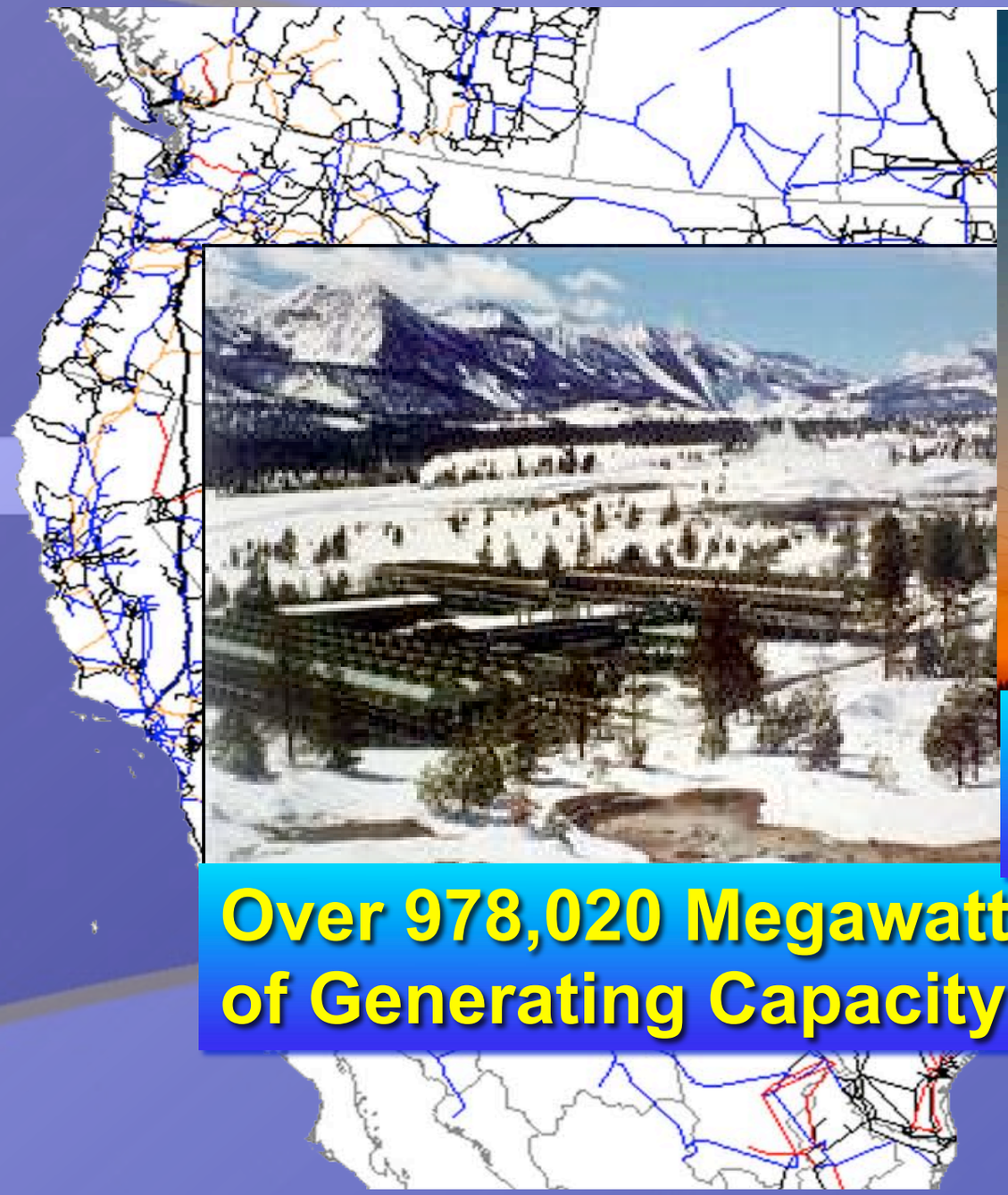
How to Improve the Efficiency of the World's Biggest Machine

While Solving a Few Other Problems Along the Way

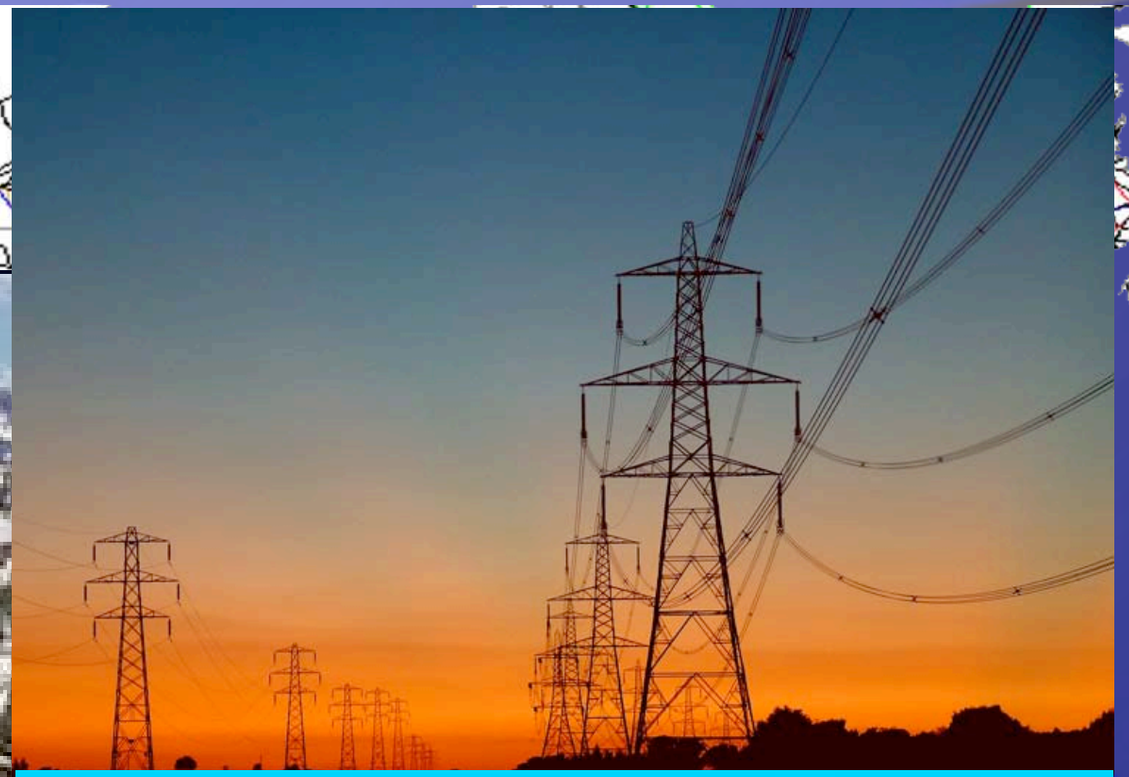
4th Annual
Cascadia Transportation
Conference

