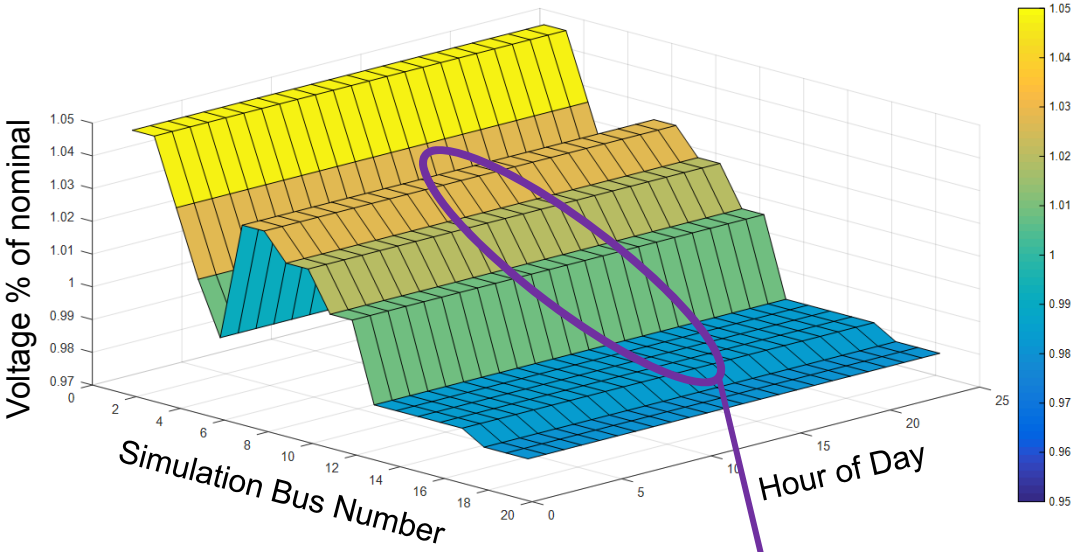


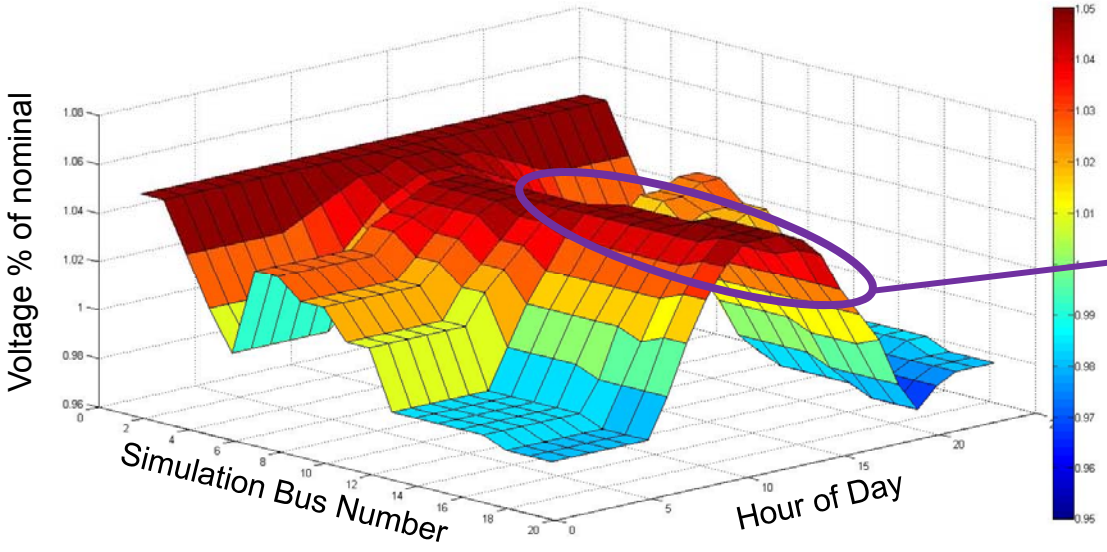
- Penetration of PV at inflection point
- Other intermittent sources and loads continue to drive complexity in distribution grid

