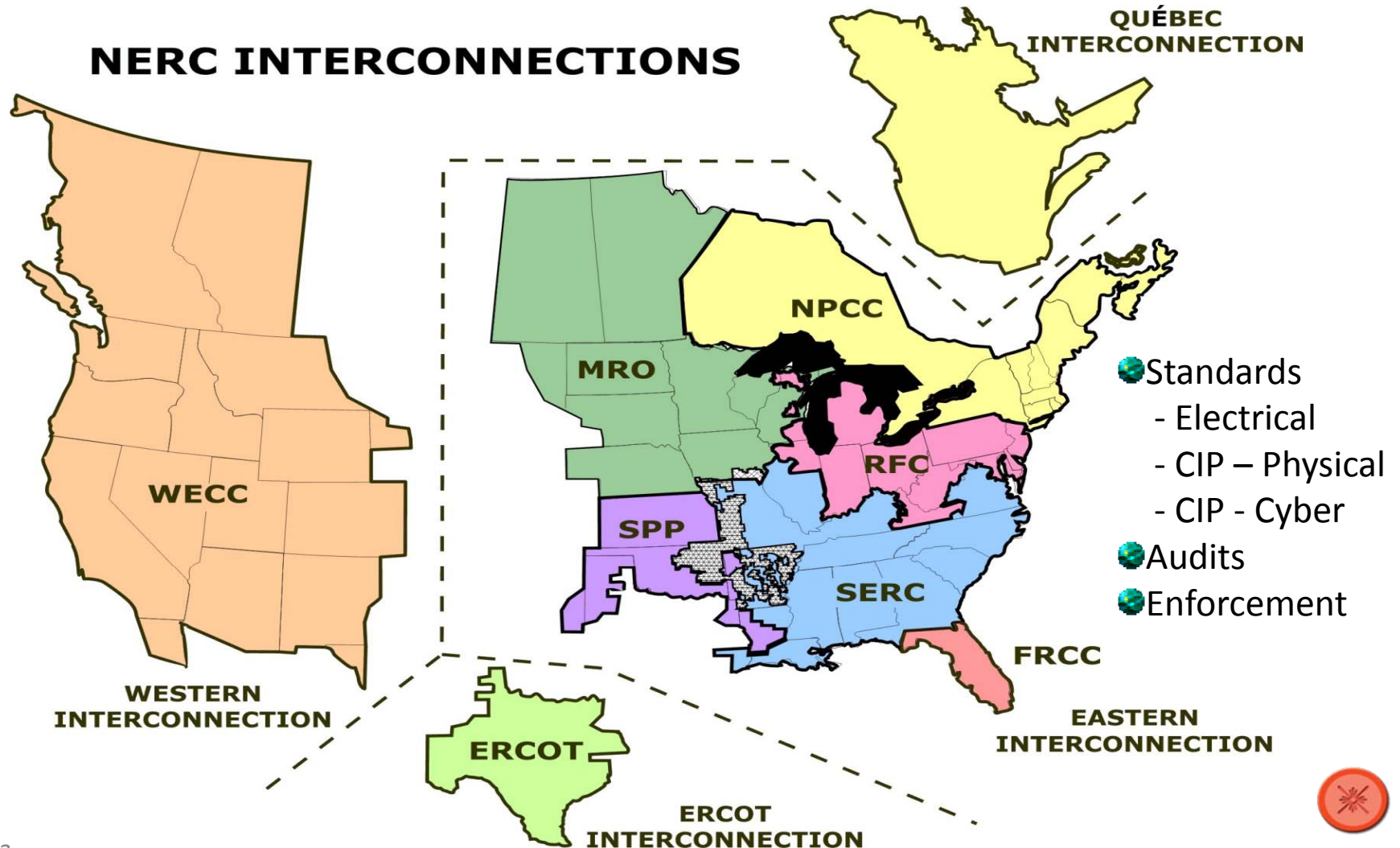


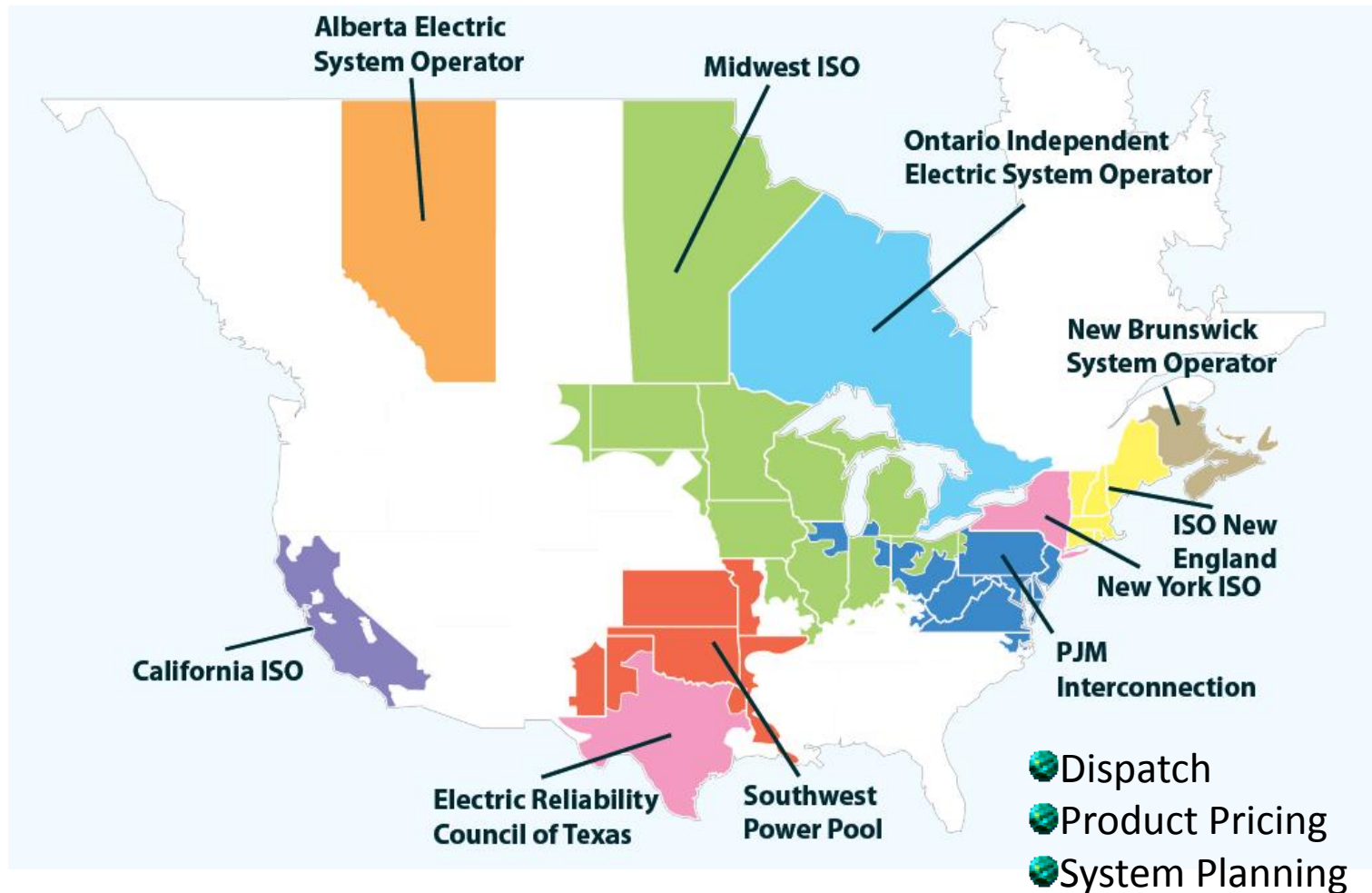


**Industry Discussion**  
**Paul J Feldman**  
**February, 11, 2010**

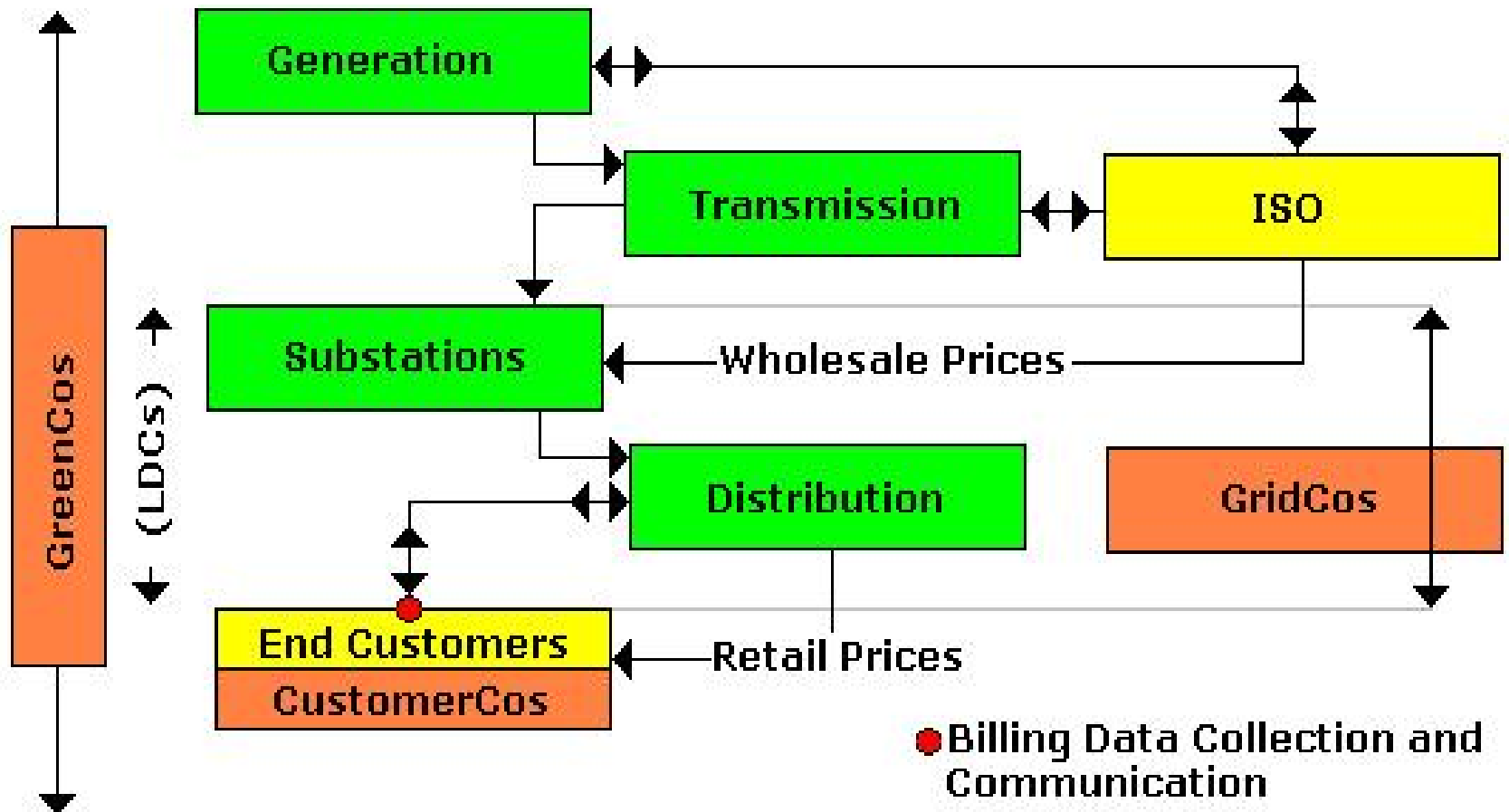
# NERC Regions



# RTOs / ISOs



# Business Model Changes



# Regulatory Trends - 1

## ● Congress

- Stimulus, renewables, carbon, transmission, energy security, cyber security

## ● FERC – Federal Energy Regulatory Commission

- Roles: NERC oversight, wholesale energy markets, transmission approvals, rates and rules
- New authorities contemplated in legislation – backstop authorities (standards, transmission), carbon, cyber-security, etc.

## ● NERC – North American Electricity Reliability Corporation

- Roles – Bulk Electric System reliability, standards development, compliance, and enforcement
- Issues – Carrot or Stick model evolution, standards confusion, compliance v reliability focus, CIP focus, under new management.

# Regulatory Trends - 2

- RTOs/ISOs (Regional Transmission Organizations, Independent System Operators)
  - Markets to facilitate transactions with associated market products (energy, reserves, capacity)
  - Wholesale prices in thousands of locations, made every 5 minutes, with intraday changes of hundreds of percent.  
<http://www.midwestiso.org/page/LMP+Contour+Map+%26+Data>
  - Demand response = Generation
  - Public Power – “RTOs may not be evil”
- State Legislatures
  - Renewables, competition/regulatory models, decoupling, economic development, redo of state energy architectures, stiff-arming and getting ahead of the feds.
- State Commissions
  - “Fire hose” regulation, complex Business Cases, Higher Rates + Customer Benefits = Inaction.

