Energy Security
Challenges & Opportunities

Oil Dependence

Infrastructure Modernization

Climate Change

"Solutions Will Require a Systems Approach"

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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Sandia's Energy Security Research Facilities

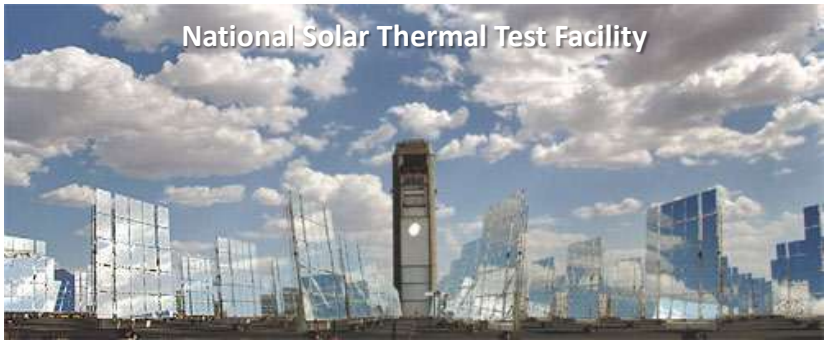

PV panels at the Distributed Energy Technologies Laboratory (DETL)


Supervisory Control & Data Acquisition (SCADA) Test Bed


Combustion Research Facility (CRF)


Joint BioEnergy Institute (JBEI)


Battery Abuse Testing Laboratory (BATLab)


National Solar Thermal Test Facility


Liquefield Natural Gas Fire Safety Test Facility


Center for Integrated Nanotechnologies (CINT)


National Infrastructure Simulation & Analysis Center (NISAC)


Red Sky High Performance Computing

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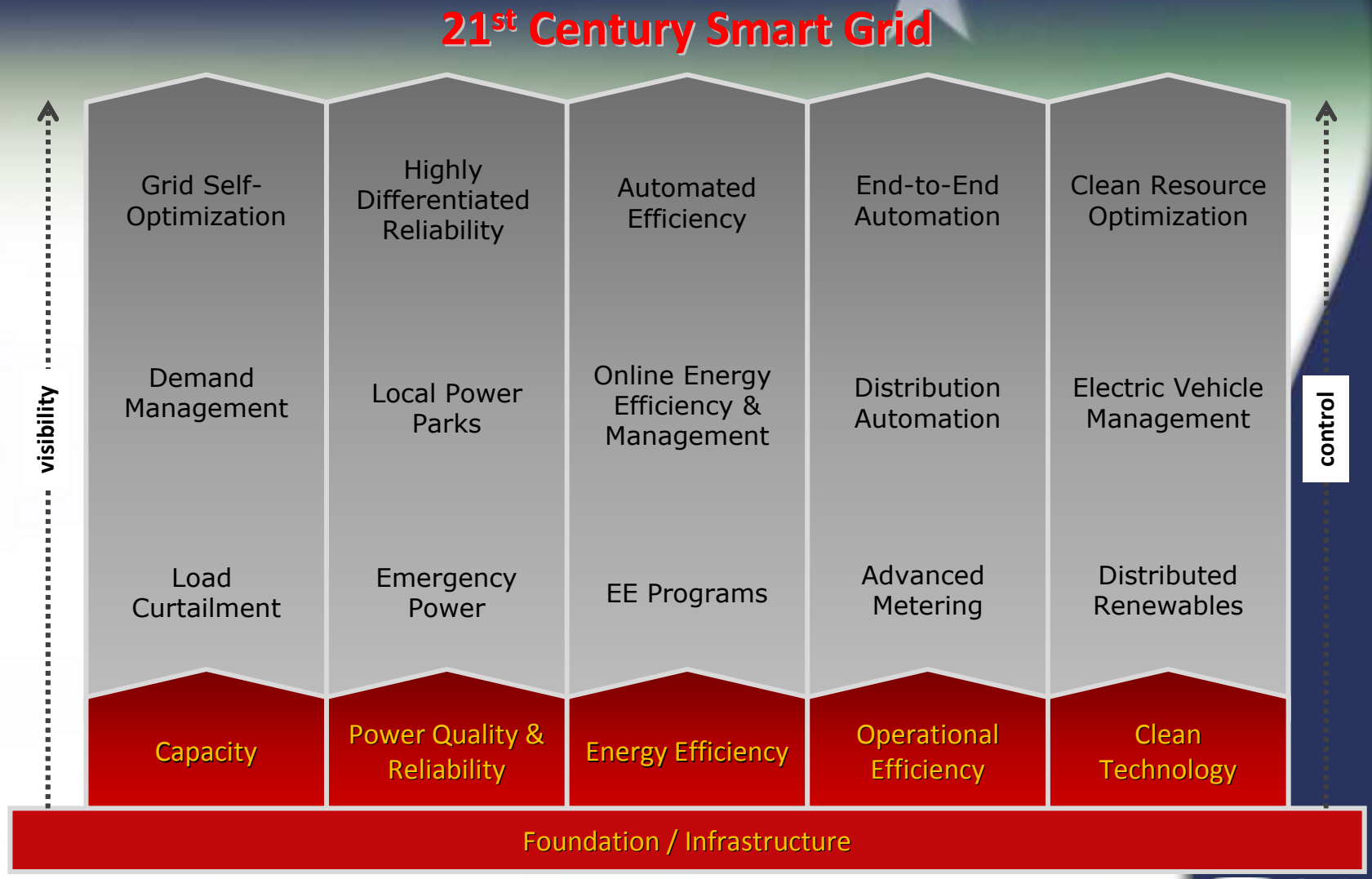
Smart Grid Value Streams