Distribution System – Power System Models

IEEE 34-Bus Test Feeder with PV integration







Voltage rise introduced by reverse power flow from PV integration

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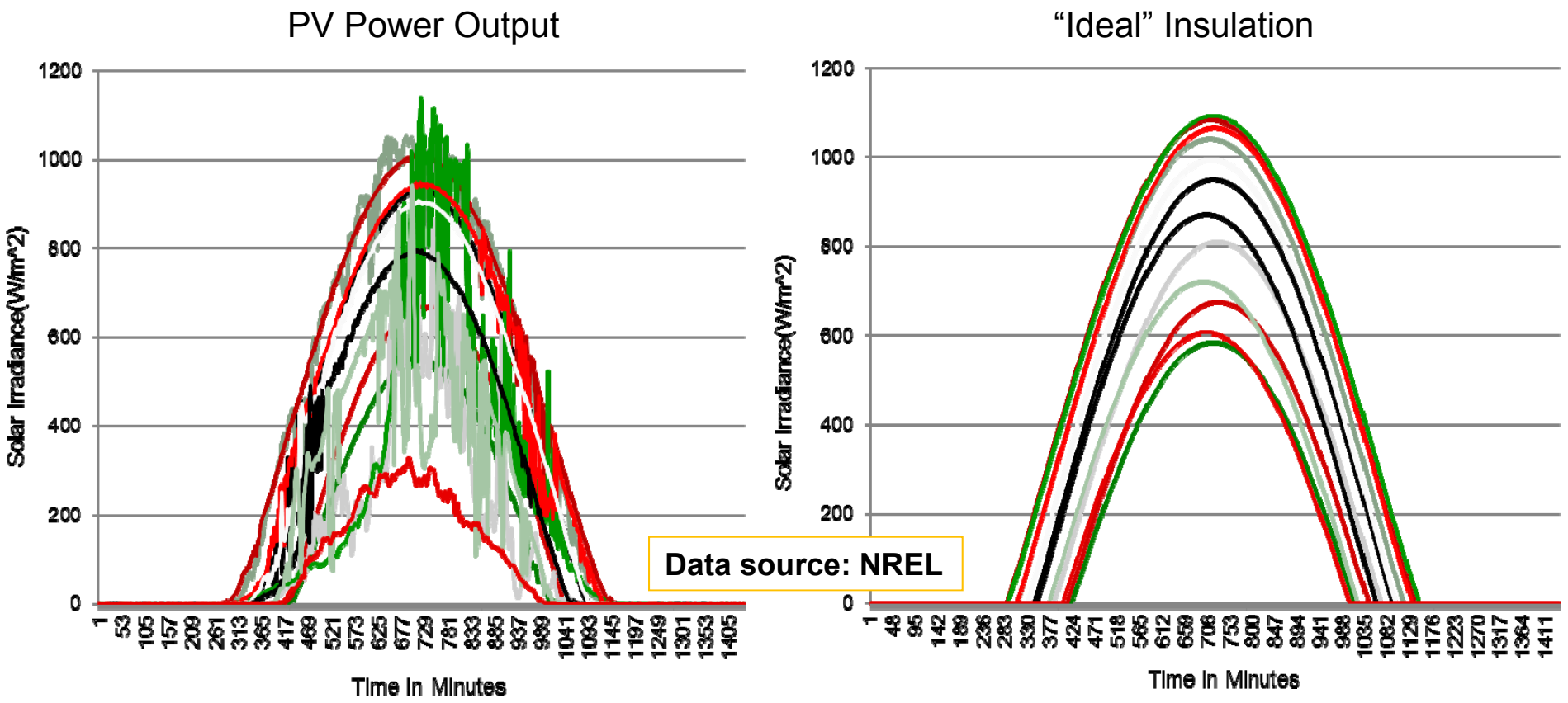
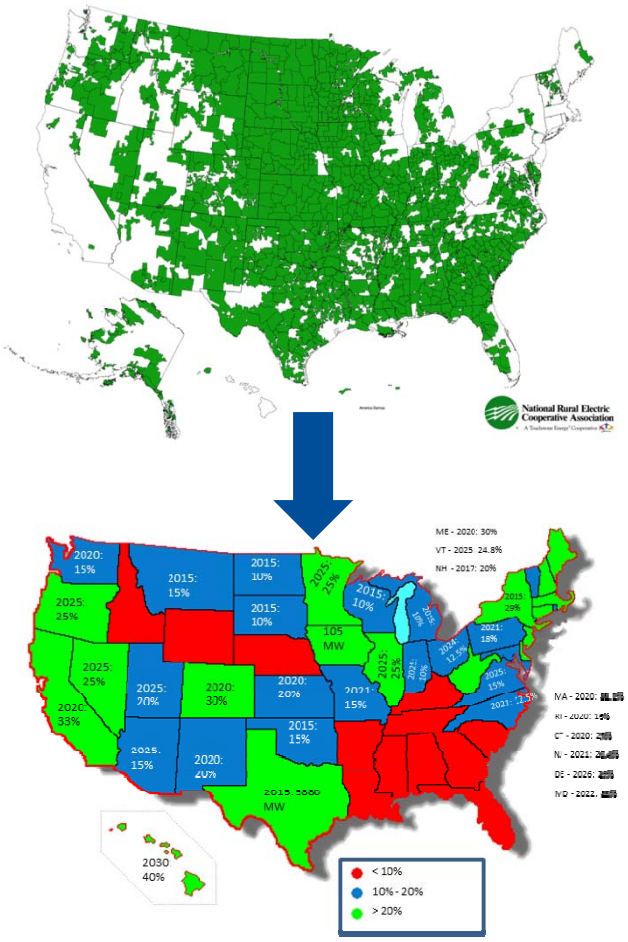
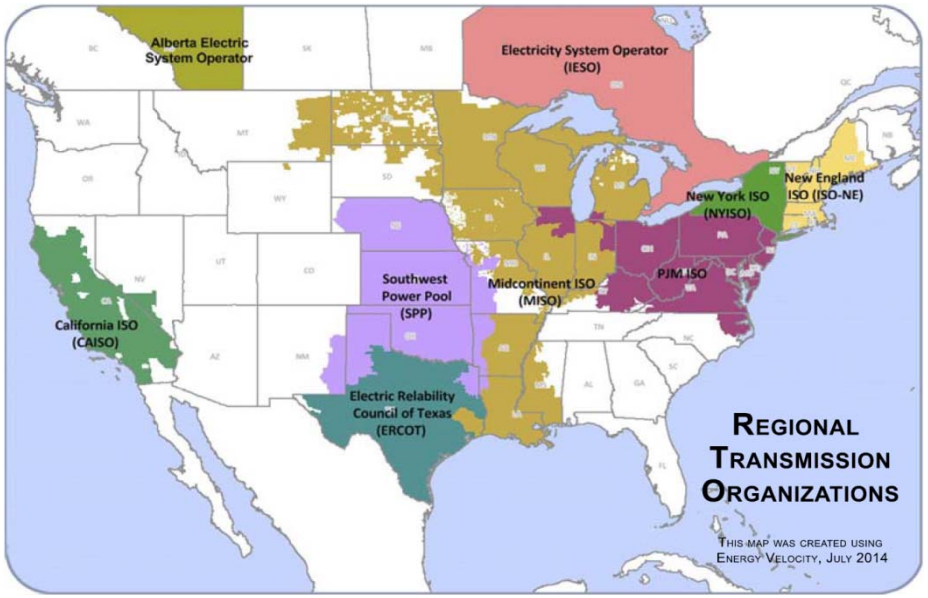
Real vs. Idealized PV Power Output