Jon Wellinghoff, Commissioner
Federal Energy Regulatory Commission
May 7, 2007

A Little Over a Century Later …
"Most Complex Machine in the World"



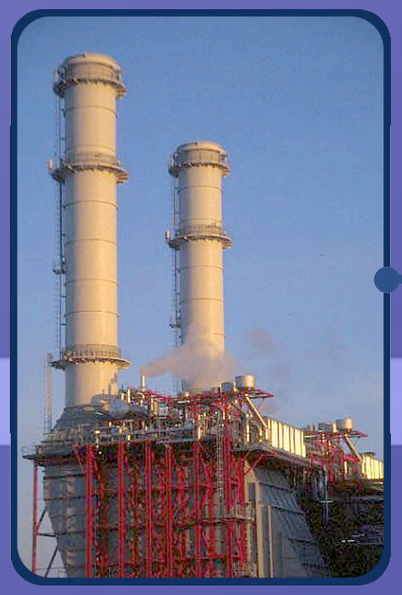
Over 978,020 Megawatts of Generating Capacity

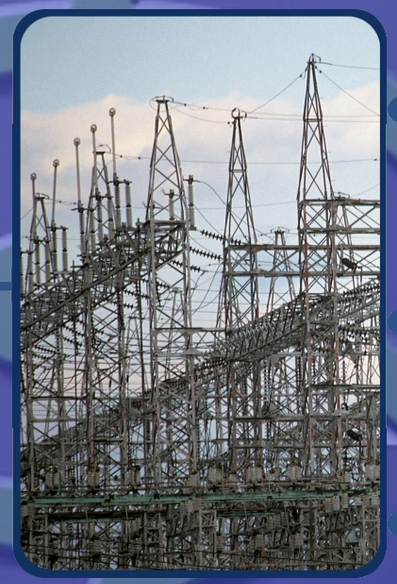


Over 351,000 Miles of Transmission Lines

Electric Grid: Billions in Investment & in Costs

Generation Transmission Distribution End Use





$97 B residential

$94 B commercial

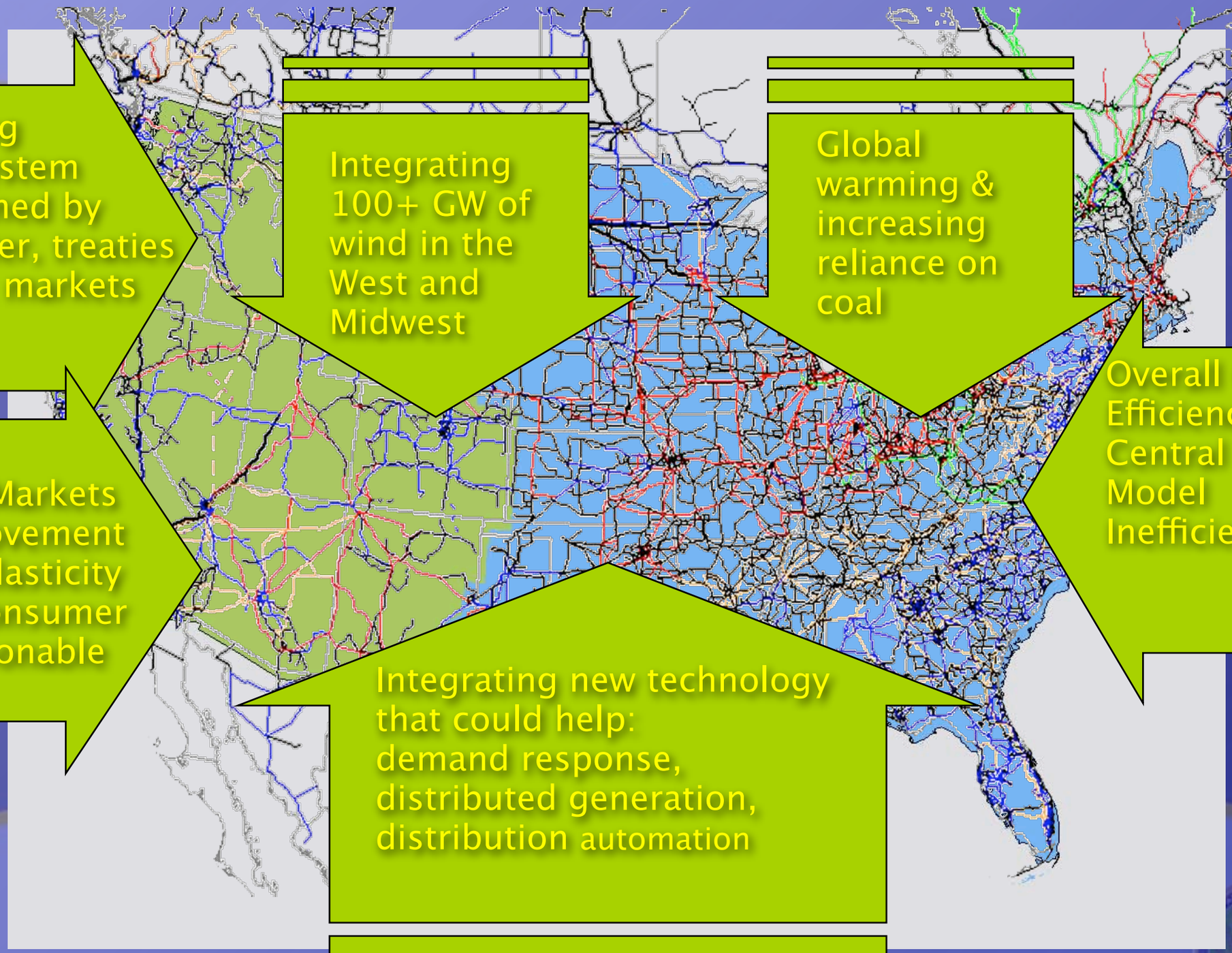
$78 B industrial

