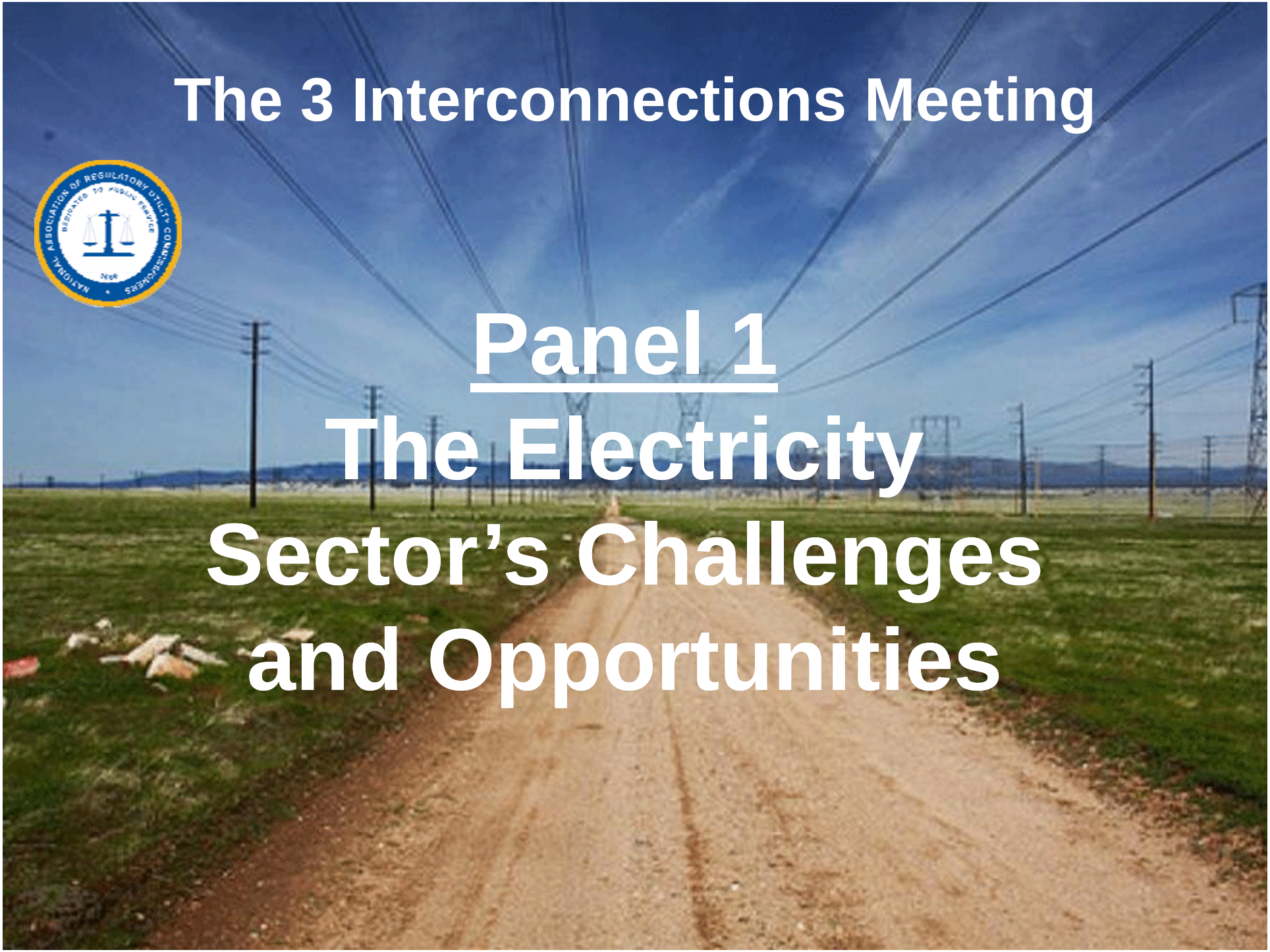

The 3 Interconnections Meeting
NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS
DEDICATED TO PUBLIC SERVICE
1889
Facing the Future
With Interconnection-Wide Planning
February 6-7, 2013
Renaissance Washington Hotel
Washington, DC


The 3 Interconnections Meeting
When in Meetings Please SILENCE Mobile Devices!


The 3 Interconnections Meeting
The Honorable
Colette Honorable
Arkansas
The Honorable
Patricia Hoffman
U.S. Department of Energy
Assistant Secretary


The 3 Interconnections Meeting
Panel 1
The Electricity Sector's Challenges and Opportunities

ANALYSIS GROUP
ECONOMIC, FINANCIAL and STRATEGY CONSULTANTS

THE STARTING POINT:

Interconnection/Grid Planning in the Face of Diversity, Technical Complexity, Uncertainties, Challenges, Opportunities

Sue Tierney

The 3 Interconnections Meeting (DOE and NARUC)
Facing the Future with Interconnection-Wide Planning
Panel on the Electricity Sector's Challenges and Opportunities, 2013 – 2030
Washington, DC – February 6, 2013

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A single country

http://upload.wikimedia.org/wikipedia/commons/a/a0/USATopographicalMap.jpg

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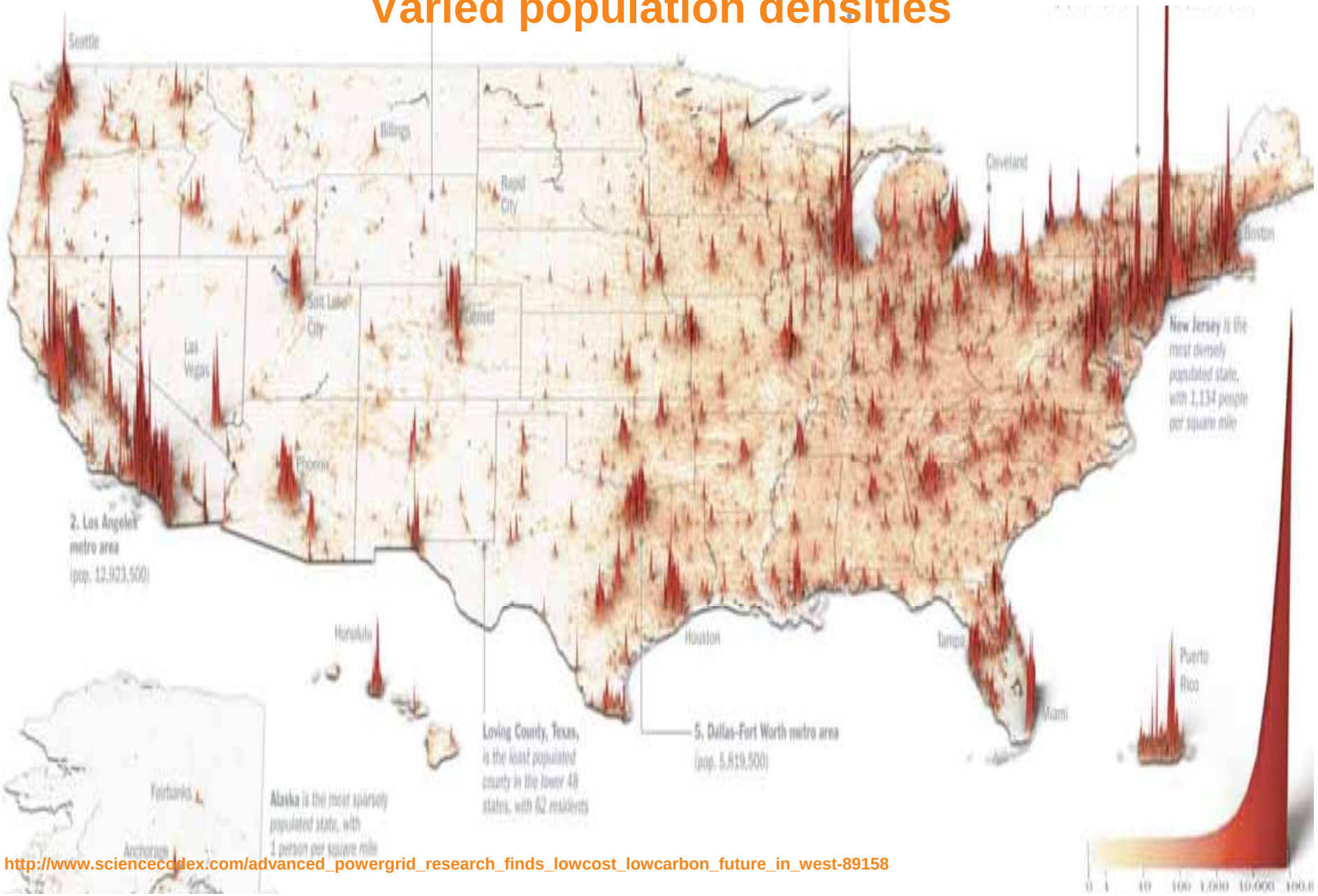
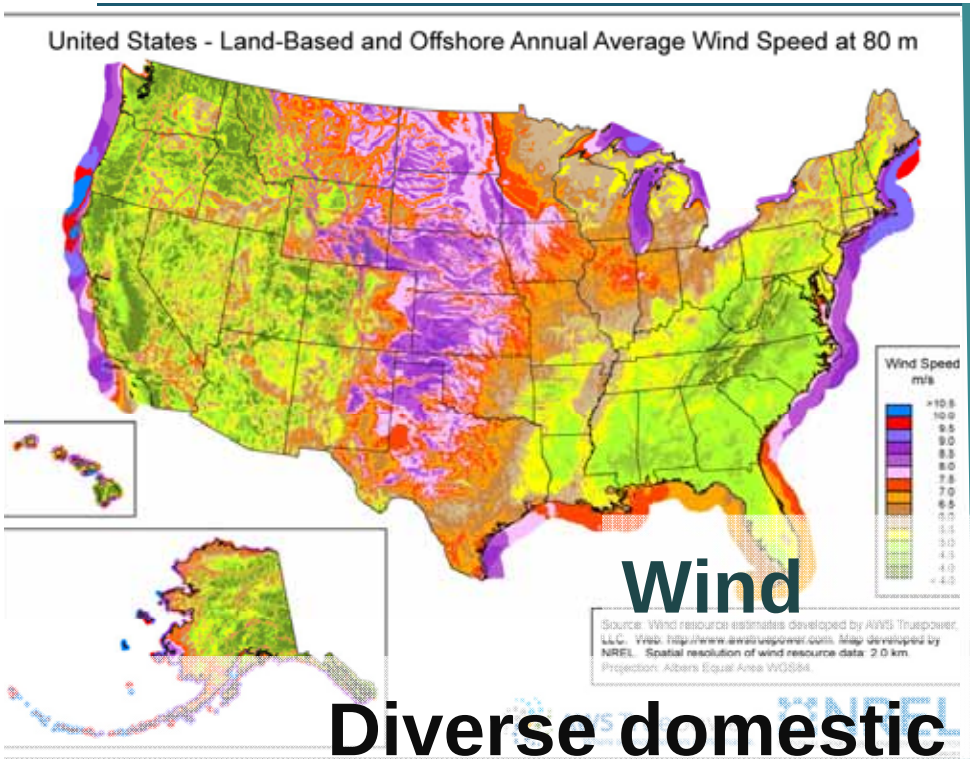
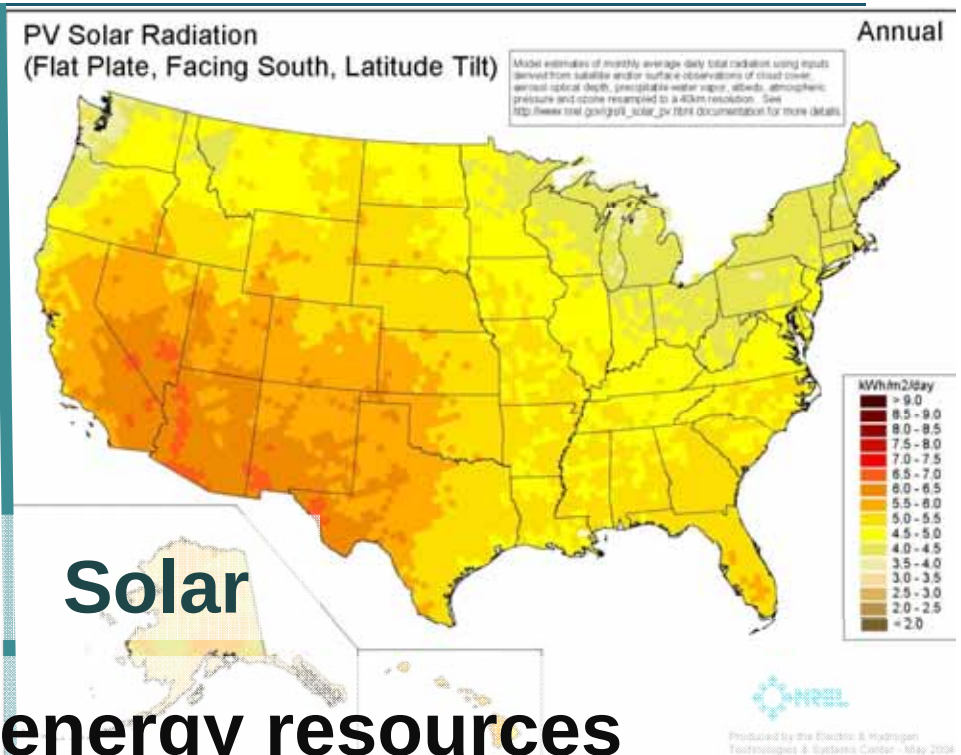
Varied population densities

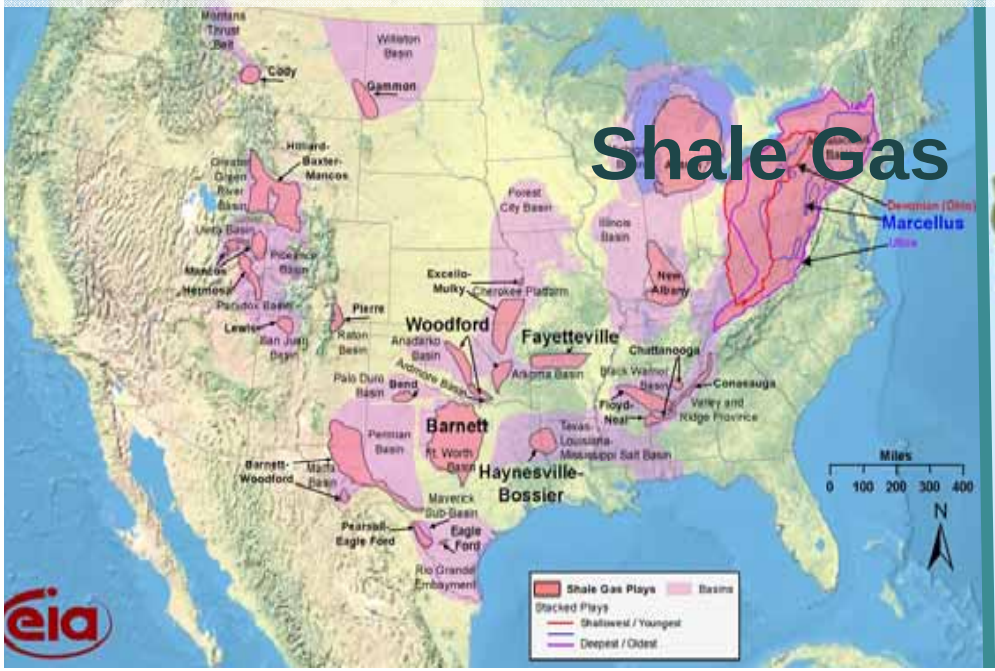


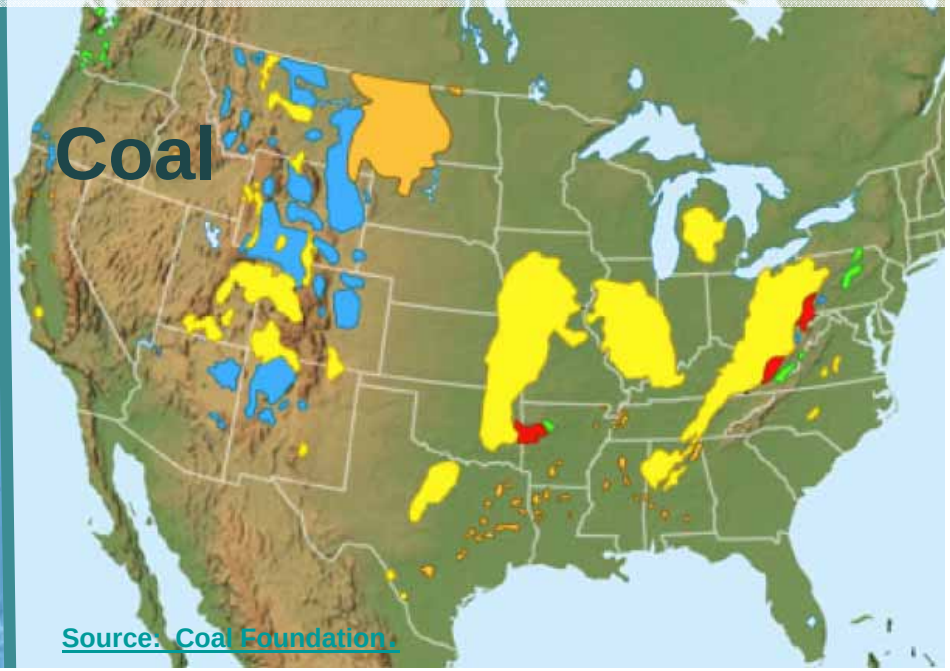
http://www.sciencecodex.com/advanced_powergrid_research_finds_lowcost_lowcarbon_future_in_west-89158





Diverse domestic energy resources





Source: Coal Foundation

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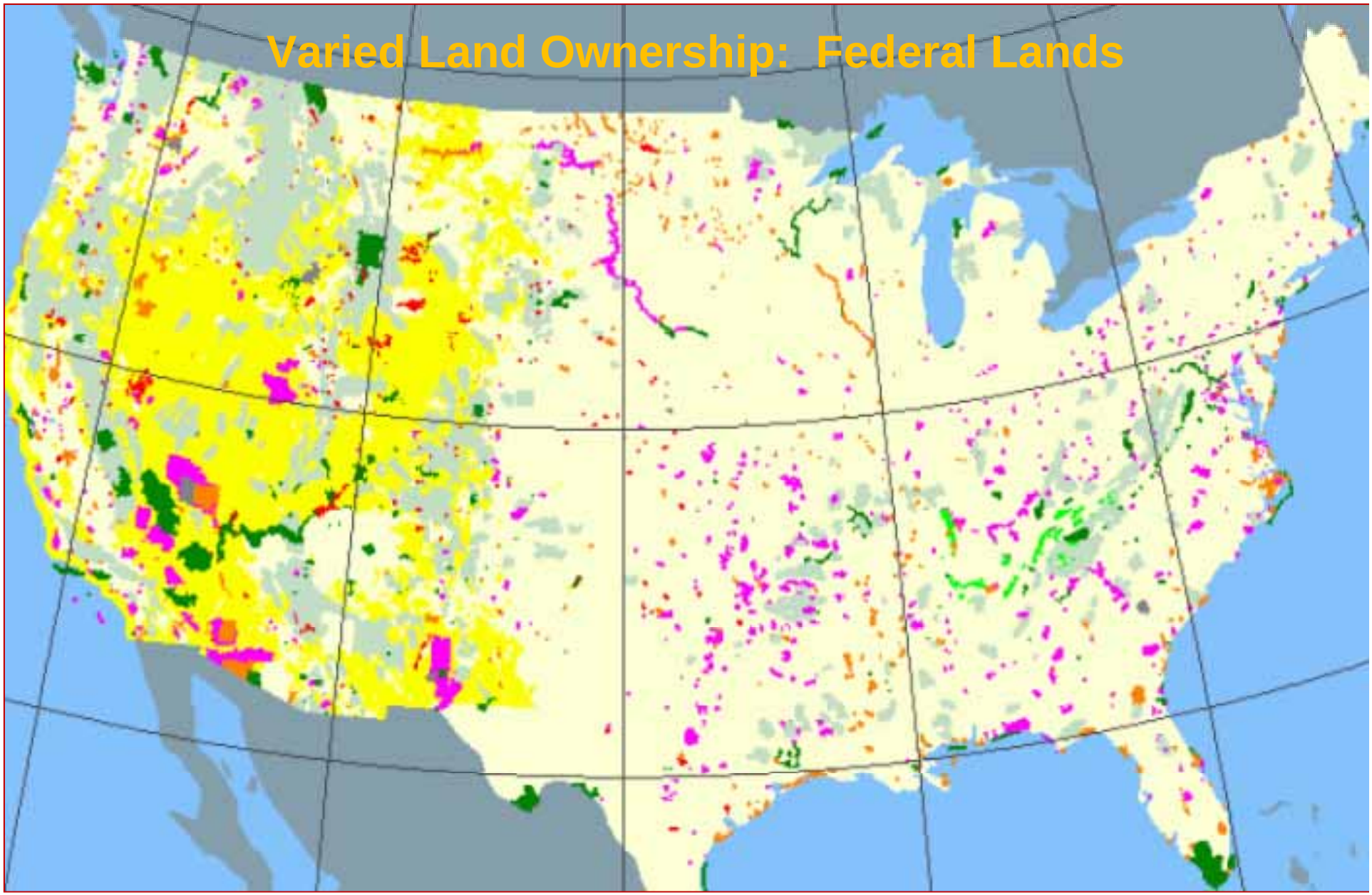
Varied Land Ownership: Federal Lands



Source of maps: Platt's, US Census

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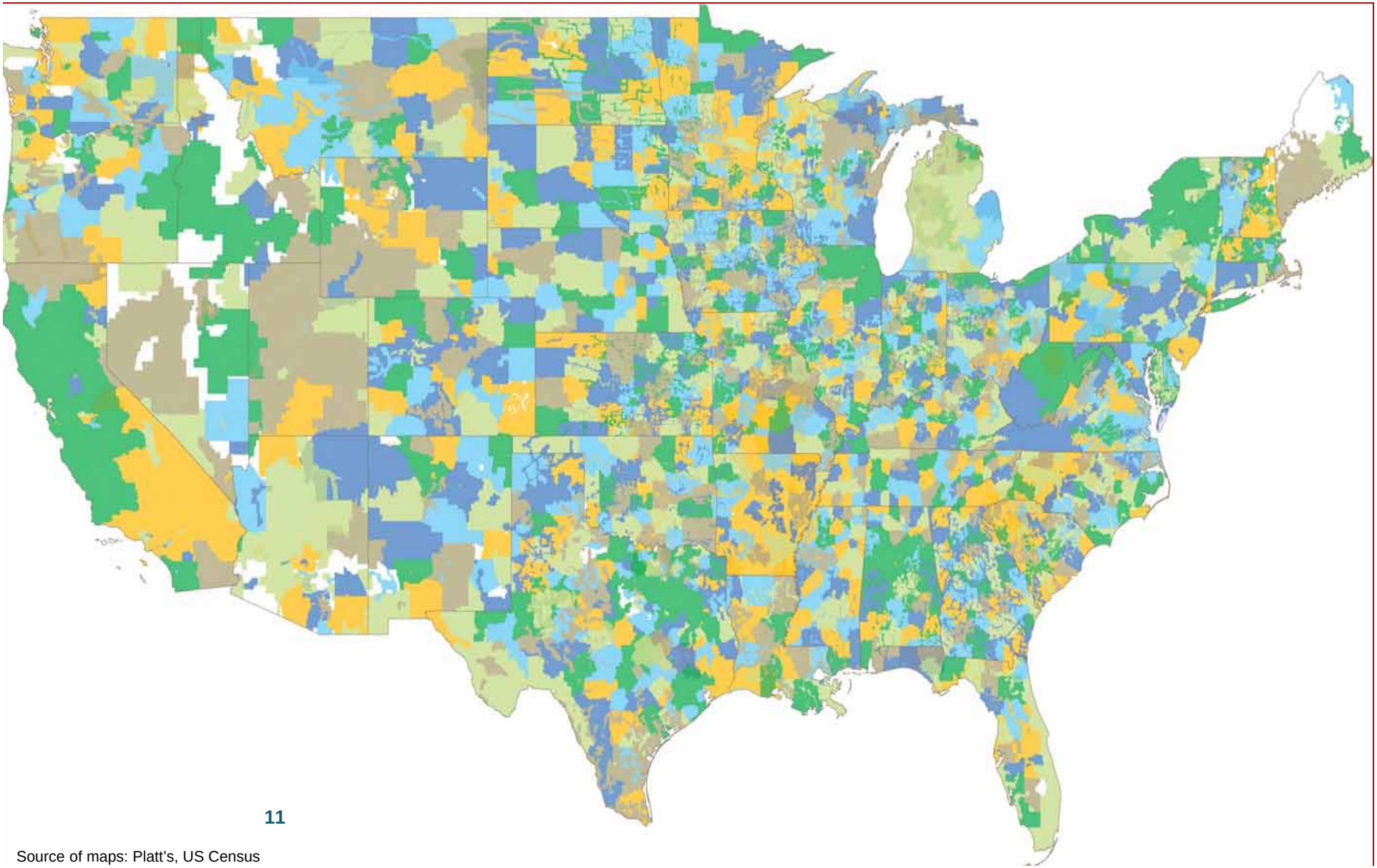
Thousands of utility service territories