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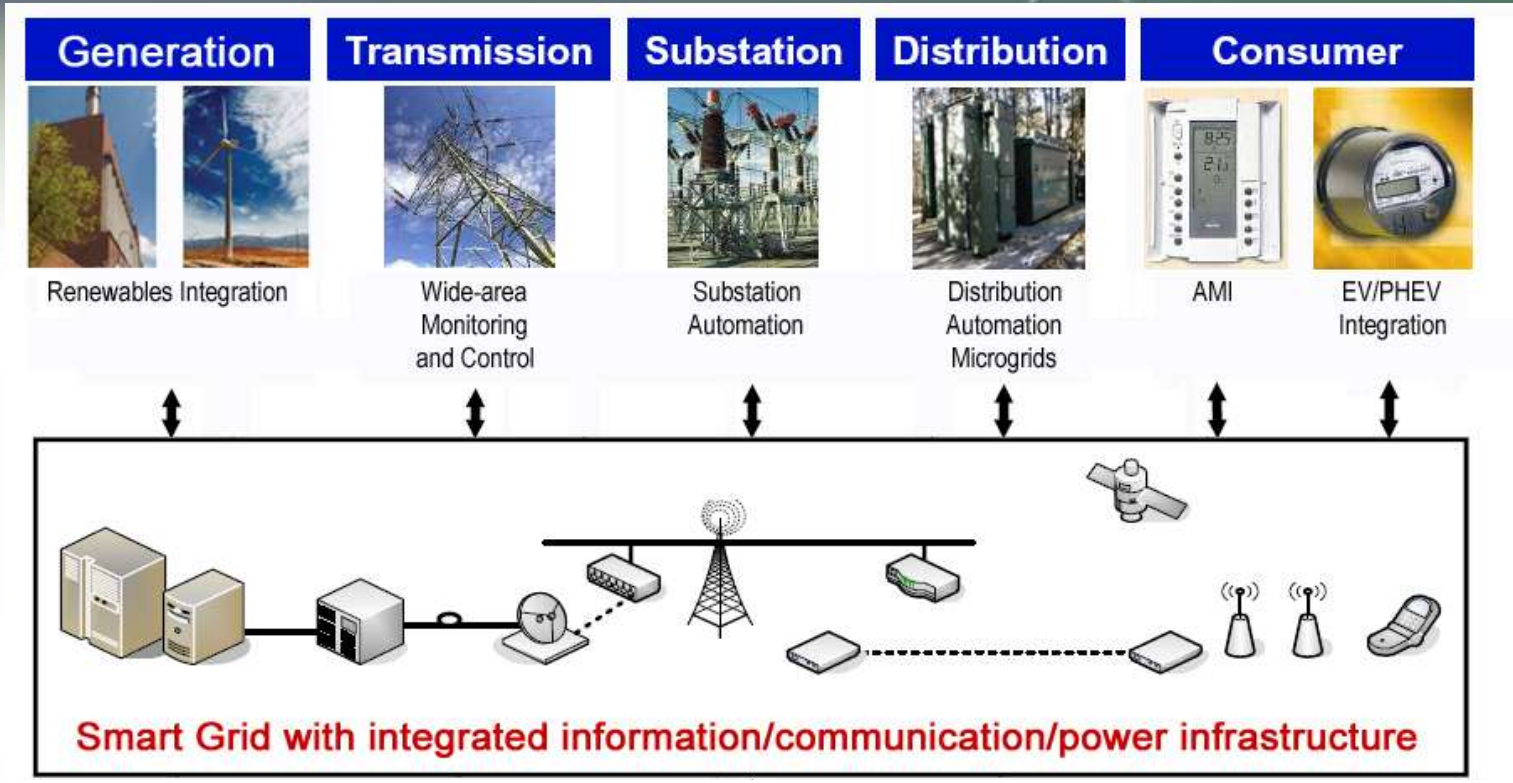
Smart Grid Enables Dynamic Optimization of Grid Resources and Operations



Use of digital technology to improve reliability, security, and efficiency of the electric system with applications for dynamic optimization of system operations, maintenance, and planning

