Partnership for 21st Century Energy Systems (P21-CES)

Reducing Risk, Cost, and Uncertainty for the Future Energy System

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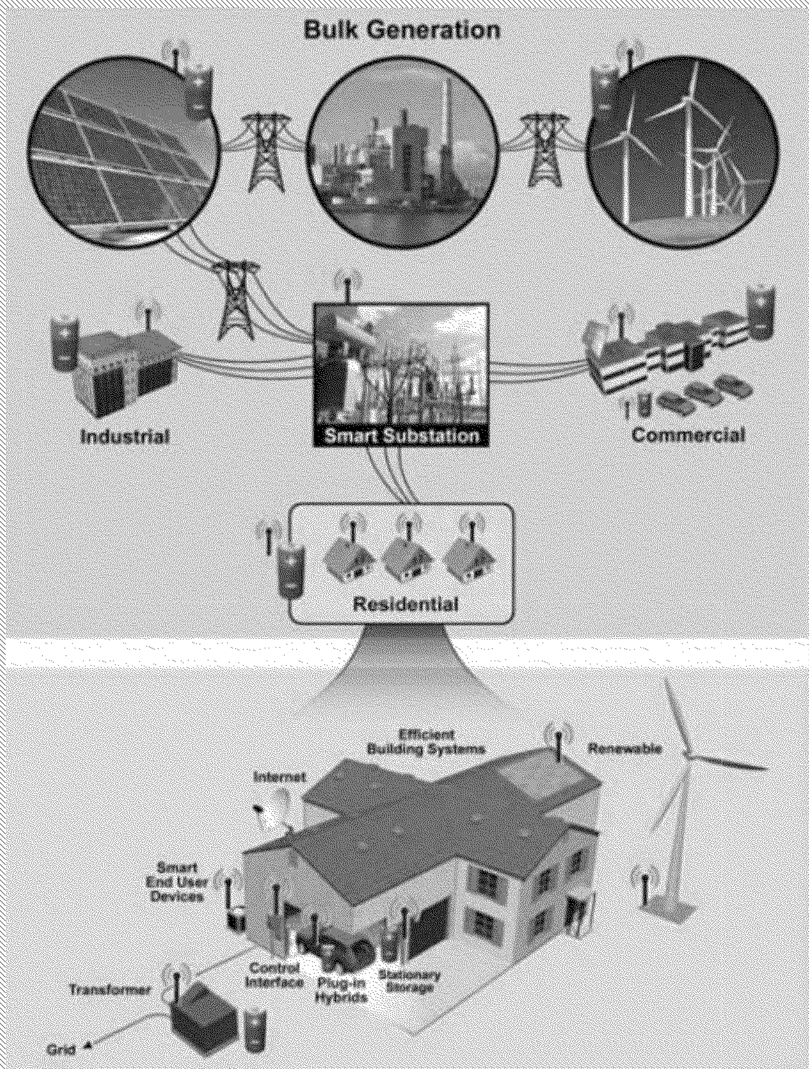
Power industry is making revolutionary end to end changes to the energy system

