Relevant DOE Office of Electricity-Funded Work

National Summit on RPS

CESA State-Federal RPS Collaborative

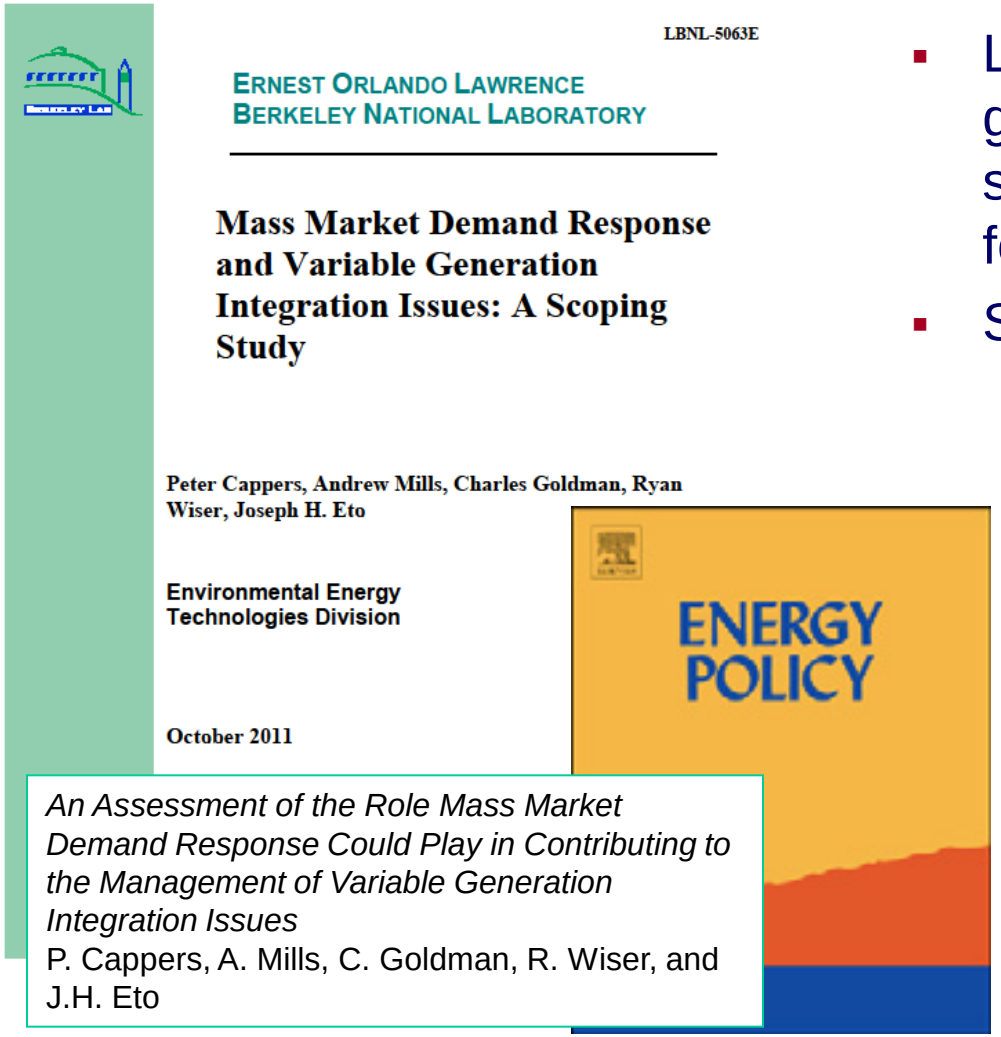
Washington, DC
December 3, 2012

Larry Mansueti, Director State and Regional Assistance

Outline

- Variable Renewables Integration
- State Policy Technical Assistance
- NARUC ARRA Assistance to Member PUCs
- Miscellaneous
- Interconnection-Wide Planning (ARRA $)
  - West
  - East
  - ERCOT
  - Generic

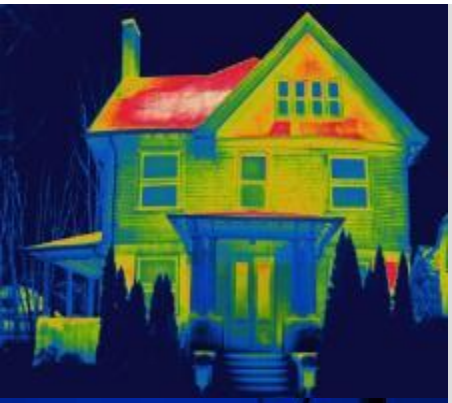
LBNL: Potential Role of Demand Response in Integrating Wind and Solar Generation



An Assessment of the Role Mass Market Demand Response Could Play in Contributing to the Management of Variable Generation Integration Issues
P. Cappers, A. Mills, C. Goldman, R. Wiser, and J.H. Eto

- Large scale deployment of variable generation resources (i.e., wind and solar) poses integration challenges for bulk power system operators
- Scoping study:
  - Assesses potential role of DR and Identifies technical, institutional and customer acceptance barriers that limit role of DR as strategy to facilitate integrating wind and solar resources
  - Develops framework and identifies metrics to compare alternative strategies currently used by system operators to integrate renewable generation

Demand Response & Storage Integration Study (EERE &OE)



Project Goals

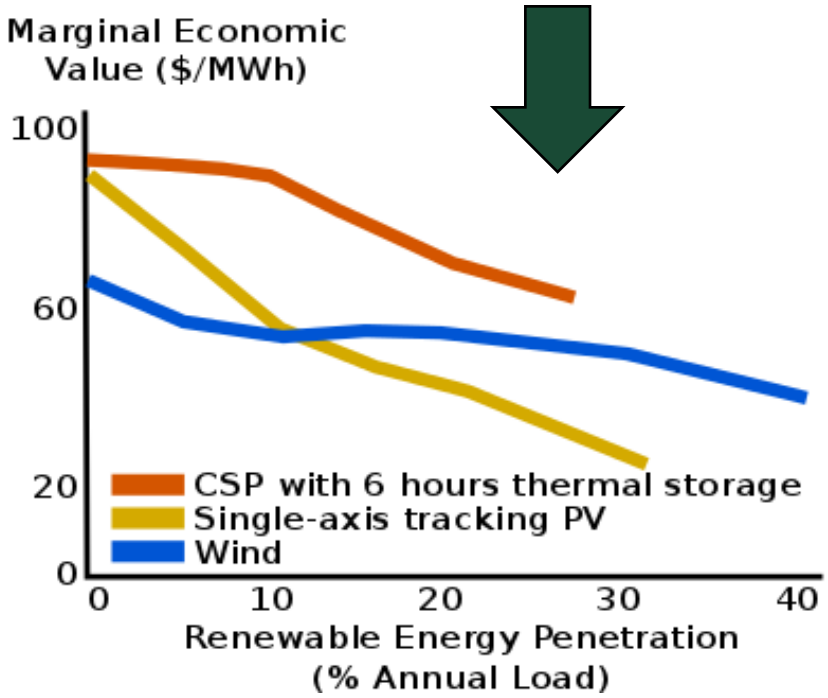
- What are the costs, availability & performance for loads providing ancillary services?
- What are the costs & benefits at the system level for demand response & energy storage providing ancillary services and energy arbitrage?
  - How do the benefits change with increased penetration of wind and solar generation?
  - How do demand response & storage compare with other opportunities for system flexibility?
- Where there are system benefits; what are the deployment obstacles to demand response & energy storage? How can we solve them?

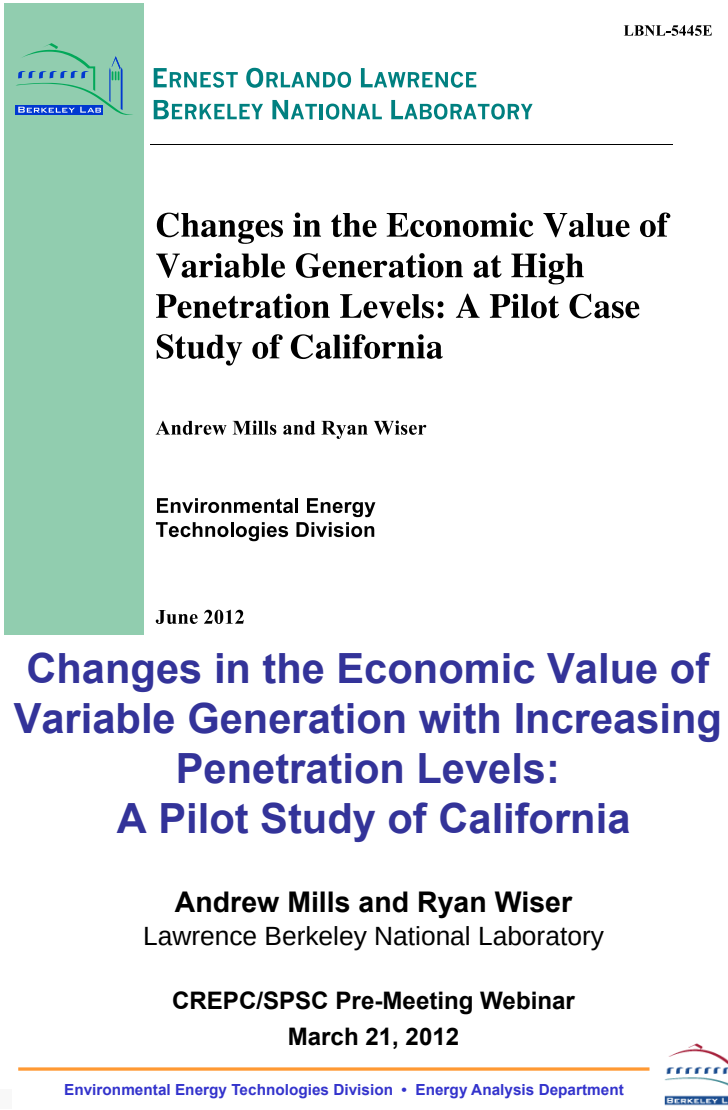
Study Footprint

- Balance scope with available time & leverage of existing efforts
- Demand response resource
  - National resource assessment
  - Detailed operational data for Western Interconnection
- Grid modeling & renewable integration
  - Test cases based on the Rocky Mountain Power Pool
  - Primary cases on full Western Interconnection
- Policy, market & regulatory
  - National overview
  - Detailed case studies on CO, WI, TX, NJ.