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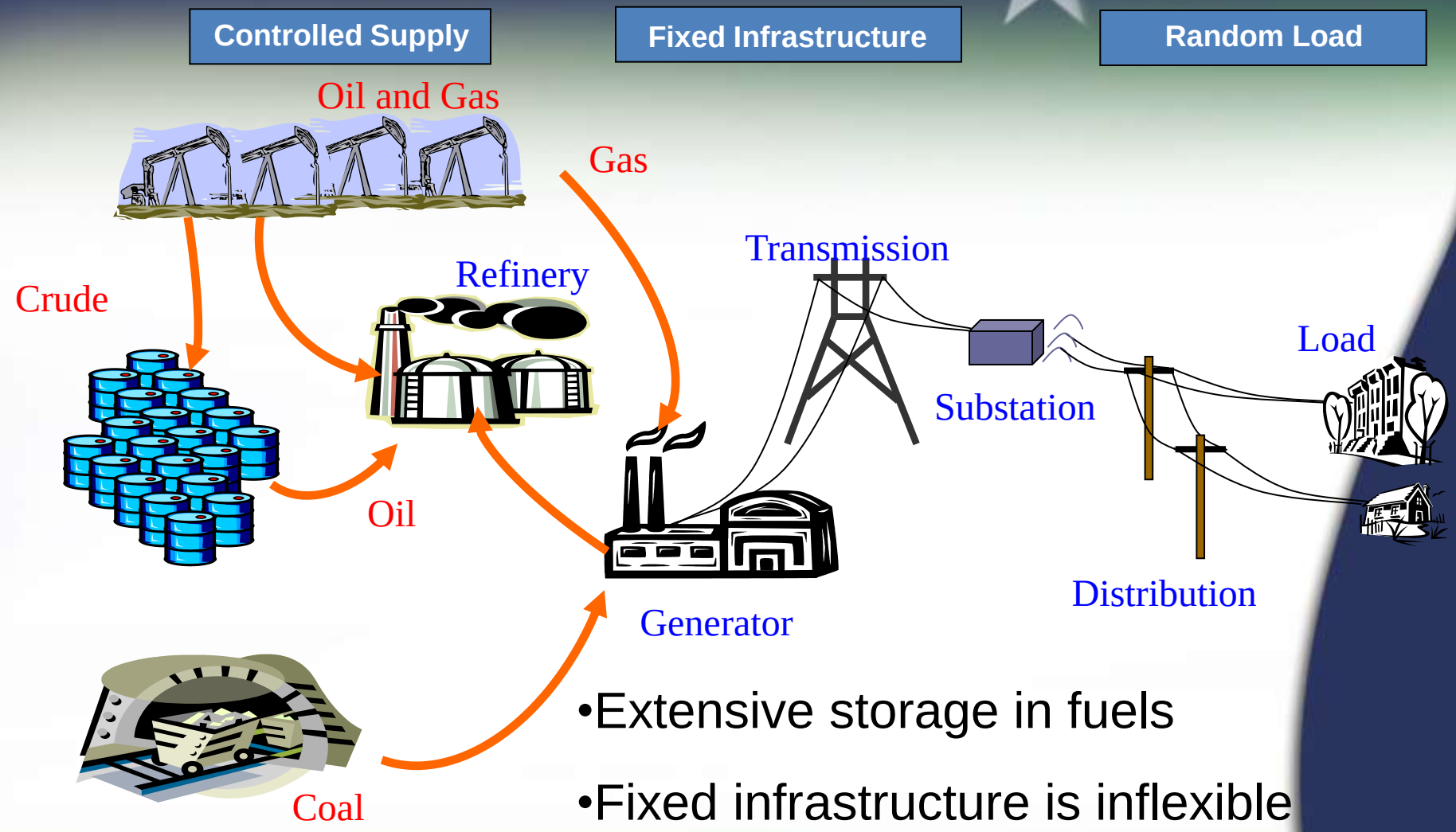
Today's Power Grid is Designed for Dispatchable Centralized Generation



- Extensive storage in fuels
- Fixed infrastructure is inflexible
- Significant human interaction