- Intermittency is one of major challenges of renewables

NRECA Customer Foot Print vs Policy vs Market





- Individual Utility Goals
- Urban and Remote Power Systems
- Feeder Level Power Issues
- Multiple Use Cases
- Seasonal Value Propositions

Demand Side Management with Adaptive Probabilistic Deconfliction

NODES Program Objectives
CATEGORY 1: Synthetic Frequency Response Reserves

DOE Project metrics

- Initial Response Time < 2 seconds
- Reserve Magnitude Target (RMT) > 2 % of load
- Reserve Magnitude Variability Tolerance (RMVT) < +/- 5%
- Ramp Time < 8 seconds
- Duration> 30 seconds
- Availability > 95 %
- Recovery < 4 Hours

Solution Metrics

- Initial Response Time 7-10 Cycles (+.12 Secs)
- Reserve Magnitude Target (RMT) 5 % of load
- Reserve Magnitude Variability Tolerance (RMVT) 2%
- Ramp Time < 2 seconds
- Duration> 10 Minutes
- Recovery < 1 hour

NRECA

Carnegie Mellon University

SPARKMETER

EATON

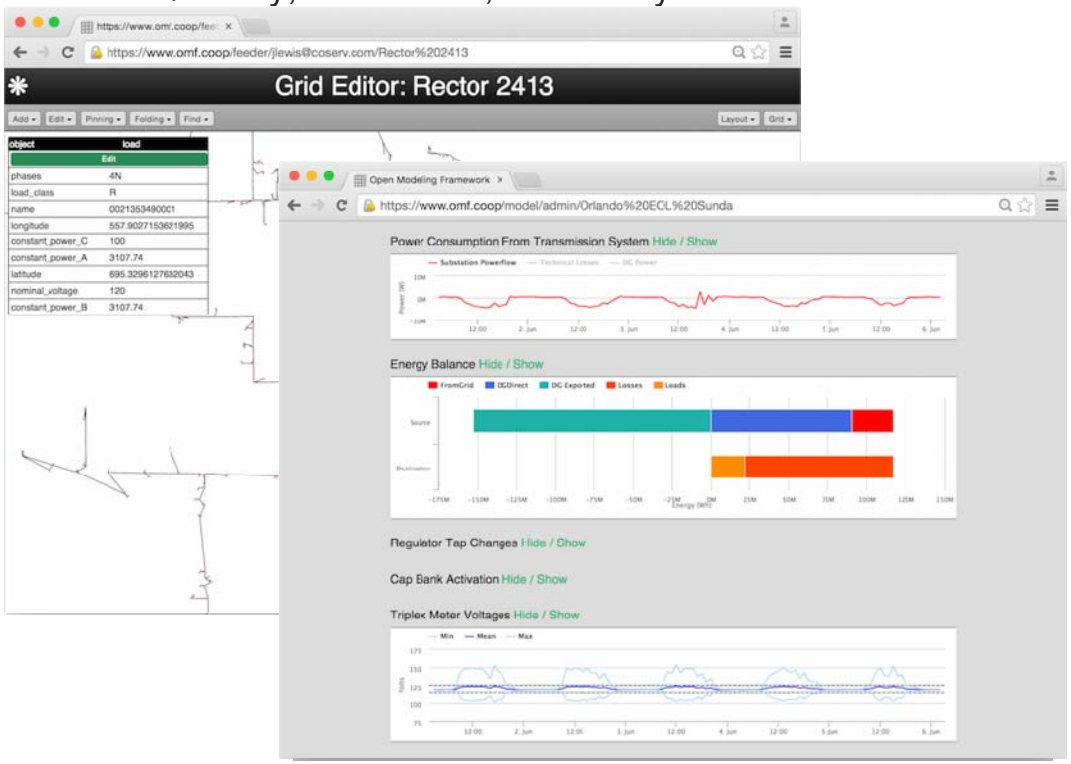
Funding agency: DOE ARPA-E

Technical Objectives of NRECA GridBallast

- Local frequency reserves & voltage management
- Integrate ordinary deferrable loads
- Probabilistic frequency & voltage response algorithms

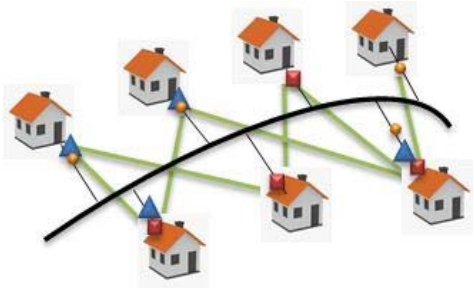
GridBallasts – Autonomous Load Control Frequency and Ramping Reserves

- **Autonomous, Collaborative & Central Control**
- **Probabilistic frequency & voltage response algorithms**
- **Power System Modelling**
  - Quantity, Placement, Sensitivity