Source of maps: Platt's, US Census

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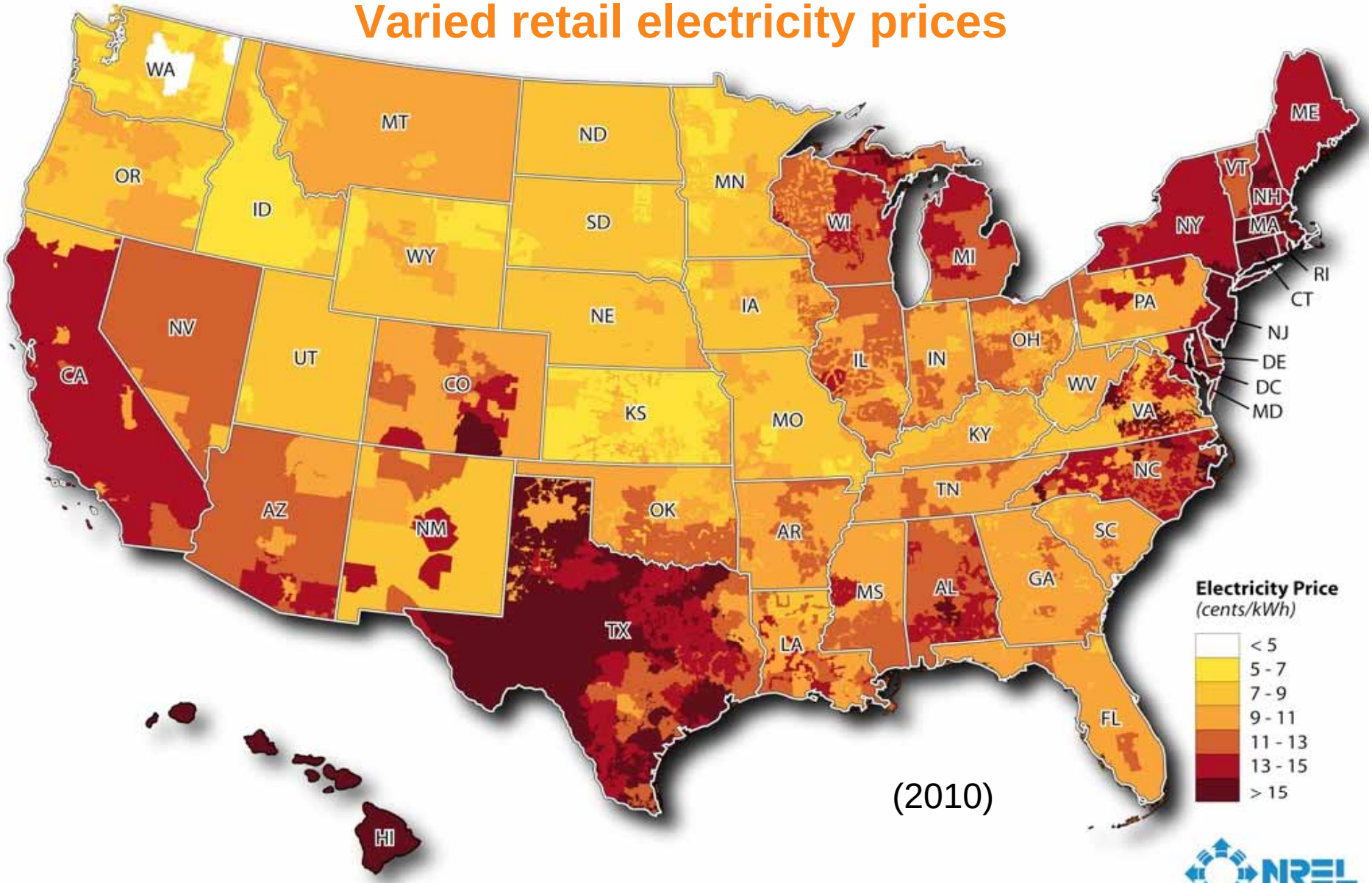
Varied retail electricity prices



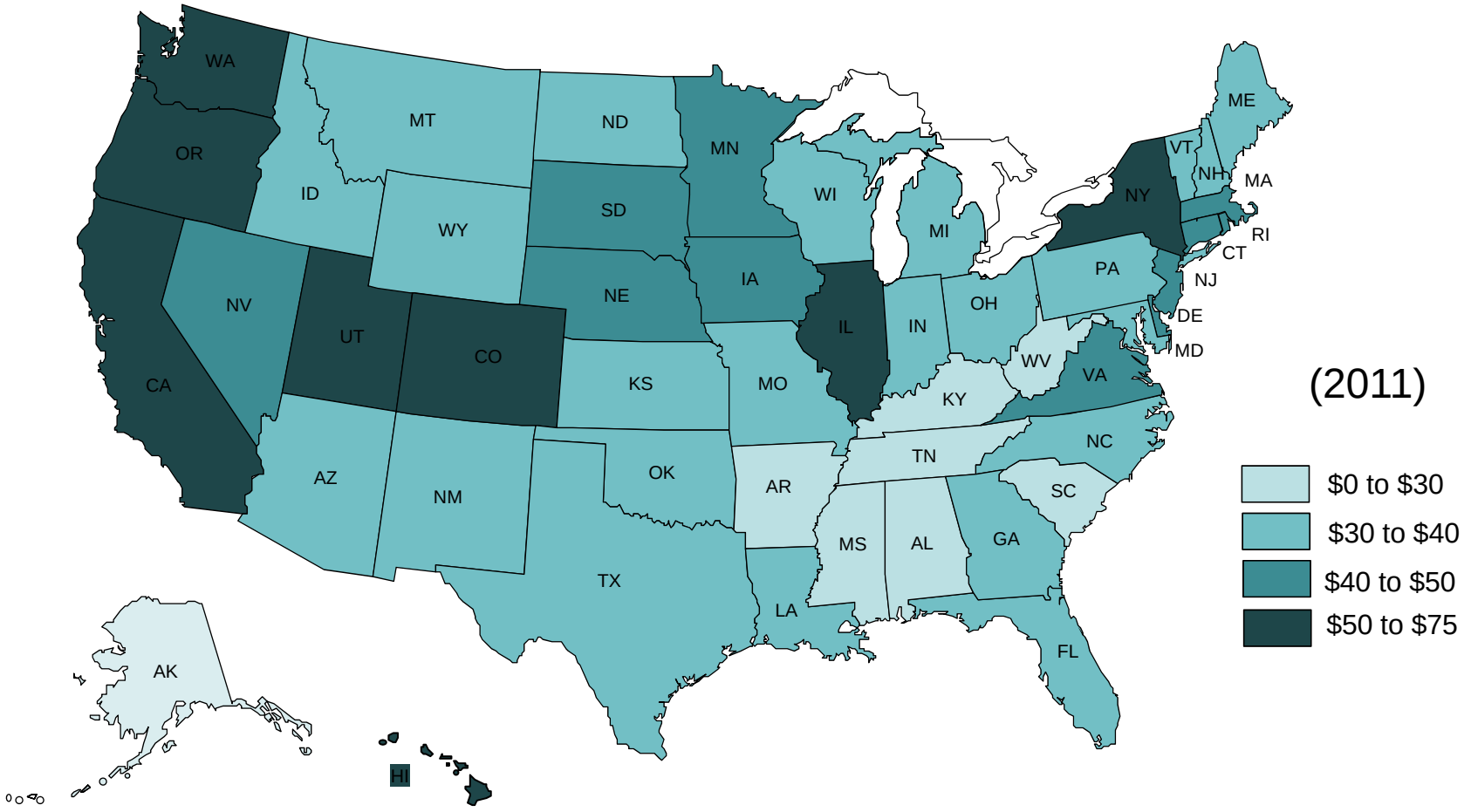
(2010)

NREL
www.nrel.gov/gis

http://geocurrents.info/wp-content/uploads/2012/06/electricity-price-map.jpg
Author : Billy Roberts - March 30, 2010

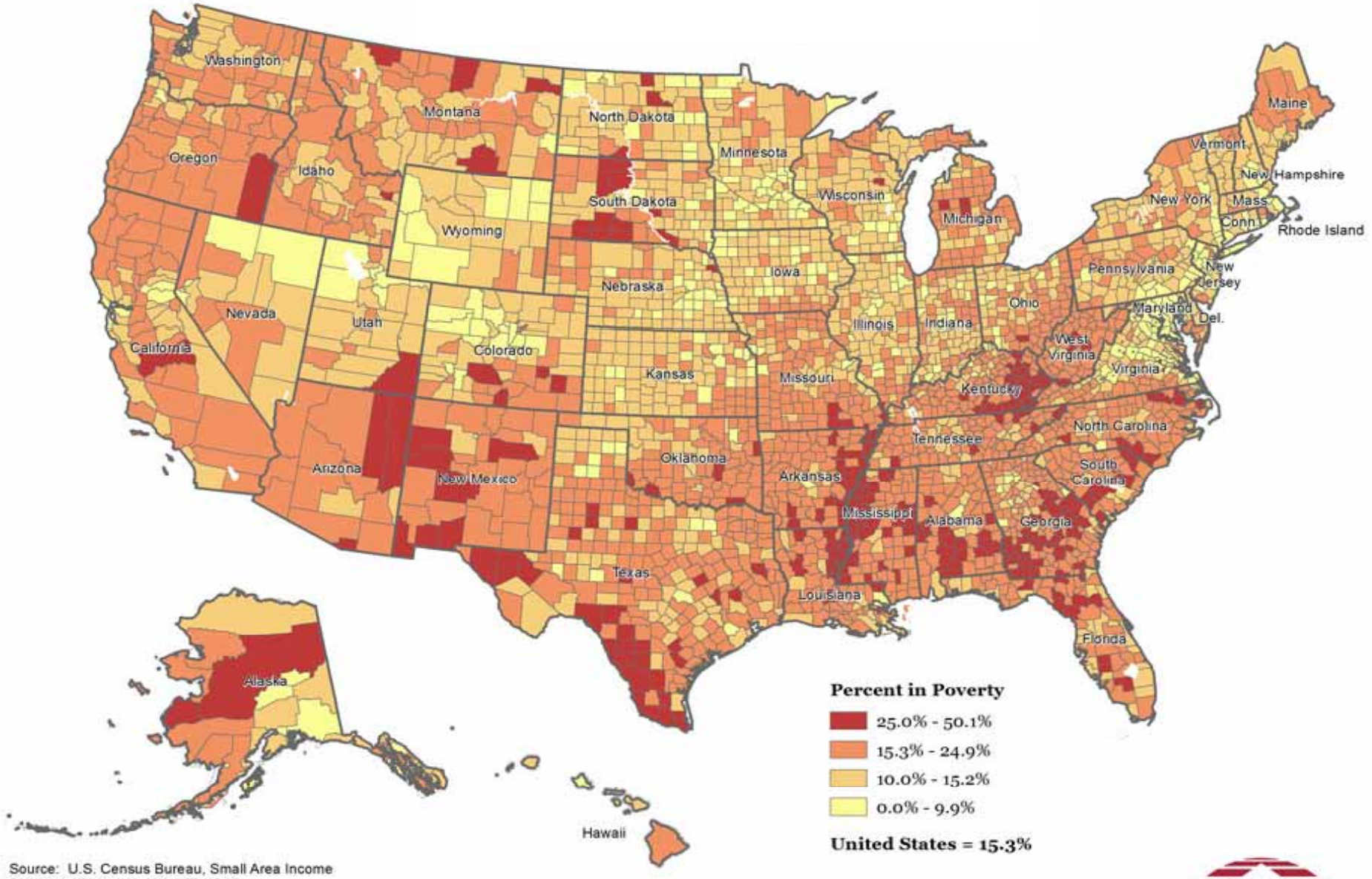
This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.

Varied electricity productivity: $ of Gross State Product per $ Spent on Electricity



Bureau of Economic Analysis Data on Gross State Product; EIA Data on Electric Retail Sales Revenues in each State

Percentage of Population in Poverty (2010)



Source: U.S. Census Bureau, Small Area Income & Poverty Estimates (SAIPE), 2010.

Note: Alaska and Hawaii not shown to scale.

http://www.raconline.org/racmaps/mapfiles/poverty.jpg

RAC
Rural Assistance Center

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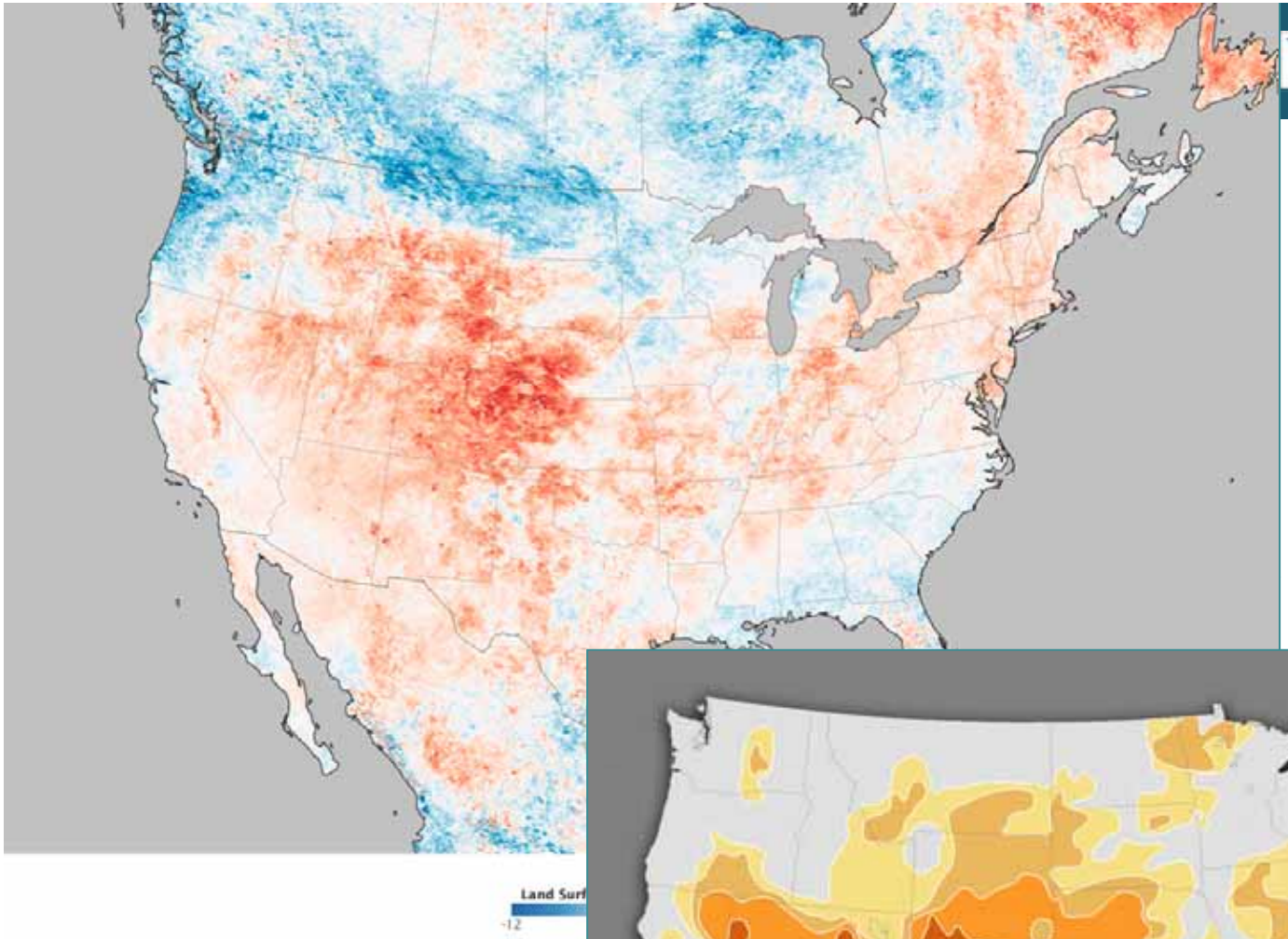
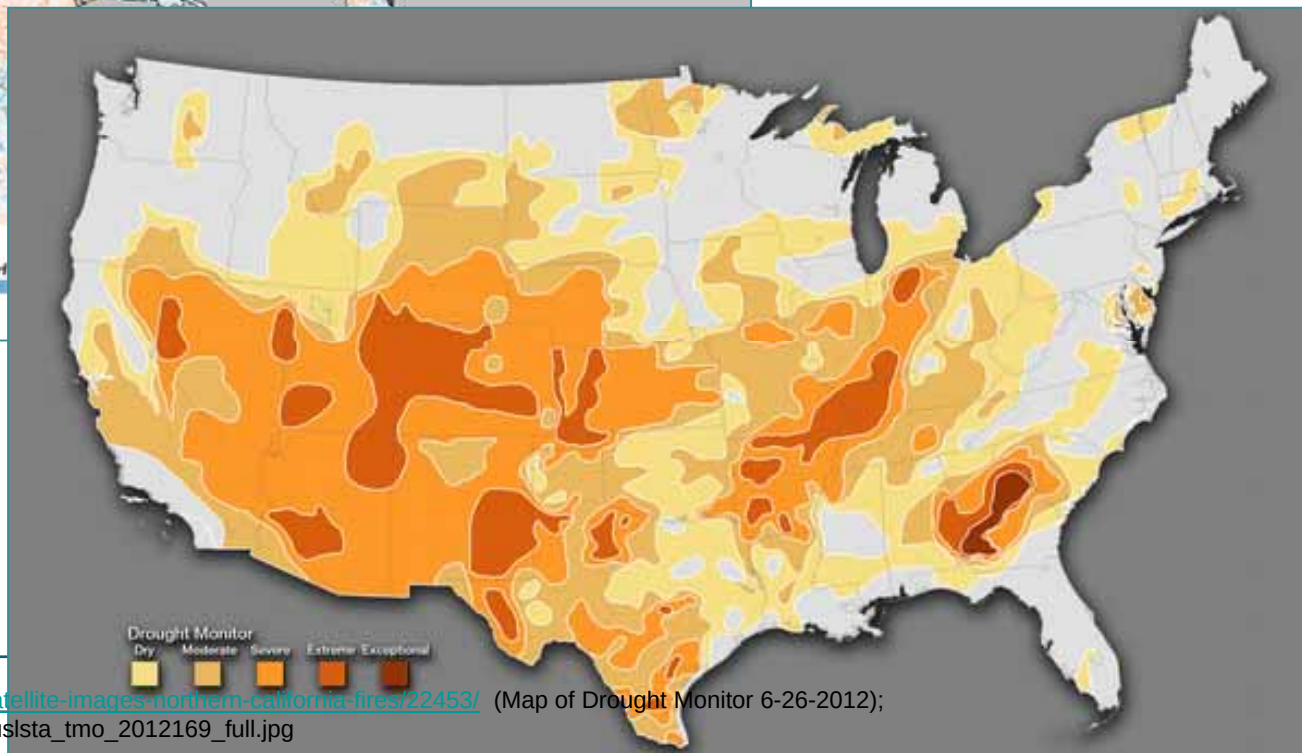
Heat Map 2012



Drought Map 2012



http://www.redding.com/photos/galleries/2012/aug/24/satellite-images-northern-california-fires/22453/ (Map of Drought Monitor 6-26-2012);
http://www.nasa.gov/images/content/664023main_contuslsta_tmo_2012169_full.jpg

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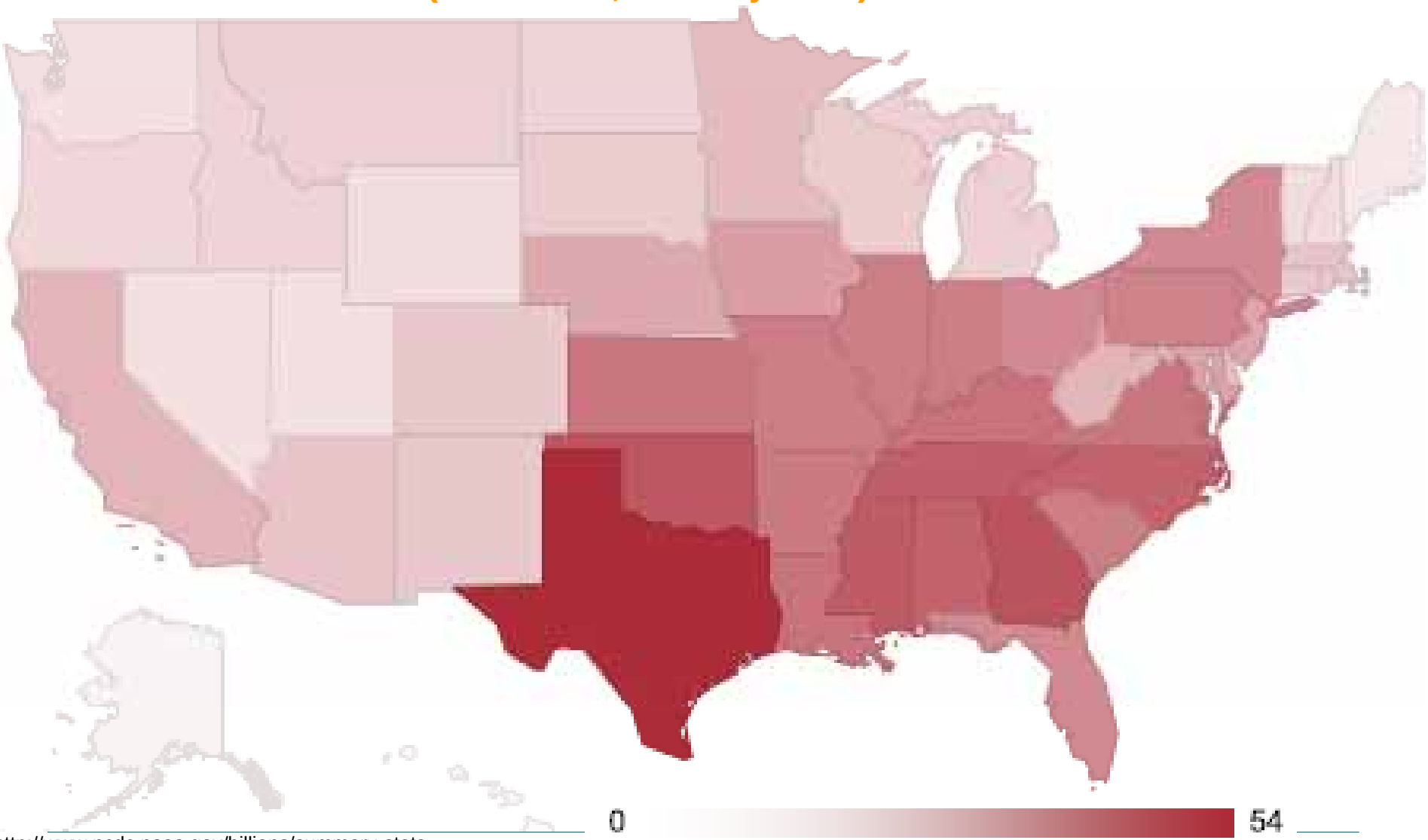
Billion-Dollar Weather/Climate Disasters
(1980-2012, CPI-Adjusted)



http://www.ncdc.noaa.gov/billions/summary-stats

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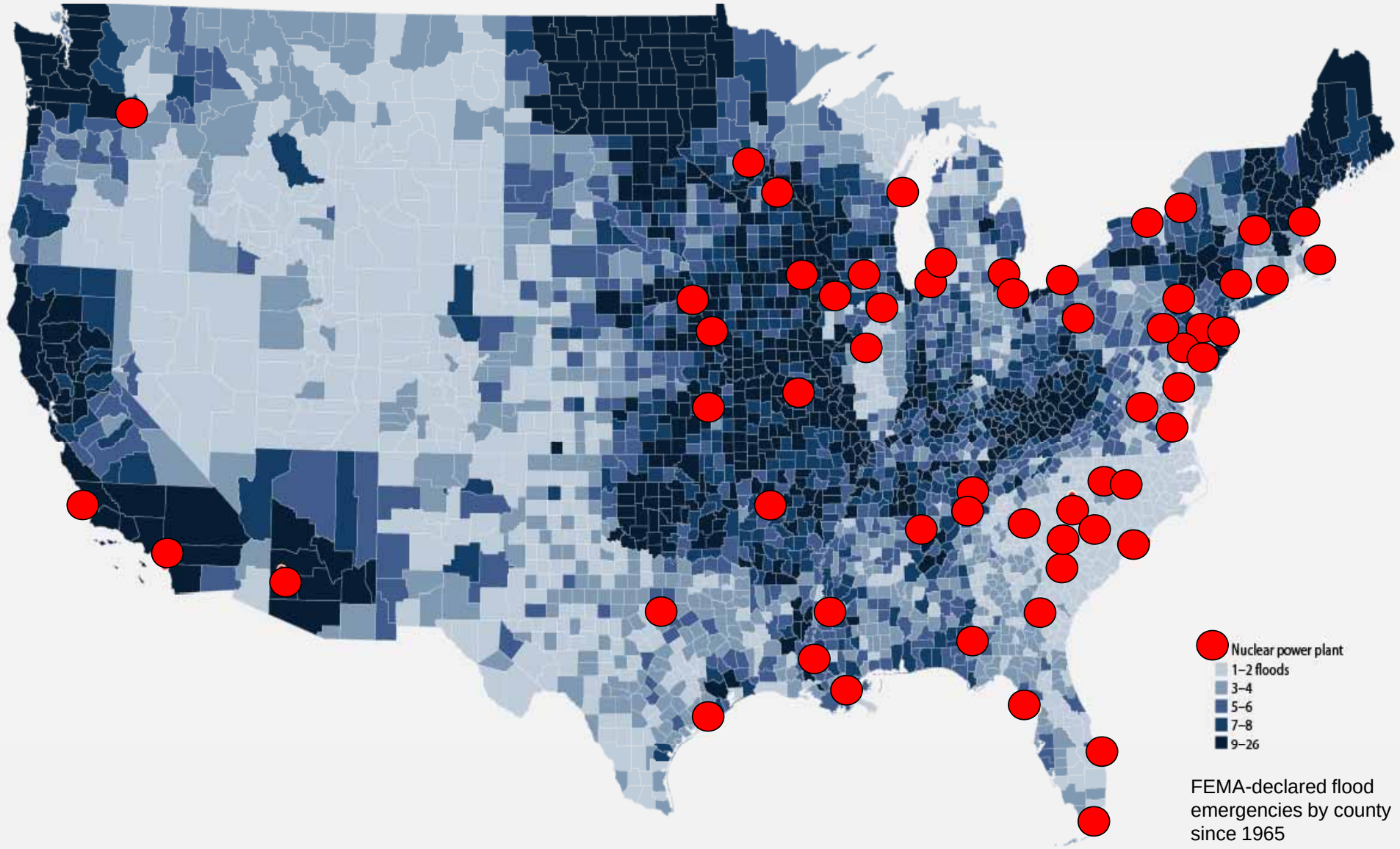
Nuclear Plants' and Exposure to Flooding



FEMA-declared flood emergencies by county since 1965

Source: Nuclear Regulatory Commission (http://www.nrc.gov/info-finder/reactor/) and Federal Emergency Management Agency (http://gis.fema.gov/index.html)

http://www.scienceprogress.org/wp-content/uploads/2011/03/NuclearFloodsFinal_Highres.png