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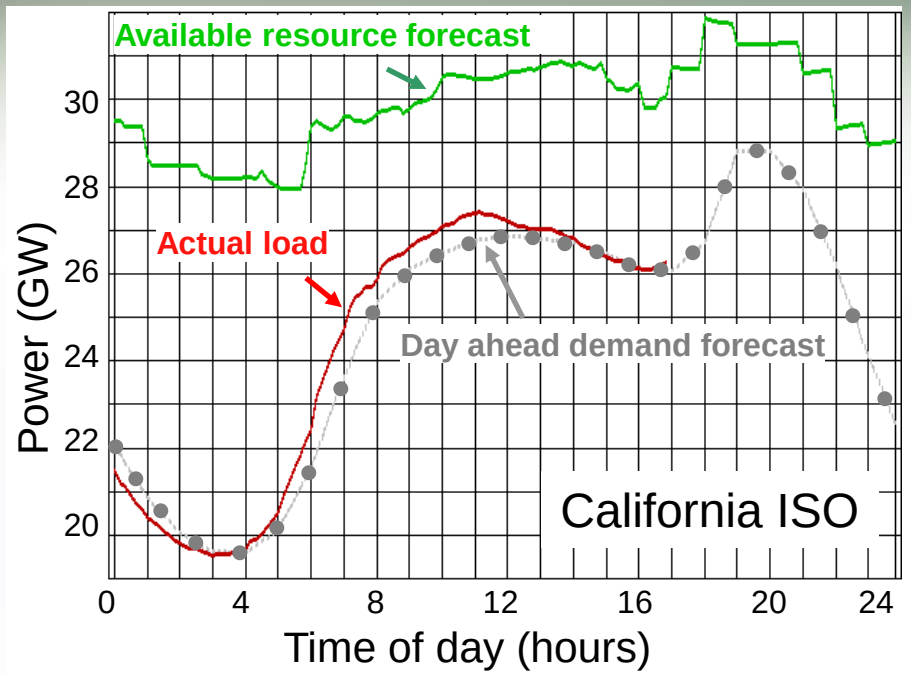
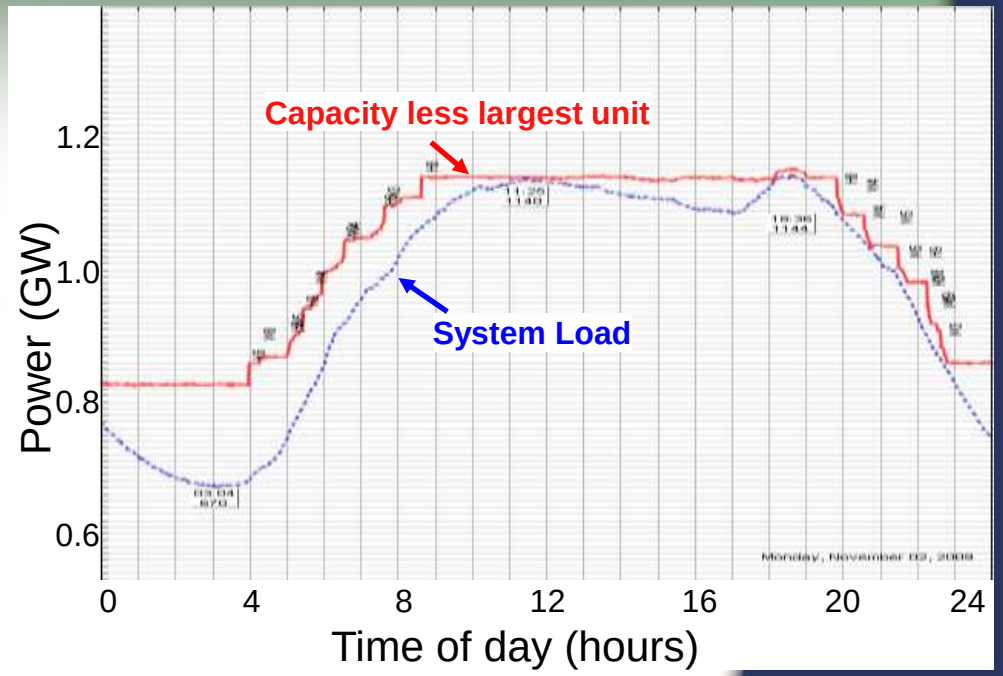
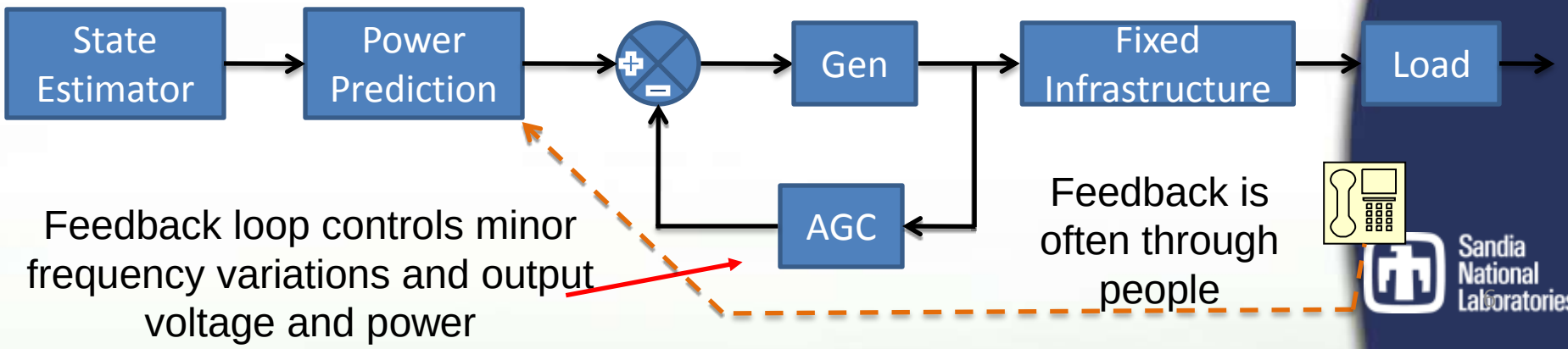
Loads are Predictable, Allowing Essentially Open-loop Grid Control