~$940 B ~$120 B ~$140 B = **$1.2 Trillion**

5% Improvement = $60 Billion Savings

(replacement costs)

Multiple Issues Seeking Solutions



Managing hydro system constrained by fish, water, treaties & future markets

Integrating 100+ GW of wind in the West and Midwest

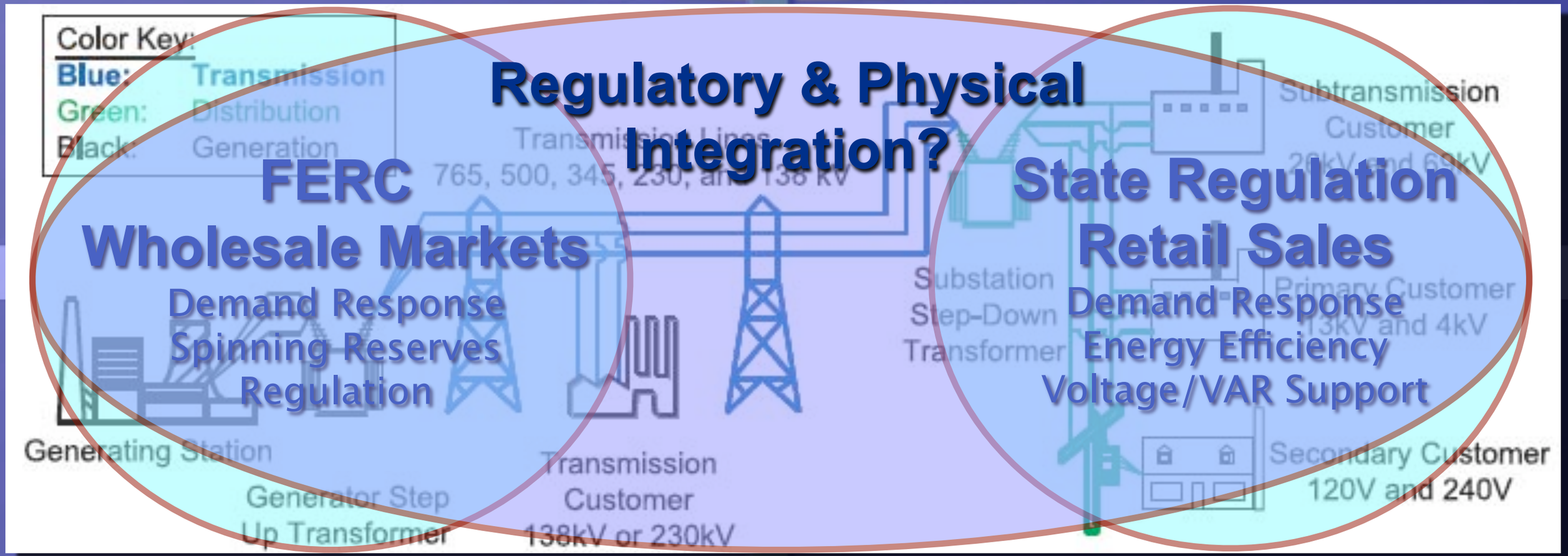
Global warming & increasing reliance on coal

Overall Grid Efficiency and Central Station Model Inefficiencies

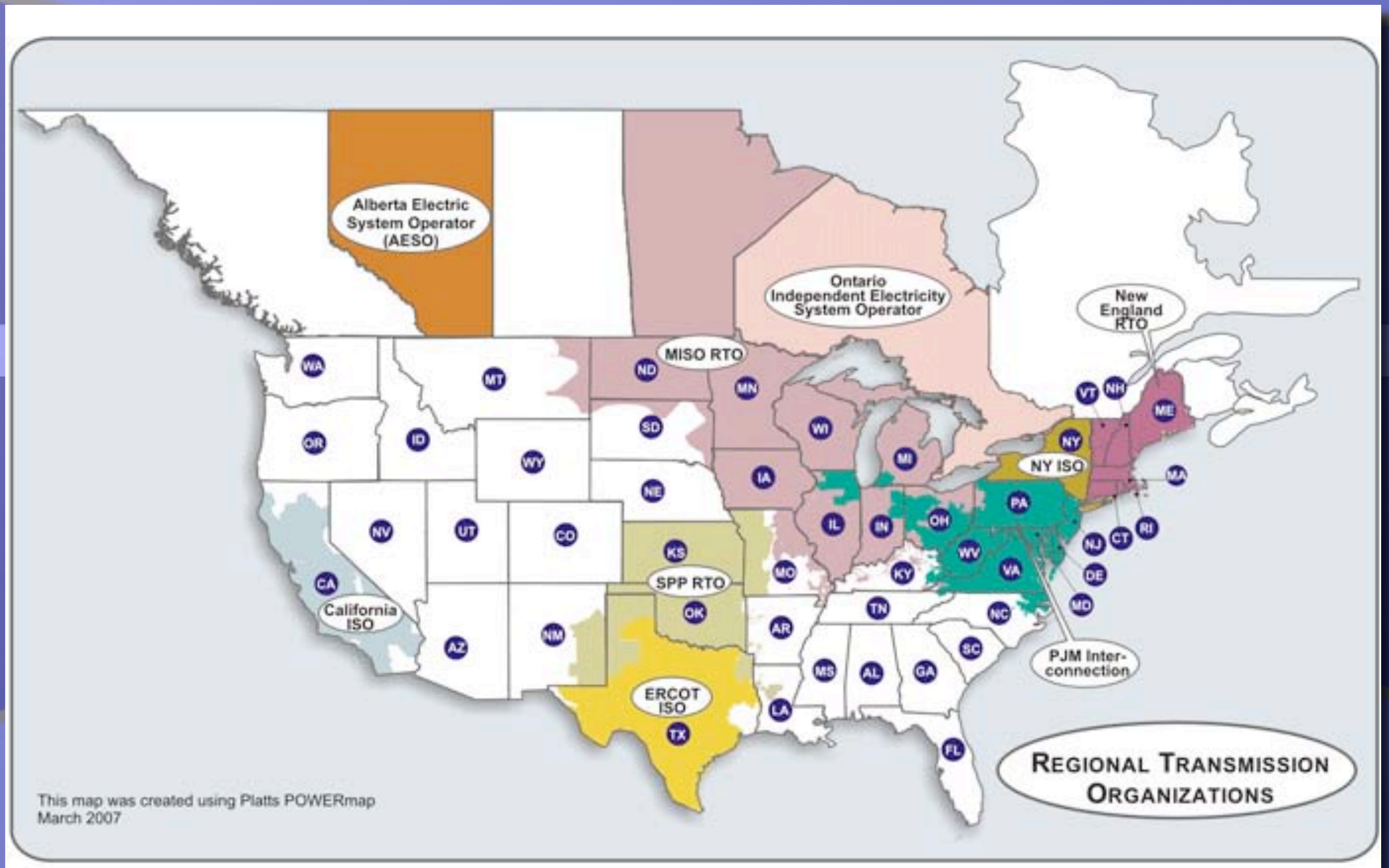
Wholesale Markets Need Improvement and More Elasticity to Keep Consumer Prices Reasonable