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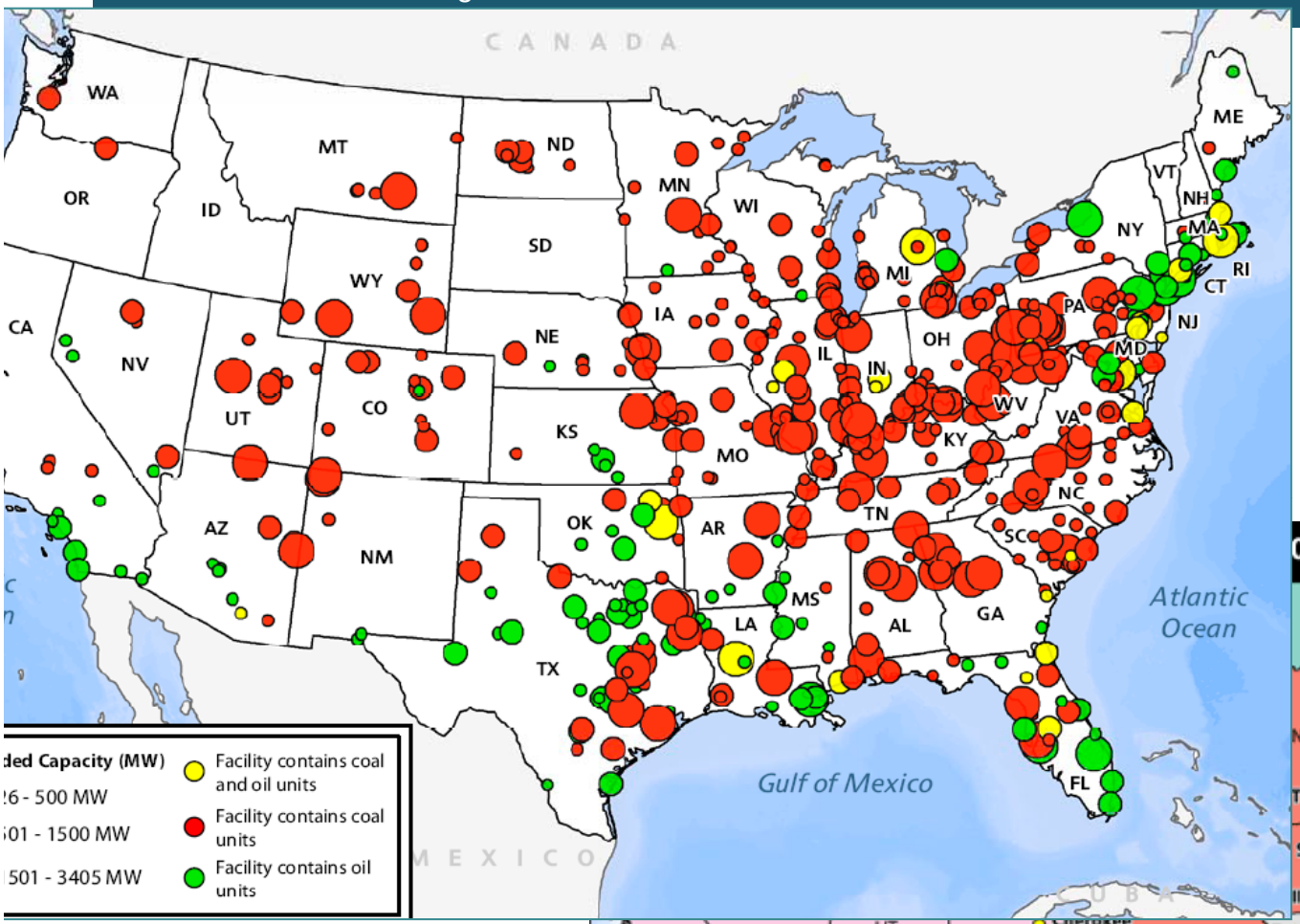
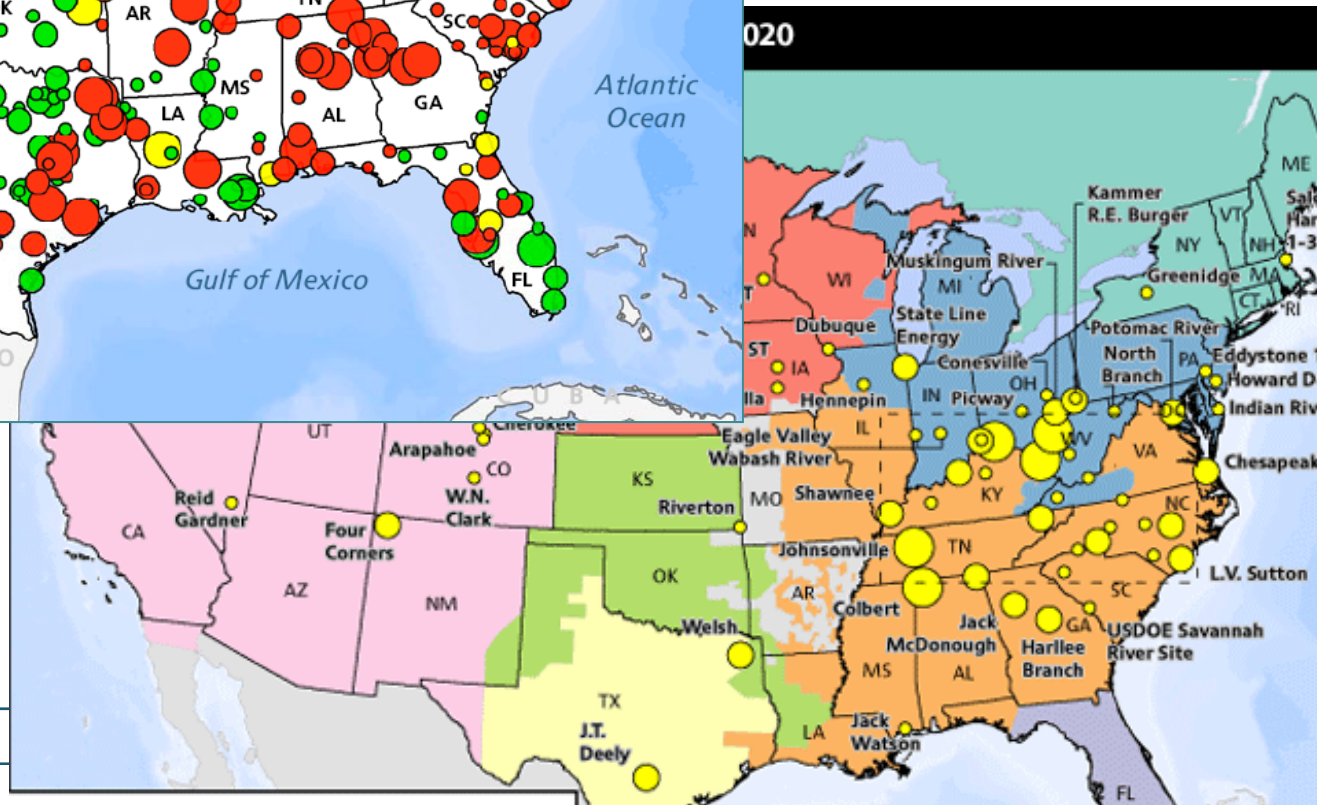
Coal and Oil Plants Affected by MATS Rule 2011





Announced Retirements (2011-2020)

September 2012

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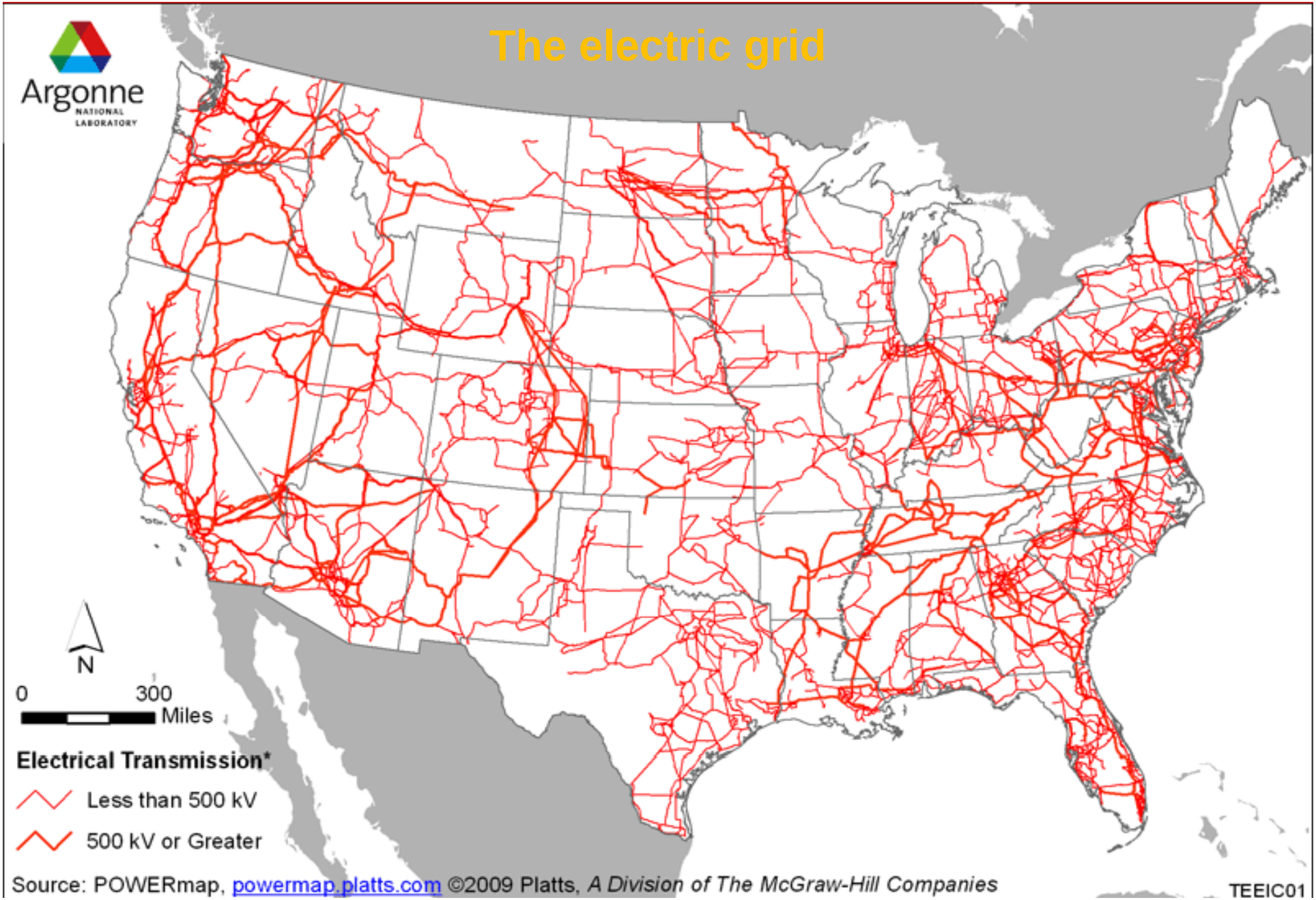
The electric grid



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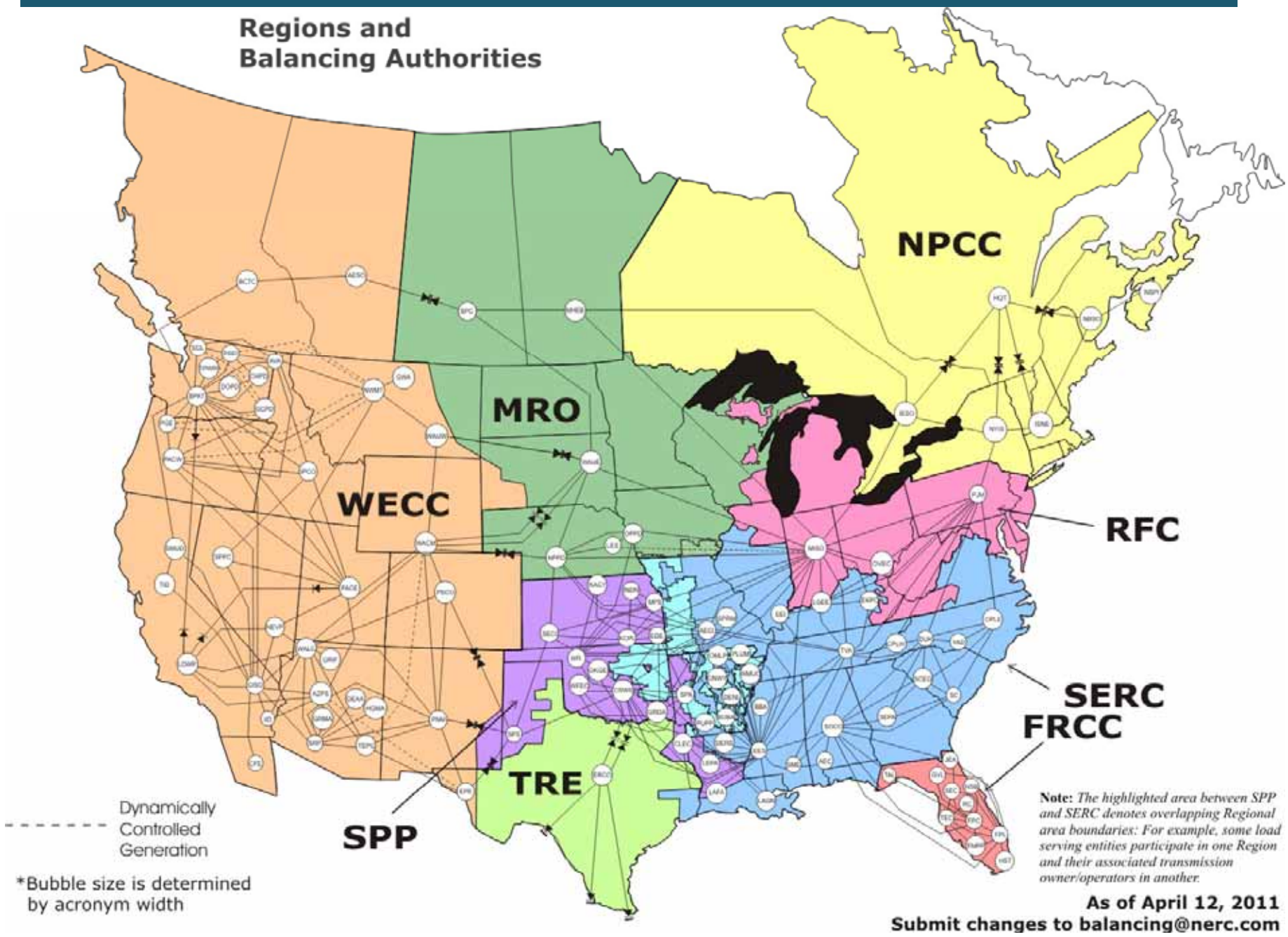
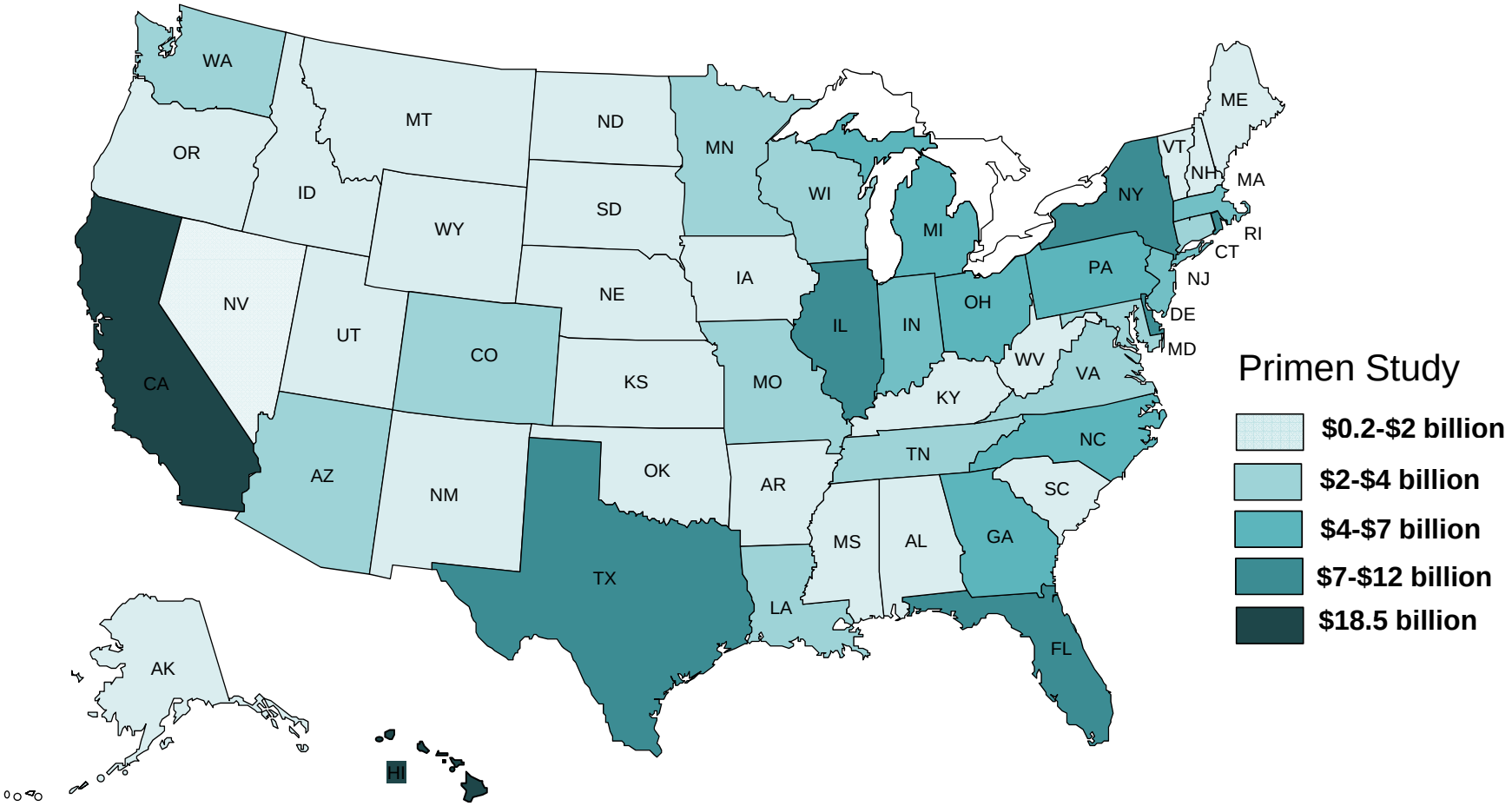


Annual Business Losses from Grid Problems: $150billion per year (2011)



http://blogs-images.forbes.com/williampentland/files/2011/04/Power-Outages-Map-of-Estimated-Costs-web.jpg

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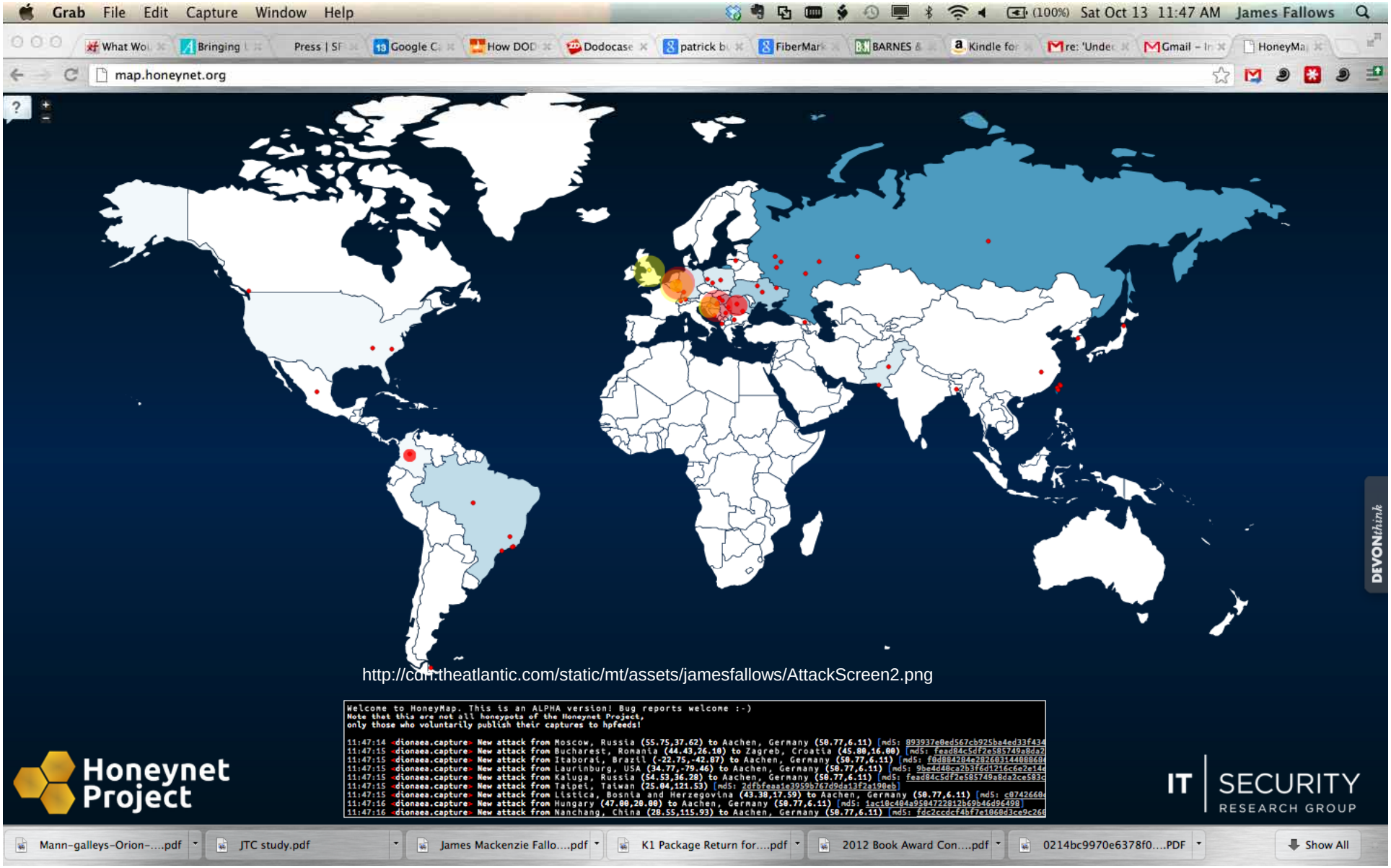
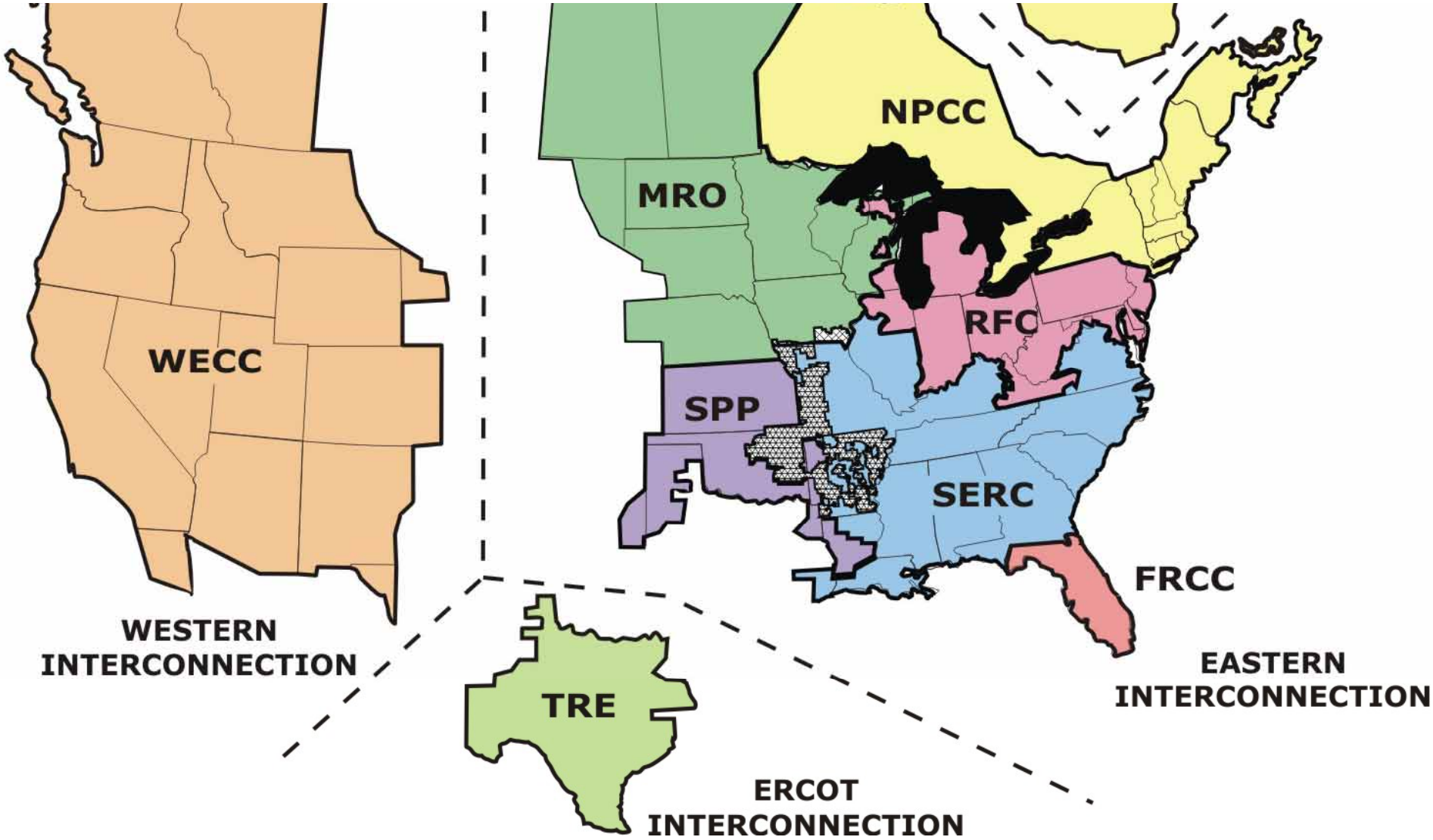
Cyber Threats



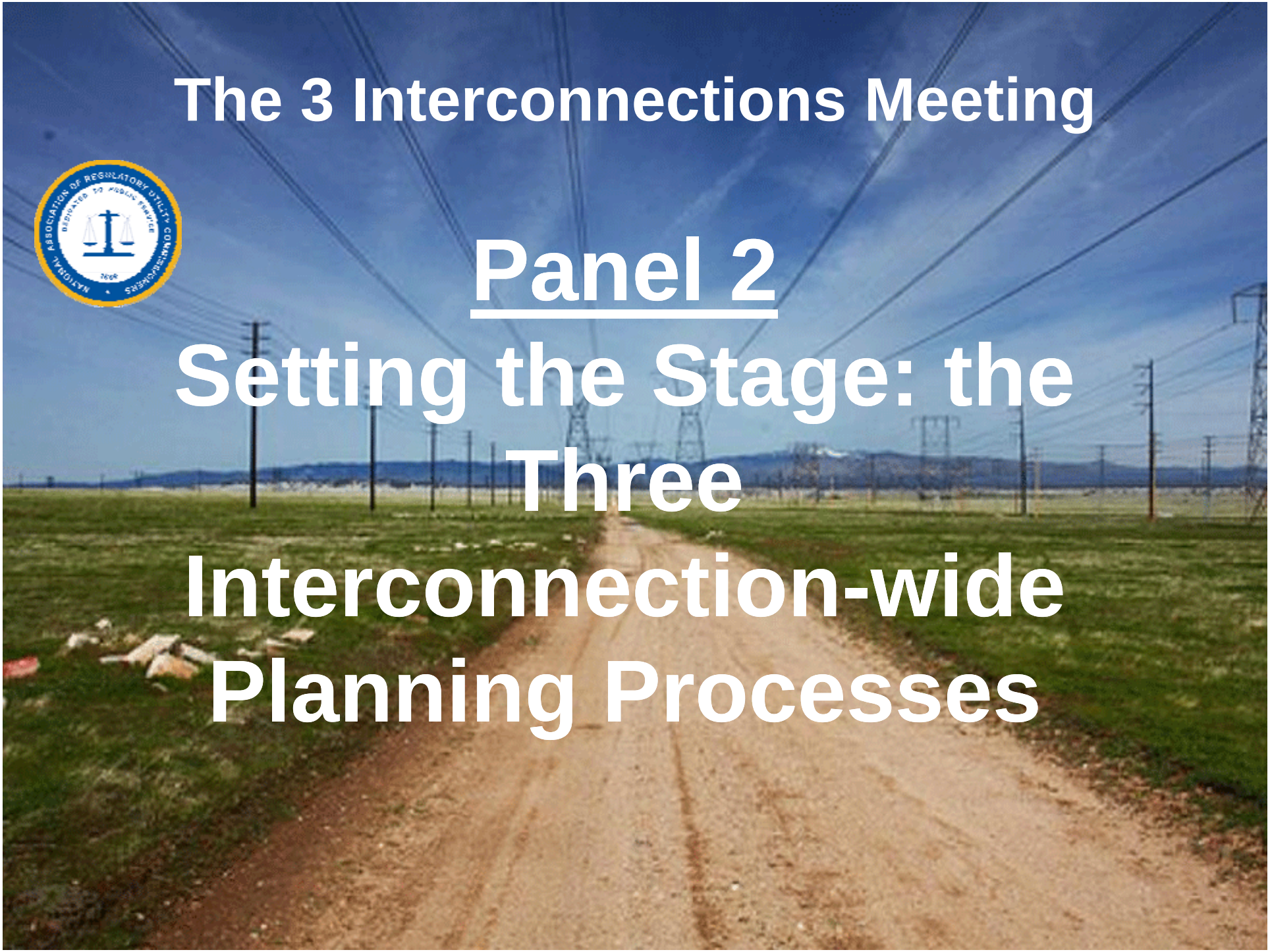
. . . . And the 3 Interconnections . . .