# 48C Awards

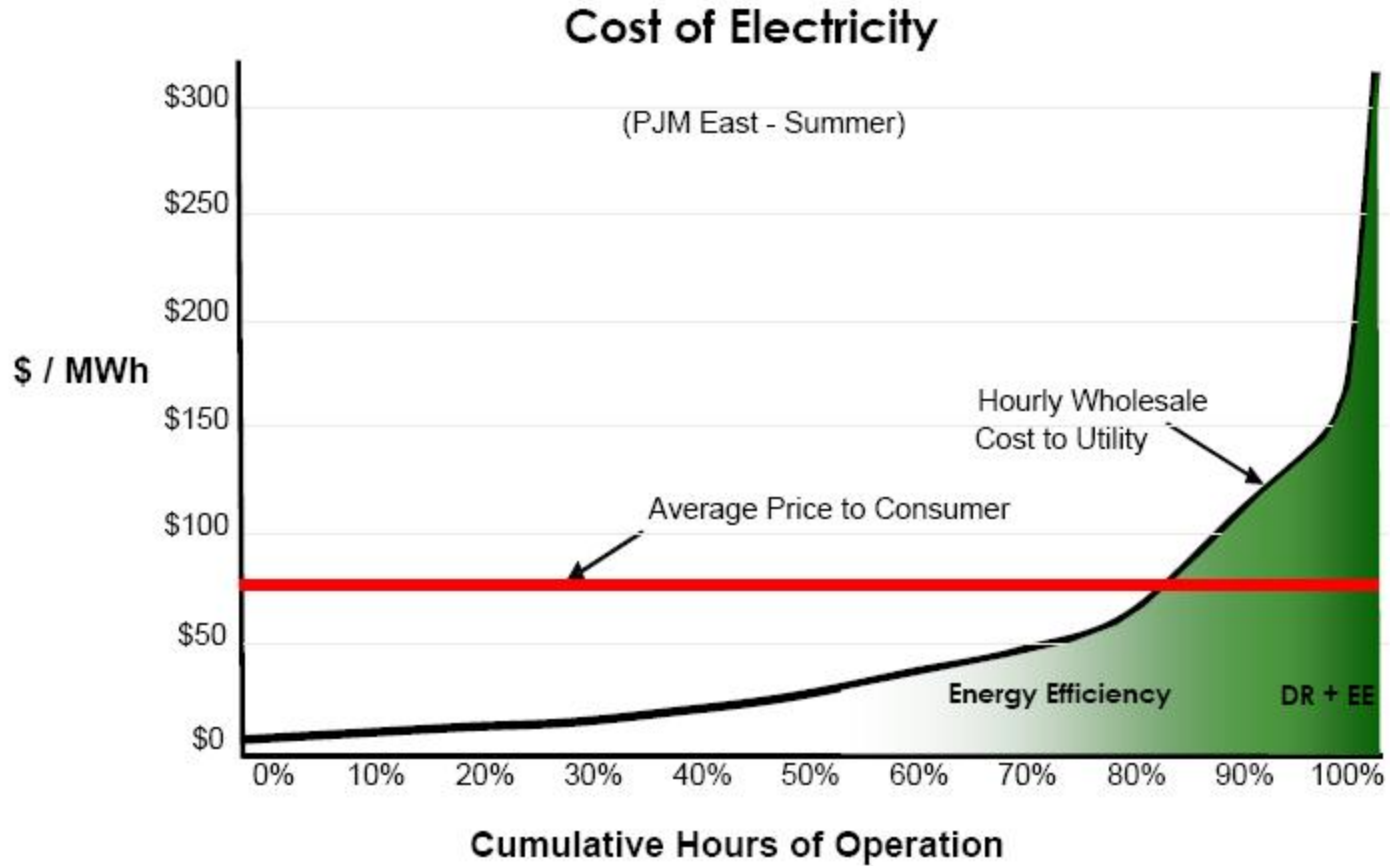
- **Awards:** In January 2010, DOE awarded \$2.3b for 183 projects in 43 states
  - Projects must be placed in service by 2014, but ~30% will be completed in 2010
- **Demand Outpaced Funding by 3X:** The 48C program received 500+ applications for over \$8b
- **More Funding:** The Administration has requested an additional \$5b for 48C
  - Congress is considering the Jobs Bill as the potential legislative vehicle

- **Notable Winners**

- General Electric: Energy Efficiency
  - 7 Awards for \$89m
- Cooper Power Sys.: Smart Grid
- Dow: Solar
- Dupont: Solar
- Siemens: Wind

Technology Area	Number of Awards
Advanced Battery Technology	5
Biomass / Renewable Fuels	2
Carbon Capture & Sequestration	2
Energy Efficiency	29
Fuel Cells	2
Geothermal	1
Nuclear Energy	2
Plug-in Electric Vehicles & Components	3
Smart Grid	9
Solar Power	47
Wind Power	35
Other Projects that Reduce Greenhouse Gas Emissions	46
<b>Total Awards</b>	<b>183</b>

# Price Realities



# Generation, Transmission, Storage

## ● Generation

- Needs: 2010 = very limited need, future = hotly debated
- Issues: national security, carbon and the environment, fuel-type lobbies, technology trends

## ● Transmission

- Needs: support renewables, relieve congestion, improve reliability
- Issues: cost sharing, state goals vs. federal goals, NIMBY

## ● Storage

- Technologies - Pumped hydro, Compressed Air (CAES), Fuel Cells, Batteries (NaS and down), thermal (PV, Ice), Fly Wheels, EVs
- Needs: Renewable integration, Price Arbitrage, Load Following, Frequency Regulation, Construction Delay,
- Issues: Rules and Regulations (lack of), Complex Business Cases, Evolving technologies