Integrating new technology that could help:
demand response,
distributed generation,
distribution automation

The Integrated Grid– Regulatory & Physical

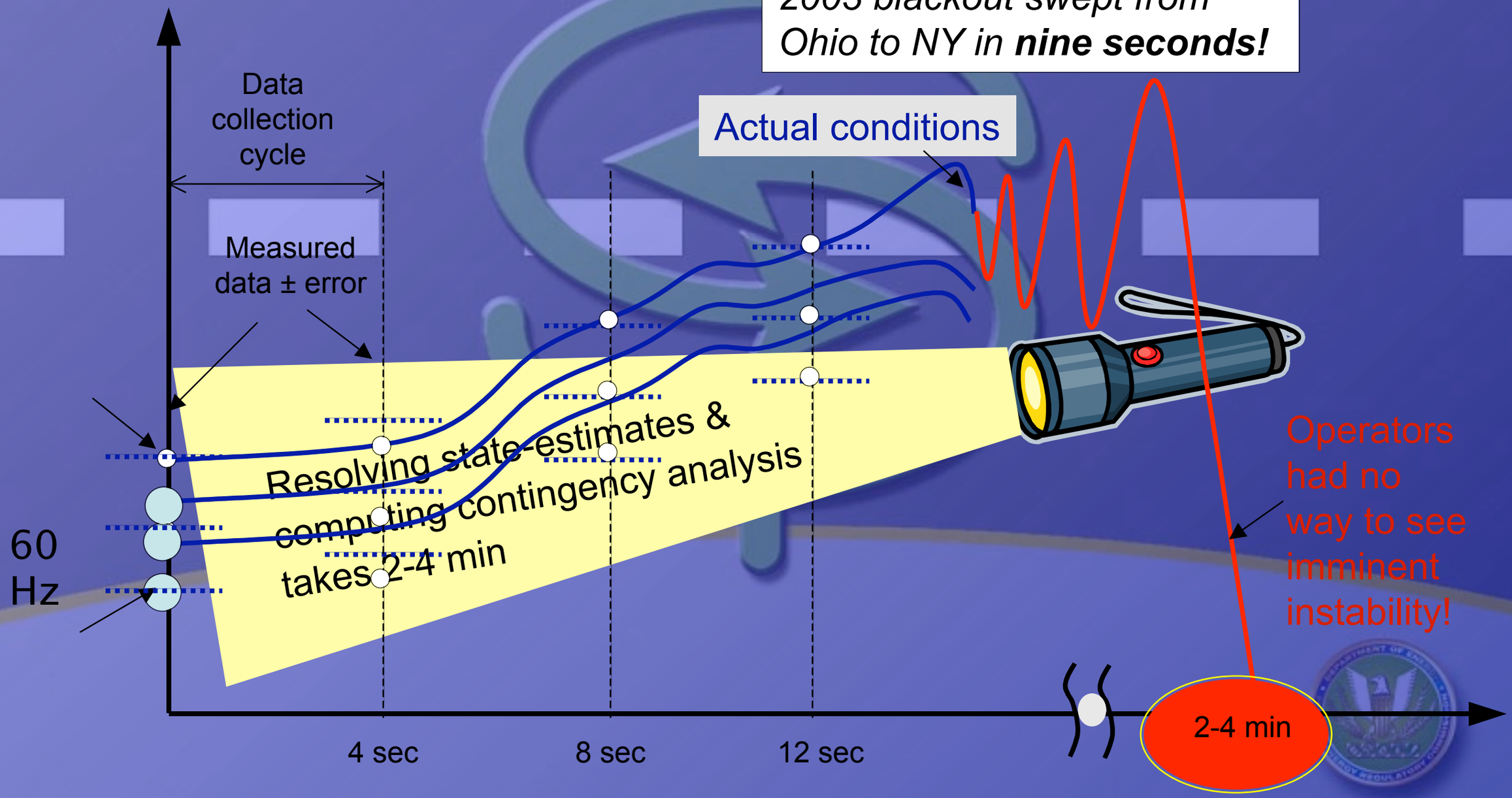


Organized Wholesale Electric Markets

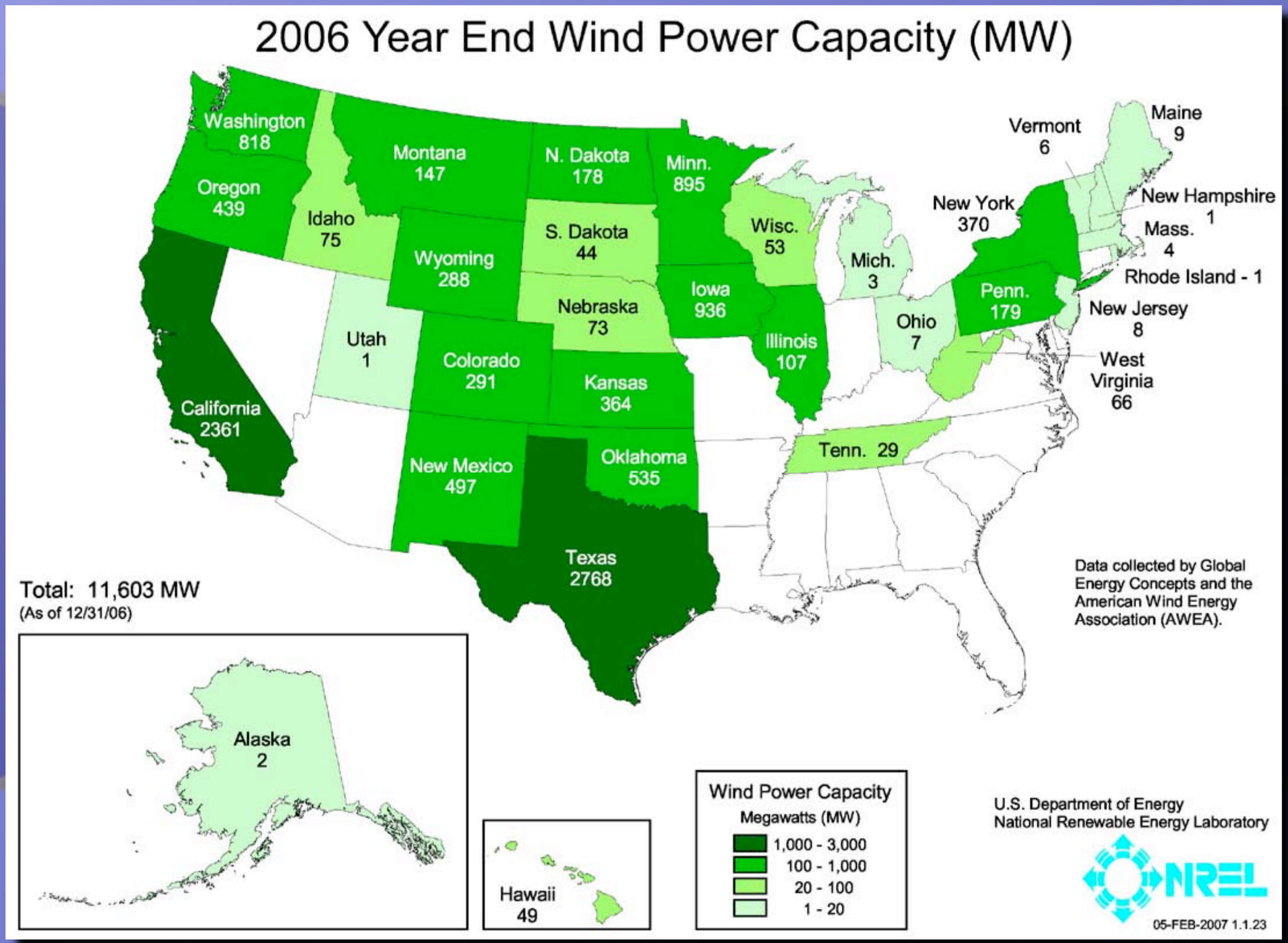


Grid Reliability– 2003 Blackout

*Once the cascade began, the 2003 blackout swept from Ohio to NY in **nine seconds!***