Forecasting is used to set generation



Hawaiian Electric Co. daily load vs capacity





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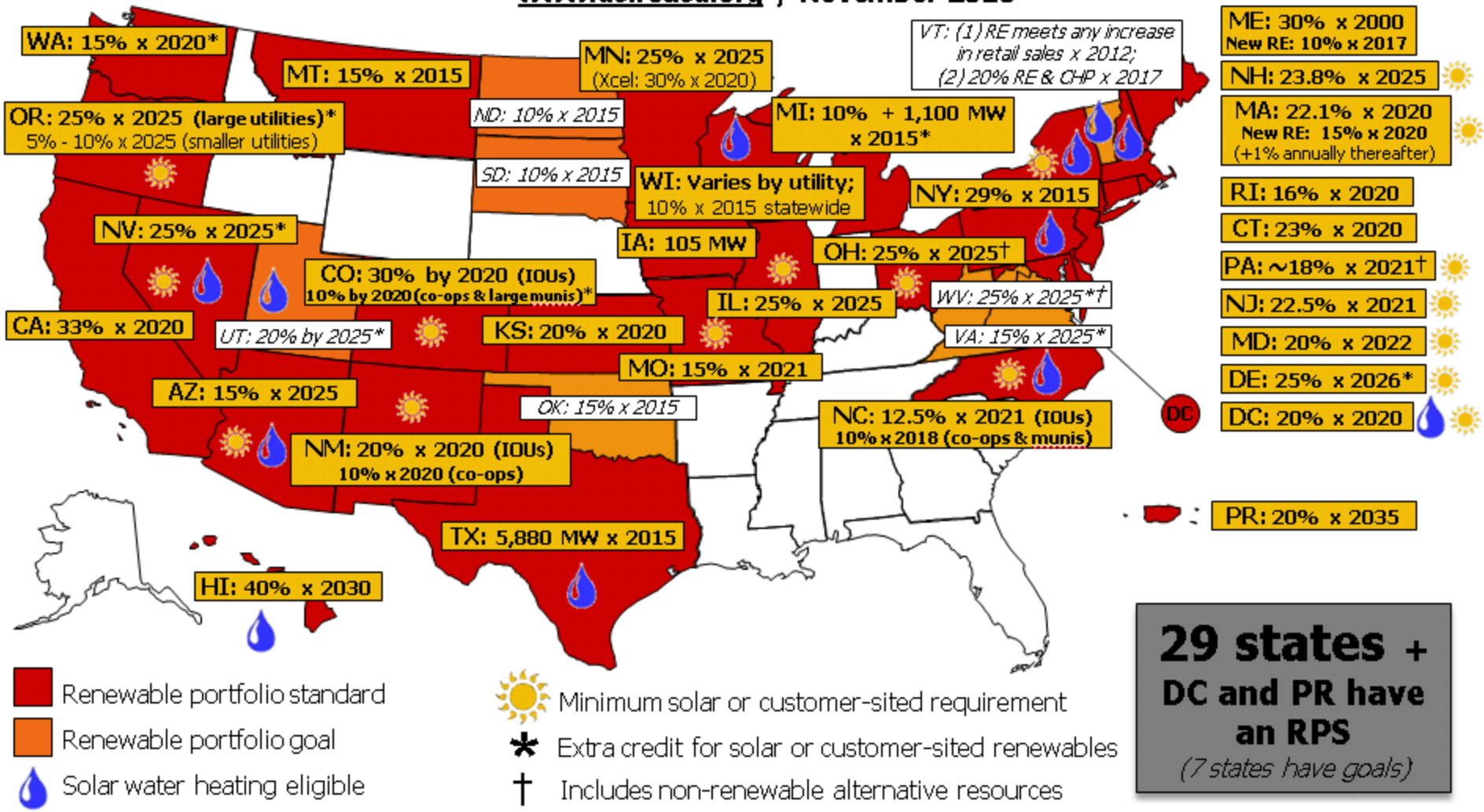
RPS Policies

www.dsireusa.org / November 2010



Renewable portfolio standard

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 and PR have an RPS

(7 states have goals)