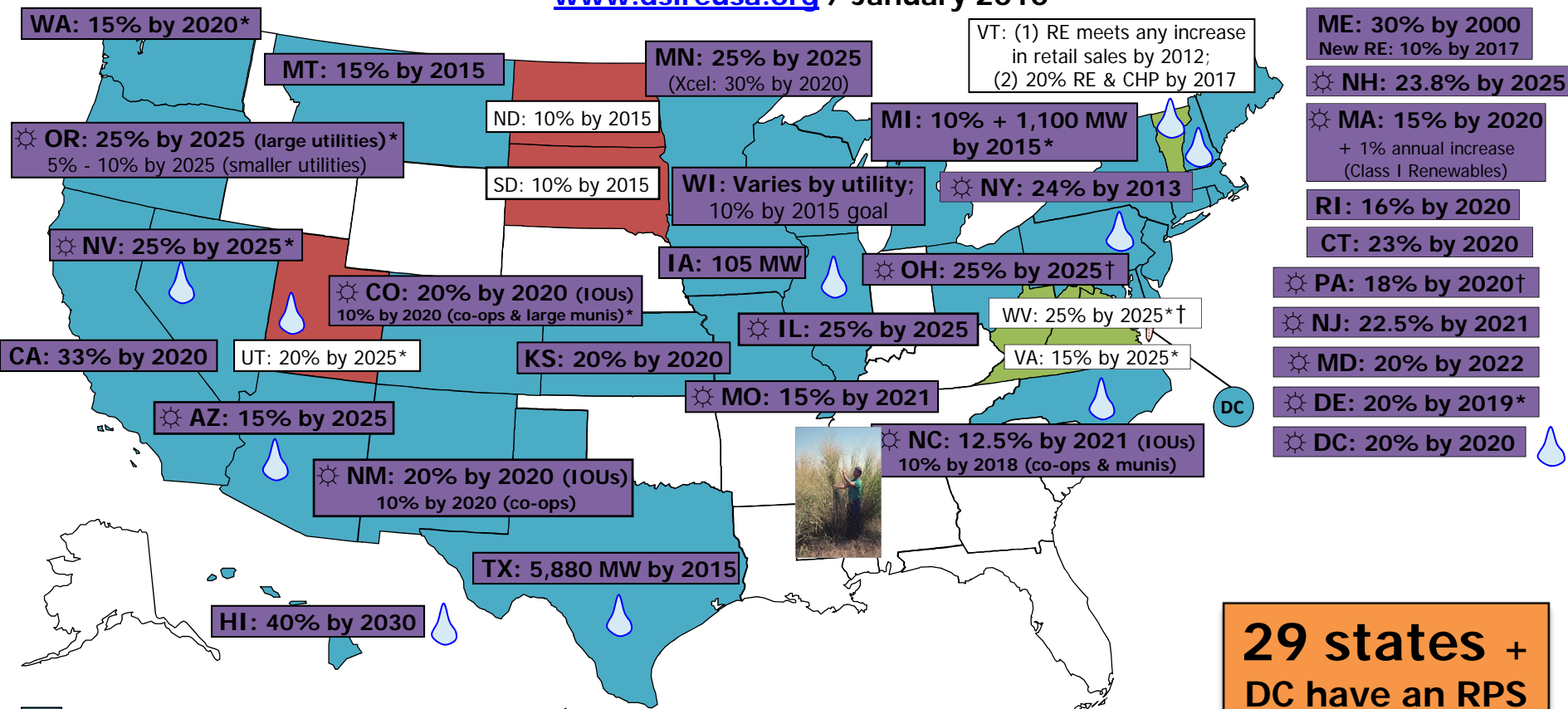
# Fuel

## ● Fuel

- Coal – abundant supply, carbon issues, sequestration unproven but in-process, base-load resource. Coal to Natural Gas chemistry.
- Nuclear – none built in past decade, lack of (and competition for) building infrastructure, high cost, base-load resource. Interest growing.
- Hydro – little incremental supply remaining, peaking and load following resource.
- Natural Gas – ½ carbon of coal, good supply (?), peaking and load following resource.
- Wind – intermittent (\*), inversely related to temperature, needs special integration handling, needs new transmission.
- Solar – intermittent, positively related to temperature, needs special integration handling (except in distribution at moderate amounts). Costs decreasing.
- Geothermal – good supply, base-load resource, attention increasing.
- Biomass – unresolved carbon questions, supply dependent, cost effectiveness questions.

# Renewable Portfolio Standards

[www.dsireusa.org](http://www.dsireusa.org) / January 2010



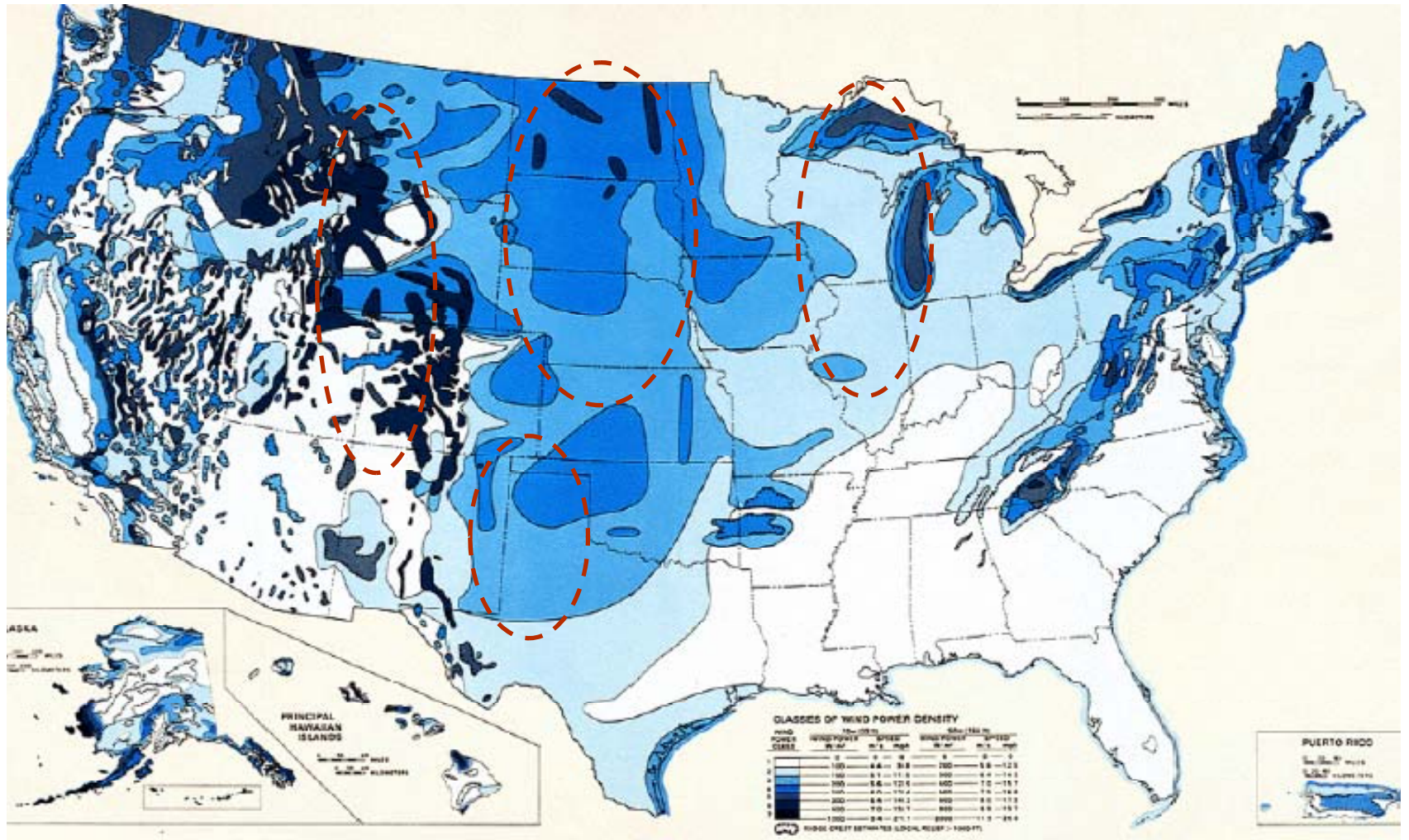
- State renewable portfolio standard
- State renewable portfolio goal
- Solar water heating eligible