Growing Use of Wind Power



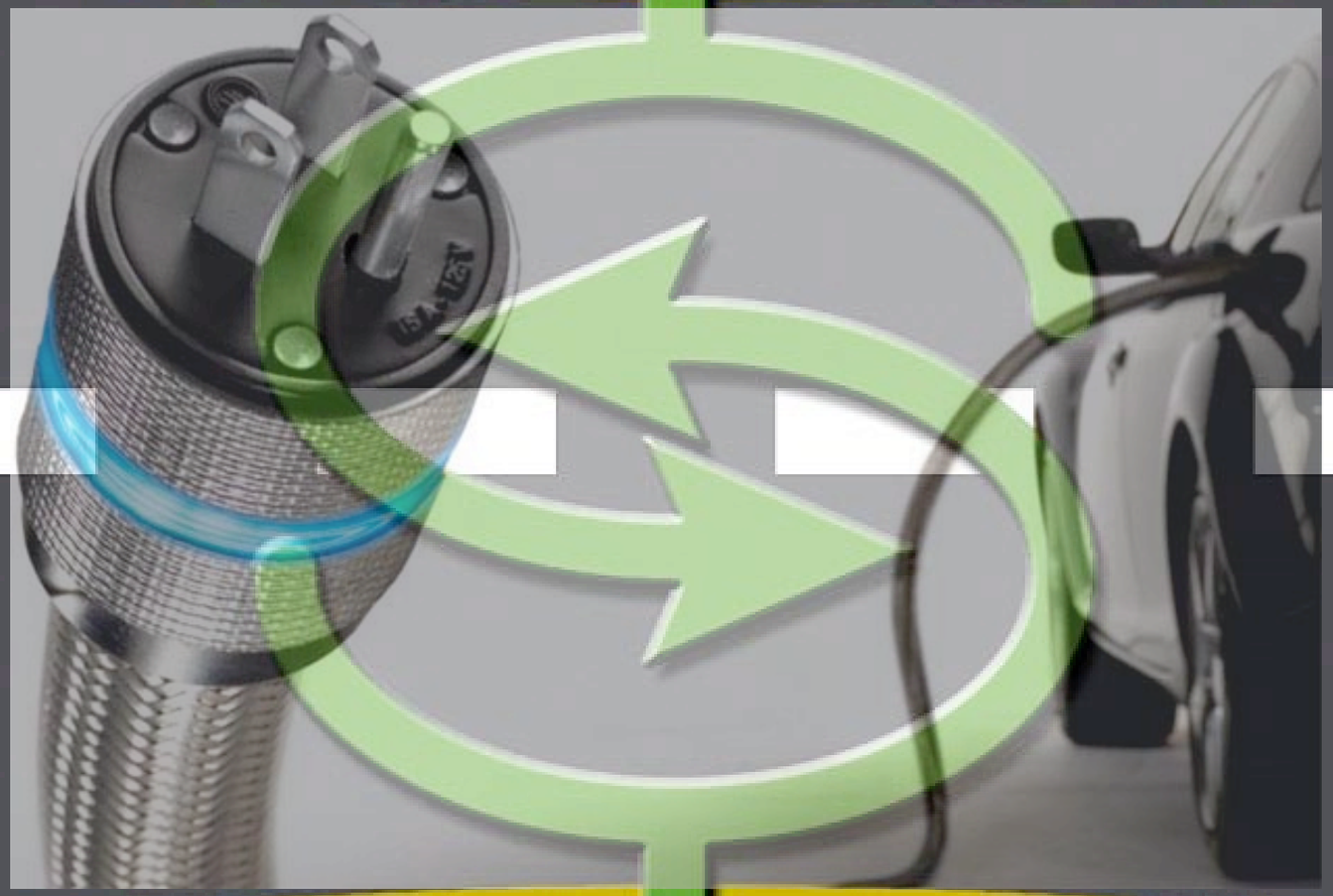
Getting to Cheap Efficient Solar Power

If solar power is going to play a significant role in the energy equation of the future, there must be advances in technologies to store that power ...concludes a new federally funded study by University of Massachusetts Amherst scientist Erin Baker.

Several of their findings bear noting, says Baker. First, even if there are research breakthroughs that made the costs of photovoltaics comparable to or less than that of fossil fuels-roughly 3 cents per kilowatt hour by 2050-***there would still be a limited impact on emissions unless the advances are combined with improvements in low-cost storage.***

"The development of complimentary technologies, in particular low-cost storage of electricity, is critical, " says Baker. Current technologies do not have good, cheap storage options, and putting all the power into the grid may make it unstable, she says. But ***when technological breakthroughs are combined with improvements in storage, using solar technology could lower emissions by 20 percent at no additional cost to the economy-taking a serious bite out of the carbon problem.***

The CashBack Hybrid



Three Types of Hybrids

- **Hybrid→ Gasoline/Electric /45 mpg (HEV)**
- **Plug-In Hybrid → HEV + Bigger Battery + One Way Plug (PHEV)**
  - **Recharged with Plug @ Home or Work**
  - **Additional Batteries Extend Electric Range to ~ 30 Miles**
- **CashBack Hybrid → PHEV + Intelligence**
  - **SMART Plug-In with Electronic Chip**
  - **2-Way Communication**
  - **Can Recharge from Grid and Supply Energy Services to Grid**
  - **Consumers Can Receive Payments for Those Services**