Our panelists

- **HANK COURTRIGHT**
  EPRI's Sr VP of Global Strategy and External Relations
- **ANJAN BOSE**
  DOE's Sr Advisor to the UnderSecretary
- **SUSAN STORY**
  Southern Co. Services' President and CEO
- **SUE KELLY**
  APPA's Sr VP and General Counsel
- **JOHN NORRIS**
  FERC Commissioner


The 3 Interconnections Meeting
Break
* 2:30 – 2:45 p.m. *


The 3 Interconnections Meeting
Panel 2
Setting the Stage: the Three Interconnection-wide Planning Processes

Commissioner David Boyd

Minnesota Public Utilities Commission

The Three Interconnections Meeting

Washington D.C.

February 2013

EASTERN INTERCONNECTION STATES' PLANNING COUNCIL

Acknowledgements

On behalf of EISPC, I want to express our on-going appreciation to NARUC and NRRI for their administrative assistance to EISPC.

In addition to my EISPC colleagues, I also want to acknowledge some of our colleagues that were instrumental in the formation and development of EISPC such as Ms. Lauren Azar and Mr. Doug Nazarian.

Disclaimers

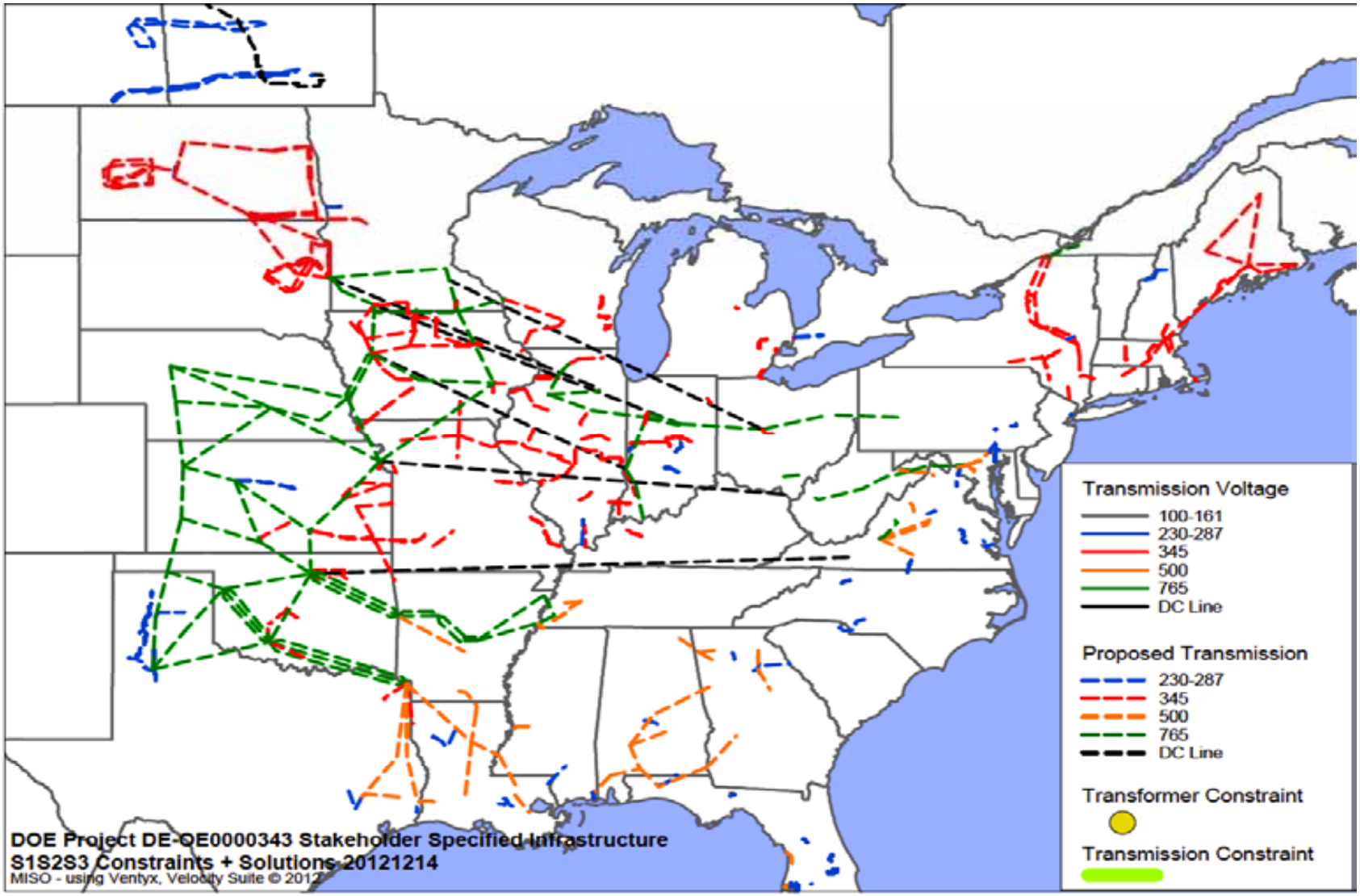
EASTERN INTERCONNECTION STATES' PLANNING COUNCIL

"Bookends" were deemed to be the best approach to analyzing *indicative* transmission options as part of a long-term (20 years) resource analysis.

- Scenario 1: Nationally-Implemented Federal Carbon Constraint with Increased Energy Efficiency/Demand Response
- Scenario 2: Regionally Implemented National Renewable Portfolio Standard
- Scenario 3: Business as Usual

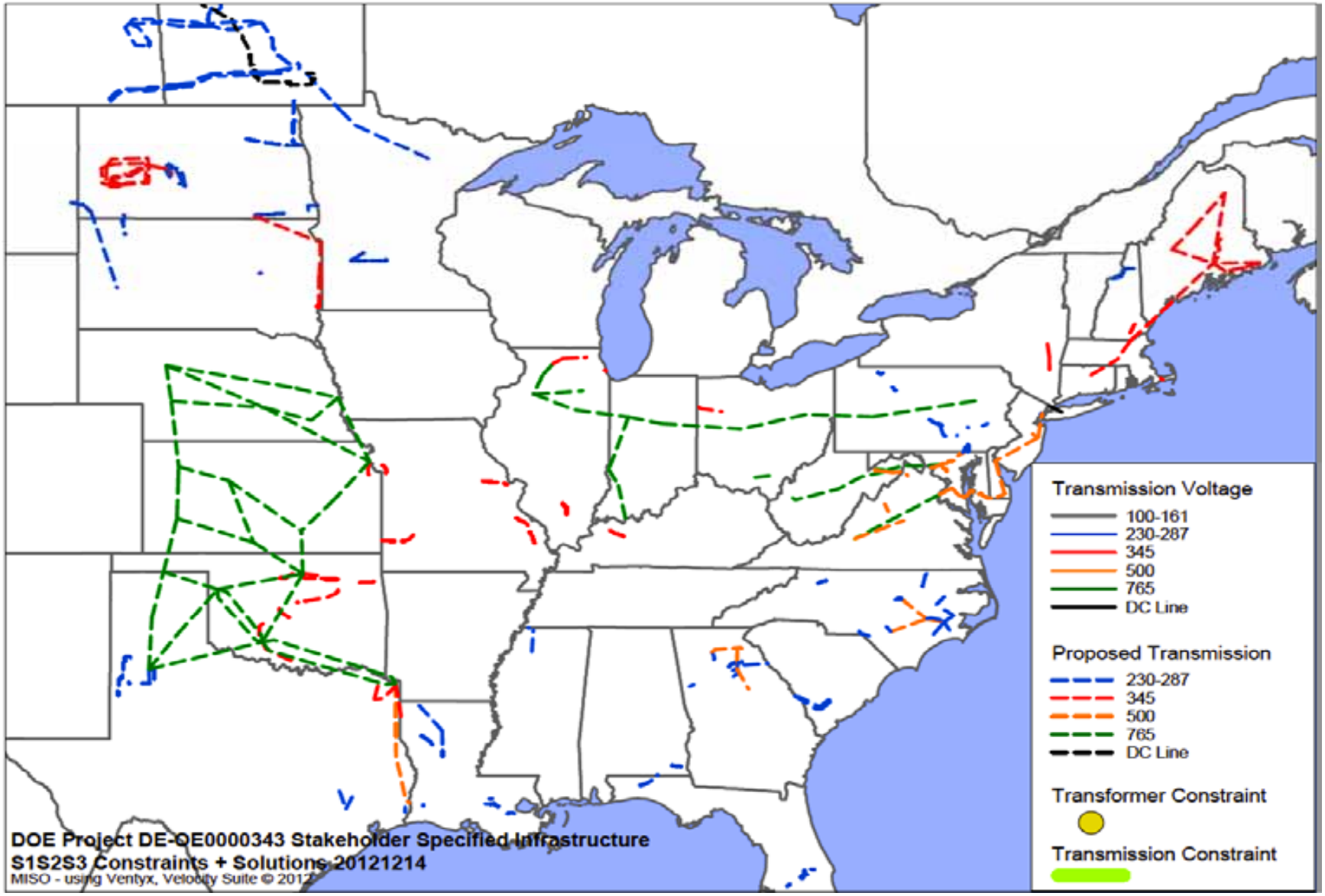
EASTERN INTERCONNECTION STATES' PLANNING COUNCIL

Scenario 1: Nationally-Implemented Federal Carbon Constraint with Increased Energy Efficiency/Demand Response

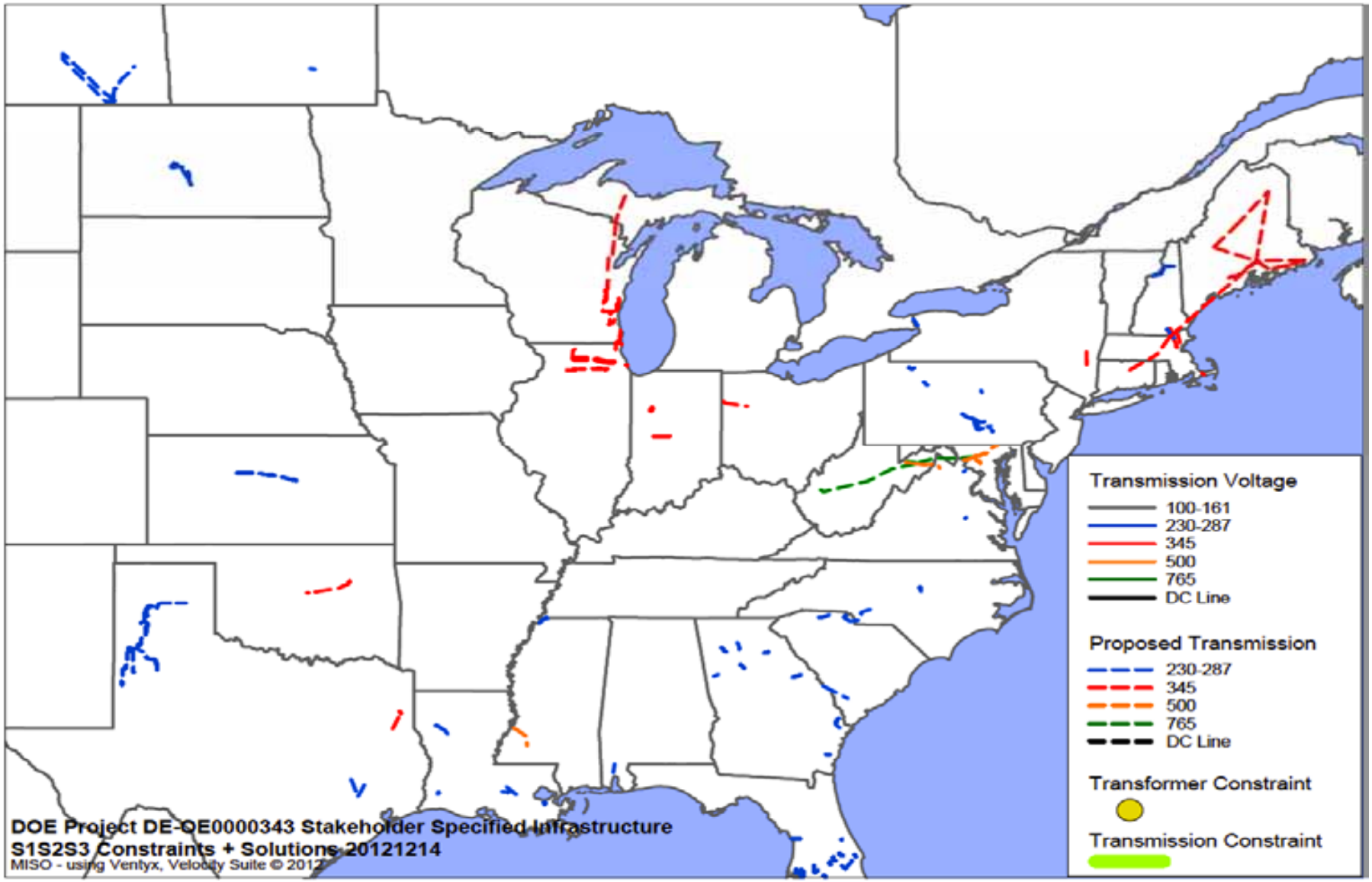


EASTERN INTERCONNECTION STATES' PLANNING COUNCIL

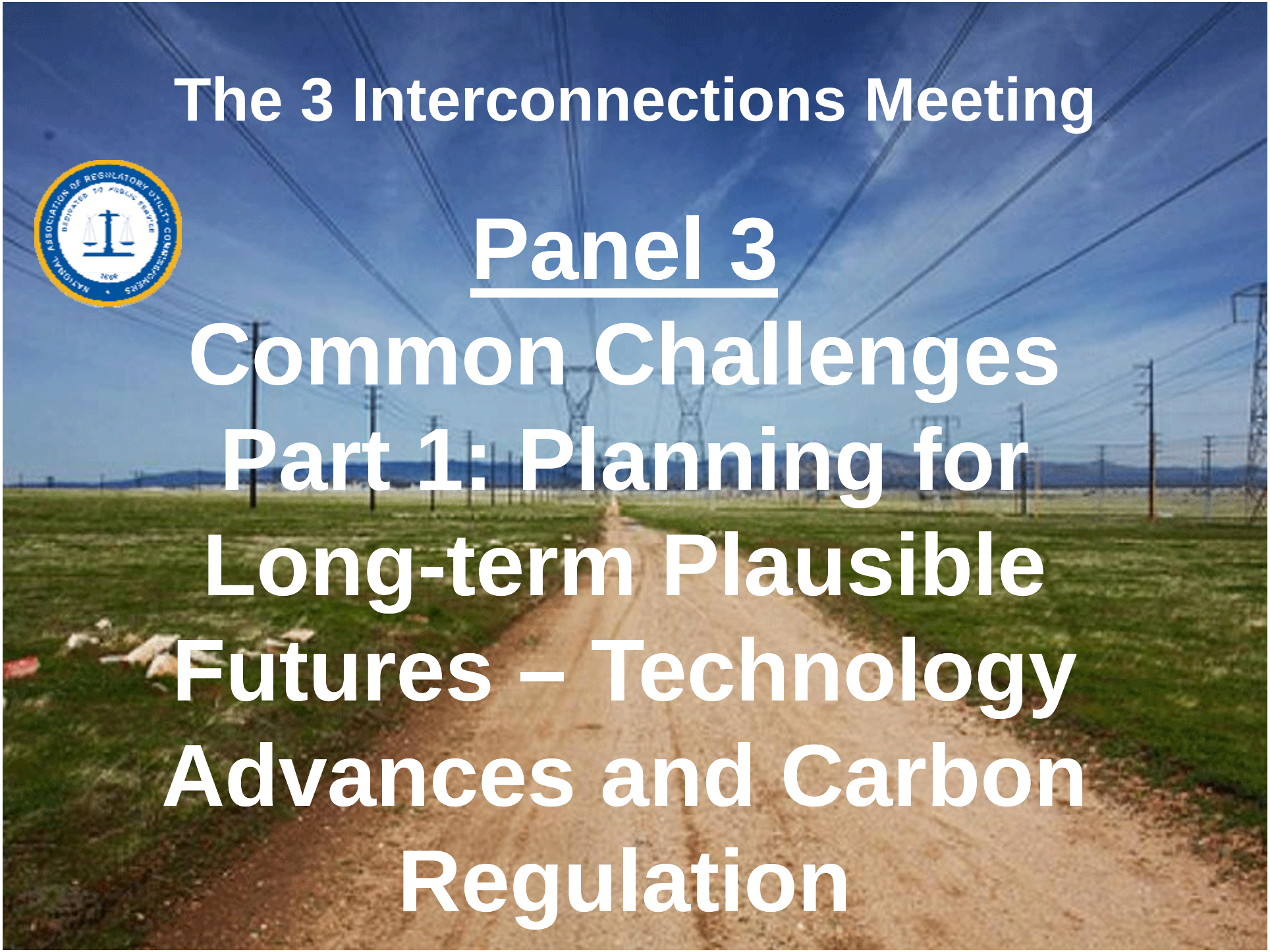
Scenario 2 : Regionally Implemented National Renewable Portfolio Standard



EASTERN INTERCONNECTION STATES' PLANNING COUNCIL
Scenario 3 – Business as Usual



Thank you!


The 3 Interconnections Meeting
Panel 3
Common Challenges
Part 1: Planning for
Long-term Plausible
Futures – Technology
Advances and Carbon
Regulation

The Three Interconnections Meeting

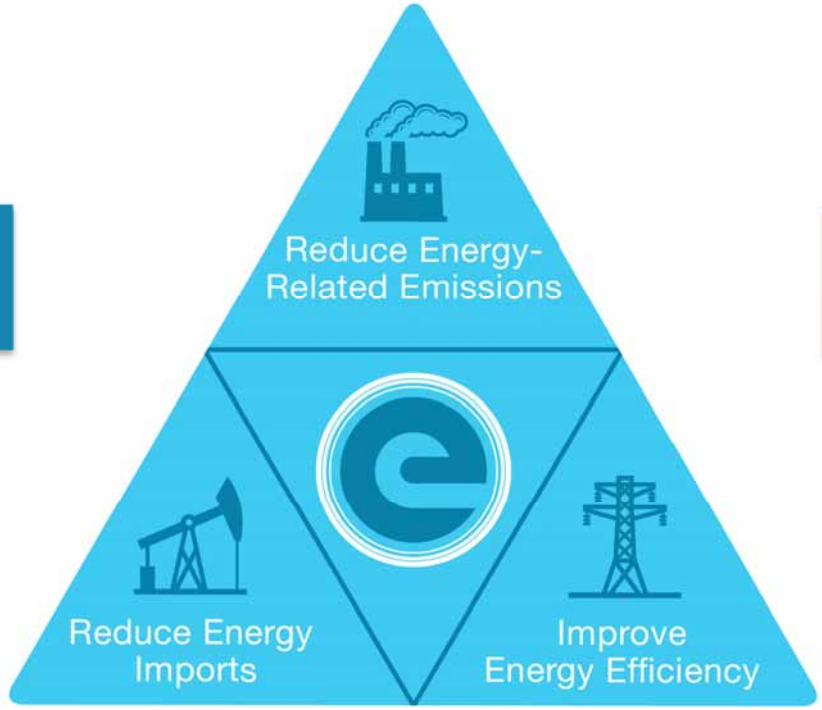
Common Challenges Panel: Planning for Long-Term Plausible Futures – Technology Advances & Carbon Regulations

Dr. Pramod Khargonekar
Deputy Director for Technology
February 6, 2013

ARPA-E Mission

Catalyze the development of transformational, high-impact energy technologies

Promoting revolutionary advances in fundamental sciences

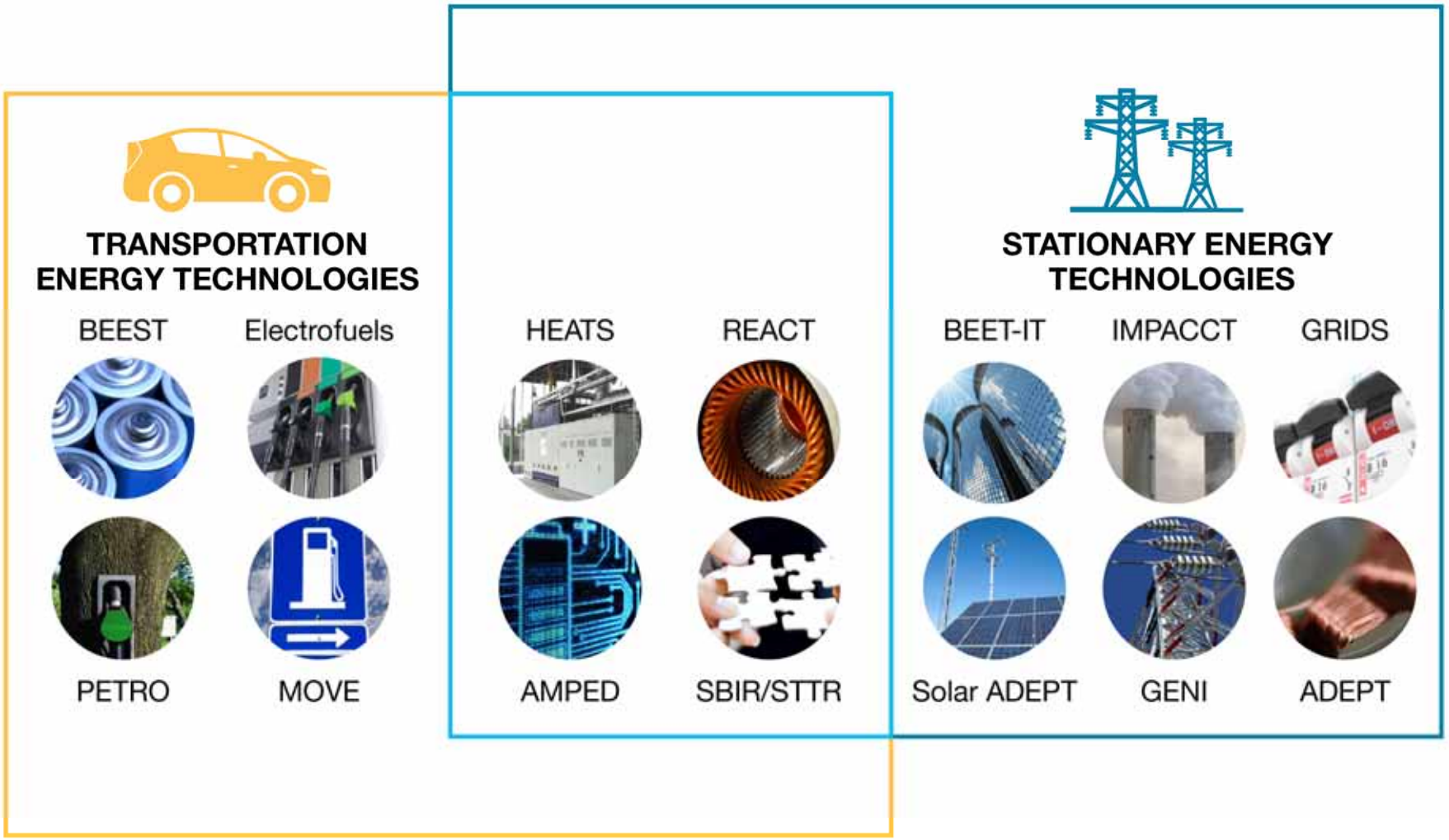


Translating scientific discoveries into technological innovations

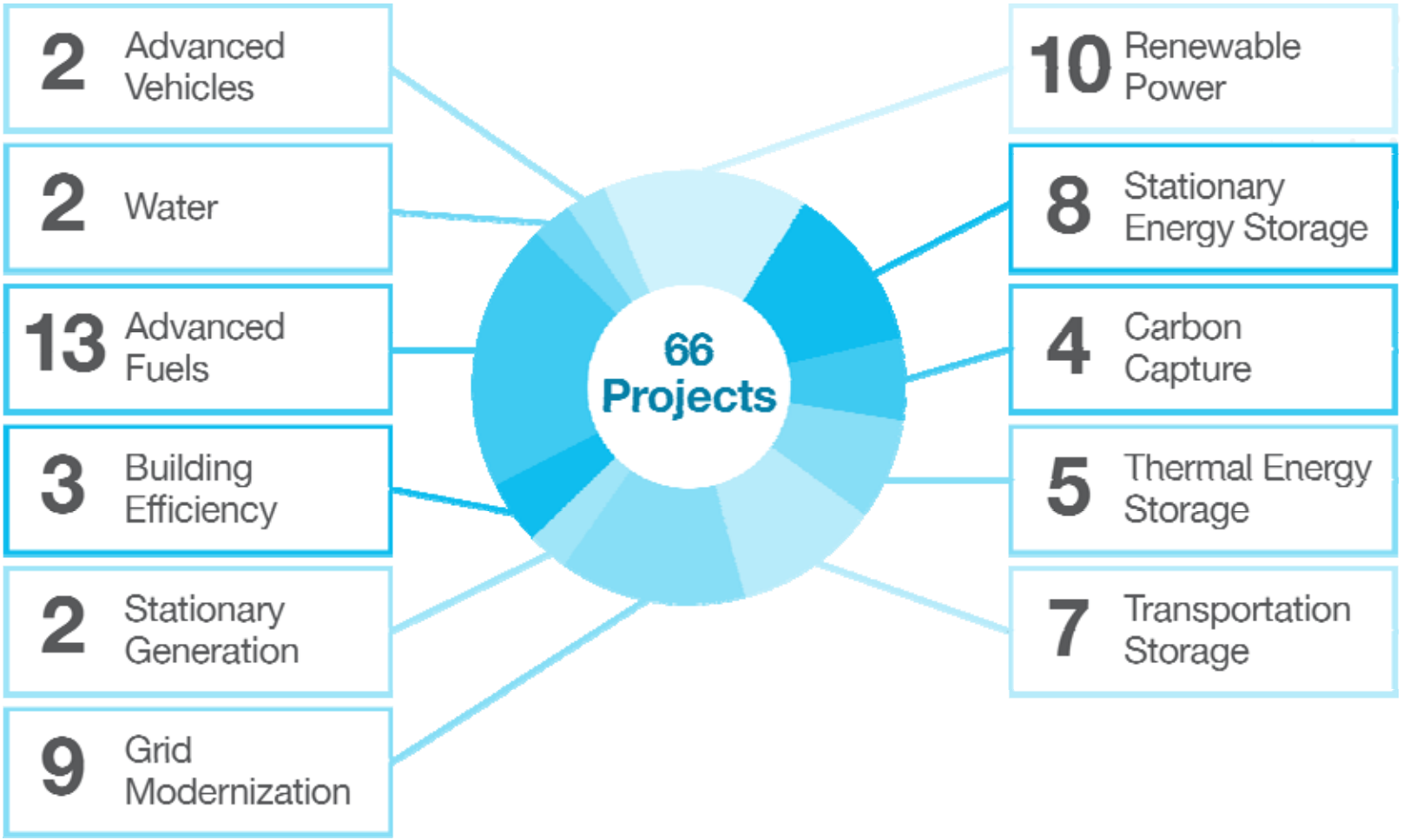
Ensure the U.S. maintains a lead in the development and deployment of advanced technologies

Accelerating transformational technological advances in areas that industry by itself is not likely to undertake

Focused Programs

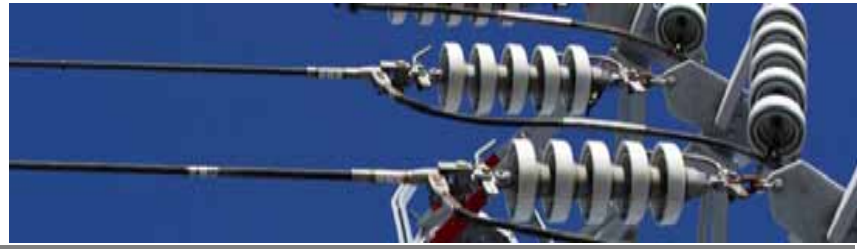


OPEN 2012: 66 Projects, 24 States, 11 Areas



GENI

GRID HARDWARE & SOFTWARE



Mission

Modernize the way electricity is transmitted in the U.S. through advances in hardware and software that provide greater control over power flows.