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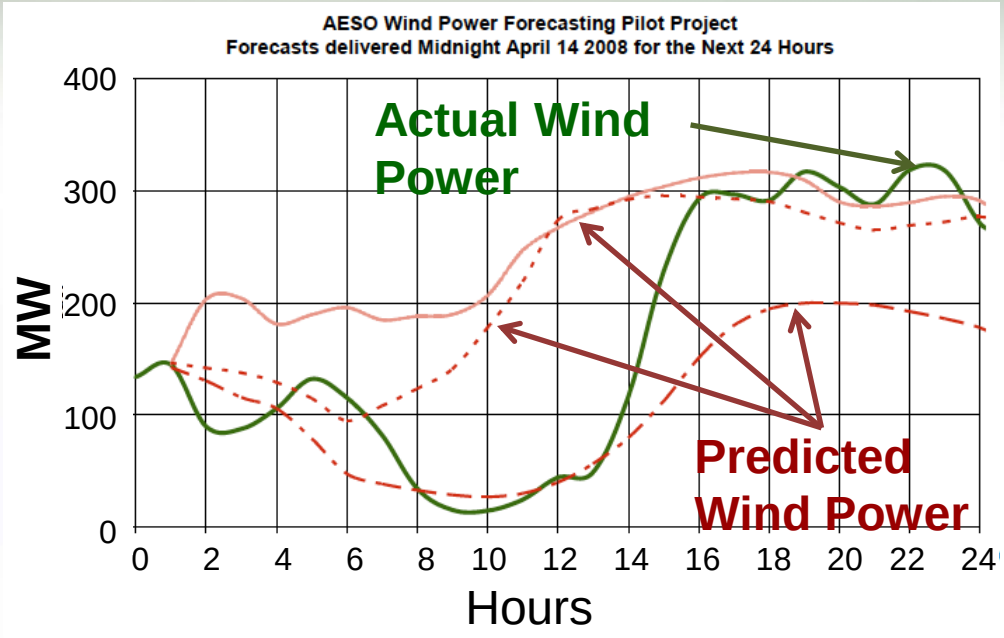
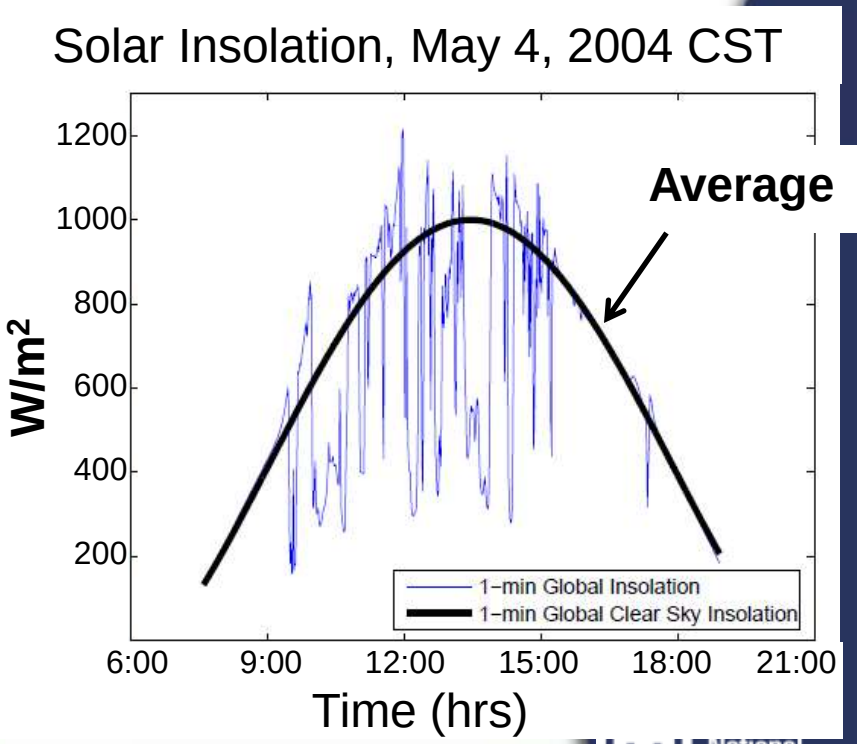
Stochastic Sources Complicate Load Forecasting