CASHBACK Hybrid

Dual Fuel & Dual Benefits

Grid Charged

Efficient Grid Support

Gasoline, Ethanol, or Diesel Powered

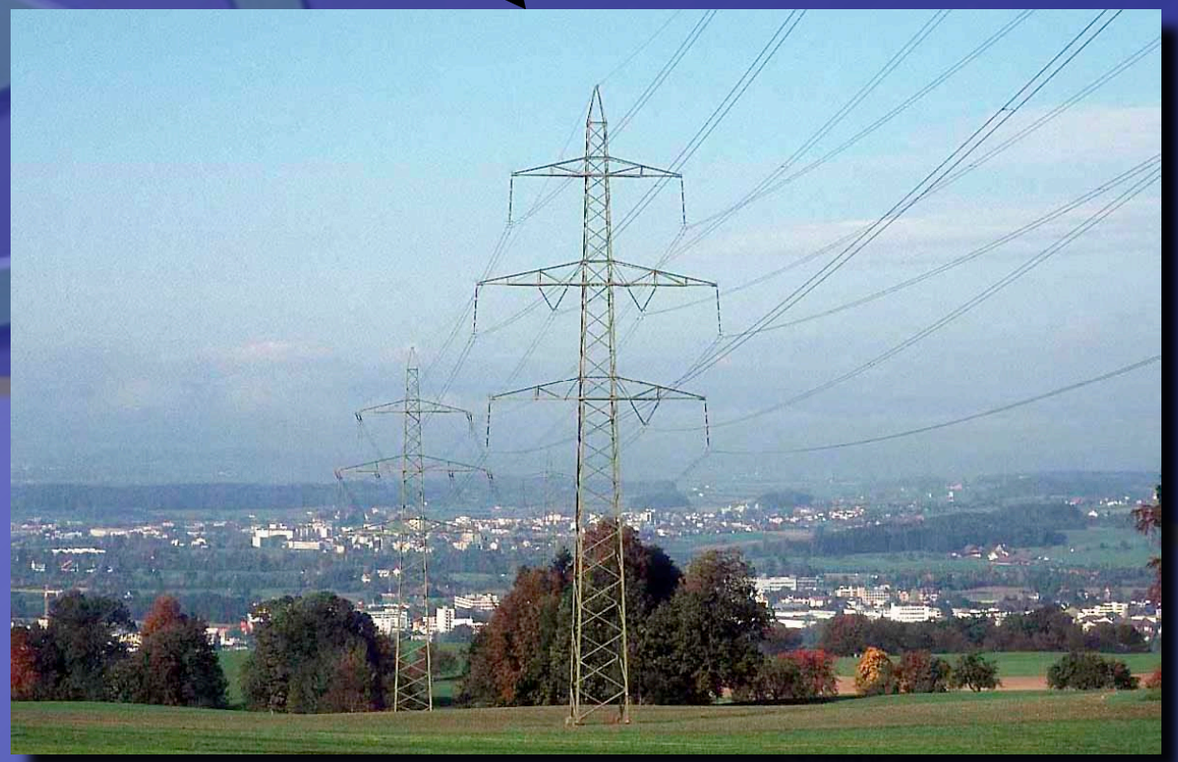
Efficient Transportation

Regulation Load Following

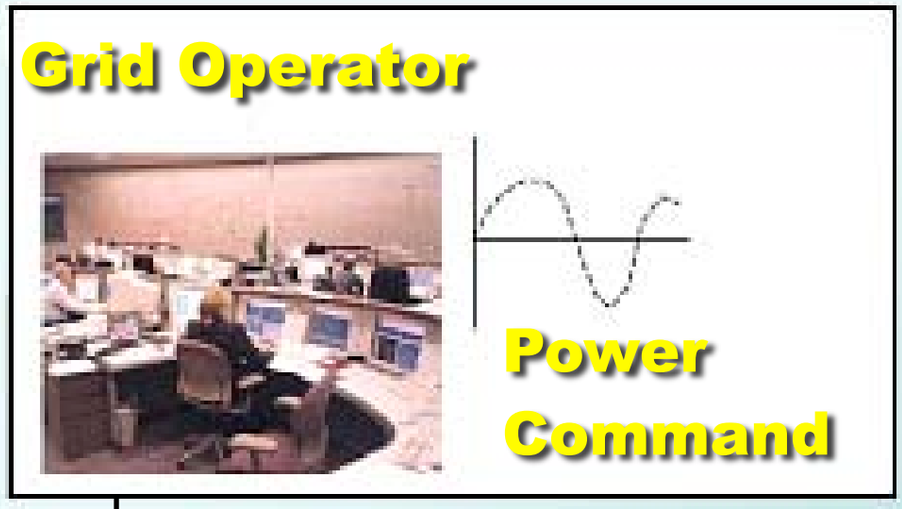
Spinning Reserve

Charge Off Peak

Discharge to Balance



CASHBACK Hybrid Grid Support



CashBack Hybrid Electric System Benefits

Efficient Grid Management

- Ancillary Services (Spinning Reserve & Regulation)
- Dispatchable Reactive Power