LBNL: Impact of Increasing Variable Generation Penetration on "Economic Value"

The incremental economic wholesale market "value" (accounting for integration costs, conventional plant flexibility limits, etc.) of variable generation changes with penetration. Changes are primarily driven by **energy** and **capacity** value.





LBNL: Short-Term Variability and Grid Integration of Variable Renewable Generation

LBNL-3884E

ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Implications of Wide-Area Geographic Diversity for Short-Term Variability of Solar Power

Andrew Mills and Ryan Wiser

Environmental Energy Technologies Division

September 2010

ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY
Environmental Energy Technologies Division
1 Cyclotron Rd., MS 90-4000, Berkeley, CA 94720
ph: 510-486-4059, fax: 510-486-6996, ADMills@lbl.gov

Review of PG&E Renewable Integration Model and CAISO 33% RPS Analysis

Andrew Mills[1], Erik Ela[2], Bri-Mathias Hodge[2], Brendan Kirby[2], and Michael Milligan[2]

[1]Lawrence Berkeley National Laboratory, Electricity Markets and Policy
[2]National Renewable Energy Laboratory, Transmission and Grid Integration Group

December 21, 2010

© PHOTODISC, SOLAR PANELS COURTESY OF SUNEDISON

THE U.S. DEPARTMENT OF ENERGY'S NATIONAL Renewable Energy Laboratory, Sandia National Laboratories, the Solar Electric Power Association, the Utility Wind Integration Group, and the U.S. Department of Energy hosted a day-long public workshop on the variability of photovoltaic (PV) plants. The workshop brought together utilities, PV system developers, power system operators, and several experts to discuss the potential impacts of PV variability and uncertainty on power system operations.

The workshop was largely motivated by a need to understand and characterize PV variability from the perspective of system operators and planners to avoid unnecessary barriers to the rapid development and interconnection of PV to

Understanding Variability and Uncertainty of Photovoltaics for Integration with the Electric Power System

By Andrew Mills, Mark Ahlstrom, Michael Brower, Abraham Ellis, Ray George, Thomas Hoff, Benjamin Kroposki, Carl Lenox, Nicholas Miller, Michael Milligan, Joshua Stein, and Yih-huei Wan

Digital Object Identifier 10.1109/MPE.2011.940575
Date of publication: 21 April 2011

NREL: Analysis of Proposed Energy Imbalance Market (EIM) in the West

- Request from Western Interstate Energy Board's PUC EIM Task Force for analyses of operational benefit of a possible EIM for better 2020 grid operations with expected wind/solar
- Objectives:
  - employ sub-hourly commitment and dispatch model to more accurately capture 5-minute EIM
  - Alternative scenarios of participation in EIM
  - Provide estimates of individual Balancing Area Benefit (operational cost savings only, implementation and other costs not considered)
- Status: Results given at PUC EIM Task Force mtgs and webinars. Draft report released for comment; final report to be released in early 2013. *Various Balancing Authorities looking at EIM and other means to improve grid operations in 2020-plus timeframe when state RPS's mature in the West.*

NREL: Analysis of Eastern Interconnection Frequency Response & Wind

- Objective:
  - FERC issued a 2011 LBNL report on issue of the grid's frequency response
  - Illustrate the impact of wind turbine active power controls on the frequency performance of the Eastern Interconnection
  - Results show primary frequency response of Eastern Interconnect for different generator response scenarios
- Status:
  - Project review meeting 11/29/12
  - Draft final report due by end of December 2012

NREL Western Wind and Solar Integration Study Phase 2

- Wind and solar can cause fossil generators to cycle on/off and ramp more frequently.
  - What are the wear-and-tear costs and emissions impacts of this type of operation?
  - Compare impacts of wind and solar
  - Simulate operations on a 5 minute timescale
- Cycling and ramping result in wear-and-tear costs, but they are small compared to overall fuel savings
- Cycling and ramping results in a small impact on avoided emissions
- Draft report released for comment; Final report expected in early 2013

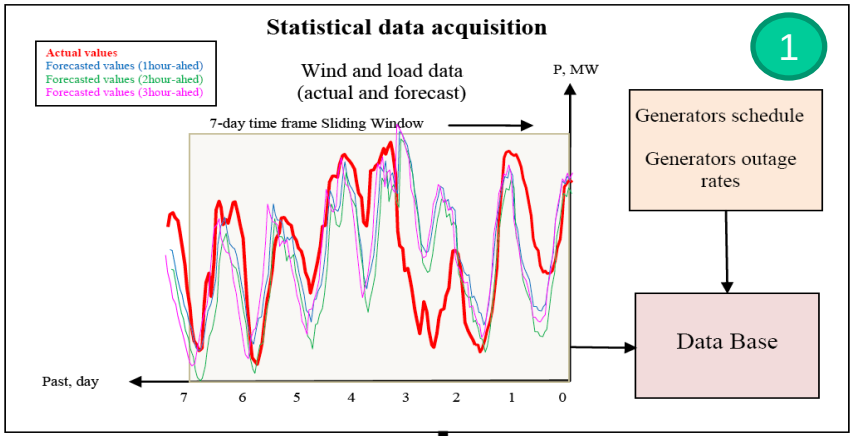
NREL: Eastern Renewable Generation Integration Study (ERGIS)

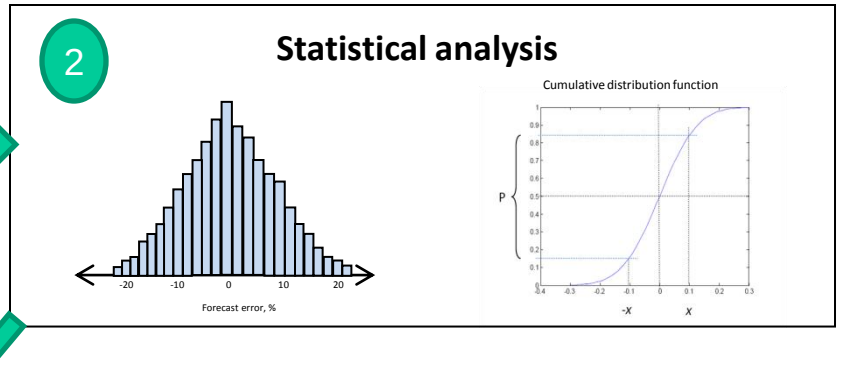
- Follow-on to 2010 Eastern Wind Solar Integration Study (EWITS)
- Look at Reserves Needed for High Wind Solar Levels
  - Statistical analysis of wind, solar and loads
  - Ramp calculations over different timescales
  - Reserve strategies for ramping
- Production Cost Analysis
  - Analyze production costs for different scenarios

NREL: Phasor Measurement Units – How Can These Sensors Help Wind Solar Integration

- PMUs give wide-footprint early warning of grid problems. Now under deployment by grid operators.
- Uses real-time monitoring of primary frequency
  - determination of variable generation impacts on primary frequency and inertia
  - oscillation detection and damping
  - assessing real-time inertia
- Active, automated control of wind and solar plants using PMU data collection and feedback

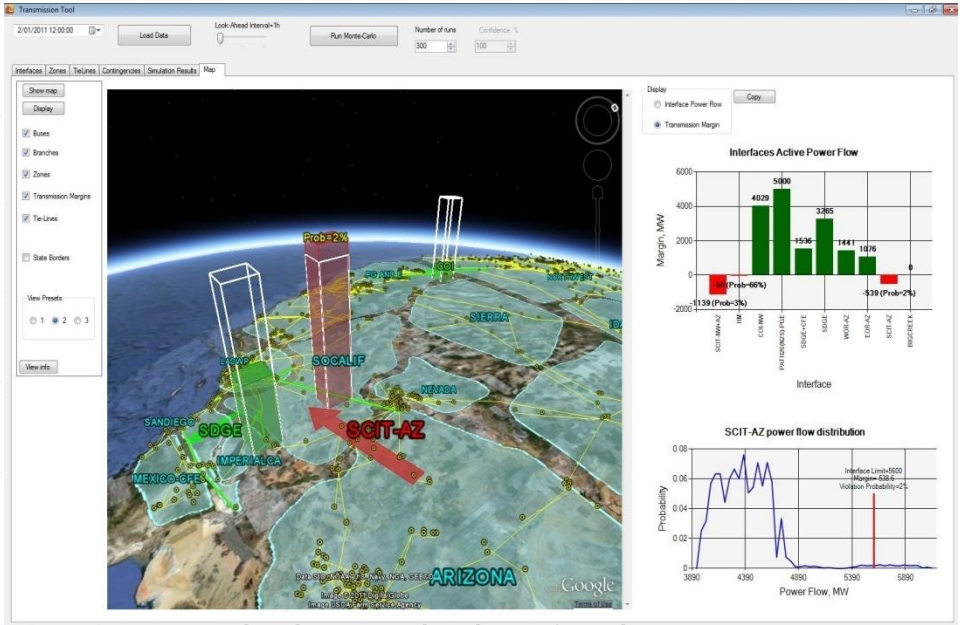
PNNL: Tool for Online Analysis & Visualization of Operational Impacts of Wind & Solar Generation