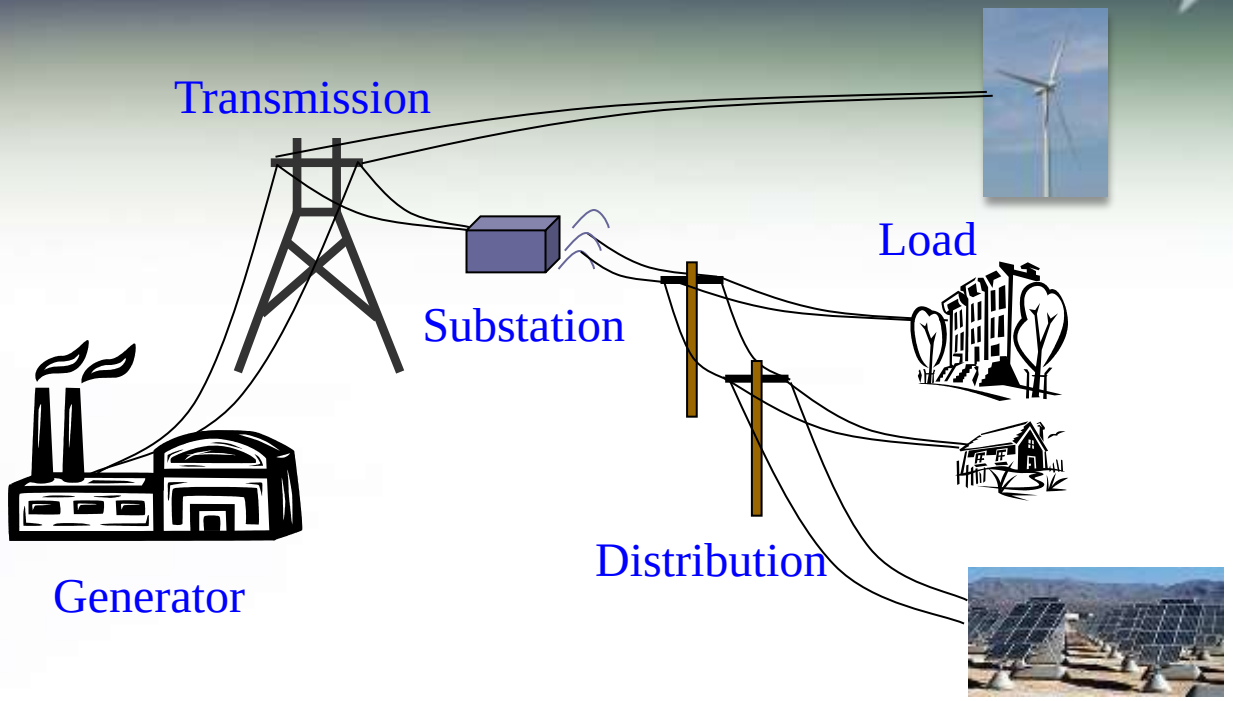
Wind power forecasting examples

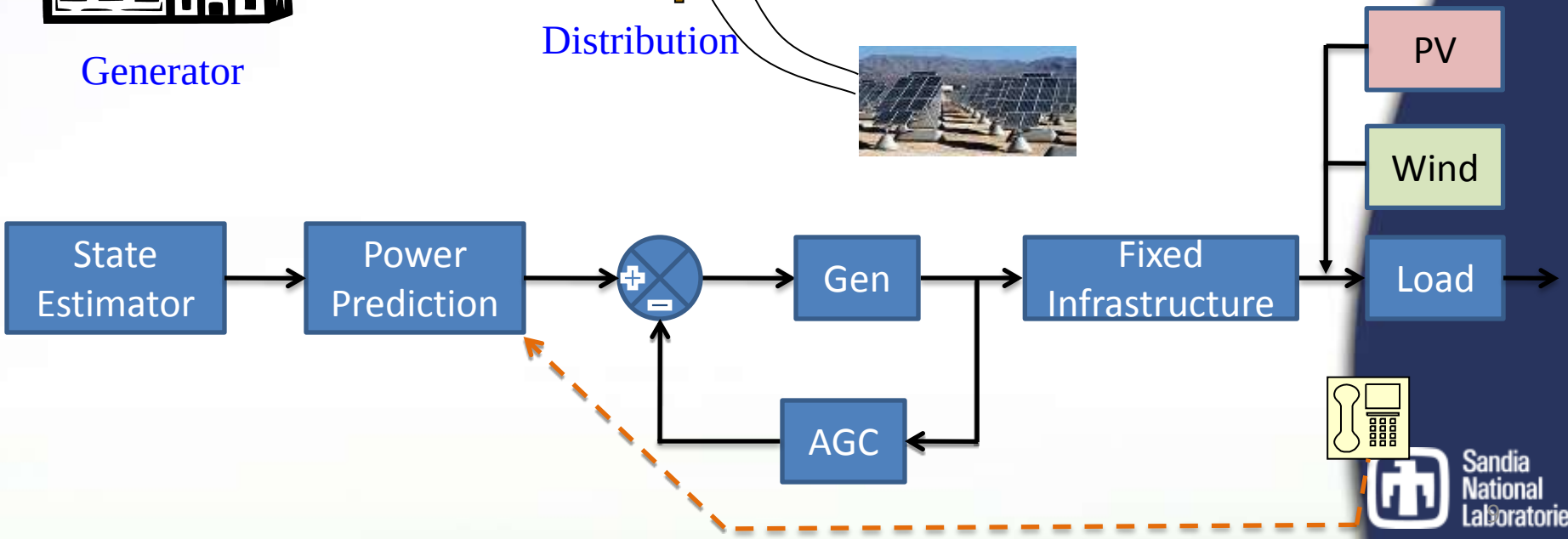




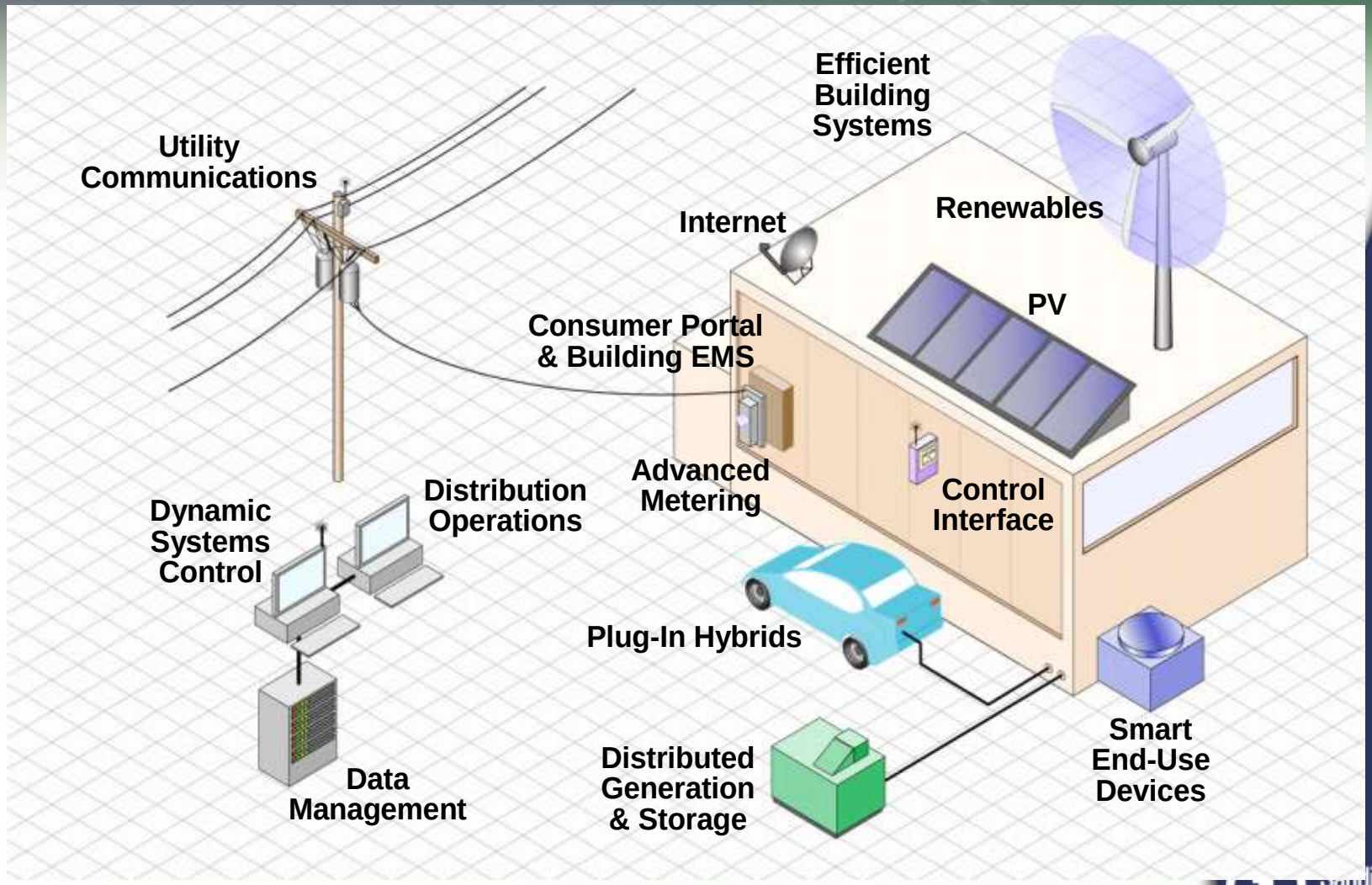
This is weather forecasting!