- Peak Demand Services (Demand Response)
- Reduced Operating and Planning Reserves
- Distribution/Substation Level Support
- Reduced Line Losses
- Improved Power Plant Efficiency
- Improved Load Factor

Storage & Integration of Renewable Power

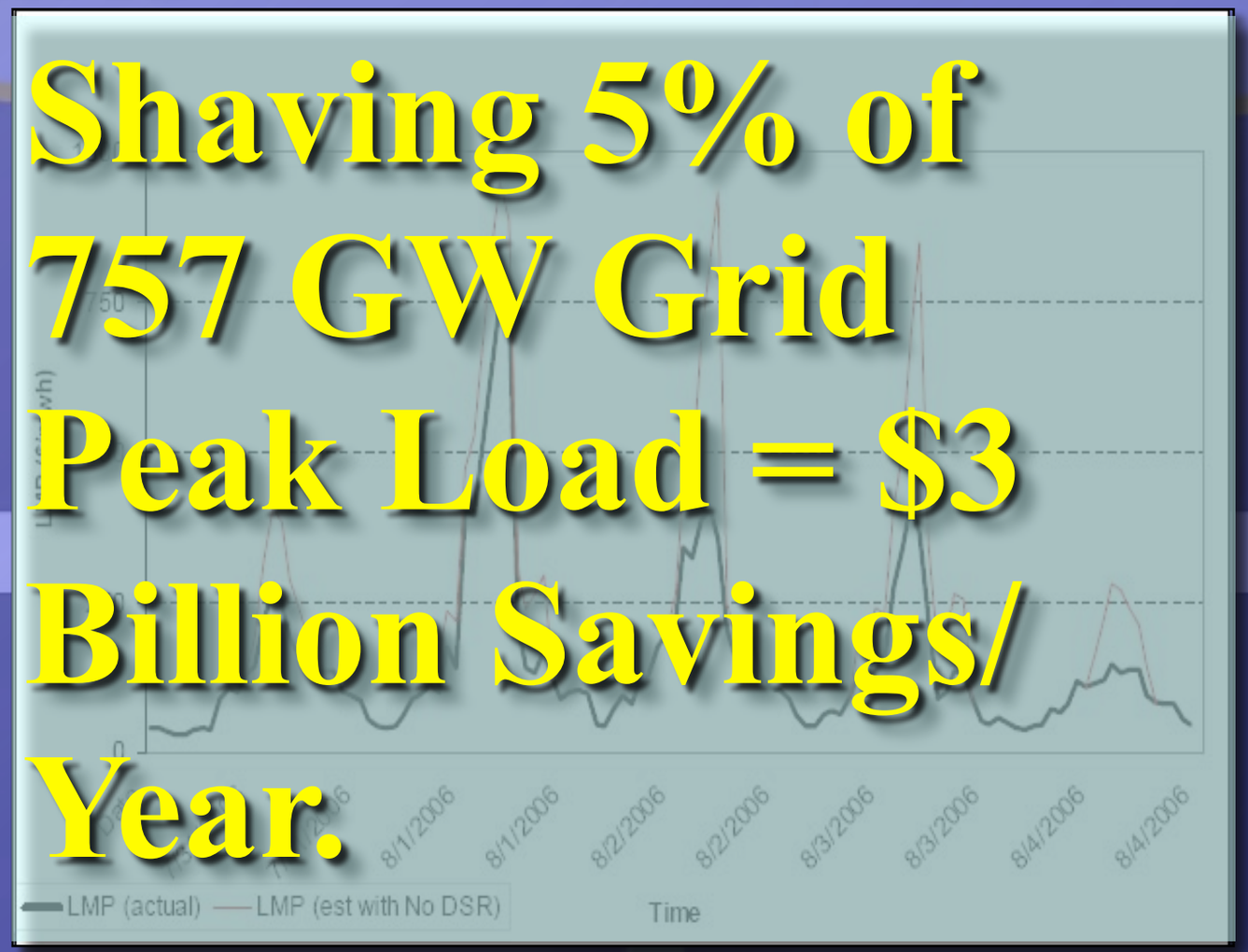
- Wind & Solar
- Load Following

Emergency Power Supply

Electric Transit Power Support

CashBack Hybrid- Clipping the Peaks

Shaving 5% of 757 GW Grid Peak Load = $3 Billion Savings/ Year.