- Minimum solar or customer-sited requirement
- Extra credit for solar or customer-sited renewables
- Includes non-renewable alternative resources

**29 states + DC have an RPS**

*6 states have goals*

# Wind – potential



# Wind – Hour/Month Plot

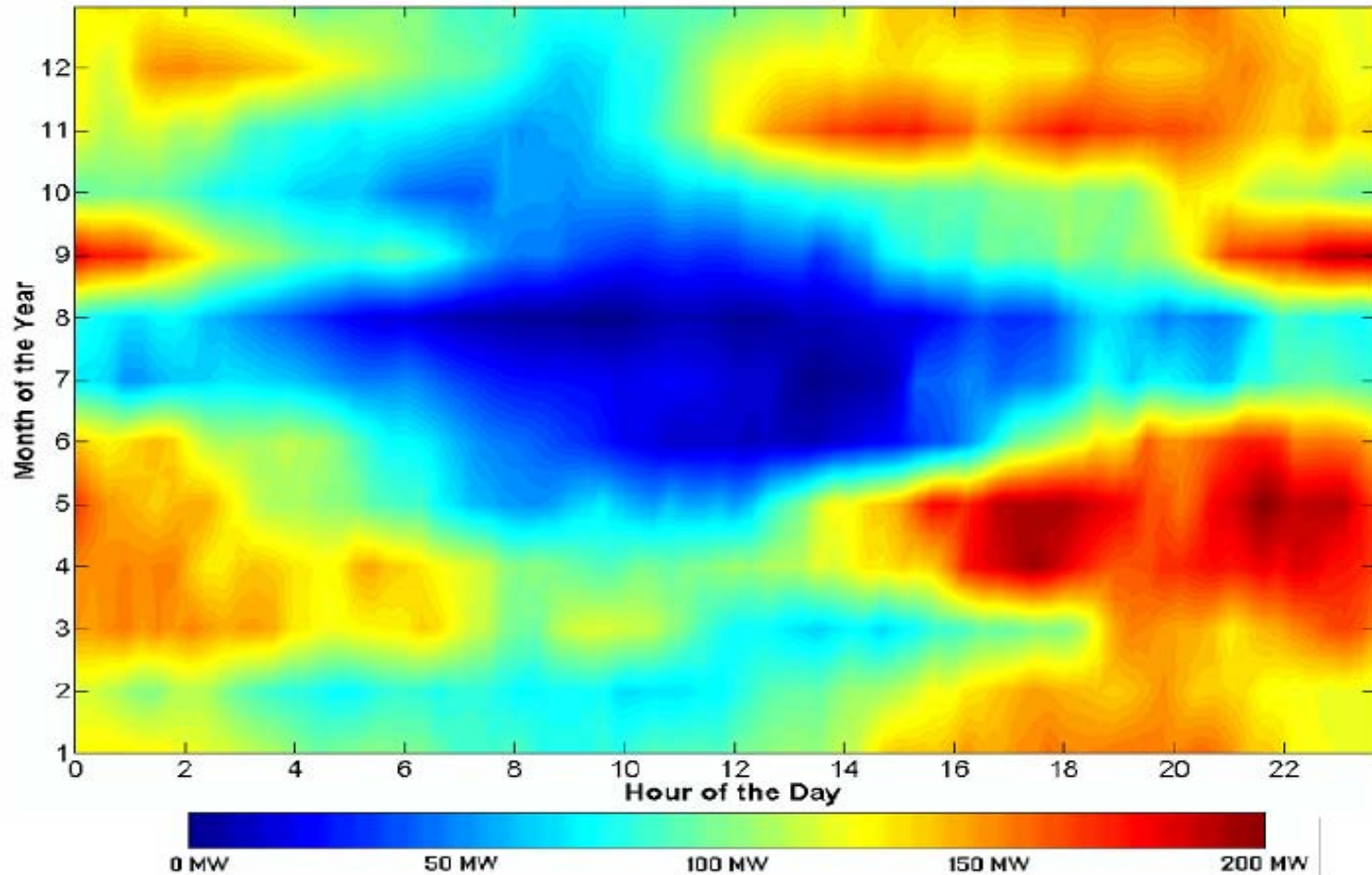
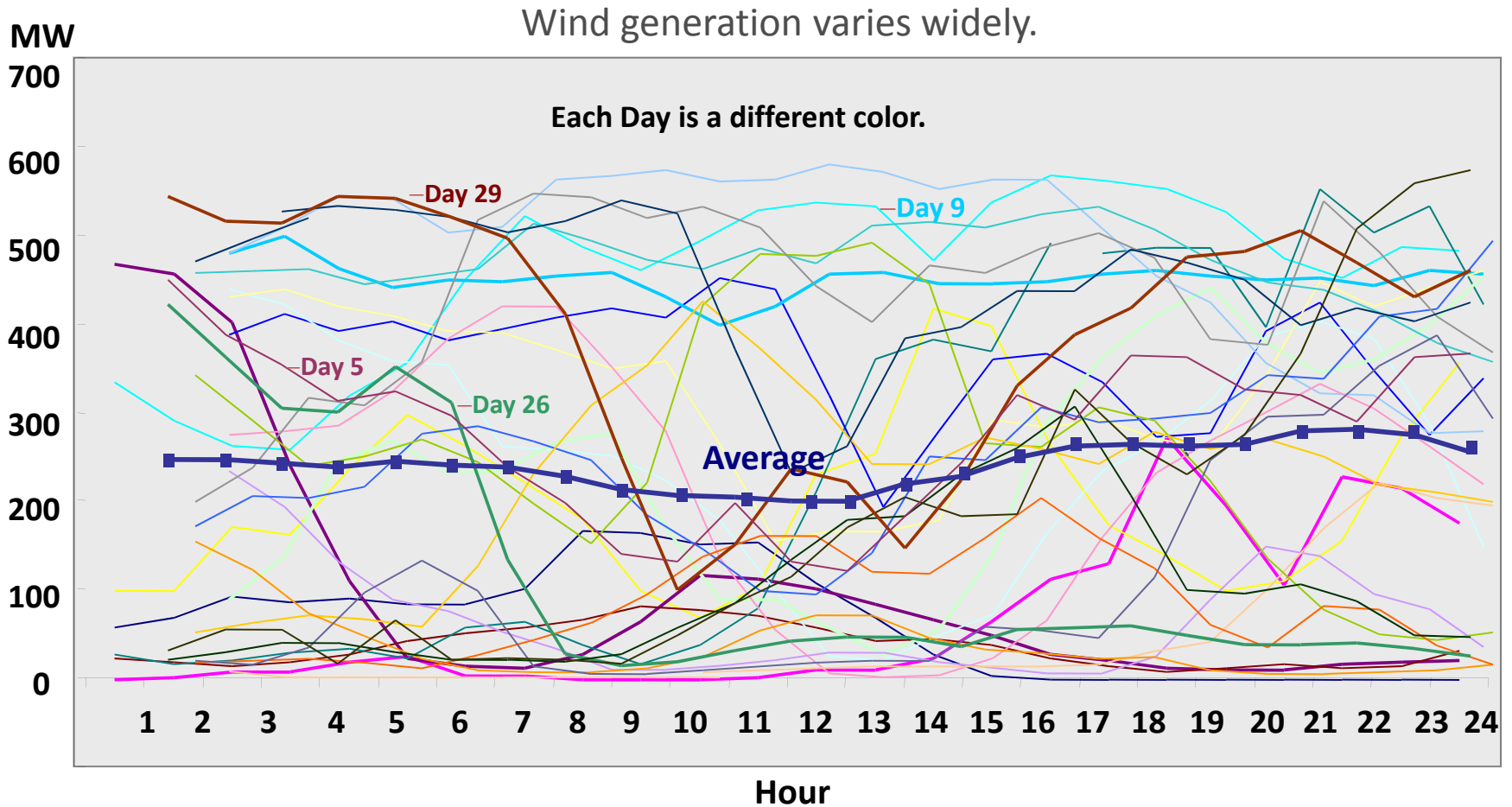