3

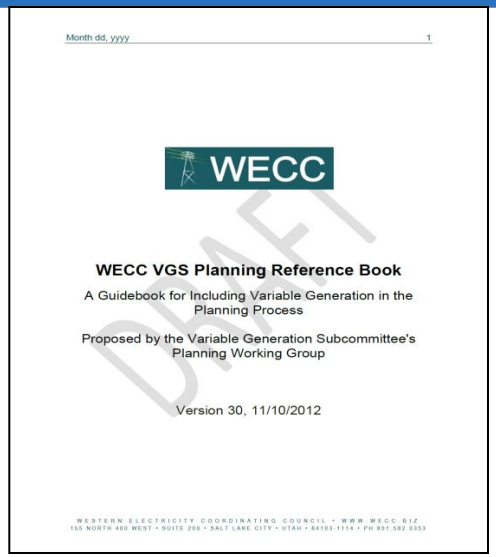
Probability of Exceeding Transmission Path Rating



Contact: Landis Kannberg, landis@pnnl.gov or Yuri Makarov, yuri.makarov@pnnl.gov

PNNL: Planning for Integration of Variable Generation

- **Unbiased snapshot of the grid planning issues and their state-of-the-art solutions related to high penetration levels of renewable generation**
- **Documents the best practices (exist and under development in power system planning)**
- **IS NOT …**
  - **Instructive, statutory, or obligatory**
  - **Duplicating existing planning standards**
  - **Covering operating or market functions, however:**
    - **System planning must be done in context of system operations and market functions**

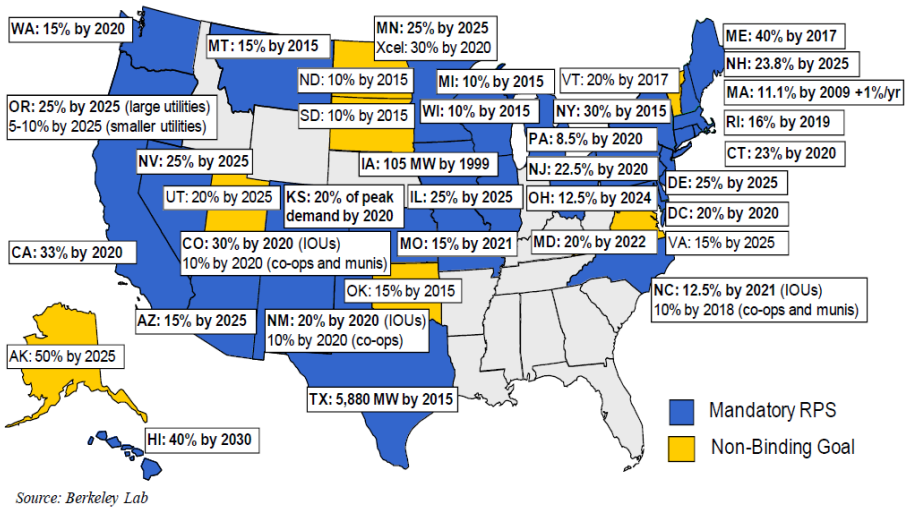


Topics	
Variable Renewable Generators and Their Impacts on Transmission	Transmission Planning
Generation Planning	VG Grid Interconnection Considerations
Considerations for Energy Storage	Other Considerations Influencing Grid Planning
Considerations for Demand Response	Existing Regional VG Planning Practices in the Industry

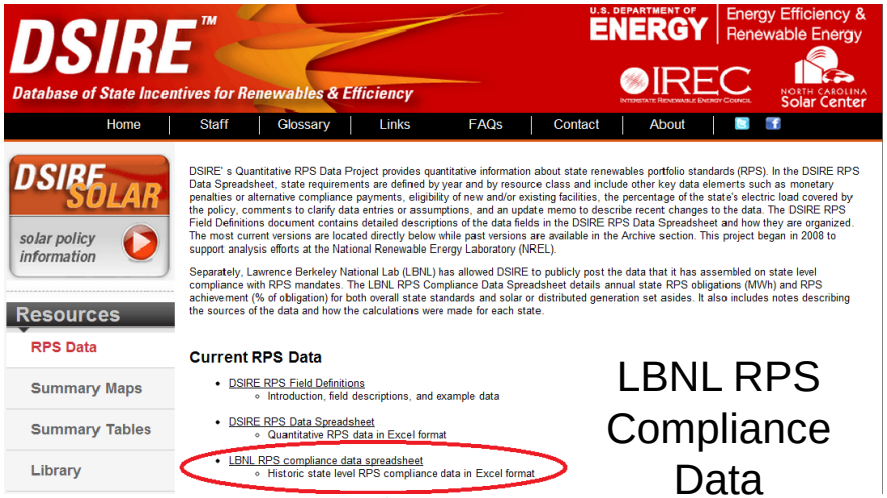
- ***Developed by WECC Variable Generation Subcommittee***
- ***Team led by Yuri Makarov, PNNL (supported by DOE-OE)***
- ***Two Volumes, over 500 References***
- ***DRAFT under WECC review (soon to be publically available)***

Contact: Landis Kannberg, landis@pnnl.gov or Yuri Makarov, yuri.makarov@pnnl.gov

Technical Assistance to and Analysis of State RE Policies: RPS and Clean Energy Funds



Source: Berkeley Lab



LBNL RPS Compliance Data

The State of the States:

Update on the Implementation of U.S. Renewables Portfolio Standards

Ryan Wiser & Galen Barbose
Lawrence Berkeley National Laboratory

2011 National Summit on RPS
Washington D.C.
October 26, 2011

Environmental Energy Technologies Division • Energy Analysis Department
2

LBNL- 3984E

ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Supporting Solar Power in Renewables Portfolio Standards: Experience from the United States

Ryan Wiser and Galen Barbose
Environmental Energy Technologies Division

Edward Holt
Ed Holt & Associates, Inc.

October 2010

Supporting Solar Power in Renewables Portfolio Standards:

Experience from the United States

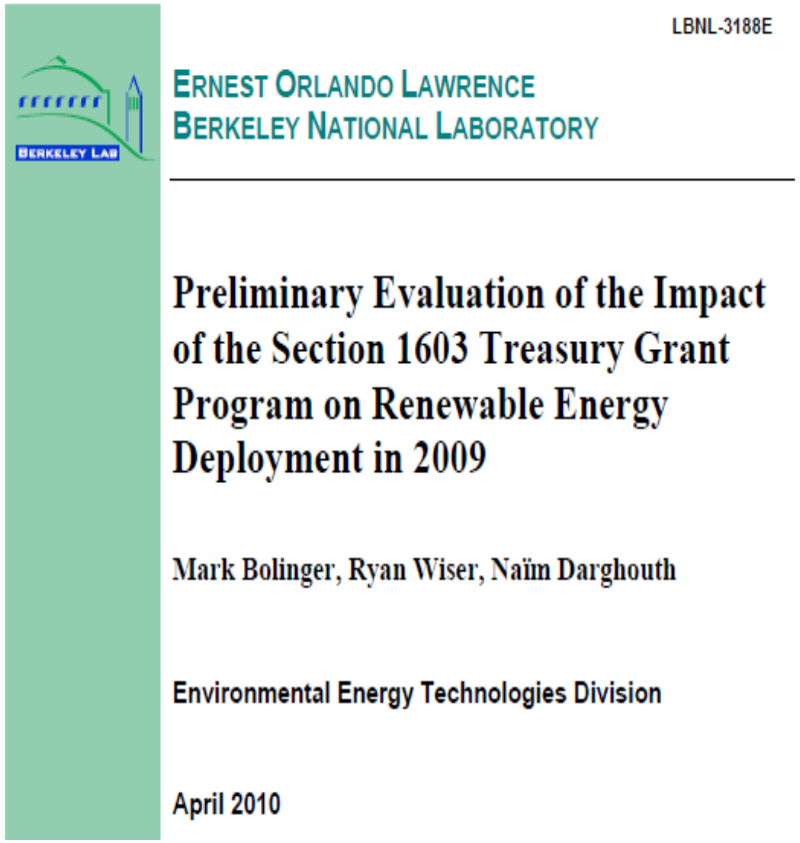
Galen Barbose
Lawrence Berkeley National Laboratory

DOE Northeast Solar Boot Camp
August 26, 2011

This work was supported by: the Office of Energy Efficiency and Renewable Energy (Solar Energy Technologies Program) and the Office of Electricity Delivery and Energy Reliability (Permitting, Siting, and Analysis Division) of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231; the National Renewable Energy Laboratory under Contract No. DEK-8883050; and the Clean Energy States Alliance.