Alonetic Operation

Collaborative Operation



Central Control

- Water heater control
- Plug load control
- Other load control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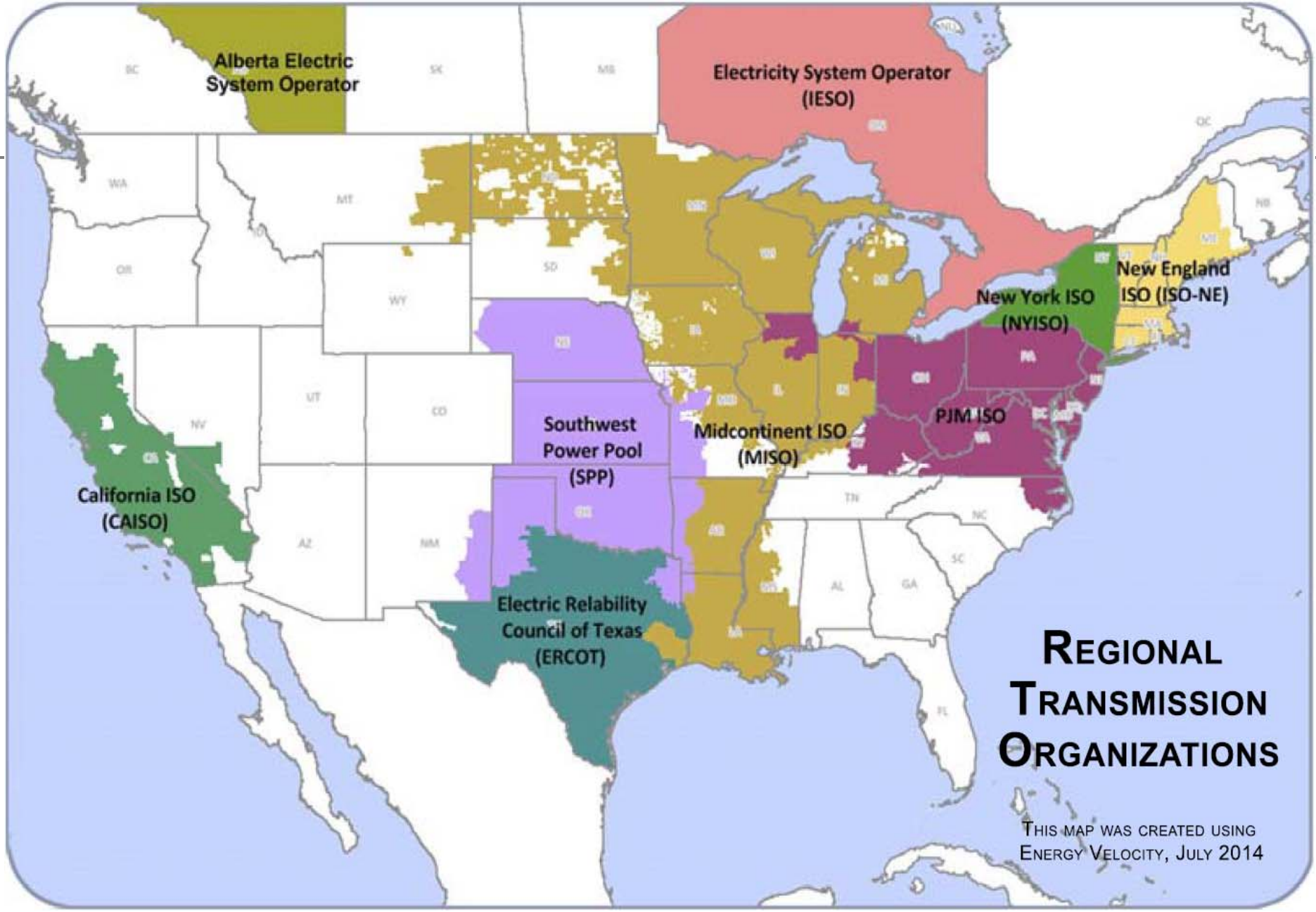
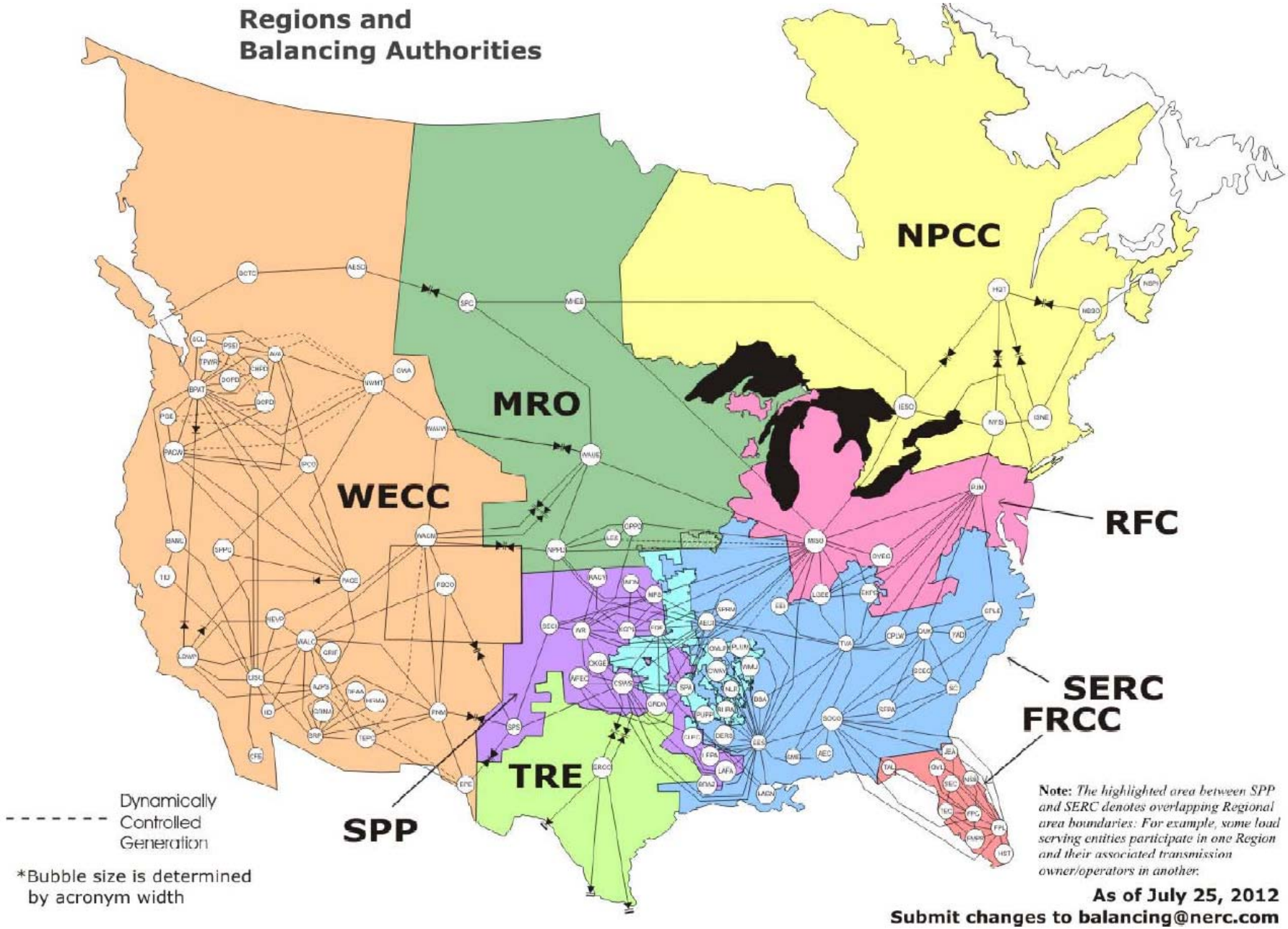
Business Discussion

- Skate to where the puck will be (Ed Cannon)
- Healthy Company
  - There are 10 times more new product ideas than funding available
- Market vs. Market Potential
  - How many products are delivered each year
  - How big can the market get
- Chicken and the Egg vs. Catch 22





Context – America's Electric Cooperative Network:

- Serve 75% of the nation's land mass.
- Provide power to approximately 42 million consumers from 65 generation and transmission co-ops.
- Operate 42% of the nation's distribution lines.