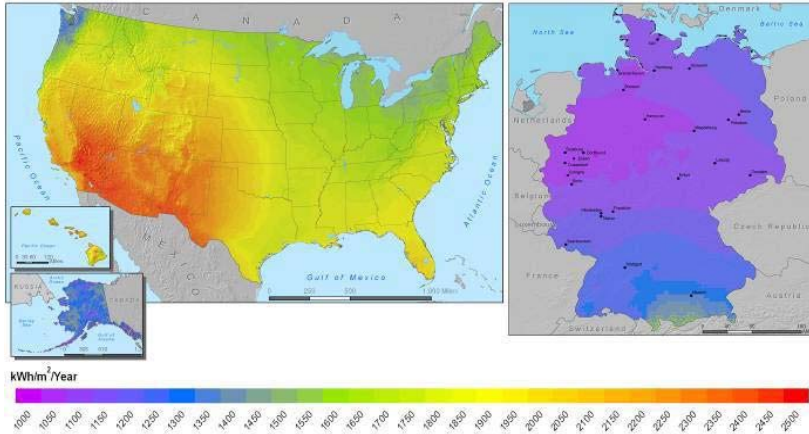
Figure 1 PNM Wind/Load Patterns



# Wind intra-day variability



# Solar potential



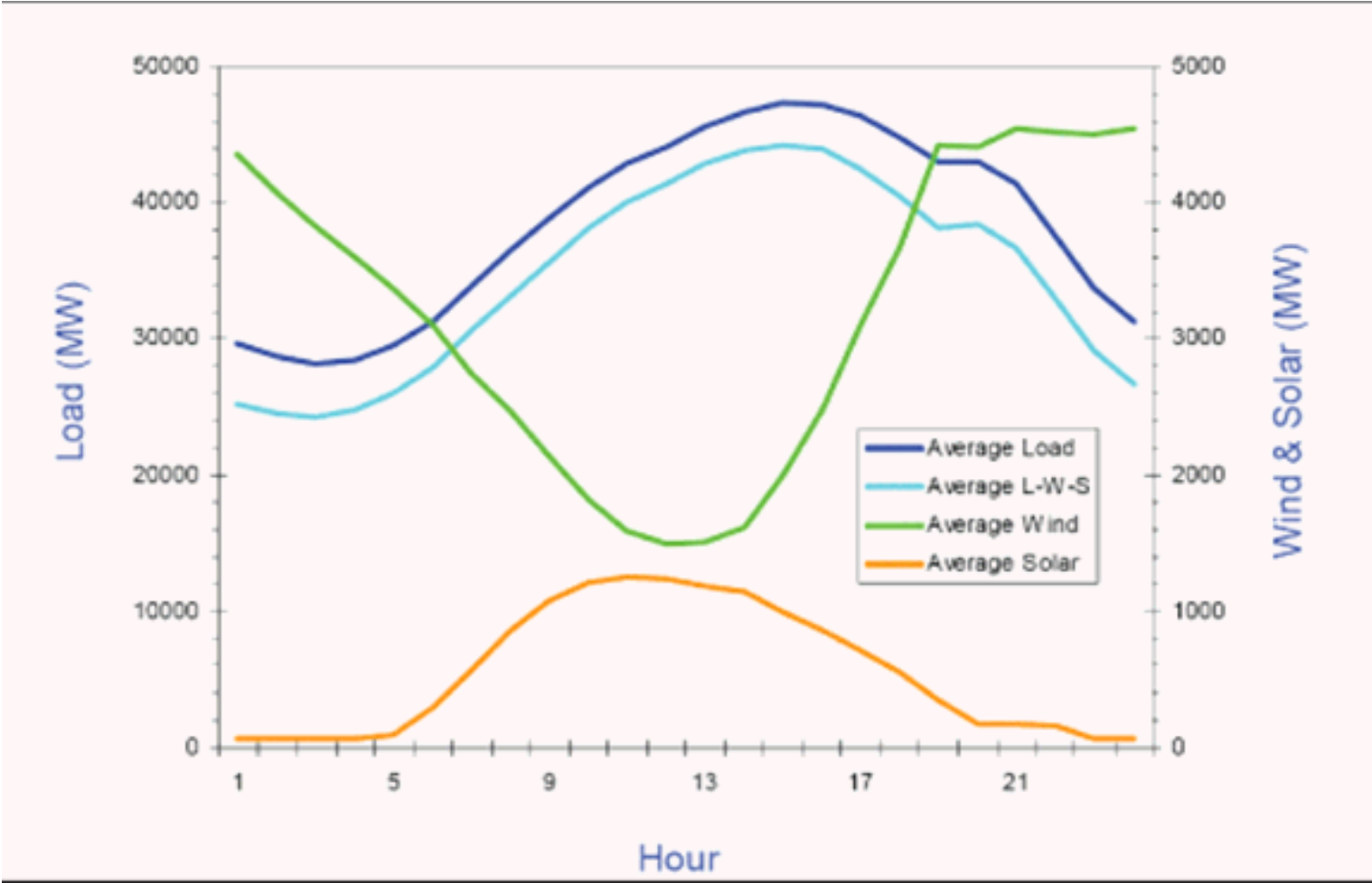
## Central Station Solar



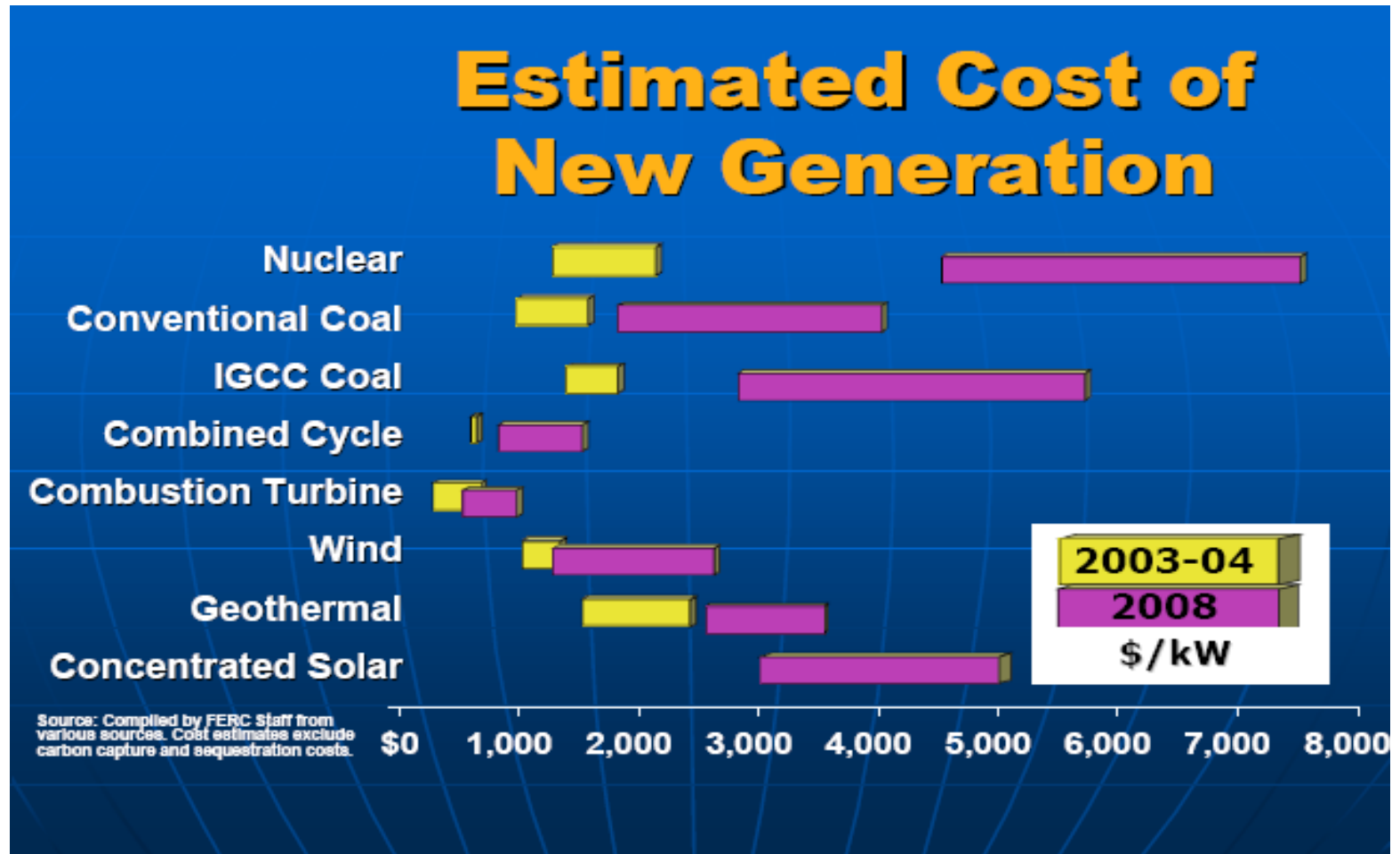
## Distributed Solar



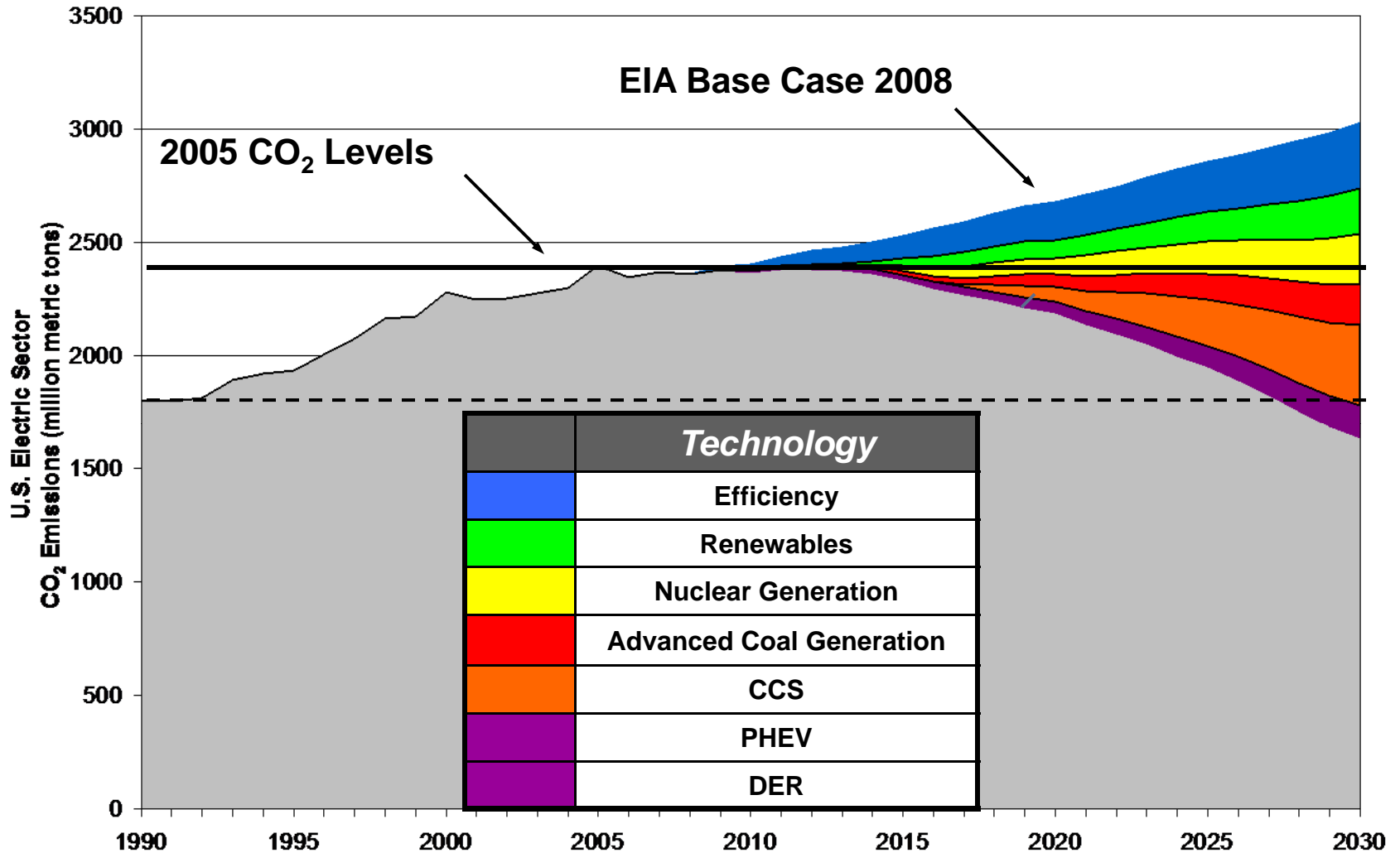
# Solar inversely related to wind



# Generation costs – trending up



# Portfolio approach possibilities for carbon



# Smart Grid Conceptual Model – Customer Domain



# The Distribution Smart Grid



- Monitored —
- Unmonitored —
- Maximized —
- Underserved —



# Smart Grid Trends

- Traditional energy companies – some thinking about themselves, some thinking about technology, some thinking about customers.
- Energy Company strategy debates – to supply needed products and services or kwh? If kwh, others will fill the void quickly.
- New companies of every size, shape, and business model.
- Model discussions - retail reregulation and competition
- Standards
- Communications - Internet, PLC, BPL, 900 Mhz, Common Carrier, etc.
- AMR and AMI
  - Preludes to the Smart Grid and retail time-of-use pricing
- Integration of renewables
- Demand Response
  - Massive funding source via RTO rules – capacity and energy.
- Energy Efficiency
  - Generation, Transmission, Distribution, Customers.
- **Ultimately the smart grid is about giving customers more reliable service and the products and services they need/want to use energy most productively.**

# End Customer Trends

- Real time – two way communications with energy possibilities: prices, products and services.