LBNL: Technical Assistance to and Analysis of Issues Related to Federal Renewable Energy Policy

- Targeted technical analysis for DOE and Congress, only on request, on Federal–State interaction issues for CES, and on past federal RES proposals
- At the request of the House Ways and Means Committee, LBNL completed an evaluation of the Section 1603 Treasury grant program, including invited testimony before full committee
- Analysis of issues related to federal tax incentives



LBNL-3188E

ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Preliminary Evaluation of the Impact of the Section 1603 Treasury Grant Program on Renewable Energy Deployment in 2009

Mark Bolinger, Ryan Wiser, Naïm Darghouth

Environmental Energy Technologies Division

April 2010

NARUC ARRA Grant – State Electricity Regulators Capacity Assistance and Training

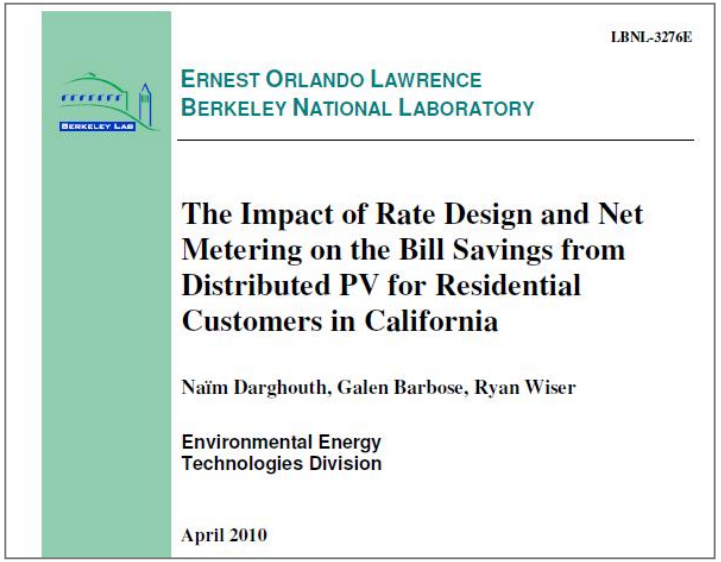
- AZ: study and manage a public hearing process for the development of aggregated net-metering of renewable resources
- MN: wind siting database
- OH: renewable energy resource assessment and alternative compliance payment guidance
- MN: wind turbine noise modeling
- MN: best practices guidelines for assessing sound emissions from proposed wind farms & measuring the performance of completed projects

NARUC ARRA SERCAT Grant (cont.)

- MN: Wind Energy and Wind Park Siting and Zoning Best Practices
- OH: Alternative Energy Resource Market Assessment
- VT: analysis of renewable energy policy options
- VT: RPS implementation guidance
- Clean Energy States Alliance: Designing the Right RPS: A Guide to Selecting Goals and Program Options for a Renewable Portfolio Standard
- http://www.naruc.org/Grants/default.cfm?page=8 *(addtl NARUC RFPs to members will occur)*

LBNL: Rate Design, Net Metering, Customer Economics of DG, and Utility Business Models

- **Past Work:** Impact of rate design & net metering on the current customer economics of commercial & residential PV
- **Current Work:** Potential impact of future changes to electricity market and rate design on the customer economics of PV
- **Next Project:** Impact of DG on utility business models, profitability; implications for regulators



LBNL-3276E

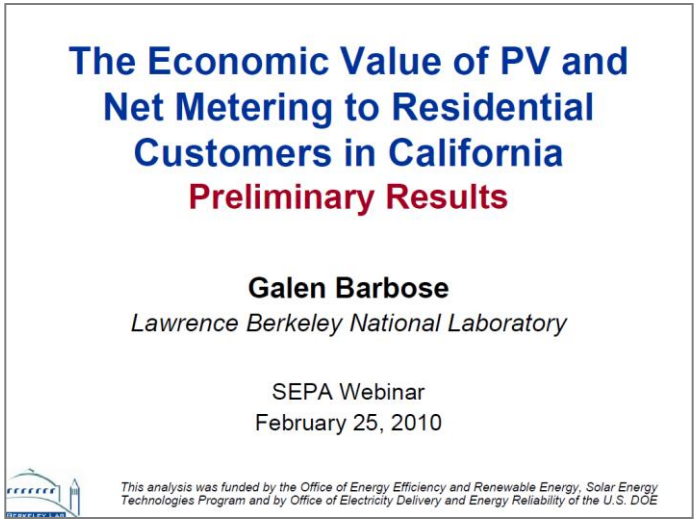
ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

The Impact of Rate Design and Net Metering on the Bill Savings from Distributed PV for Residential Customers in California

Naïm Darghouth, Galen Barbose, Ryan Wiser

Environmental Energy Technologies Division

April 2010

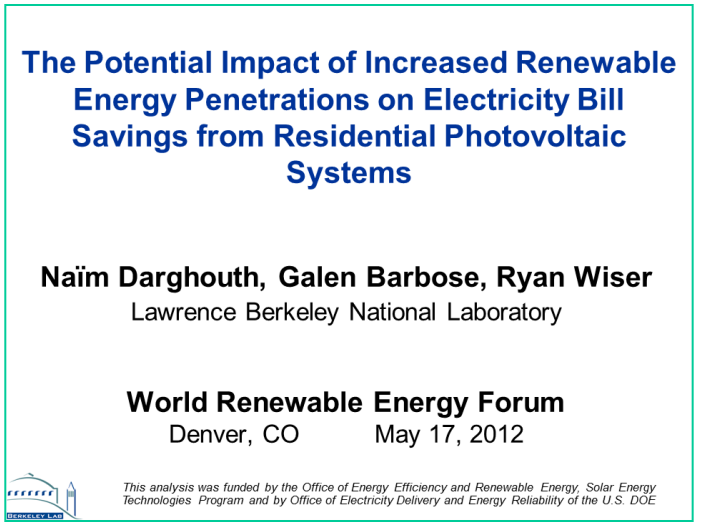


The Economic Value of PV and Net Metering to Residential Customers in California
Preliminary Results

Galen Barbose
Lawrence Berkeley National Laboratory

SEPA Webinar
February 25, 2010

This analysis was funded by the Office of Energy Efficiency and Renewable Energy, Solar Energy Technologies Program and by Office of Electricity Delivery and Energy Reliability of the U.S. DOE



The Potential Impact of Increased Renewable Energy Penetrations on Electricity Bill Savings from Residential Photovoltaic Systems

Naïm Darghouth, Galen Barbose, Ryan Wiser
Lawrence Berkeley National Laboratory

World Renewable Energy Forum
Denver, CO May 17, 2012

This analysis was funded by the Office of Energy Efficiency and Renewable Energy, Solar Energy Technologies Program and by Office of Electricity Delivery and Energy Reliability of the U.S. DOE

CESA: State & Federal Energy Storage Technology Advancement Partnership (ESTAP) Overview

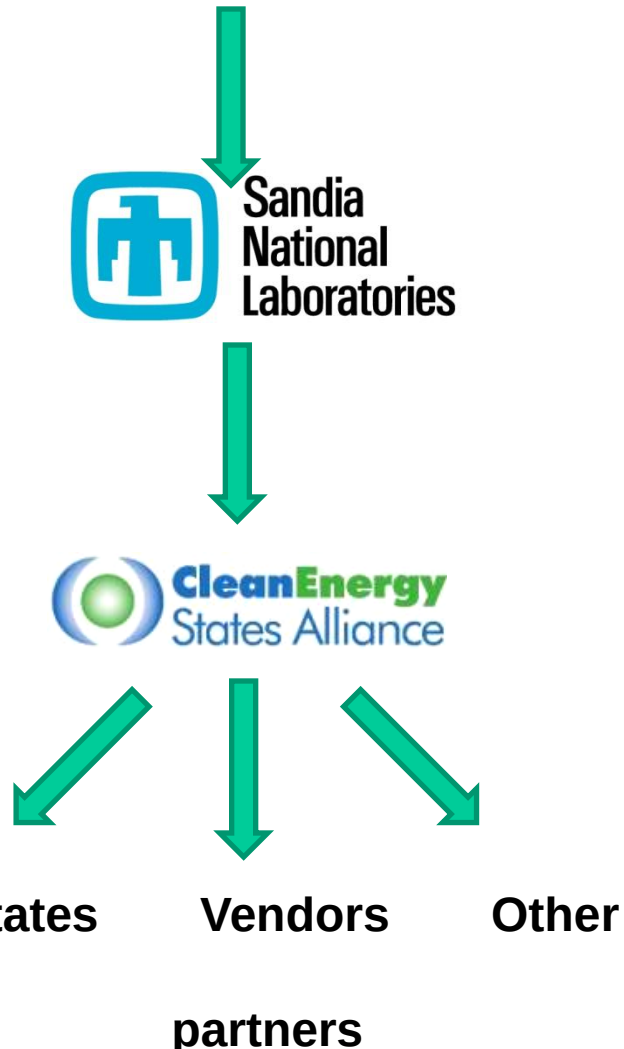
DOE Office of Electricity Delivery and Energy Reliability

Purpose: Create new DOE-state energy storage partnerships and advance energy storage, with technical assistance from Sandia National Laboratories

Focus: Distributed electrical energy storage technologies

Outcome: Near-term and ongoing project deployments across the U.S. with co-funding from states, project partners, and DOE

CESA project director: Todd Olinsky-Paul
(Todd@cleanegroup.org)



PNNL Project: National Assessment of Energy Storage Considering Regional Differences