Program Director	Projects	Total Investment
Tim Heidel	15	$39.4 Million

Goals

- Enable 40% intermittent non-dispatchable generation penetration
- Facilitate implementation of "real-time" electricity markets
- >10x reduction in power flow control hardware (target < $0.04/W)
- >4x reduction in HVDC terminal/line cost relative to state-of-the-art

Highlights

- AutoGrid
  - Utilizing cloud computing and advances in forecasting and optimization to enable fast highly dispatchable and distributed demand response
- Varentec
  - Developing compact, low-cost transmission power flow controllers with fractional power rating (substantial cost reductions over state of the art).
  - Enabling greater use of grid assets.

ADEPT

EFFICIENT POWER CONVERSION

Mission

Paving the way for more energy efficient power conversion and advancing the basic building blocks of power conversion: circuits, transistors, inductors, transformers, and capacitors.

Program Director	Projects	Total Investment
Tim Heidel	14	$34.5 million

Goals

- Improve the energy efficiency of electronic devices and power systems
- Contribute to the development of a smart grid

Highlights

- Virginia Polytechnic Institute (VPI)
  - Exceeded 1,000 W/in3 for GaN power conversion modules utilizing new inductors.
  - Partnering with Enpirion to develop a manufacturable converter
- Cree
  - Partnering with ABB, Powerex, & NCSU to develop high-voltage SiC insulated transistors that can replace current distribution transformers (8000lb) with a 100lbs and 98% efficient transformer
  - Demonstrated 15kV blocking voltage for SiC IGBT device.

GRIDS

Grid-Scale Renewable Energy Storage

Mission

Develop technologies that can store renewable energy for use at any location on the grid at an aggressive investment cost less than $100 per kilowatt hour, creating a stronger and more robust electric grid.

Program Director	Projects	Total Investment
Mark Johnson	12	$27.7 Million

Goals

- Balance intermittent renewable sources connected to the grid

- Efficiently store and send electricity anywhere in the U.S. at a lowest possible cost

- Strong, efficient, stable and robust electric grid

Highlights

- ABB/SuperPower/Brookhaven NL
  - $4.2M follow-on funding from US Army Research Laboratory for SMES development and testing in DOD microgrids
- Bosch/Lawrence Berkeley NL
  - Attained highest power density ever in hydrogen-bromine flow battery system
- Raytheon partnering with Primus Power
  - development of energy storage system for a microgrid at Marine Corps Air Station Miramar

www.arpa-e.energy.gov

Byron Woertz
Senior Project Manager

Facing the Future in the Western Interconnection

February 6, 2013

Washington, DC

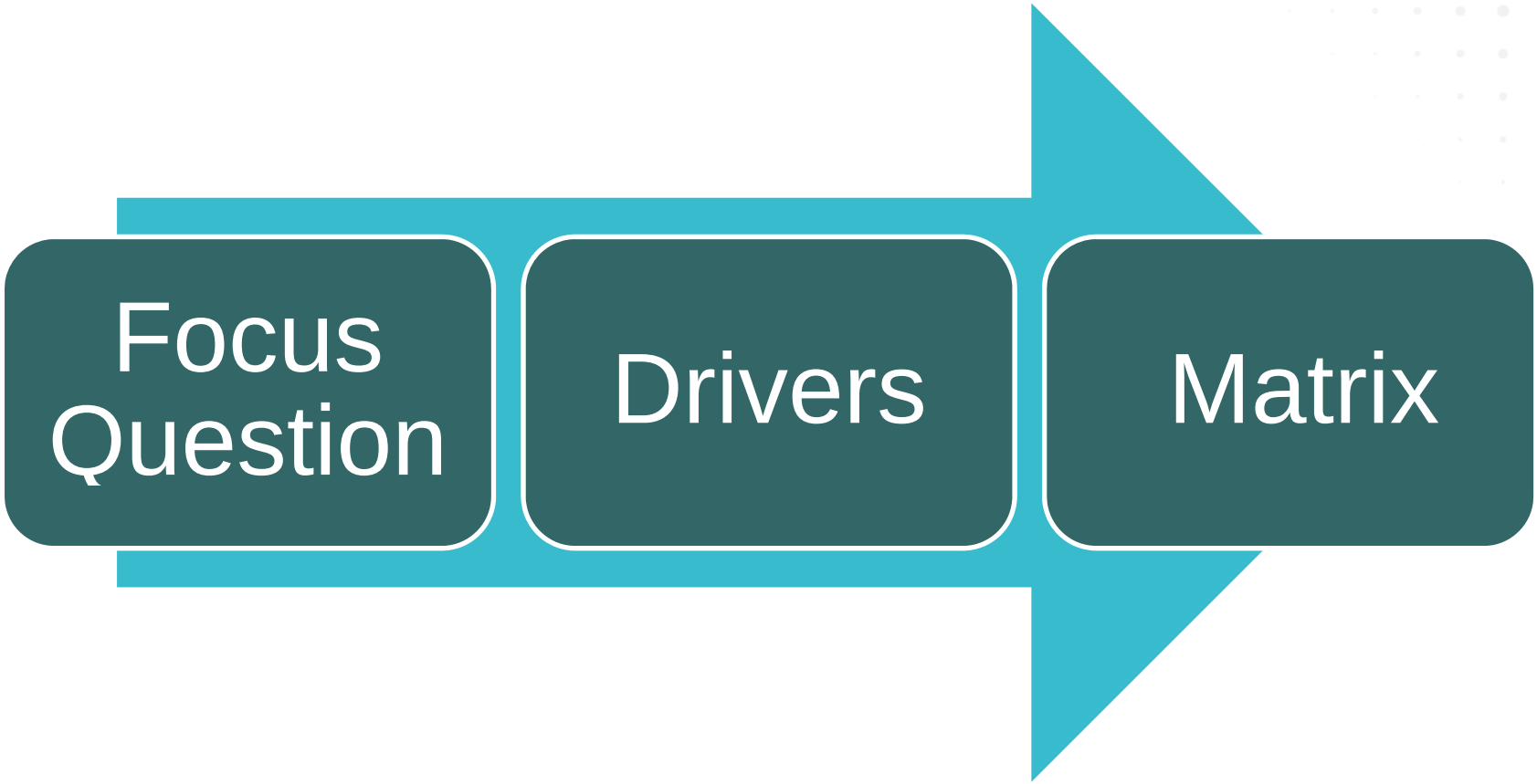
arpa·e
CHANGING WHAT'S POSSIBLE

What is Scenario Planning?

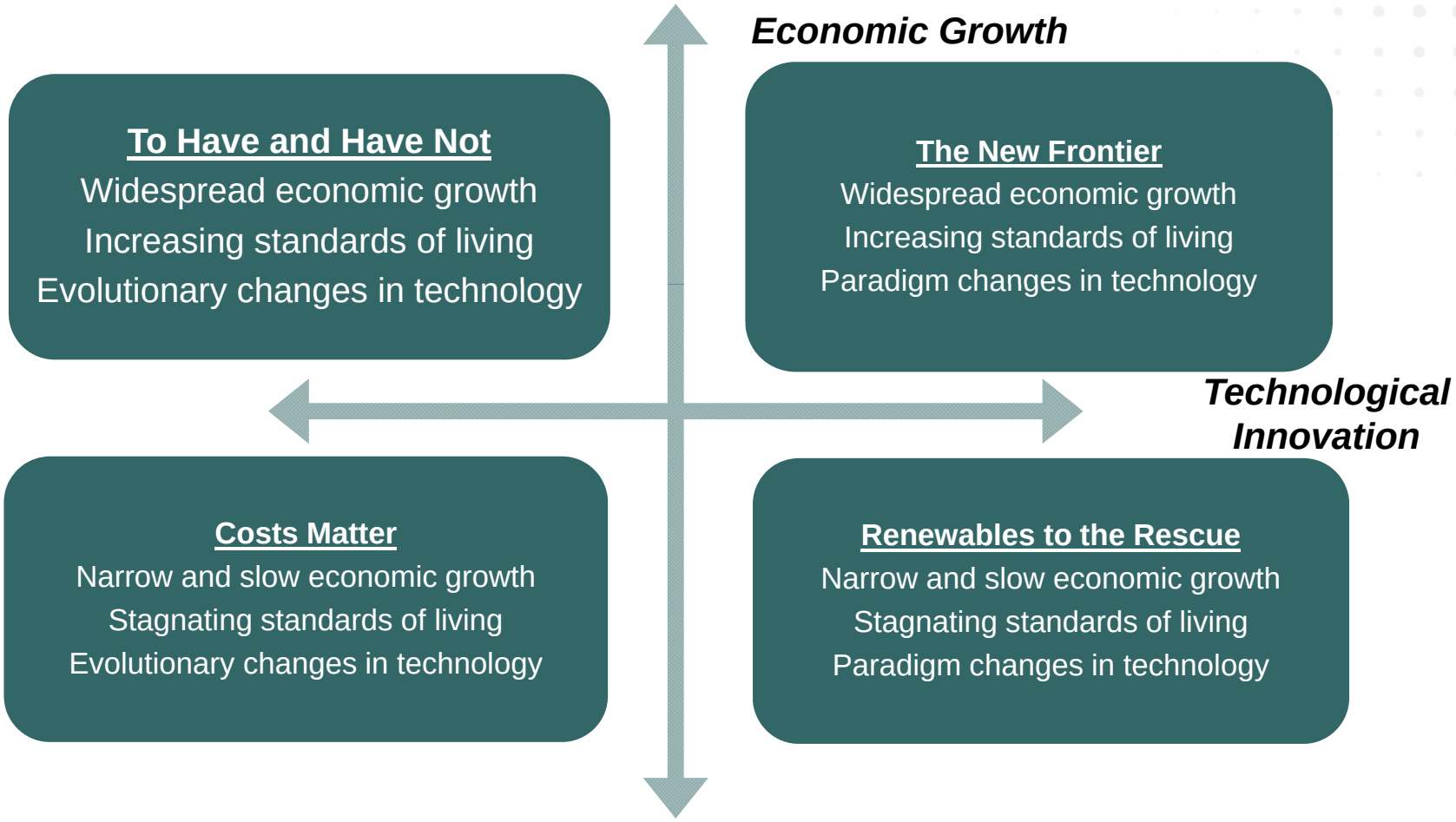
Create plausible futures
Manage uncertainty
Use broad approach

Technological inputs
Sociological influences
Economic drivers
Political influences

Scenario Development Process



WECC Scenarios



The Long-Term Planning Tool will be used to analyze the long-term scenarios

Questions

Byron Woertz
Senior Project Manager
Western Electricity Coordinating Council
155 North 400 West, Suite 200
Salt Lake City, Utah 84103
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Building a High DSM/DG Study Case for the WECC 20-Year Study

Charles Goldman
Lawrence Berkeley National Laboratory

3 Interconnections Meeting
Washington, DC
February 6, 2013

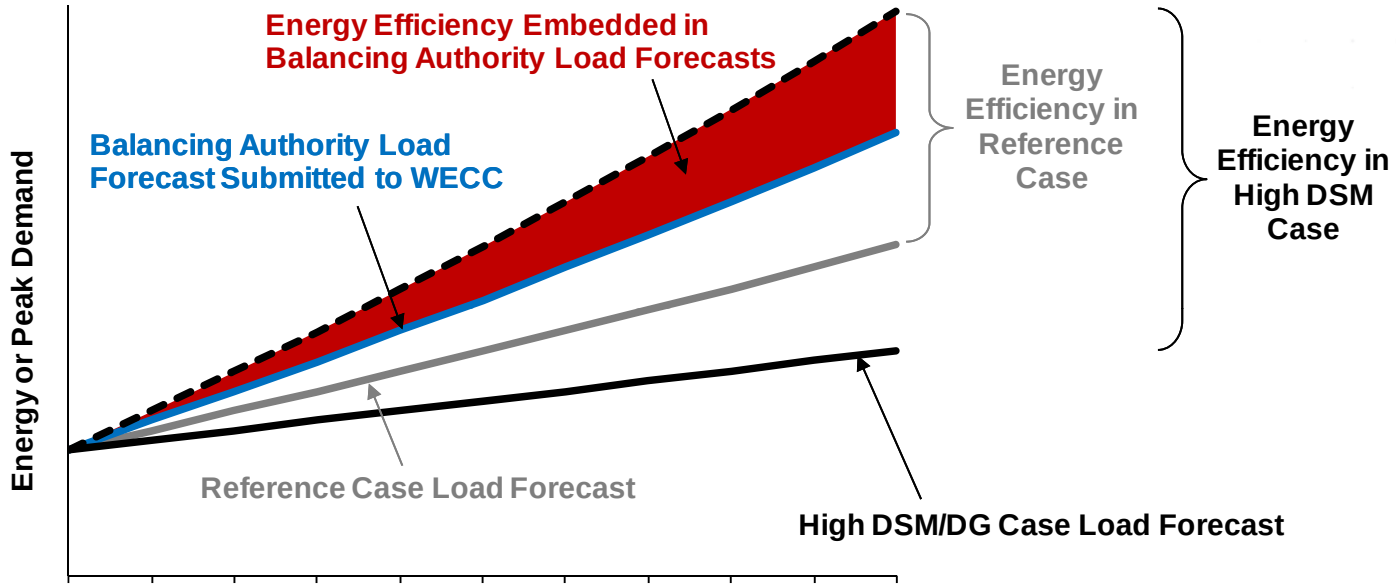
arpa·e
CHANGING WHAT'S POSSIBLE

SPSC 20-Year High DSM/DG Study Case

Overview

- State-provincial steering committee (SPSC) study requests included High DSM/DG study cases for both the 10-year and 20-year WECC transmission plans
- Three components of the High DSM/DG study cases
  - Energy Efficiency (EE)
  - Demand Response (DR)
  - Distributed Generation (DG)
- Analytical Team: LBNL, Itron, Brattle Group, E3
- Review and input by state and provincial representatives and regional DSM experts

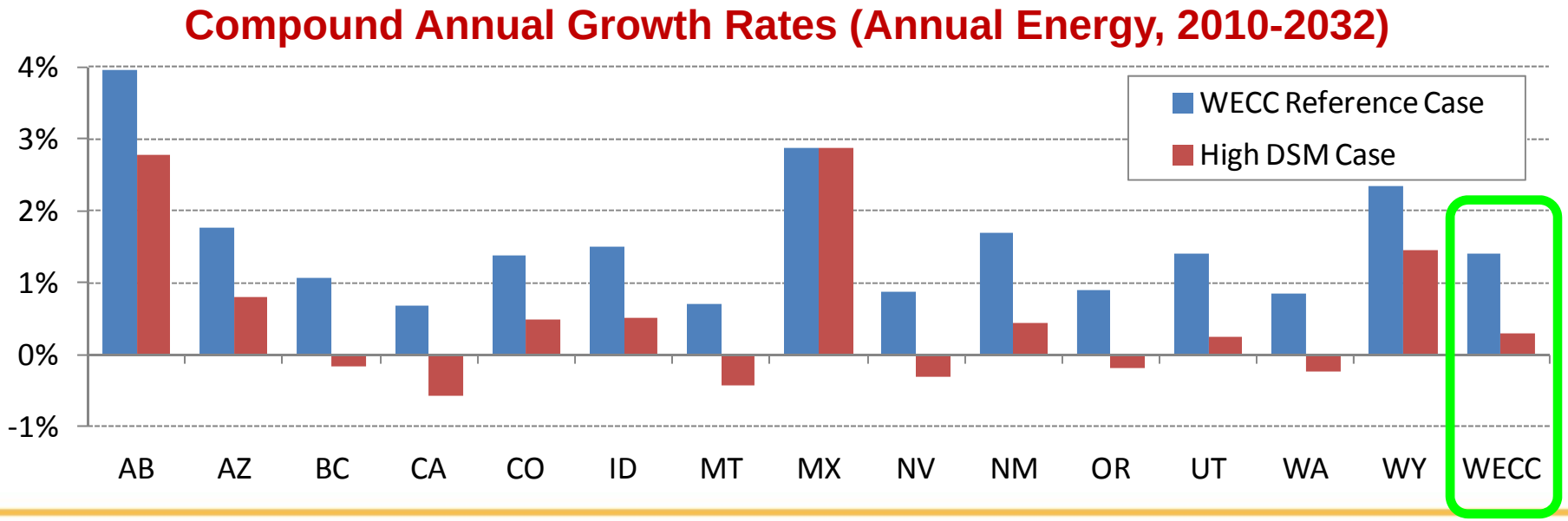
High DSM Load Forecast Requires Explicit Accounting of Energy Efficiency Impacts



- Load forecasts submitted to WECC by balancing authorities include some amount of embedded EE
- Adjustments made for Reference Case load forecast, to fully account for current policies and program plans
- Further adjustments made for High DSM case to reflect more aggressive EE assumptions

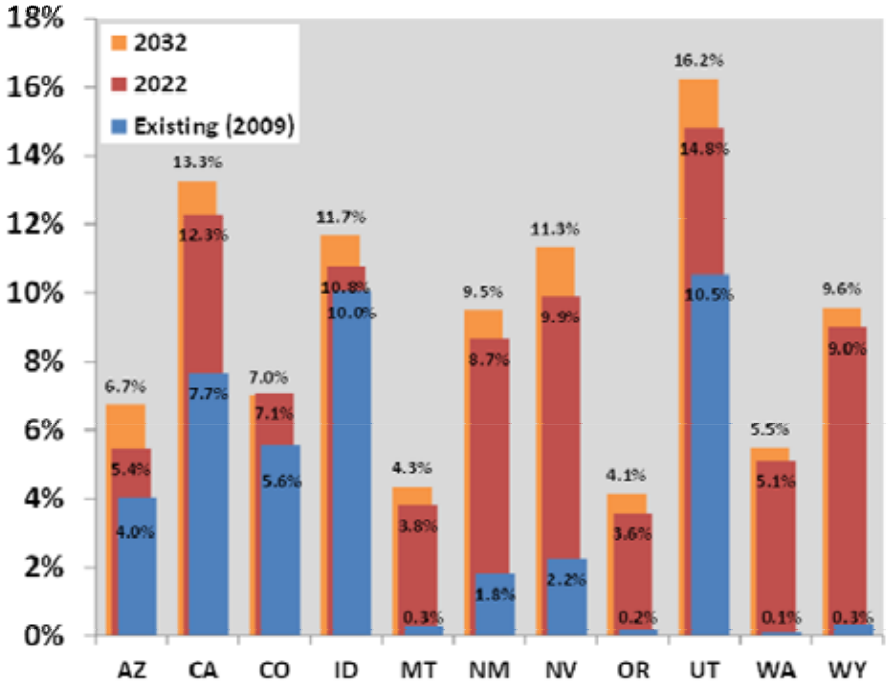
EE Assumptions for High DSM Case Yield Nearly Flat WECC-Wide Load Growth

- Itron's Statistically Adjusted End-Use (SAE) load forecasting framework
- Average stock efficiency for each end use assumed to reach level equivalent to the most efficient model commercially available today
- 20% reduction in WECC-wide annual energy relative to reference case load forecast → reduction in WECC-wide CAGR from 1.4% to 0.3%

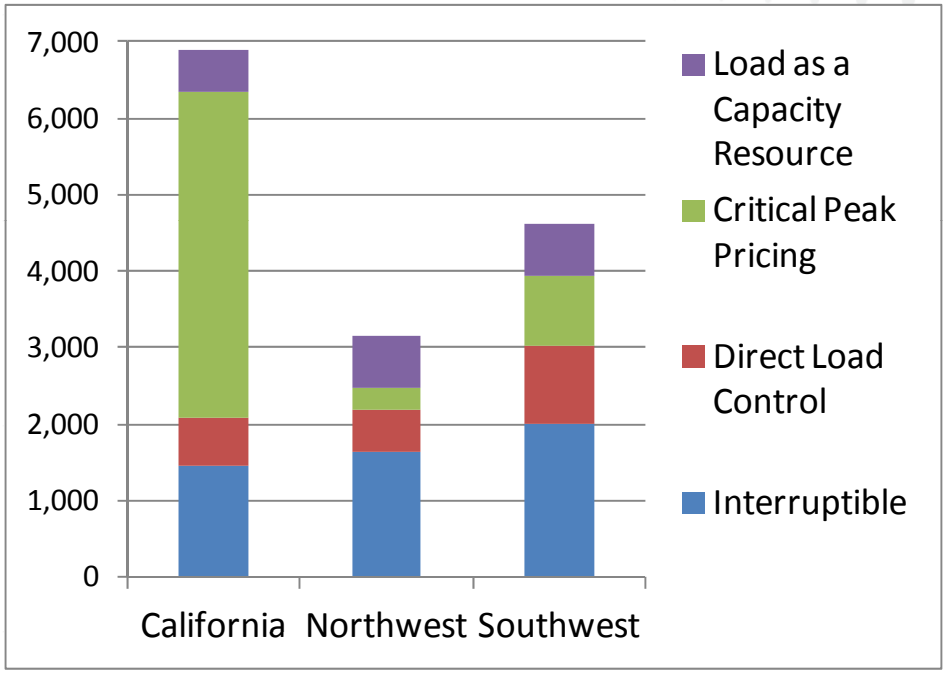


DR Potential Estimates from 2009 FERC Study Updated & Extended for 2032 High DSM Case

DR Capability (% of Peak Demand) in High DSM Case

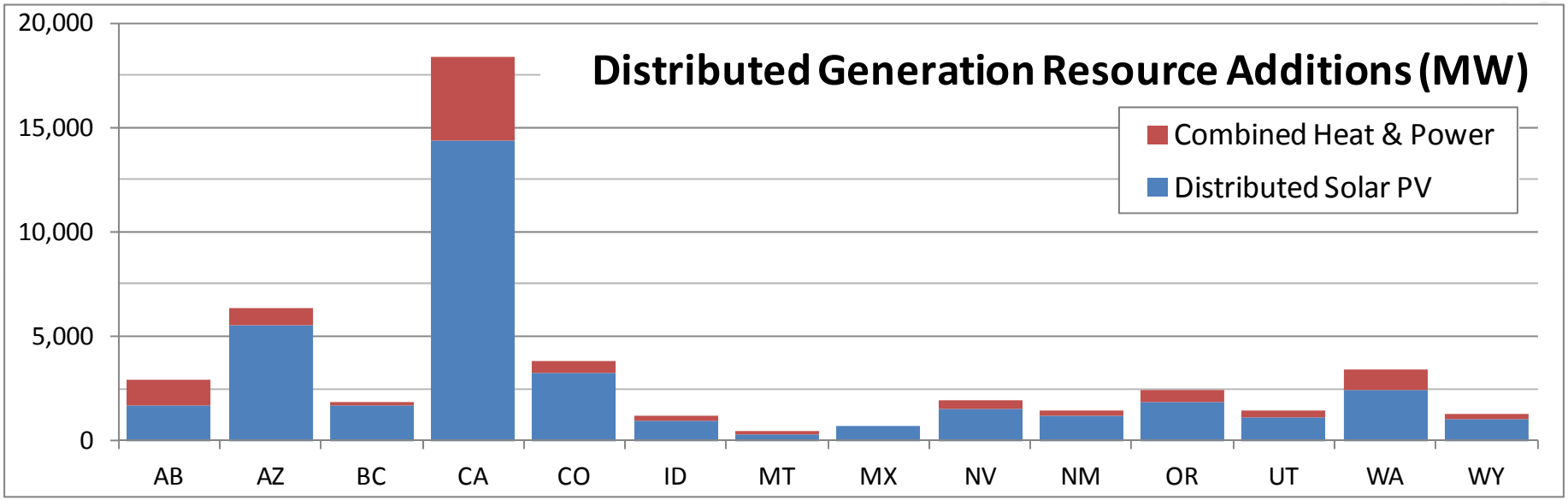


2032 DR Capability by Program Type



- In addition to updated DR potential estimates, LBNL developed "DR dispatch tool" to simulate DR program operation for production cost and capacity expansion modeling

Distributed Generation Projections Leverage Recent Potential Studies



- WECC-wide: 38 GW of distributed PV, 10 GW of distributed CHP
- CHP additions represent a fixed percentage (~40%) of technical potential in each state, leveraging recent ICF CHP potential studies
- Distributed PV additions based on “interconnection potential” from E3 study for CA, extrapolated to other states and adjusted according to relative economics

DSM in Regional Resource Planning:
Challenges and Uncertainties

- Huge technical potential for EE exists, but there are challenges to capturing that potential through ratepayer-funded efficiency programs.