- Gateways and devices
  - E.g.: <http://www.outsmart.com>
  - E.g.: <http://www.alertme.com>
- Energy Efficiency
- Demand Response
- Generation: traditional engines, photovoltaic, CHP.
- Electric Vehicles
- Storage – batteries, thermal via ice,
- Facility Management Systems – industrial, commercial, residential
  - Residential: Optimal Energy, Security, Medical, ...
  - Business: Optimal Energy, Carbon footprint, Security, Production and Resource Management,...

# Distribution Trends

- Communications enable monitoring, manipulation, agreement execution (e.g. DR for capacity), and measurement/verification.
- Devices in the distribution grid:
  - Monitoring, equipment manipulation, reliability and cost saving possibilities
- Some form of real time pricing is a requirement for progress.
- Storage
  - NaS, CAIS, traditional batteries, Li-Ion, thermal ice, etc.

# Distribution Trends

## ● Distributed Generation

- Generator sets, PV, CHP, etc.

## ● Customer (load) participation

- Communications and gateways drive demand response and energy efficiency.
- Electric cars are load, storage, energy generation, and ancillary services – and geographically concentrated.
- PV is competitive with peak wholesale prices and coming down the cost curve.

## ● Traditional load forecasting is obsolete

## ● Distribution Projects

- ConEd – “The Boeing Company to create a secure and comprehensive common operating environment and command-control network for the smart grid.”
- PSE&G – 200,000 poles x 200W/pole = 40MW.


## ● Customers of all sizes move from passive users to active participants.

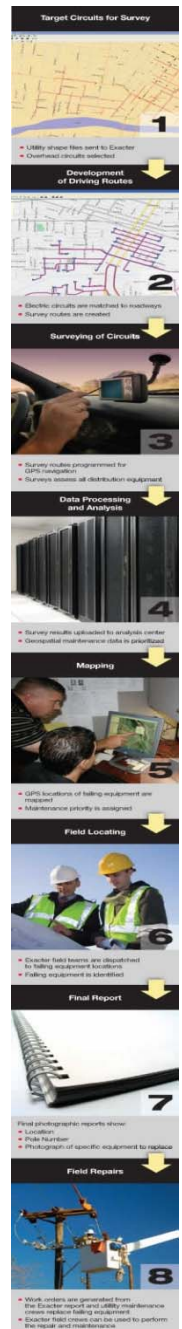