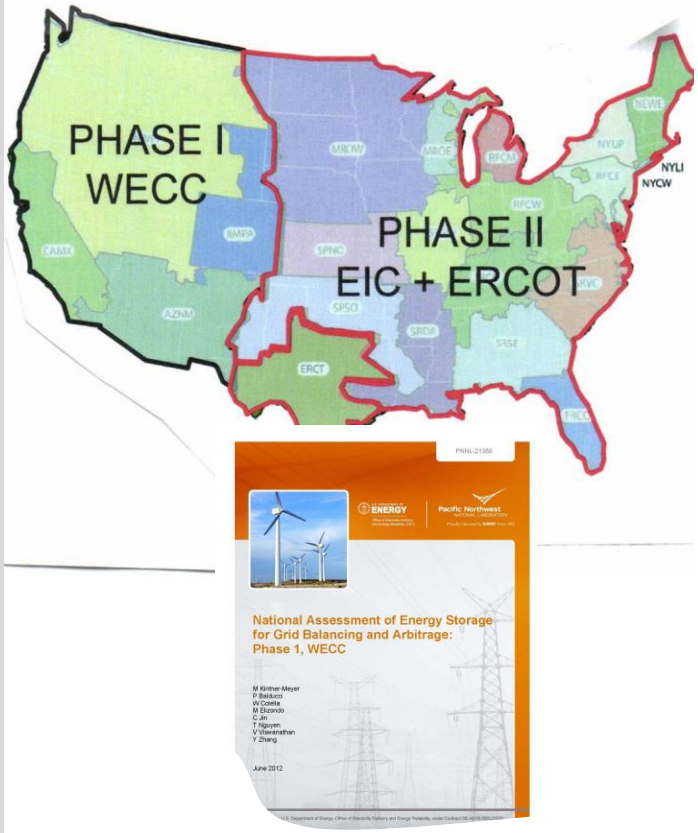
Objectives

Determine:

- Future balancing requirements needed by 2020 to accommodate assumed 20% RPS,
- Market size for storage and respective cost targets for balancing and energy arbitrage by regions,
- Most cost-effective technologies to meet additional balancing requirements.

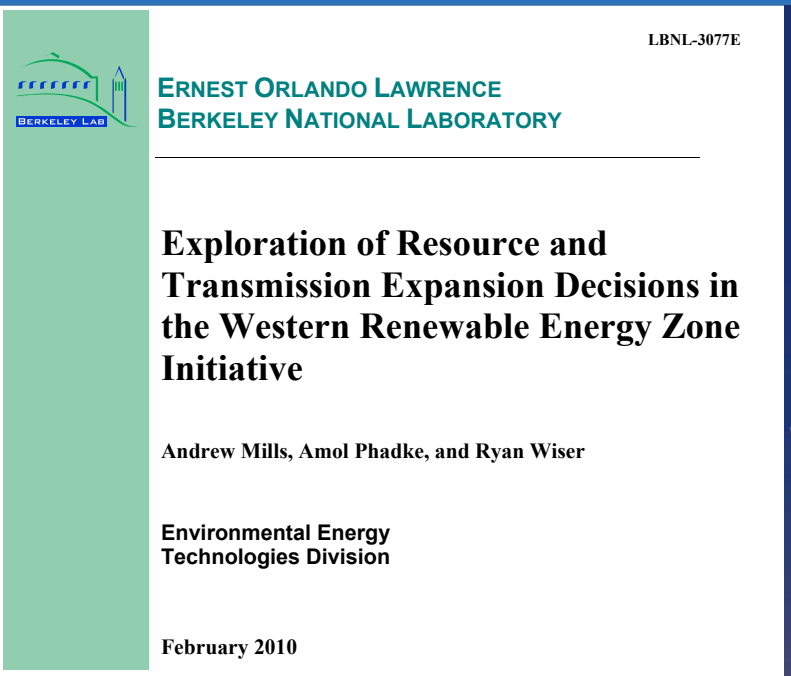
Value:

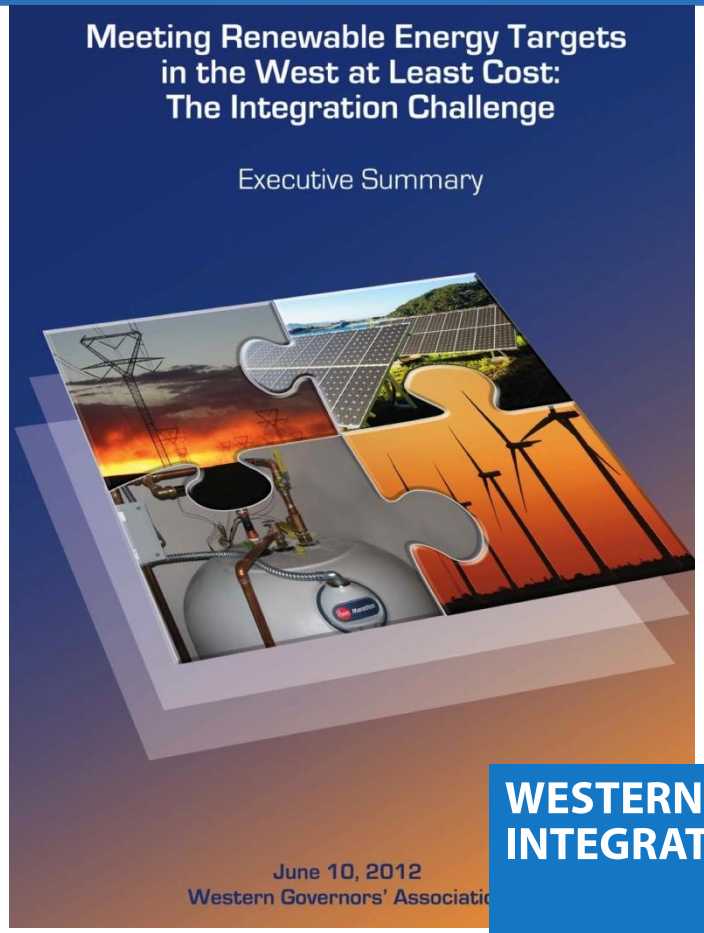
- Provides plausible market potential estimates of energy storage for the investment community and policy makers in a nine-year forecasting time horizon (2020)
- Differentiates markets for short- (< 1h) and longer-term storage (>4 hours)
- Reveals key assumptions and their influence on the outcome of the analysis



National Assessment: Phase I- Report available at: http://energyenvironment.pnnl.gov/pdf/PNNL-21388_National_Assessment_Storage_Phase_1_final.pdf

Western Renewable Energy Zones and Integration Technical Assistance: LBNL

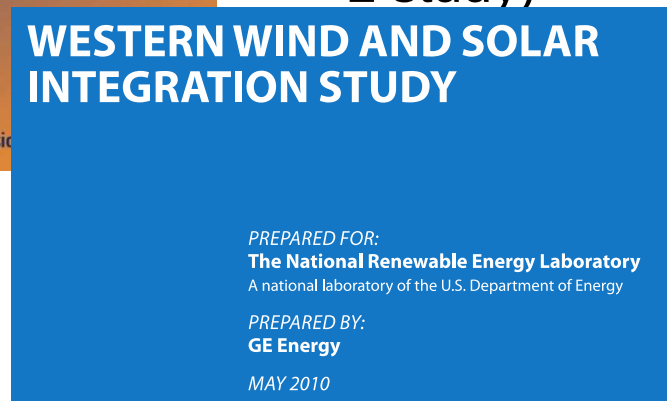




Technical review committee member of:

WGA renewable integration challenges report

WWSIS (currently serving on TRC for follow-up Phase 2 study)



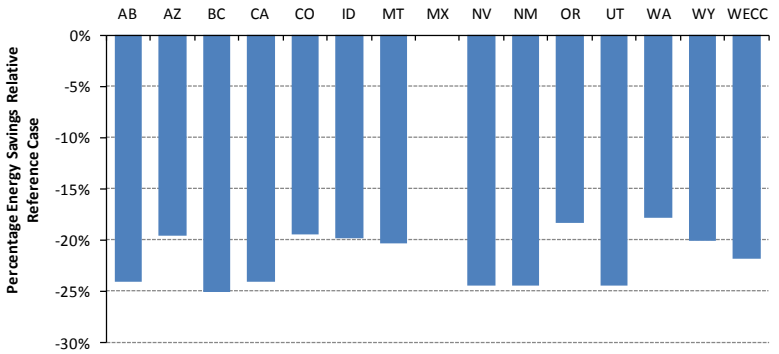
WECC

Western Renewable Energy Zone (WREZ) Initiative
Tuesday, September 27th 2011
Webinar

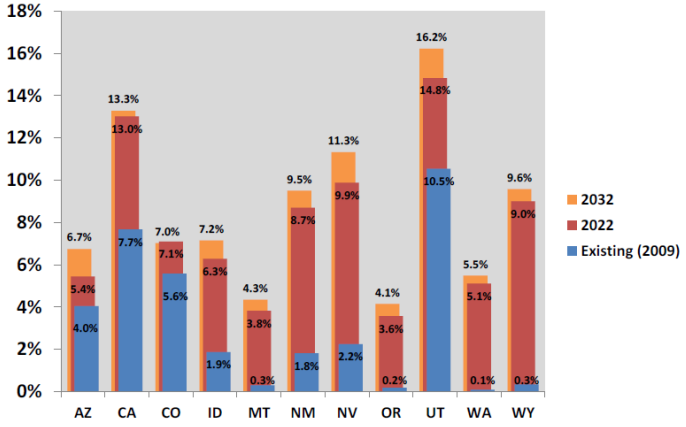
Advising Western Regional Transmission and Utility Planning: LBNL

- Assist WGA and WECC with modeling energy efficiency, demand response, DG, and RE in transmission planning
- Tech. lead for DSM Working Group: analyze utility load forecasts to assess extent to which current DSM policies/ programs are captured, develop high DSM forecasts to reflect cost-effective EE
- Lead development of updated DR potential estimates for western states; develop DR dispatch algorithms for production cost and capacity expansion modeling
- Conducted comparative analysis of utility resource plans and synthesized data for application to regional planning studies
- Nearing completion of an evaluation of solar valuation methods used in utility resource planning and procurement processes
- Past work examining how utilities manage carbon regulatory risk, & treat renewable energy

High DSM Scenario Energy Efficiency Savings



Updated DR Potential
(Percent of Peak Demand)



Note: Existing DR is included here as it was reported by utilities to FERC for its 2008 and 2010 Assessment of Advanced Metering and Demand Response.