- PV costs are falling rapidly, but its deployment as a distributed resource will ultimately depend on policy decisions about how customers with onsite PV systems will be compensated

- Heavy reliance on EE and DG create fundamental business model challenges for utilities
- In low load growth environment, EE and DG can potentially yield flat or negative load growth in some regions. Implications for regional planning?
- Will DR become an integral part of the solution to renewables integration and overcome technical and institutional challenges?

State-Provincial Steering Committee
WECC Low Carbon Scenarios Tool

Arne Olson

Energy and Environmental Economics, Inc., on behalf of LBNL

3 Interconnections Meeting

February 6, 2013

SPSC Low Carbon Scenarios Tool

- **LBNL funded E3 to develop the "Low Carbon Scenarios Tool" to support State/Provincial Steering Committee low-carbon study request**
  - **Low Carbon Scenarios Tool develops a Western Interconnection electricity-sector carbon reduction target that is consistent with an economy-wide GHG reduction plan, including cross-sector interactions**

- **SPSC Study Case carbon reduction targets based on economy-wide Waxman/Markey bill**
  - **17% below 2005 levels by 2020**
  - **42% below 2005 levels by 2030**
  - **83% below 2005 levels by 2050**
  - **Based on the Intergovernmental Panel on Climate Change (IPCC's) recommendations to avert global warming above 2˚C**

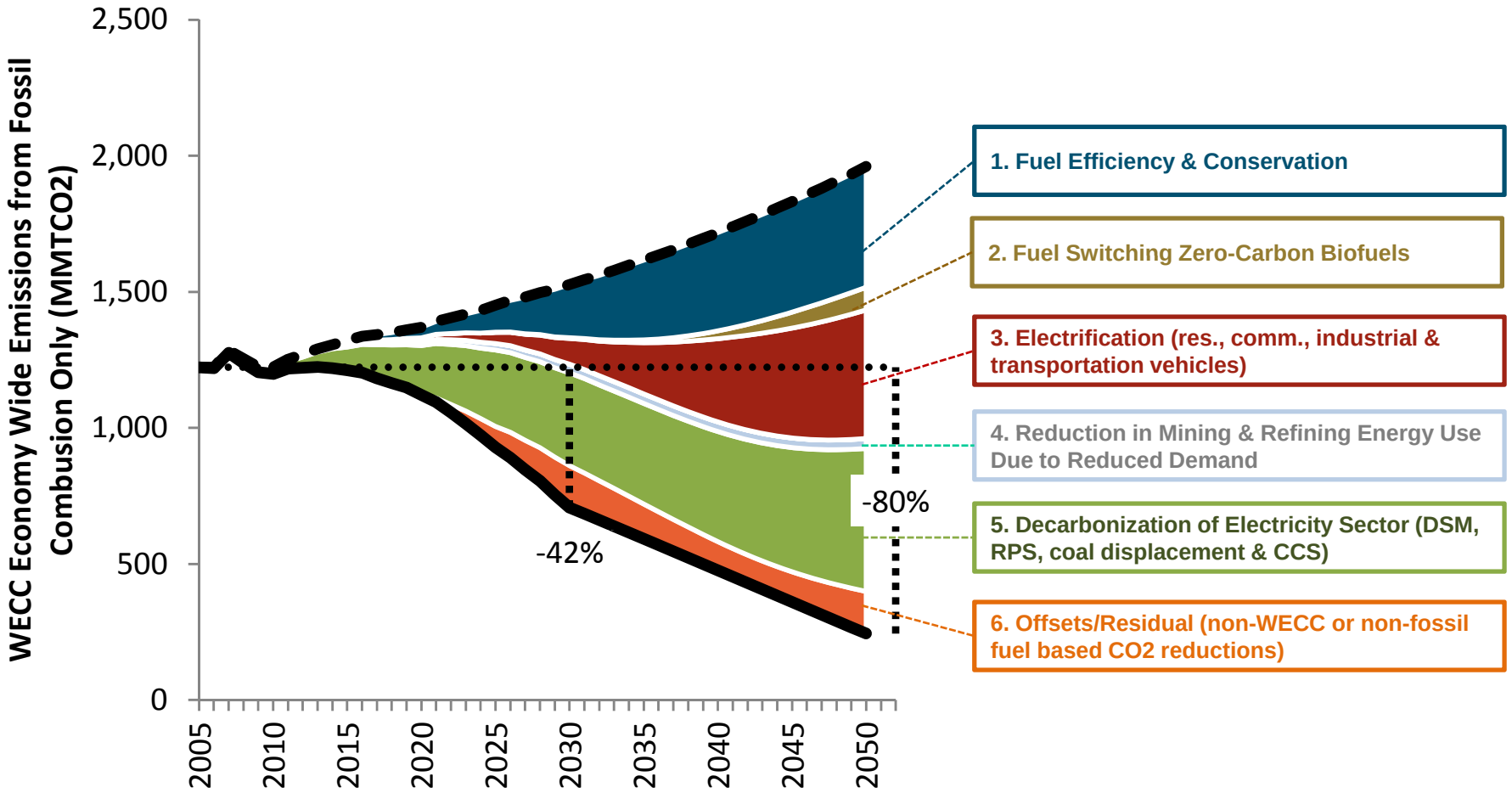
Lessons Learned from Existing Studies of Low Carbon Futures

- **Previous studies of 80% reductions by 2050 have a number of common findings:**
  - **Energy efficiency critical to achieving goals at lowest cost**
  - **Limited tools for carbon reduction in non-electric sectors**
  - **Electricity sector plays a key role through (a) higher carbon reduction targets, and (b) electrification of fossil fuel end uses in other sectors**

***"Power Perspectives 2030: on the road to a decarbonised power sector"*, European Climate Foundation**

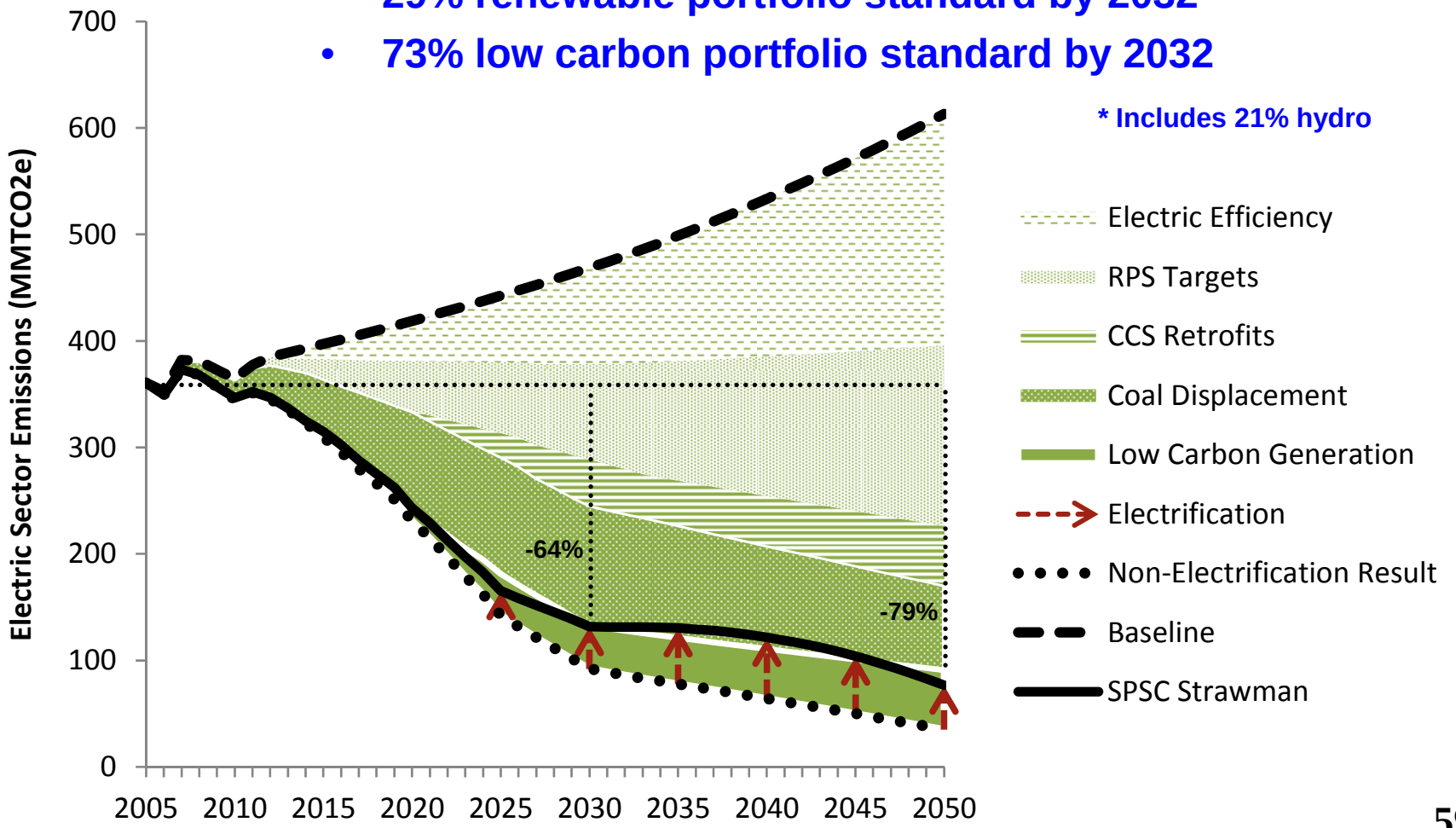
GHG reductions compared to 1990	2005	2030	2050
Total	-7%	-40 to -44%	-79 to -82%
Sectors			
Power (CO_2)	-7%	**-54 to -68%**	-93 to -99%
Industry (CO_2)	-20%	-34 to -40%	-83 to -87%
Transport (incl. CO_2 aviation, excl. maritime)	+30%	+20 to -9%	-54 to -67%
Residential and services (CO_2)	-12%	-37 to -53%	-88 to -91%
Agriculture (non-CO_2)	-20%	-36 to -37%	-42 to -49 %
Other non-CO_2 emissions	-30%	-72 to -73%	-70 to -78%

SPSC Low Carbon Scenario



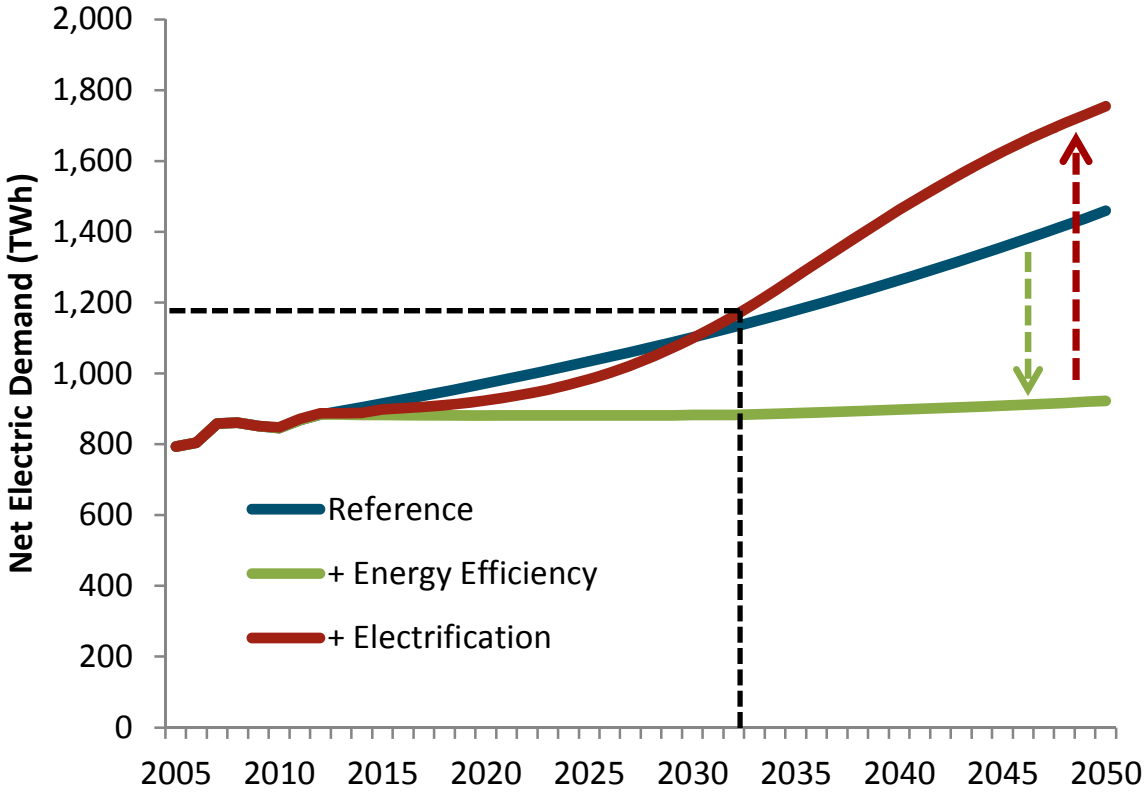
SPSC Low Carbon Scenario: Impacts in Electricity Sector

- **64% reduction in electricity-sector GHGs by 2032**
- **29% renewable portfolio standard by 2032**
- **73% low carbon portfolio standard by 2032**



SCPC Low Carbon Scenario: WECC Electrification Impacts

- **Net impact of electrification and energy efficiency results in slightly higher load growth than reference case in 2032**



2032	GWh at generator
Residential	29,600
Commercial	16,750
Industrial	114,352
Transportation	117,917
Light duty	*83,827*
Total	**278,620**

Approx. # of electric cars in light duty transportation by 2032:
19.7 million

Thank You!

Contact:
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Energy and Environmental Economics, Inc.
101 Montgomery Street
San Francisco, CA 94104
(415) 391-5100
http://www.ethree.com

Energy+Environmental Economics

The EIPC Transmission Study: Facing the Future

Presented to the

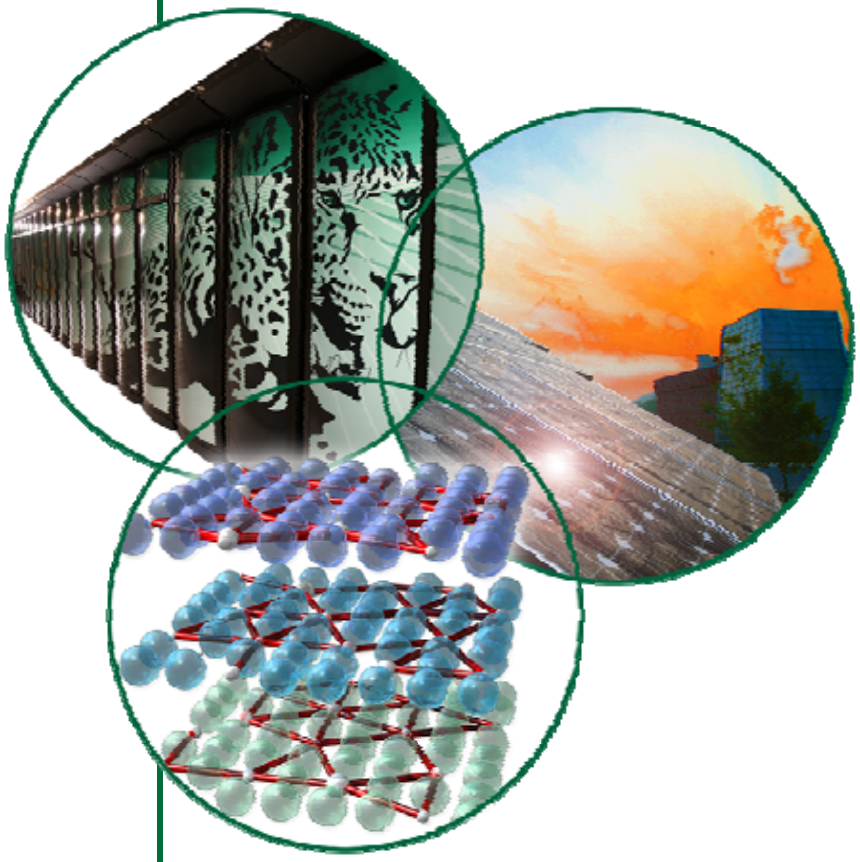
3 Interconnections Meeting

February 6, 2013

Stanton W. Hadley

Senior Researcher – Power & Energy Systems

Oak Ridge National Laboratory



U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

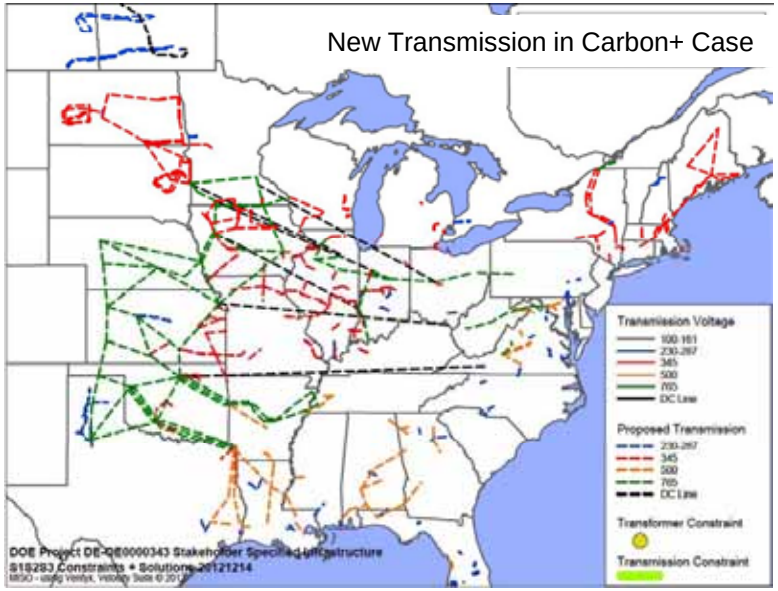
EIPC Process Recap

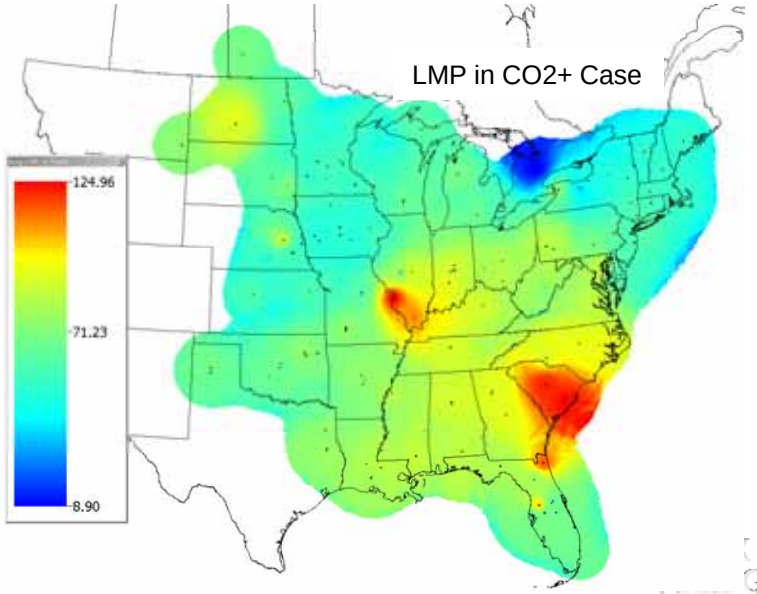
- EIPC create Stakeholder Steering Committee with EISPC and other sectors
- Phase 1 in 2010-2011
  - Capacity expansion modeling through 2040
  - 8 major futures plus 72 sensitivities
  - Regional "Bubble and Pipe" model
- Phase 2 in 2012
  - 3 scenarios for 2030 as "bookends"
  - Build-out of transmission lines for reliability
  - Production simulation for 2030
  - Base scenarios plus 6 sensitivities
  - Capital cost estimations refined from Phase 1

Futures Studied (Phase 2 in red)
Business As Usual
Carbon Constraint – National
Carbon Constraint – Regional
Aggressive EE/DR/DG
RPS – National
RPS – Regional
Nuclear Resurgence
Carbon + Aggressive EE/DR/DG

Successes and Limitations

- Wide collaboration from industry, states, and stakeholder groups
- Better understanding by all of the complexities in interconnection-wide planning
- Produced possible transmission requirements and cost estimates under significantly different policy drivers
- Serial flow from model to model limited analysis
- Non-traditional resources difficult to model





Technology Unknowns

- Supply
  - Cost-competitive solar, off-shore wind, hydrokinetics, small nuclear, carbon sequestration, ...
  - Natural gas supply expansion
- Demand
  - Widespread deployment of smart grid responsive equipment
  - Application of energy efficiency with lower demand growth
  - Transportation electrification
- Delivery
  - Cost-competitive distributed bulk storage
  - HVDC deployment acceleration
  - HVAC advances in capacity and control
  - Operational response through advanced grid modeling

Paradigm Shift affects future planning and operations

Old Paradigm

- Supplies more controllable
  - Thermal and hydro generation
  - Most generation near load
  - Main fuel supplies stable
- Demand less controllable
  - Plan capacity to meet peak demand
  - Interruptions only used in emergency
  - Customers not aware of cost variations

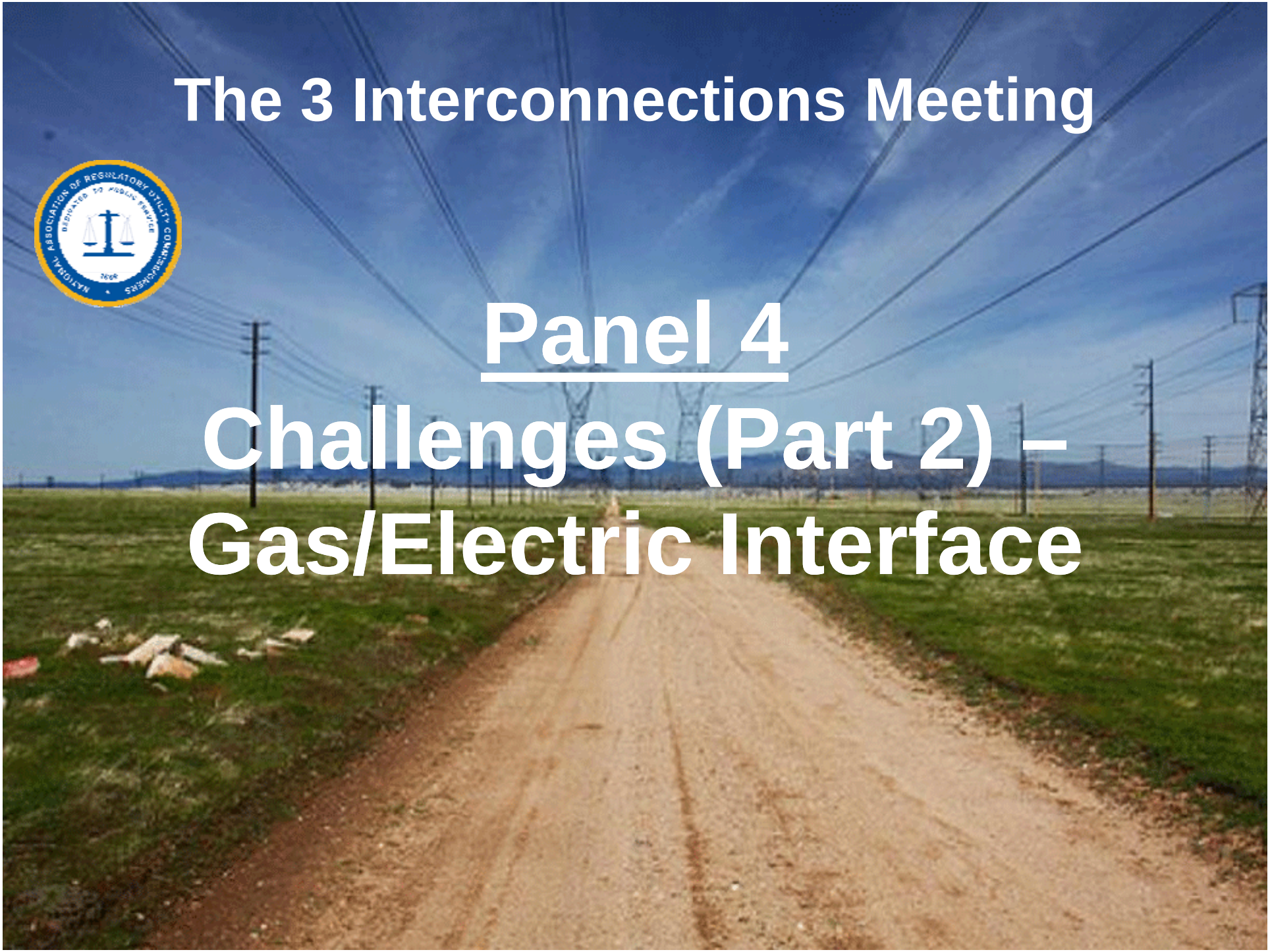
New Paradigm

- Supplies less controllable
  - Wind and solar generation
  - Gas increasing as fuel
  - Generation further from load
  - Independent markets
  - New construction difficult
- Demand more controllable
  - Smart Grid-enabled demand response
  - Widespread information flow to and from customers