# *Distribution Reliability*



Berkeley Lab Study Estimates \$80 Billion Annual Cost of Power Interruptions - 70 page study. <http://www.EnergyCollection.us/Energy-Reliability/The-Cost-Of-Power-Interruptions-2004-09-01-70.pdf>

# Distribution reliability

- Over- engineered and underperforms.
- Customer's most important gateway for smart grid access.
- Distribution reliability must improve for the smart grid to be a reality.**
- The Reliability issue:
  - Vegetation – budget and crews.
  - Animal damage – guards and configurations.
  - Weather – engineering protection and configurations.
- Failing components – now we have Exacter.** 



- Paul J. Feldman
- Email or call if I can be of help: [Paul@PaulJFeldman.com](mailto:Paul@PaulJFeldman.com); 703-623-1762.
- Link to this presentation as PPT:  
<http://www.EnergyCollection.US/Papers/Exacter-An-Industry-Perspective.pptx>
- Link to this presentation as PDF:  
<http://www.EnergyCollection.US/Papers/Exacter-An-Industry-Perspective.pdf>
- Link to SynchroPhasor film on Florida outage:  
<http://www.EnergyCollection.US/Energy-Transmission/VTech-Florida.avi>
- Link to Midwest Wind film in March:  
[http://www.EnergyCollection.US/Energy-Wind/03-March\\_2004.wmv](http://www.EnergyCollection.US/Energy-Wind/03-March_2004.wmv)
- Link to Midwest Wind film in August:  
[http://www.EnergyCollection.US/Energy-Wind/08-August\\_2004.wmv](http://www.EnergyCollection.US/Energy-Wind/08-August_2004.wmv)
- My notes on Distribution: <http://www.EnergyCollection.US/Energy-Distribution-498.htm>