Today, Stochastic Renewable Sources are Treated as Negative Loads



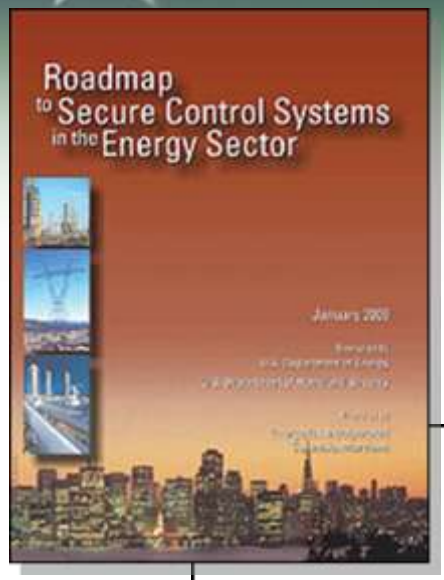


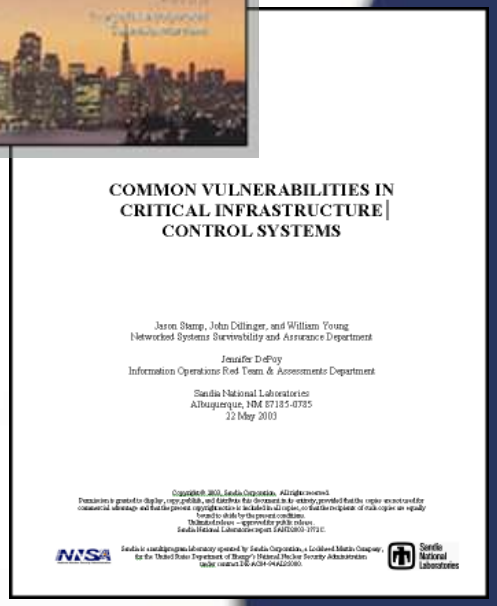
Smart Grid Enables Consumer Participation and Demand Response



Trends Impacting Power Grid Cyber Security

- Interconnected to Other Systems
  - Connections with enterprise networks to obtain productivity improvements and information sharing
- Common Operating Systems
  - Standardized computer platforms increasingly used to support control system applications
- Reliance on External Communications
  - Increasing use of public telecommunication systems, the Internet, and wireless for control system communications
- Increased Capability of Field Equipment
  - “Smart” sensors and controls with enhanced capability and functionality




COMMON VULNERABILITIES IN CRITICAL INFRASTRUCTURE CONTROL SYSTEMS

Jason Stamp, John Dillinger, and William Young
Networked Systems Survivability and Assurance Department

Jennifer DePoy
Information Operations Red Team & Assessments Department

Sandia National Laboratories
Albuquerque, NM 87185-0785
22 May 2003

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Top 10 Possible Smart Grid Privacy Concerns

1. **Identity Theft**
2. **Determining personal behavior patterns**
3. **Determining specific appliances used**
4. **Performing real-time surveillance**
5. **Revealing activities through residual data**
6. **Targeted home invasions**
7. **Providing accidental invasions**
8. **Activity censorship**
9. **Decisions and actions based upon inaccurate data**
10. **Revealing activities when used with data from other utilities**

Dr. Christopher Velstos, proponent of Privacy Impact Assessment/NIST (IT Compliance)

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Energy Surety

Performance Parameters	
Safety	Safely supplies energy to end user
Security	Maintains power in a malevolent environment
Reliability	Maintains power when and where needed
Sustainability	It can be maintained for mission duration
Cost Effectiveness	Produces energy at lowest predictable cost

A Sandia developed risk-based approach to implement and measure energy system effectiveness

"Toward an Energy Surety Future"
www.infoserve.sandia.gov/sand_doc/2005/056281.pdf

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Thank You!

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