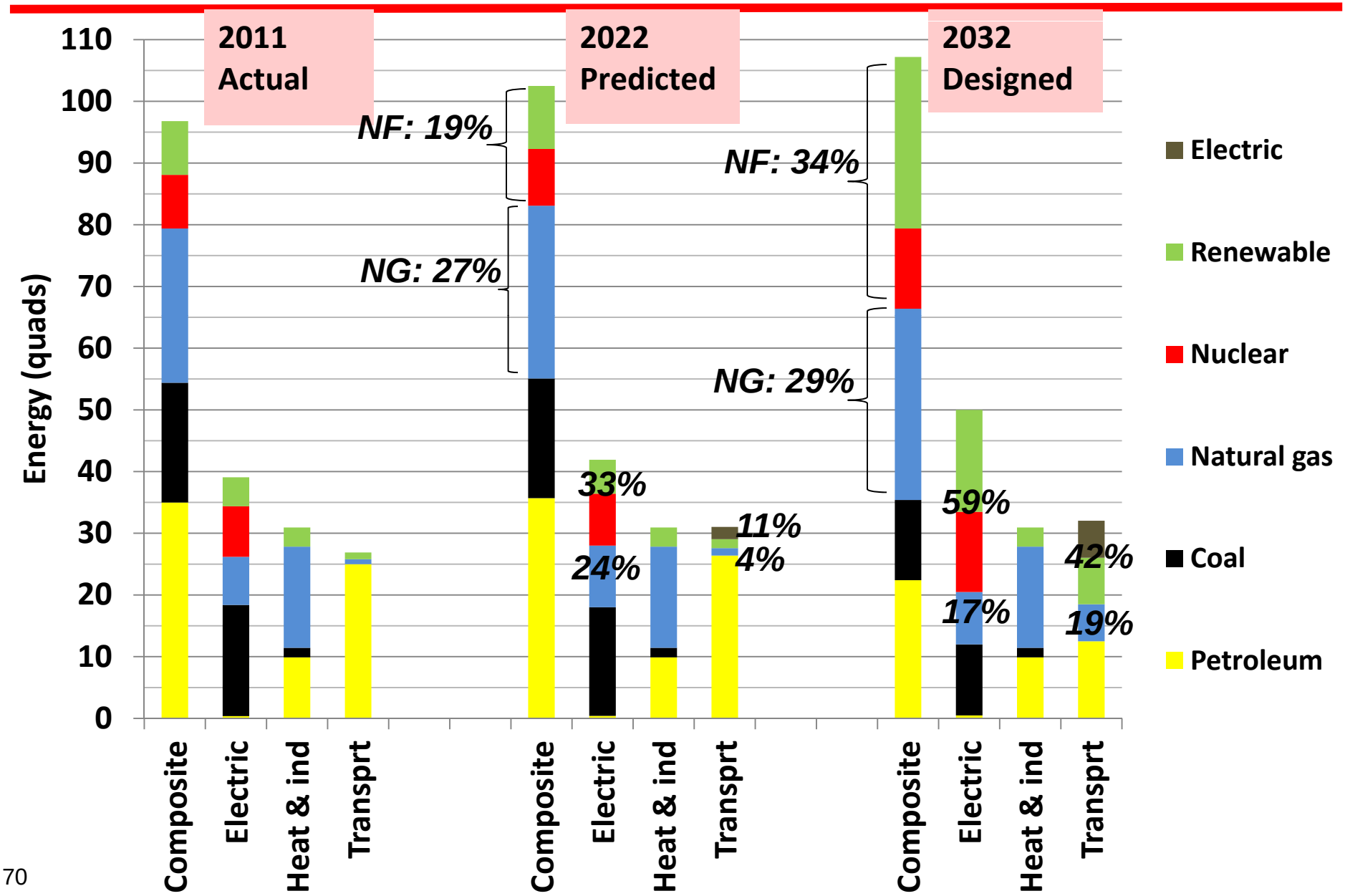
- Any shift filters through a sector at different speeds
- The amount of shift is a key unknown that hinders planning


The 3 Interconnections Meeting
Adjourn for the Day
Reconvene tomorrow
at 9 a.m. in
Renaissance Ballroom

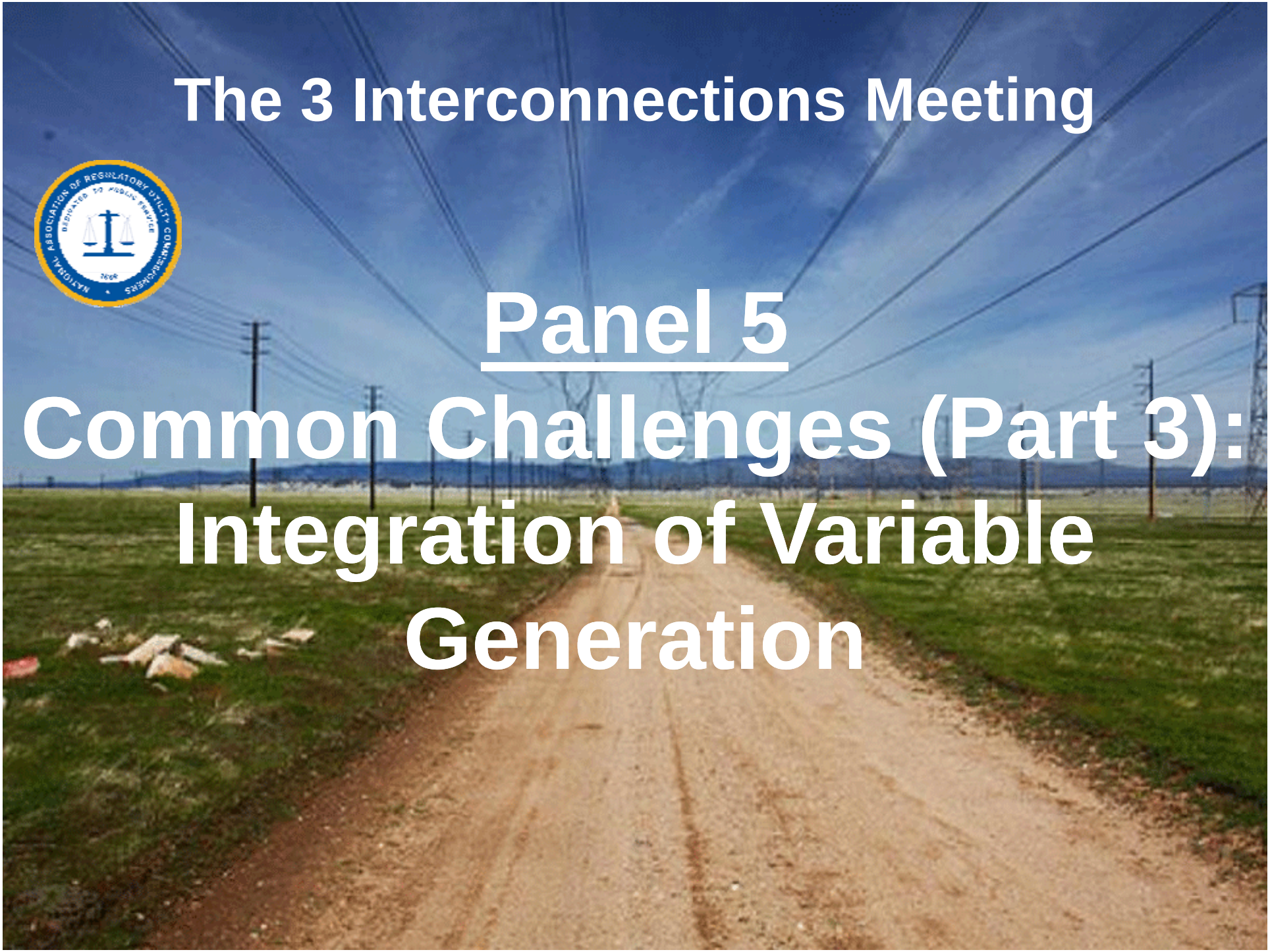

The 3 Interconnections Meeting
The Honorable
Colette Honorable
Arkansas


The 3 Interconnections Meeting
Panel 4
Challenges (Part 2) –
Gas/Electric Interface

The national energy portfolio




The 3 Interconnections Meeting
Break
* 10:30 – 10:45 a.m. *


The 3 Interconnections Meeting
Panel 5
Common Challenges (Part 3): Integration of Variable Generation

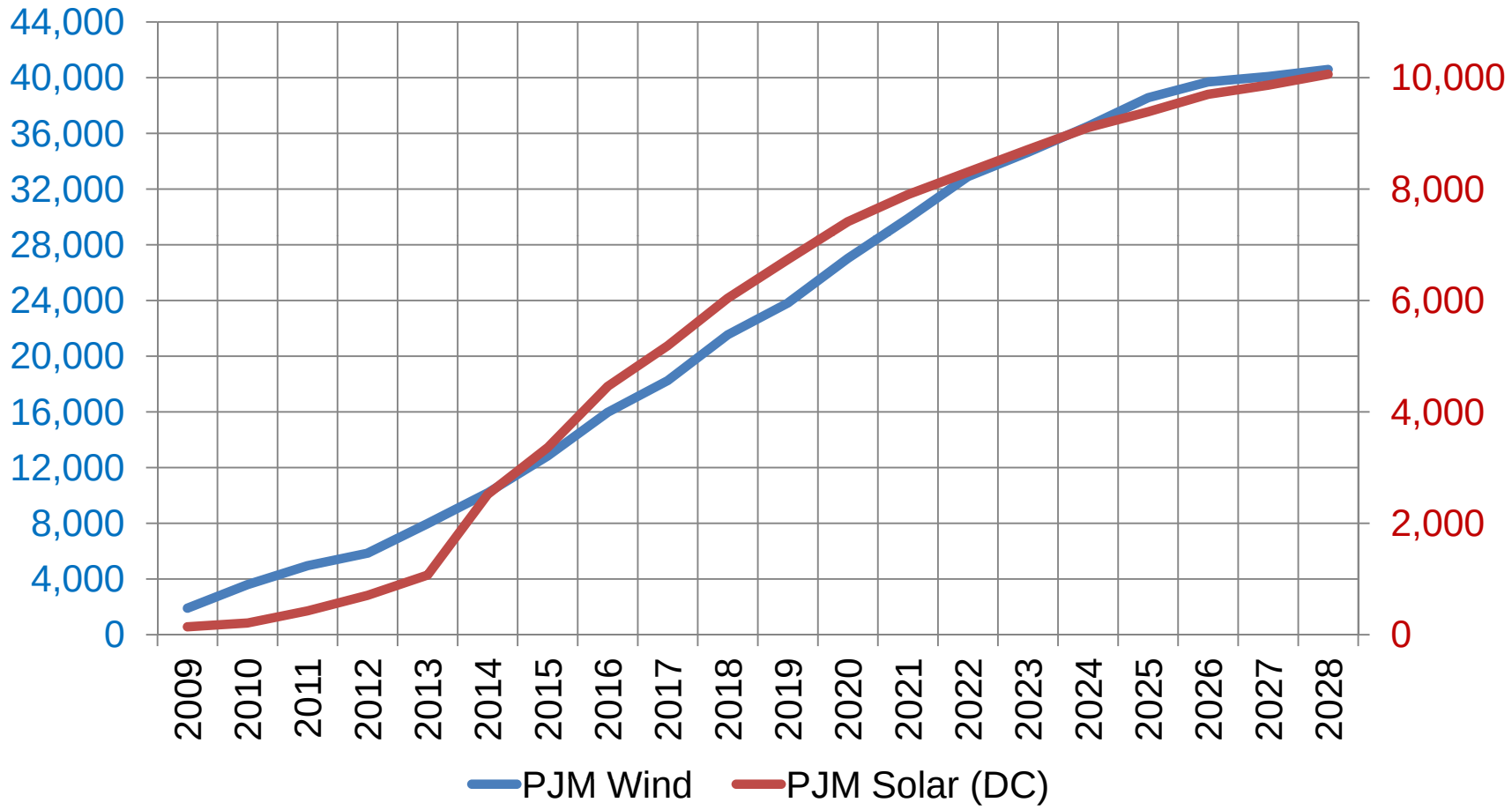
Kenneth A. Schuyler, PE

Manager, Renewable Services

PJM Interconnection, LLC

Projected Renewable Energy Requirements in PJM

By 2028: 133,000 GWh of renewable energy, 13.3% of PJM annual net energy (**40 GW** of wind and **10 GW** of solar)



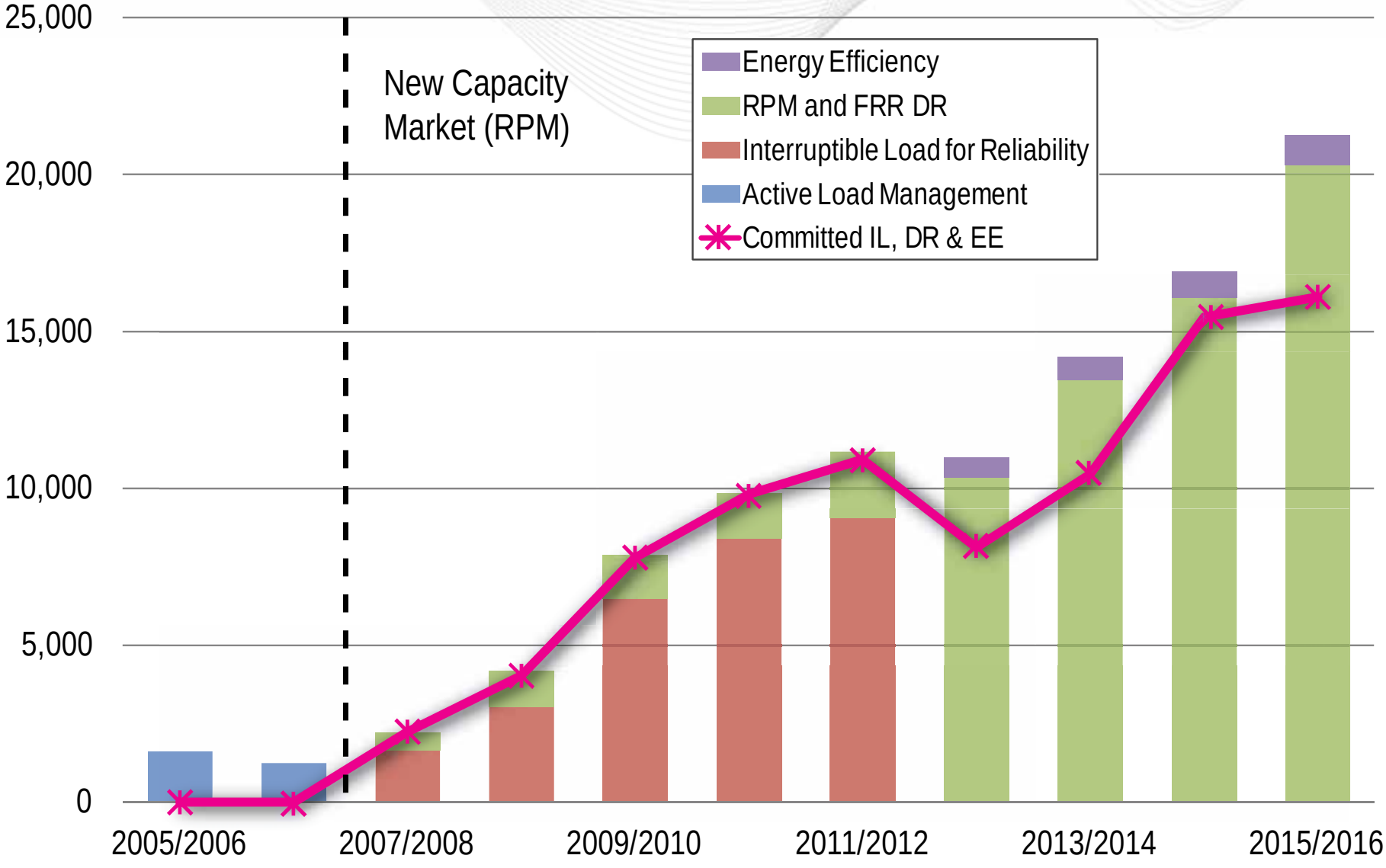
ISOs and RTOs reduce Variable Energy Resource integration costs:

Characteristic	Impact to Integration Cost
Larger balancing areas	• Reduces overall increase in variability • Less regulation and ramping service required
Faster markets, i.e., shorter scheduling intervals (5-15 minutes)	• Less regulation required to accommodate intra-hour variations
Larger geographic area	• Increases weather diversity and reduces overall variability
Centralized wind power forecasting	• Cost-effective approach to reduce scheduling impacts
Regional / Interregional Transmission Planning	• Cost-effective upgrades to ensure grid reliability and mitigate congestion

PJM Initiatives to Address Impacts

- **Energy Markets / Operations**
  - Implemented a centralized wind power forecast service.
  - Implemented changes to improve wind resource dispatch / control.
  - Demand Response / Price Responsive Demand improves operational flexibility
  - Frequency Regulation – incents better performing resources (like storage)
- **Transmission Planning**
  - Light load criteria implemented to improve grid reliability
  - Expansion planning considers public policy impacts (i.e., RPS)
  - Grid interconnection requirements for wind and solar being evaluated
- **Evaluating Potential Grid Impacts**
  - Initiated a PJM Renewable Integration Study (PRIS) to assess grid impacts
- **Advanced Technology Research Program**
  - Pilot programs to evaluate new technologies and remove barriers to participation in PJM markets and operations.

Demand Resources Provide Operational Flexibility

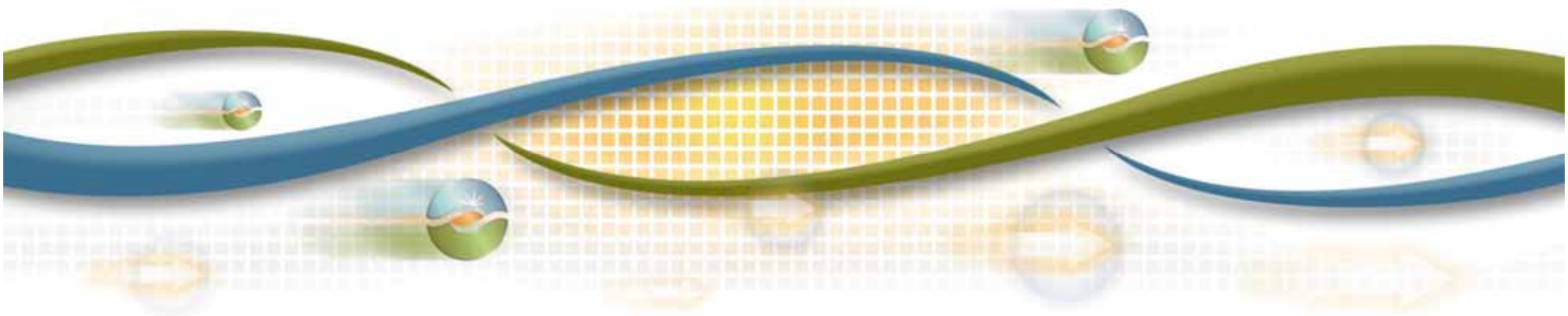


The 3 Interconnections Meeting
Facing the Future with interconnection-Wide Planning

Clyde Loutan
Senior Advisor – Renewable Energy Integration

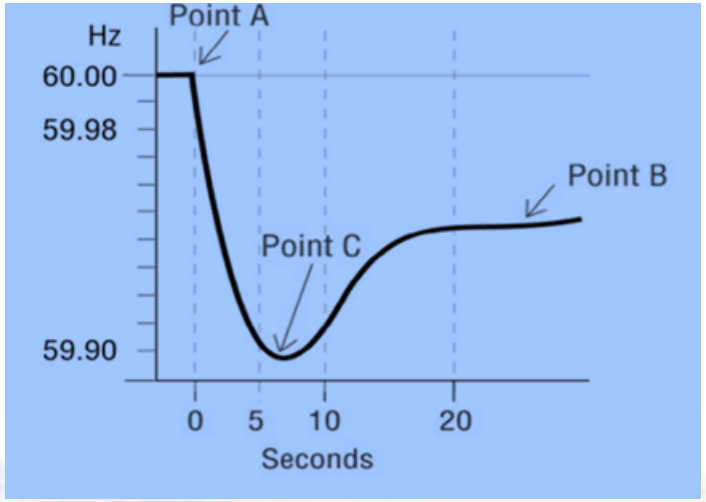
Panel 5: Common Challenges – Integration of Variable Generation

February 6-7, 2013

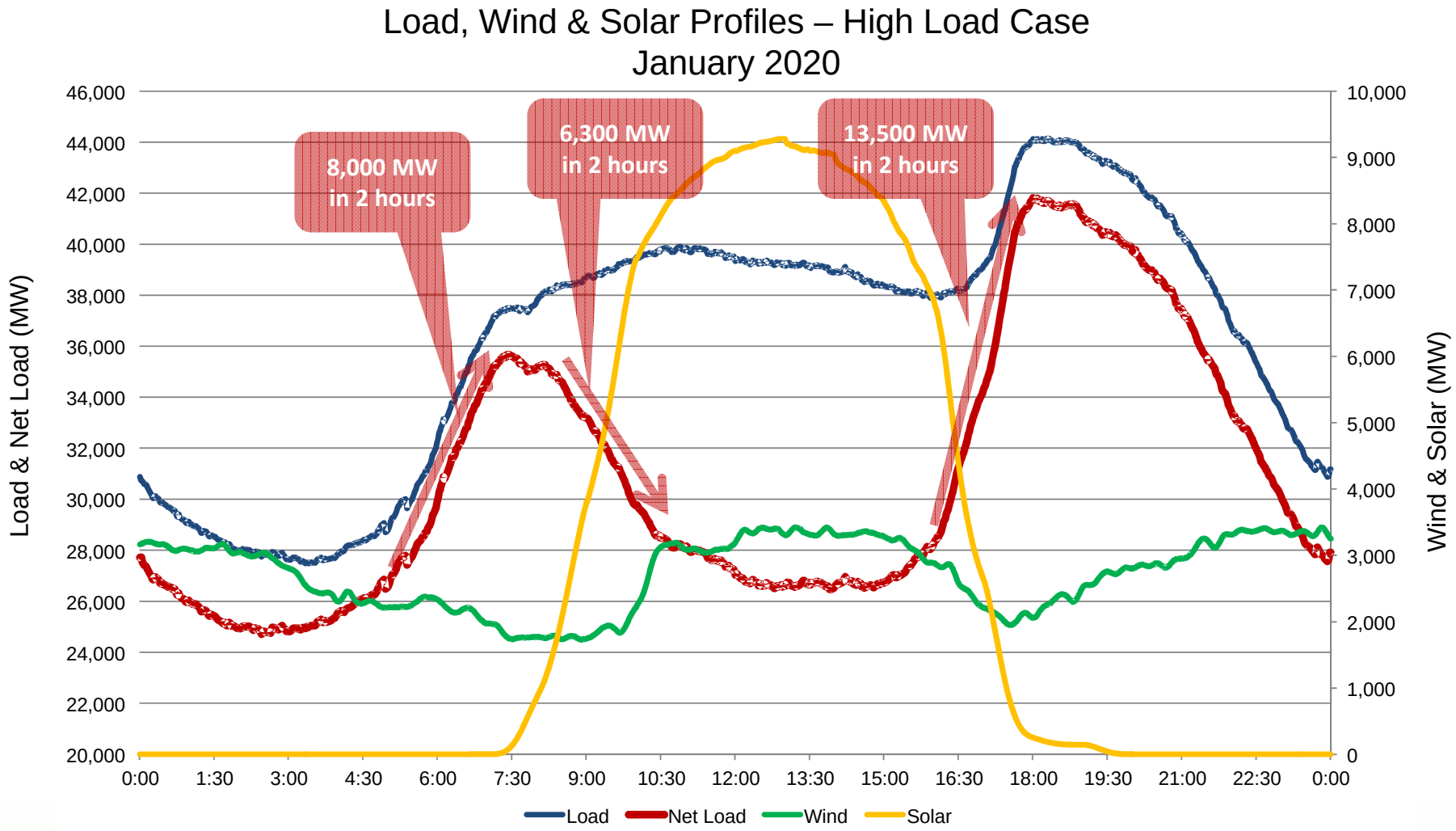


Summary of operational impacts to manage a grid that is more complex

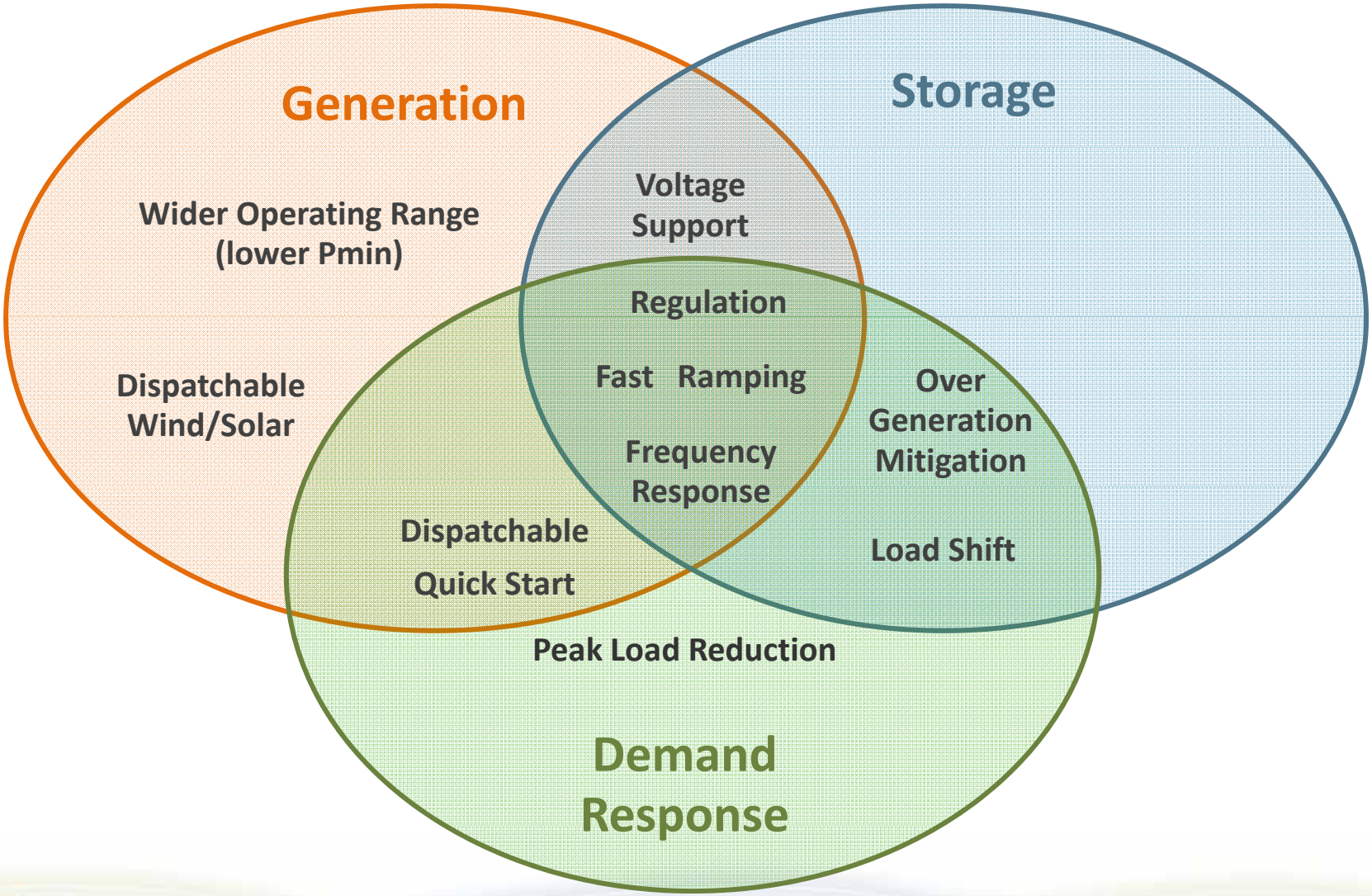
- Increased frequency and magnitude of operational ramps across various time-frames
- Increased frequency and magnitude of over-generation conditions
- Increased intra-hour load-following up and down requirements … need for additional reserves? …or a new product?
- Increased requirements for regulation Up/Down
- Impact of DER and non-traditional resources on the transmission grid is still not fully understood
- Lack of common standards and clarity of existing standards
- Concerns of arresting frequency post contingency
- Inadequate tools to assess the system in real-time



Conventional resources will be dispatched to the net load demand curve – High Load Case



Meeting the operational challenges beyond 20% RPS



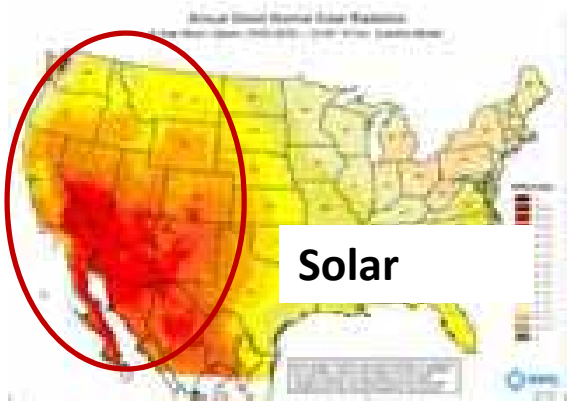
The ISO has identified four characteristics of conventional generation that variable resources should provide

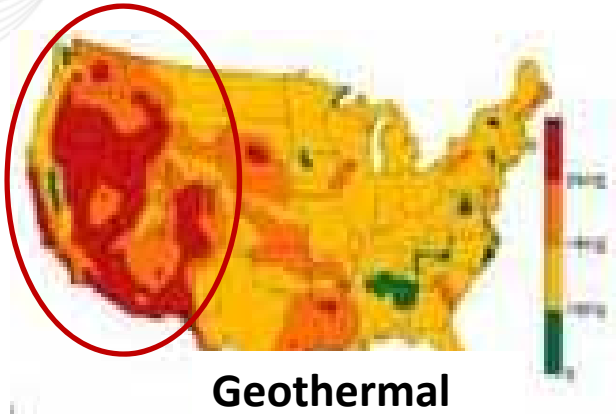
- Capability to provide reactive power support to the electric system;
  - Design and operating criteria
  - Voltage regulation and reactive power control requirements
- Capability to provide inertial response,
- Capability to increase or reduce energy output automatically in response to system frequency, and
- Ability to limit power production as needed (in smallest reasonable increments up to and including disconnection), for reliability reasons.