Smart Grid Investment Grants (DOE ARRA)

Deploying technologies for immediate commercial use supporting manufacturing, purchasing, and installation of smart grid technologies

Customer Systems	Advance Metering Infrastructure	Electric Distribution Systems	Electric Transmission Systems	Equipment Manufacturing
				
• Displays • Portals • Energy management • Direct load controls	• Smart meters • Data management • Back office integration	• Switches • Feeder optimization • Equipment monitoring • Energy storage	• Wide area monitoring and visualization • Synchrophasor technology • Energy storage	• Energy devices • Software • Appliances

99 projects, $3.4B Federal + $4.6B Private Investments

Smart Grid Demonstration Program (DOE ARRA)

Smart Grid Demonstration Projects.

Total Value of $1.6 Billion.

Demonstrate emerging technologies and alternative architectures to validate business models and address regulatory/scalability issues

Grid-Scale ES Applications

- Large Battery Systems (3 projects, 53MW)
- Compressed Air (2 projects, 450MW)
- Frequency Regulation (20MW)
- Distributed Projects (5 projects, 9MW)
- Technology Development (5 projects)

Smart Grid Regional Demonstrations

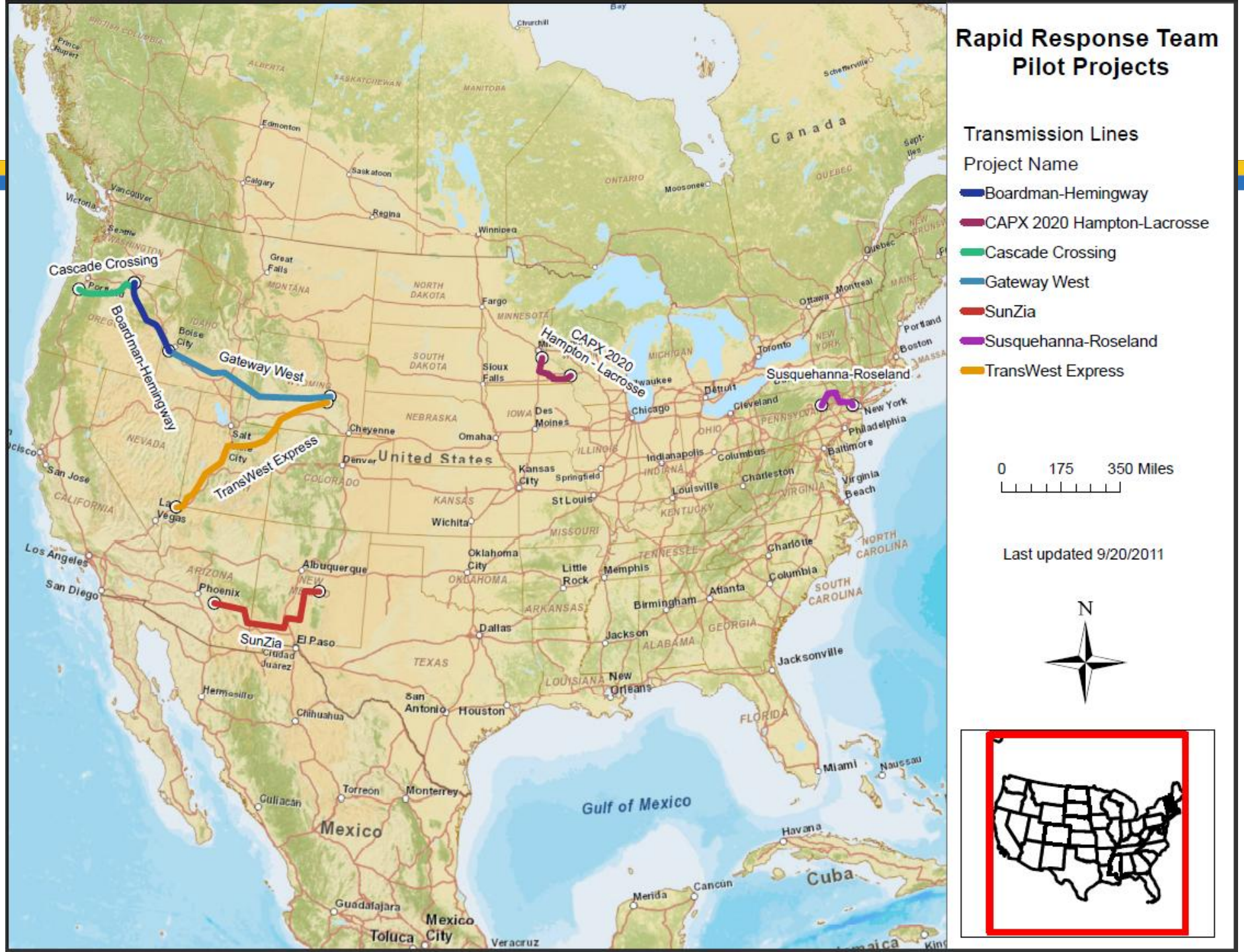
- 12 AMI
- 10 PEV charging points
- 10 HAN
- 9 In-home displays
- 9 SCADA improvements
- 8 Energy storage
- 8 Distribution automation

32 projects, $620M Federal + $980M Private Investments

Federal Rapid Response Team for Transmission

- The Federal Rapid Response Team for Transmission (RRTT) continues its dual mission:
  - 1) *Near Term*: work with seven pilot projects to capture lessons learned and best practices regarding transmission permitting and siting processes
  - 2) *Long Term:* implement institutional changes to transform the way transmission is sited and permitted

  → *The purpose is to improve efficiencies and communication among Federal agencies, as well as with state, local, and tribal governments on current and future transmission projects*


Rapid Response Team
Pilot Projects
Transmission Lines
Project Name
Boardman-Hemingway
CAPX 2020 Hampton-Lacrosse
Cascade Crossing
Gateway West
SunZia
Susquehanna-Roseland
TransWest Express
0 175 350 Miles
Last updated 9/20/2011
N
Cascade Crossing
Boardman-Hemingway
Gateway West
CAPX 2020 Hampton - Lacrosse
Susquehanna-Roseland
TransWest Express
SunZia
United States
Canada
Mexico
Gulf of Mexico
Cuba

2012 DOE Transmission Congestion Study

- Final draft being routed for concurrence, and will be posted in Federal Register soon
- Recommendations to make 2015 Congestion Study a much more efficient and effective assessment based on consistently defined and monitored flowgates within regions and across seams

DOE's Internal Grid Tech Team: Vision of the Future Grid

(Is a cross-cutting DOE internal team to better coordinate DOE R&D efforts)

A *seamless*, cost-effective electricity system, from generation to end-use, capable of meeting all clean energy demands and capacity requirements, while allowing consumer participation and electricity use as desired:

- Significant scale-up of clean energy (natural gas, nuclear, renewables, fossil with CCUS)
- Allows 100% consumer participation and choice (including distributed generation, demand-side management, electrification of transportation, and energy efficiency)
- 100% holistically designed (including regional diversity, AC-DC hybrid configurations, microgrids, and centralized-decentralized control)
- Accommodates two-way flows of energy and information
- Reliable, secure (cyber and physical), and resilient

Highlights from Interconnection-Wide Planning: West

- Builds on earlier work by Western Electricity Coordinating Council (WECC) and Western Governors Association (WGA)
- Key products:
  - 2011WECC 10-Year Regional Transmission Plan
  - 2013 WECC 10- and 20-Year Regional Transmission Plans (in prep)
  - Creation of West-wide environmental and water consumption information for use in transmission planning analyses
  - Creation of a GIS-based long-term capital expansion planning tool
  - Continuation of Western Renewable Energy Zones & lots more

Interconnection-Wide Planning: West

- Western Renewable Energy Zones various analyses – done for and by Western Gov. Assn
  - Phase 1 Report – ID of Qualified Resource Areas
  - Phase 2 - modeling tool that estimates the relative economic attractiveness of delivering energy from QRAs to load; regional conversations around specific QRAs; report on interviews with resource planners and states
  - Phase 3 Report – CA renewables and transmission planning
- Review of Western utility resource plans (periodic)
- Examination of how utilities in the west manage carbon regulatory risk in their resource plans and assumptions about renewables within utility IRPs
- Estimated the cost of transmission for wind energy based on a review of transmission planning studies