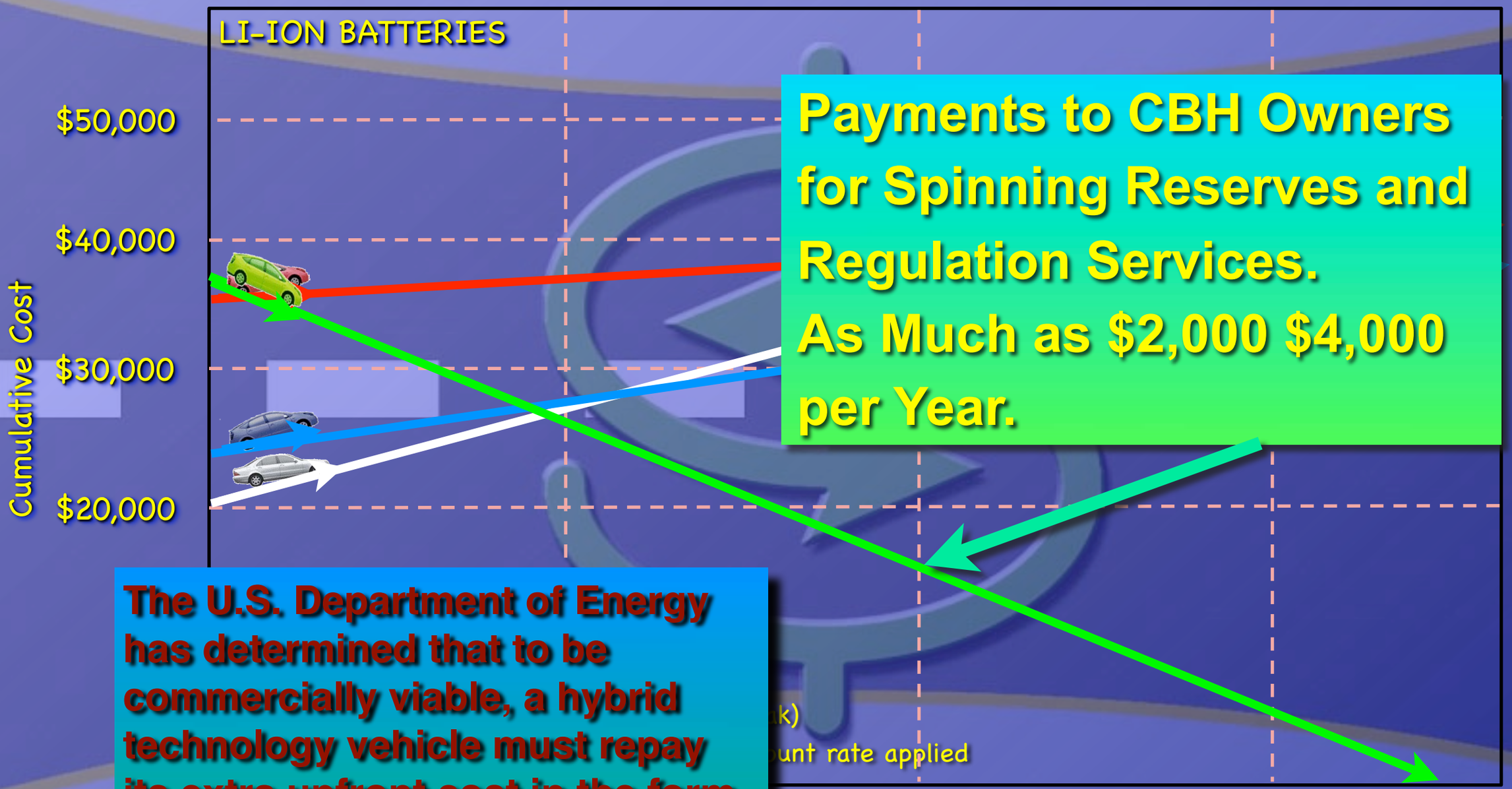


$650 Million in Consumer Savings from Demand Response- PJM

Economic Benefits to the Electric Utility Industry & Consumers

- No New Investment….Use Scarce Capital Elsewhere
- Increases Revenues from Residential Customers from Additional Off-Peak Consumption- While Lowering Consumer's Total Energy Bills
- Spreads Fixed Costs of Generation, Transmission, Distribution Over More kWh – Average Fixed Costs Are Reduced Lowering All Electric Consumer's Bills

The "Cash Back" in CashBack Hybrid



The U.S. Department of Energy has determined that to be commercially viable, a hybrid technology vehicle must repay its extra upfront cost in the form of fuel savings within three years of the initial purchase

Conclusions

- **The CASHBACK Hybrid :**
  - **Will Save Their Owners Money on Their Total Energy Bills**
  - **Will Cost Less Than a Conventional Gasoline Car in 5 Years or Less of Ownership (Incorporate Savings into Financing to Lower 1st Costs)**
  - **Will Improve the Overall Efficiency of the Electric System and Save All Consumers on Their Electric Bills**
  - **Will Reduce GHG and Urban Pollution**
  - **Will Reduce Foreign Oil Imports**
  - **Will Improve Electric Grid Reliability and Security**

Quote

“If I’d asked my customers what they wanted, they’d have said a faster horse”
Henry Ford