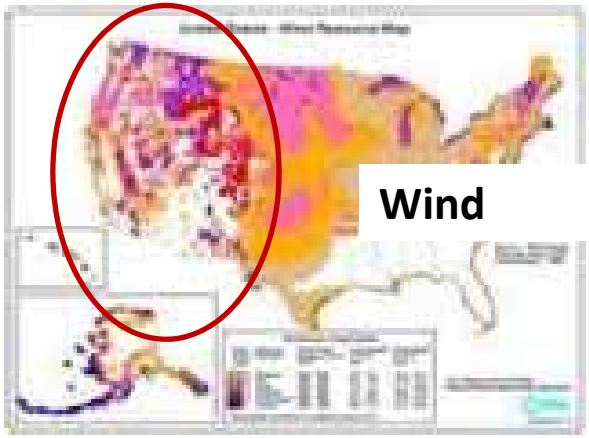
Rebecca Wagner
Public Utilities Commission of Nevada

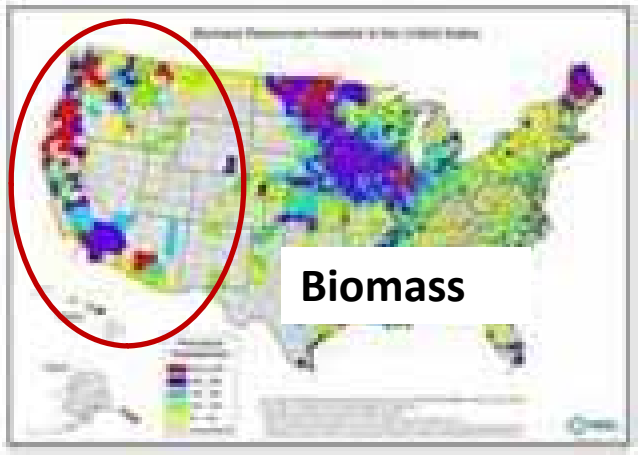
Panel # 5 Integration of Variable Generation
Feb. 7, 2013

Excellent and Diverse Renewable Resources

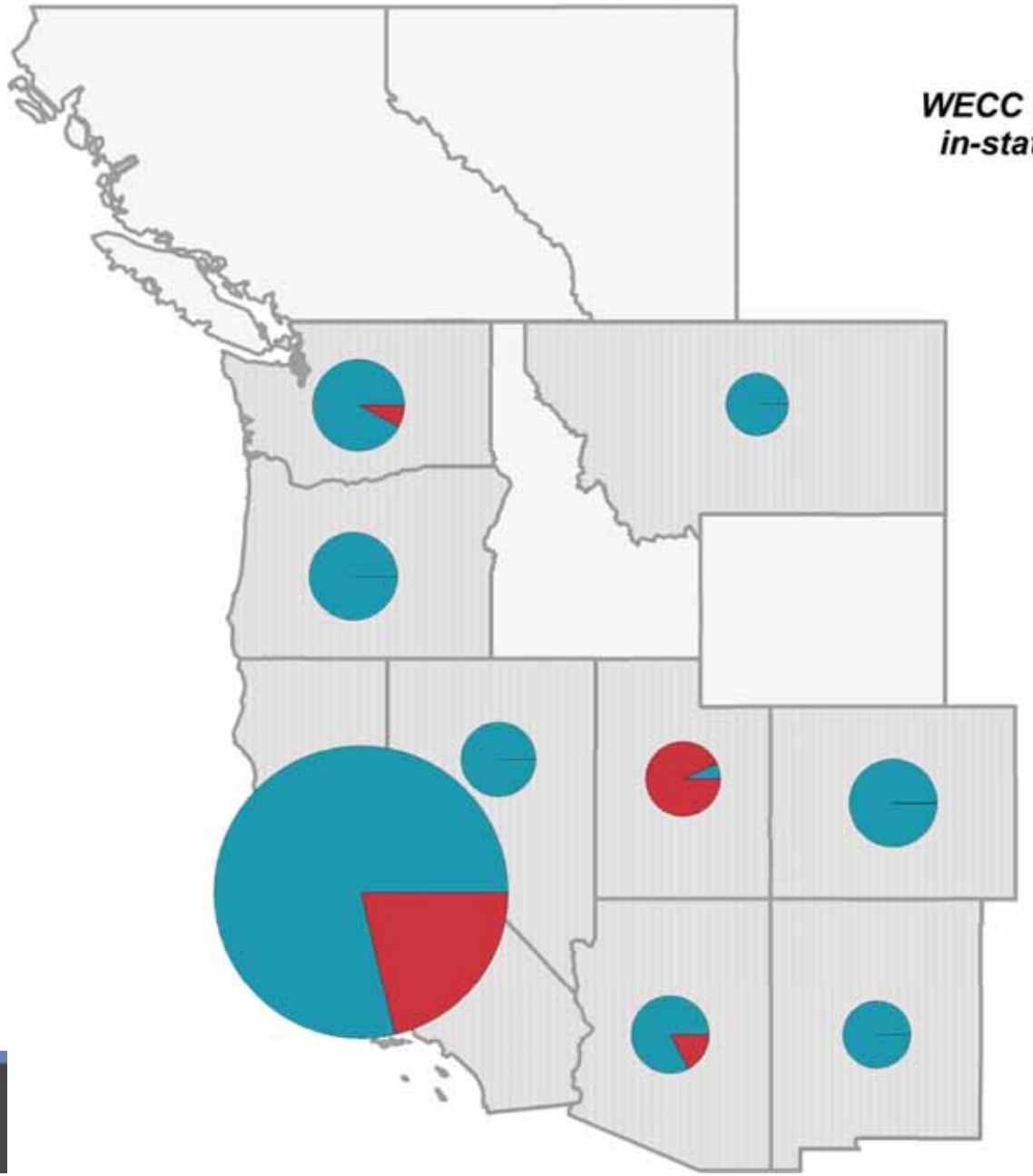








RPS Compliance Using In and Out of State/Province Resources (by Energy)



WECC Wide: 81% of RPS energy served by in-state resources in 2022 Common Case

State/Province with RPS Goal or Mandate

State/Province without RPS Goal or Mandate

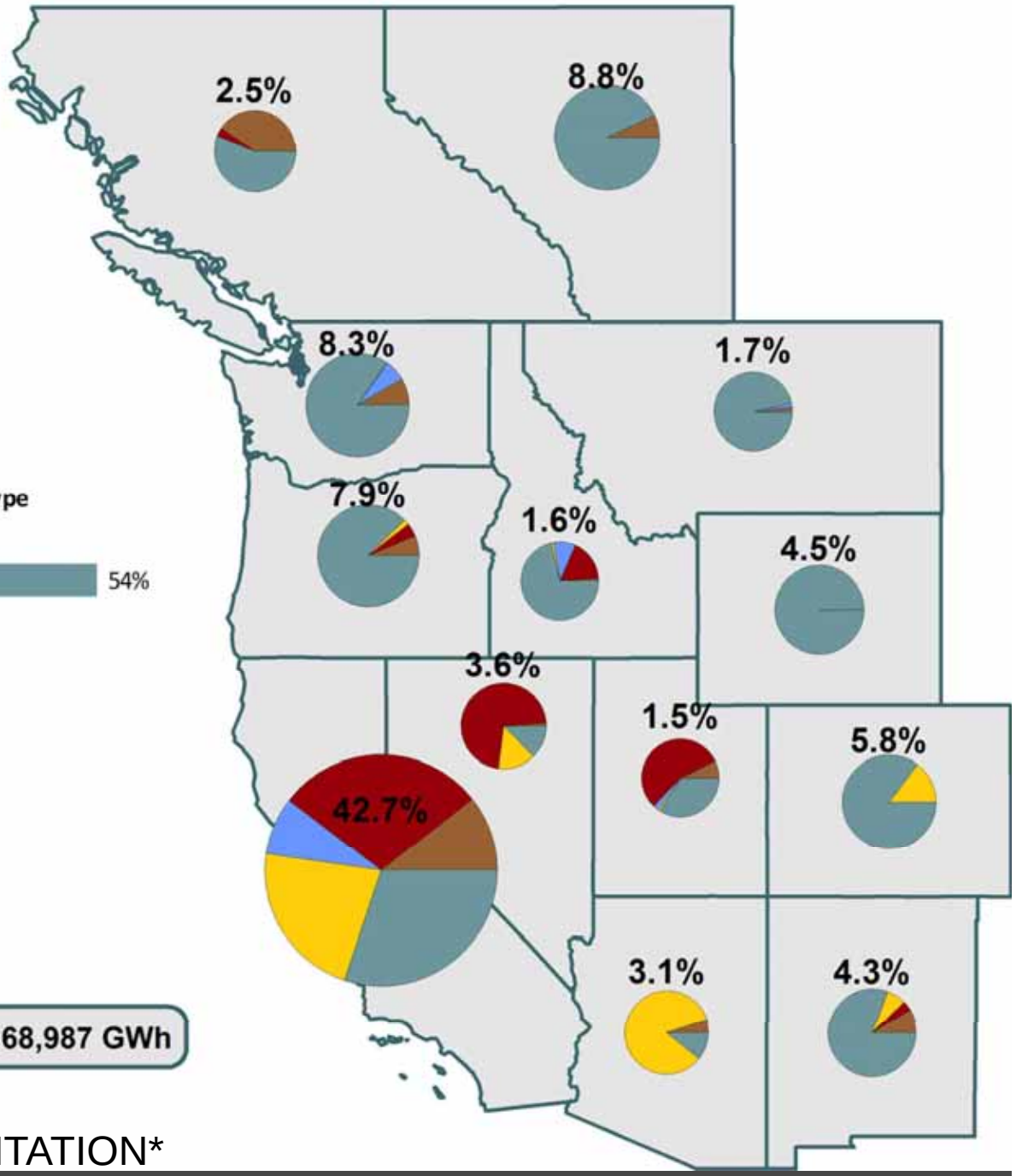
In-State Resources

Out-of-State Resources

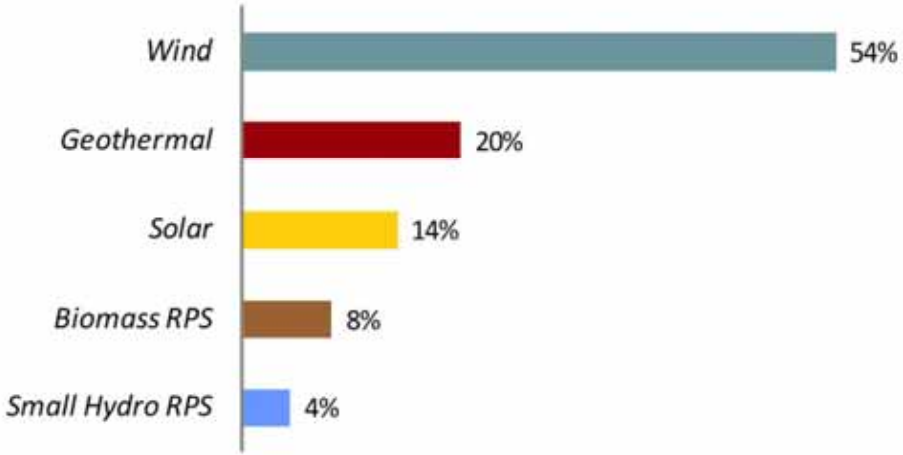
Percentage of 2022 Total Renewable Energy Generation by Type and State/Province

- Biomass RPS
- Geothermal
- Small Hydro RPS
- Solar
- Wind

Note: Mexico (CFE) = 3.7%
Texas (El Paso) = 0%



Percentage of Renewable Generation by Type



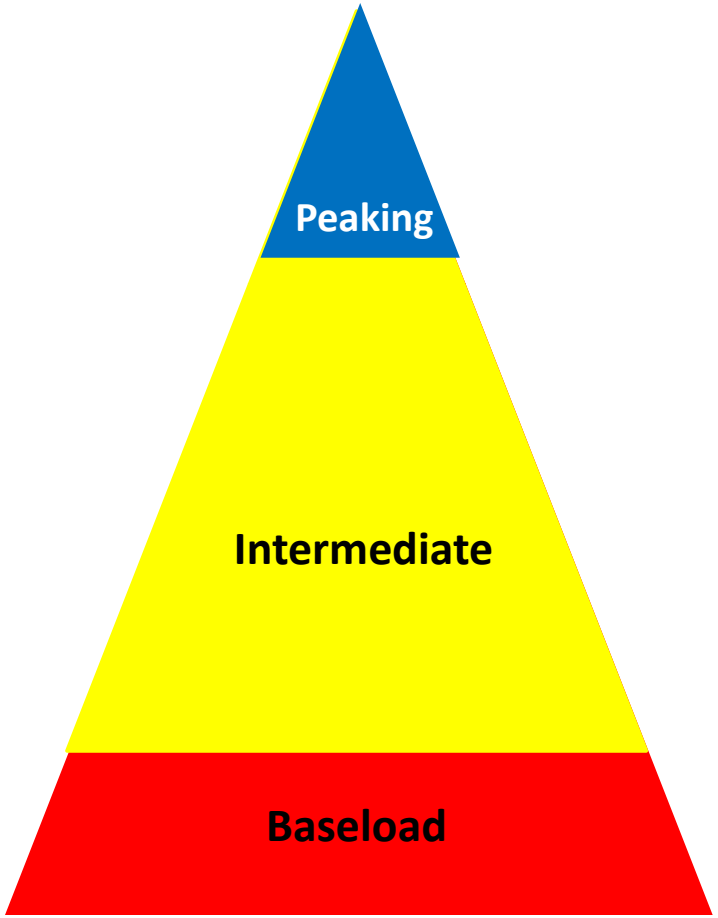
2022 WECC Renewable Generation: 168,987 GWh

END OF THIS PRESENTATION

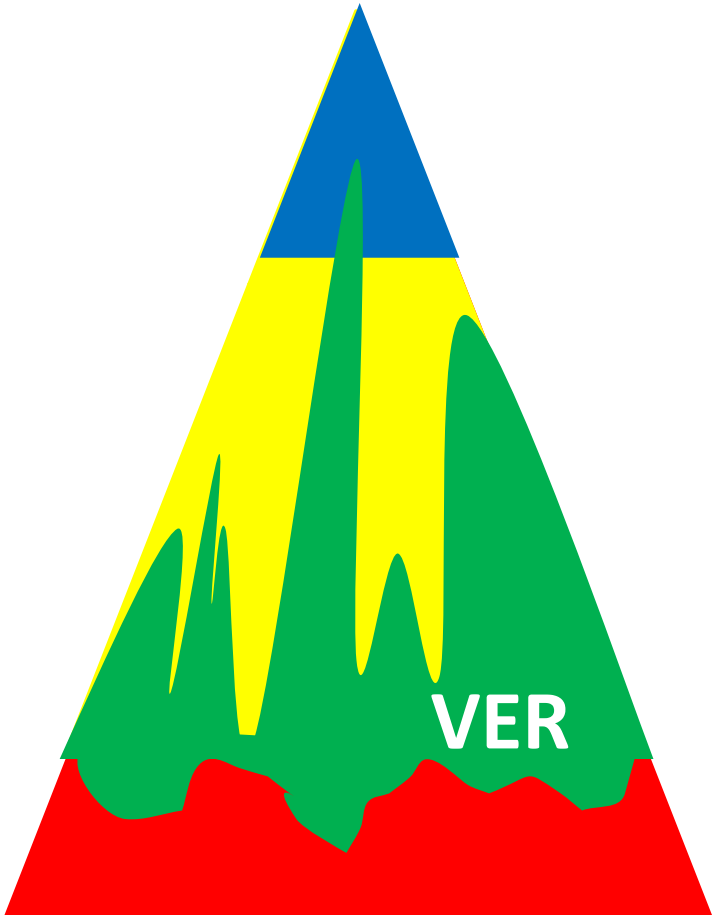
Integration of Variable Generation

Doug Larson, Executive Director
Western Interstate Energy Board

What we need: MORE SYSTEM FLEXIBILITY



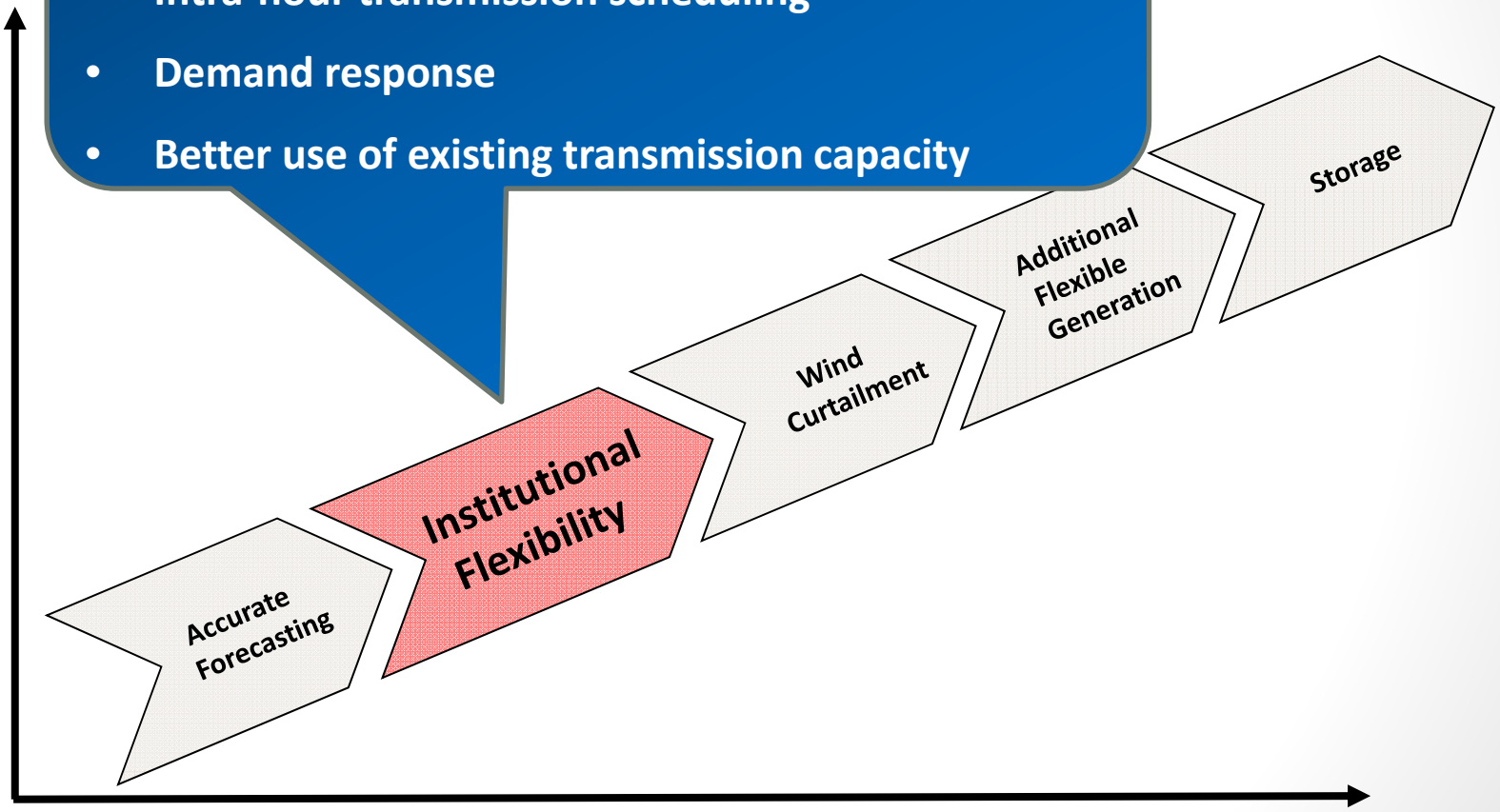
Old Paradigm



New Paradigm

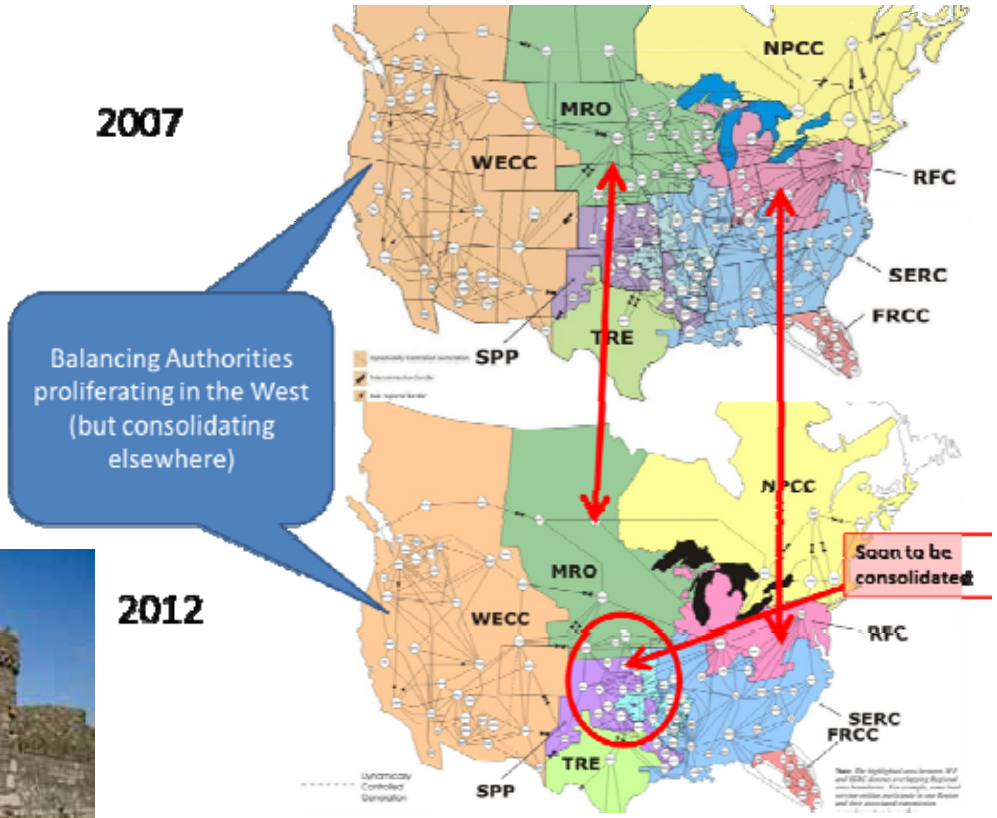
Flexibility Supply Curve

- Balancing resources over a large geographic area
- Faster energy markets
- Intra-hour transmission scheduling
- Demand response
- Better use of existing transmission capacity



What we have:

38 SEPARATE BAs, SLOW BI-LATERAL MARKETS



What's Being Done Now

- Better wind/solar forecasting practices are being developed and deployed
- Measures to increase institutional flexibility are being considered
  - Energy Imbalance Market being studied
    - Past analyses by the PUC EIM Group and WECC
    - Ongoing study by the Northwest Power Pool
  - Other flexibility measures being studied
    - Expand a largely unused tool for faster bi-lateral markets
    - Dynamic scheduling
    - Intra-hour transmission
    - Reform of reserve sharing pools to address extreme ramps
- States/provinces are also –
  - Developing a "dashboard" on company actions to lower integration costs
  - Studying the use of Demand Response for integrating variable generation
  - Evaluating historical flows, schedules and ATC on transmission paths
  - Exploring new transmission technologies

END OF THIS PRESENTATION

NARUC “3-I” Meeting

Steve Beuning

Thursday 2/7/13, 1045AM

Comments from Xcel Energy

303-571-2711

Wind Penetration (YE 2012)

	PSCo	NSP	SPS
Installed Capacity (MW) as % of System Peak Load	***(2168)*** **31%**	***(1867)*** **20%**	***(734 / 1478)*** **13%**
Installed Capacity (MW) as % of System Minimum Load	83%	55%	28%
Wind Generation (MWh) as % of Annual System Energy	16%	11%	6.6%

Outlook for Xcel Energy Renewable Development

- NSP System
  - Next resource plan seeking more renewables, will issue an RFP in mid-February
- PSCO System
  - Will test the market for wind later this year, and will decide based on economics
- SPS System
  - Set for couple years, but seeing increased QF volume, which does not credit towards RPS compliance (per Texas RPS statute)

Renewable Integration Observations

- What works:
  - Large regional markets
  - Regional network transmission access
  - Optimized ancillary services
  - Reliability-Based Control (RBC) balancing standard
- Less efficient:
  - Bilateral-only markets
  - Balkanized transmission providers
  - Lack of regional tools for seams coordination and dispatch optimization

END


The 3 Interconnections Meeting
Lauren Azar
U.S. Department of Energy
Senior Advisor


The 3 Interconnections Meeting
Keynote Speaker
Dr. Steven Chu
U.S. Department of Energy
Secretary of Energy

The 3 Interconnections Meeting

Lunch

* 12:30 – 1:15 p.m. *


The 3 Interconnections Meeting
Panel 6
Interconnection-wide
Planning and Regulation


The 3 Interconnections Meeting
Closing Remarks
The Honorable
Colette Honorable
Arkansas