Interconnection-Wide Planning: West

- WECC 10 and 20 yr transmission plans under various scenarios. 20 yr study cases feature:
  - High DSM/DG case
  - Breakthrough technologies case (enhanced geothermal, EVs, solar, offshore wind)
  - Low carbon
- Demand-side inputs (EE, DR, and DG) for WECC transmission planning reference case and alternative scenarios
- Analysis of capacity additions and retirements for TEPPC cases
- CREPC/SPSC transmission technologies forum – spring 2013

Interconnection-Wide Planning: West

- Sponsored three utility resource planners forums – "what are they planning to buy and build…and why"
  - Ex: Oct. 2012 covered –
    - Review of Western utility IRPs
    - Integration of variable renewables
    - Distribution/transmission interface, particularly with more distributed resources
    - Risk analysis in utility planning
    - Gas/electric interdependencies
- Inclusion of wildlife/environmental/cultural sensitivity info in transmission planning
- State wildlife decision support tools
  - Southern Great Plains Crucial Habitat Assessment Tool
  - State-by-state GIS wildlife mapping and tools

Interconnection-Wide Planning: West

- WECC List of "Common Case Transmission Assumptions" (formerly "Foundational Project List")
  - Transmission planner's guesses of what really will be built 10 yrs out in the west
  - WECC analysis of if those lines are sufficient to meet RPSs
- Discussions and various studies on how to better integrate wind and solar
  - PUC EIM Task Force mtgs and supporting analyses by WECC, NREL
  - PNNL integration work for WECC and NWPP
  - WECC reliability analysis for 33% wind/solar
  - WECC Efficient dispatch toolkit
  - WGA's "Meeting Renewable Energy Targets in the West at Least Cost" Report
  - Summary of BA actions to integrate variable generation
  - Review of utility bulk power integration charges

Interconnection-Wide Planning: West

- WGA identification and recommendations on western transmission siting issues – state and Federal siting
- Western Interstate Energy Board and WECC-brokered discussions on FERC Order 1000 implementation
- WECC study of changes that would have to be made across sectors to achieve a 42% reduction in CO2 by 2032
- WECC Long Term Transmission Planning Tool

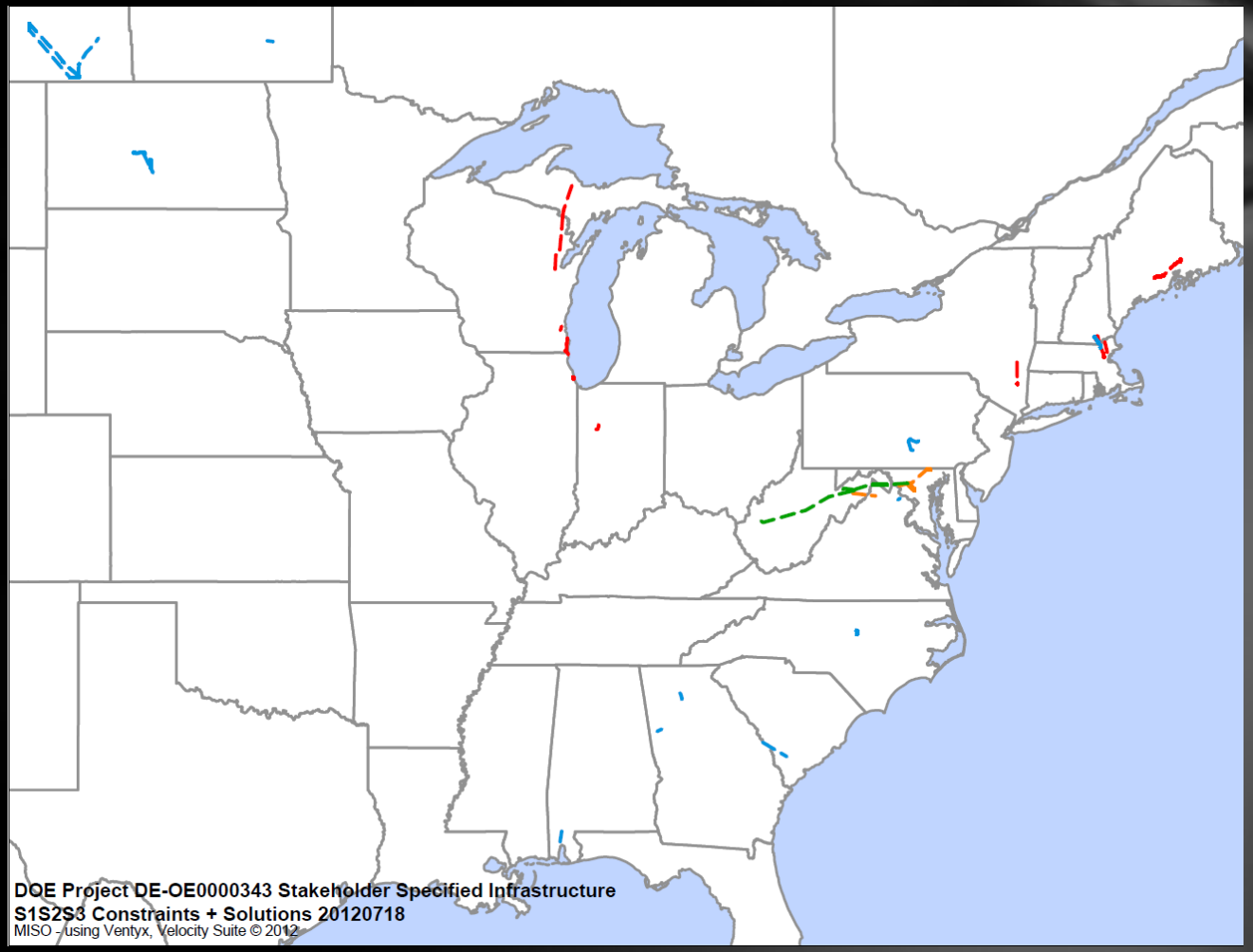
Highlights from Interconnection-Wide Planning: East

- Two new organizations established: Industry-based *Eastern Interconnection Planning Collaborative (EIPC)*, and state-based *Eastern Interconnection States Planning Council (EISPC)*
- Key products:
  - First-ever rollup of 10-year plans prepared by Interconnection's 26 Planning Authorities
  - Phase 1 report: eight 20-year macro-economic futures, with 72 sensitivity cases
  - Phase 2 report (Dec 2012): *three 20-year transmission build-out scenarios chosen to show possible transmission - "bookends"*
  - Eastern "EZ mapper" tool – an electronic energy resource atlas that states and others can use to analyze possible energy zones, transmission routes, pipeline routes, etc

Eastern Interconnection (EIPC) Scenario 3: Business as Usual

Existing conditions including load growth, existing Renewable Portfolio Standards, and current proposed environmental regulations.

Around 200 lines added (50 Generation Interconnection; 165 Constraint Relief). No HVDC. Includes PATH Line through West Virginia (*included to make scenario* feasible).

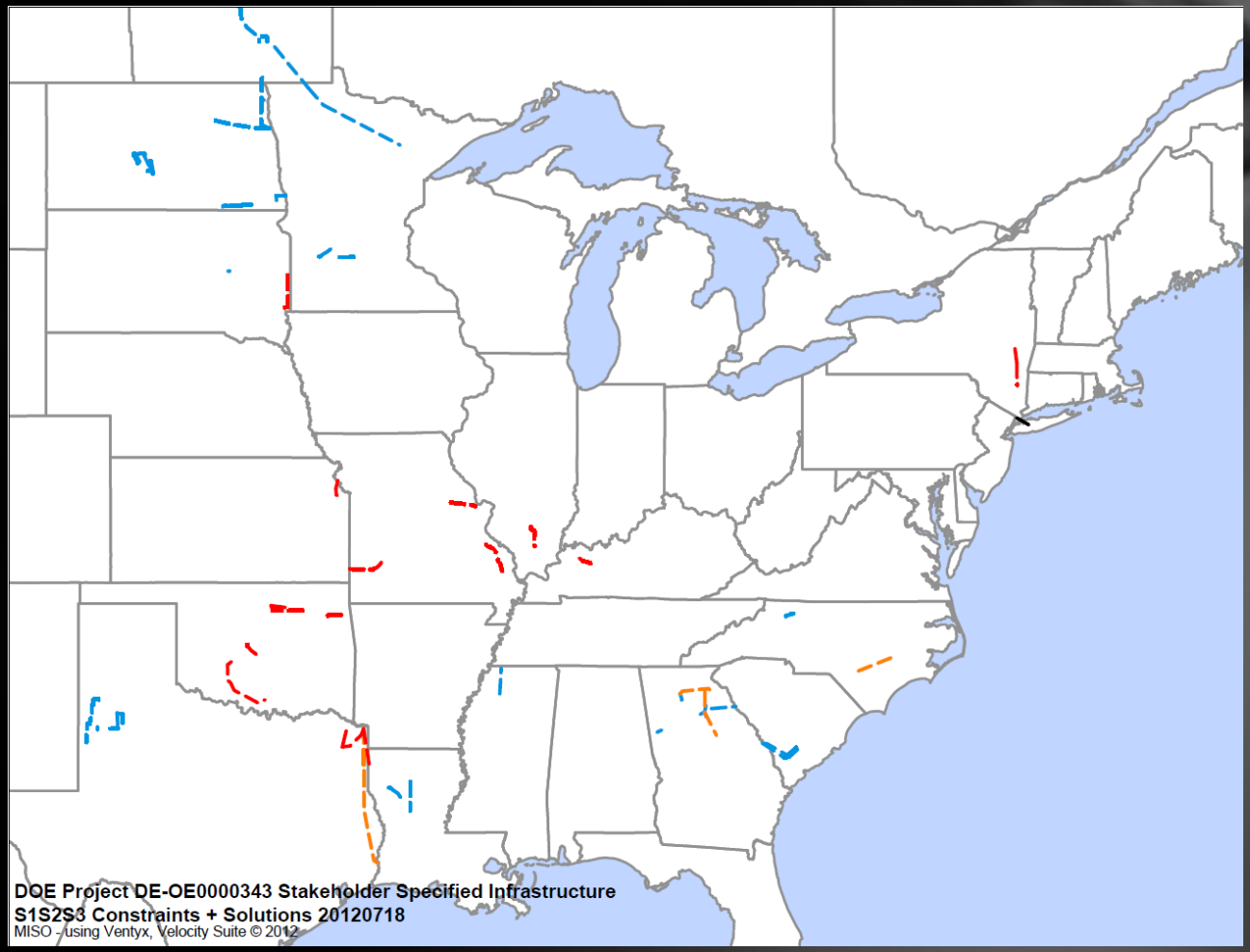


Eastern Interconnection (EIPC) Scenario 2: Nat'l RPS with *Regional* Implementation

Regional implementation

30% of the nation's electricity requirements from renewables by 2030

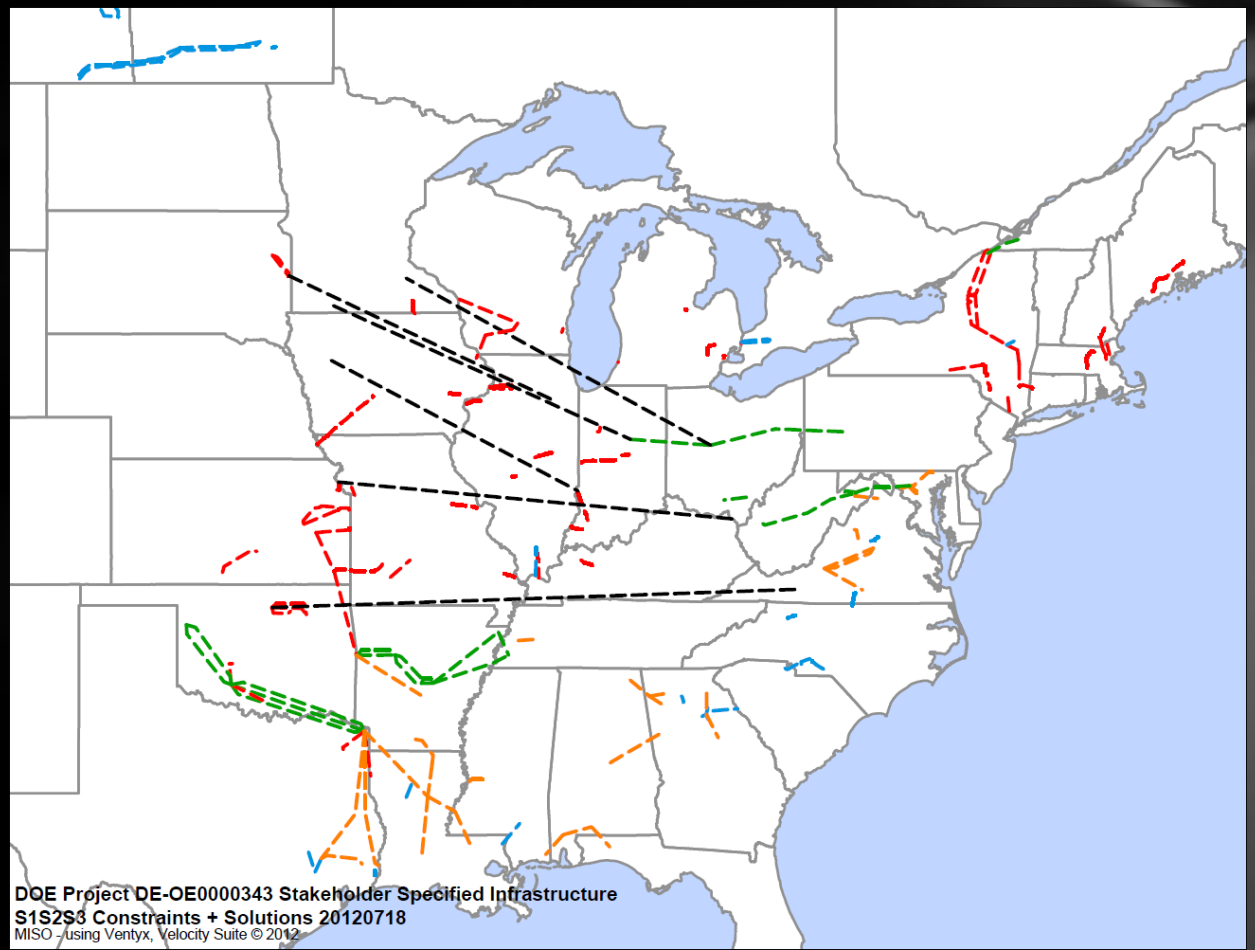
500 Lines added (280 Generation Interconnection; 200 Constraint Relief). No HVDC.



Eastern Interconnection (EIPC) Scenario 1: Combined Federal Climate and Energy Policy

1. Nationwide implementation
2. Economy-wide carbon emissions reduced by 50% from 2005 levels in 2030 and 80% in 2050;
3. Meet 30% of electricity requirements from renewables by 2030;
4. Significant deployment of EE, DR, DG, smart grid, and other low-carbon technologies

Low carbon "kitchen sink": cap&trade, nation RPS, etc -- 600 lines (290 generation interconnection; 325 constraint relief) PLUS 6 long distance HVDC.



Interconnection-Wide Planning: East

- EIPC's Phase I report – details eight 20-year macroeconomic futures (72 sensitivities)
- EIPC's Phase II is 20-year transmission expansion buildout
  - under 3 "bookend" scenarios (BAU, medium, high buildouts)
  - with sensitivities: (1) Demand response variations; (2) Improved/varied wind performance; (3) Fuel costs changes; (4) Carbon cost changes
- EISPC eastern Clean Energy Zones
  - Natural gas, clean coal, nuclear, & renewables resources
  - Includes relevant state laws, regulations, rules and orders (CESA)
  - All in a GIS-based tool

EISPC Clean Energy Technologies

Biomass

- Forest biomass and wood waste
- Agricultural biomass and waste resources
- Dedicated energy crops
- Methane from landfills
- Methane from wastewater treatment
- Methane from animal manure processing

Clean Coal

- New clean pulverized coal technology
- New integrated gasification combined cycle
- New coal fluidized bed
- Retrofitted pulverized coal

Geothermal

- Enhanced geothermal systems
- Geopressured geothermal

Natural Gas

- Combined cycle
- Underground natural gas storage
- Above-ground natural gas storage

Nuclear

- Large light-water reactor
- Small modular reactor, integral pressurized-water reactor
- High-temperature gas cooled reactor/ Very high temperature gas-cooled reactor

Solar

- Concentrating solar power
- Utility-scale photovoltaic
- Rooftop photovoltaic solar

Storage

- Hydroelectric pumped storage
- Compressed air energy storage

Water

- Added output from existing hydropower dams
- New output from existing non-powered dams
- In-stream hydrokinetic energy
- Tidal hydrokinetic energy
- Wave energy

Wind

- Onshore wind turbines
- Offshore wind turbines

Planned suitability models

Report based on inventory, or basic resource

Source: Eastern Interconnection States' Planning Council

Interconnection-Wide Planning: East

- EISPC studies/whitepapers on:
  - Coal and nuclear prospects
  - Catalog of Eastern Interconnection mkt structures and transmission planning processes
  - Probabilistic risk assessment and transmission planning
  - Co-optimization of generation and transmission
  - Economics of resource adequacy
  - Economic ramifications of resource adequacy requirements & an updated assessment of the “one-day-in-ten-year Loss of Load Probability” criterion that underlies current generation reserve margin requirements

Interconnection-Wide Planning: ERCOT

- Development of improved tools for evaluation of resource and transmission expansion futures and options
- BAU resource expansion future and related sensitivities
- Incorporation of demand-side, solar and geothermal, storage, and Evs into long-term planning tools and processes

Interconnection-Wide Planning: Generic

- All five interconnection-wide grantees (WGA/EISPC/WECC/EIPC/ERCOT) launching major gas/electric interdepencies (operational and planning) studies
- DOE update of New England gas/electric interdependency study
- WGA/ERCOT Energy-Water Nexus work
  - Multiple natl lab team
  - State-by-state water supply assessment
  - Evaluate impact of availability or drought on transmission & generation futures
  - Propose mgt practices or policies to facilitate compatible energy-water development
  - Develop decision support tool for generation water impacts
  - Western States Water Council to take over after ARRA grant

Interconnection-Wide Planning: Generic

- February 2013 Three-Interconnection Mtg replaces DOE/NARUC Electricity Forum
  - Not just lessons learned but long-term thinking/dialogue
- Analyses of interconnection-wide frequency response and fault-induced delayed voltage recovery