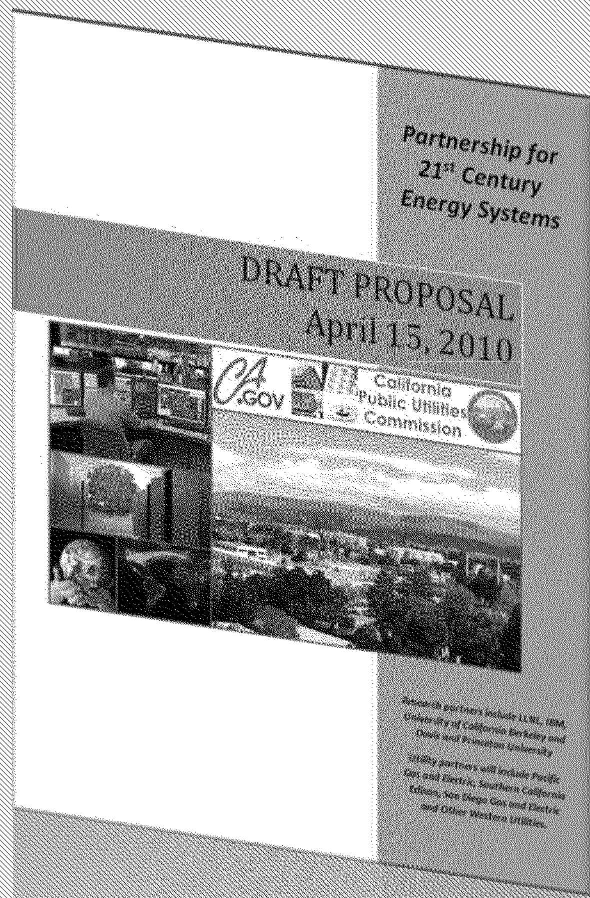


<u>The challenge is integration:</u>

- Renewable integration
- Improving grid operation
- Demand-side management
- Electric vehicles
- Cyber security
- Weather and climate impacts
- Economic viability

P21-CES is proposed to wisely build capabilities to meet energy, policy, and environmental goals

- Develop a predictive modeling and simulation capability to address integration challenges
- Apply world-class HPC to understand scenario impact and to inform tactical and strategic decisions
- Enhance cyber security



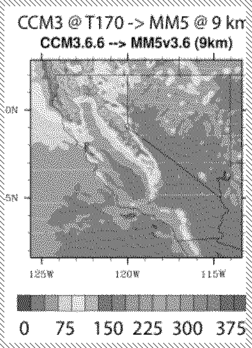
Discover risk, threats and reliability concerns before expensive investments are made

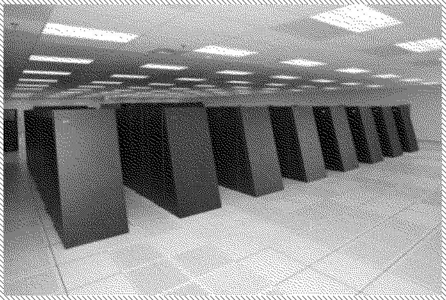
Level of Precision and Speed Necessary to Support Decision Makers Requires HPC

Western region generation planning

- Today: CAISO model 1 hour time steps for a 30-year simulation. 30k actors requires 6 months … too long for decisions
- LLNL-HPC: Scaling code and algorithms and HPCs could reduce runtime by 100 to 1000
- Future: DSM, Smart Grid, renewables, DG E-Vehicles, 30-year simulation w/ 30m+ actors.

Need World Class HPC

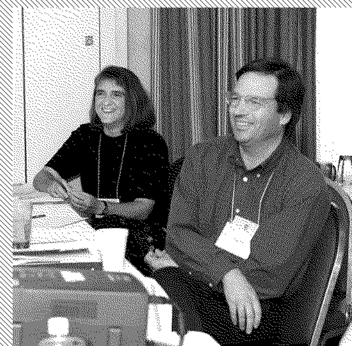




Multi-disciplinary teams required to attack such problems

We will develop a partnership model where hard problems drive research and development

- Utility/CAISO/LLNL staff work at HPC-IC to focus research, **build commonly accepted models**



- LLNL, IBM staff work at power sites for deployment, consulting, red teams, etc.

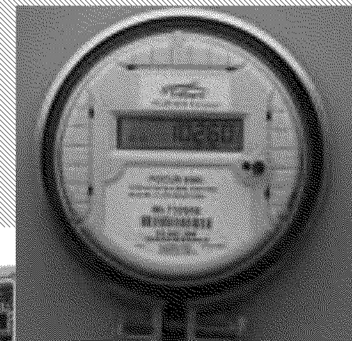
- Establish agreements to share data and proprietary information, etc.

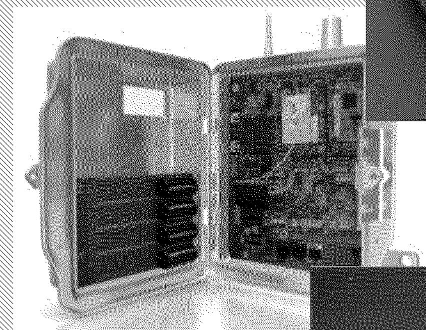
Planning – Improve decision making and investment strategies

- **Need**
  - Reducing uncertainty in technology, climate, and policy
  - Current models oversimplify to achieve results in a timely manner
- **Approach**
  - Add details (e.g., all transmission lines) into models to achieve greater accuracy
  - Enhance code scalability to improve fidelity and resolution
  - Incorporate hedging strategies in resources allocation to formally incorporate uncertainty (climate, policy, new technologies)
- **Benefit**
  - Optimal resource planning

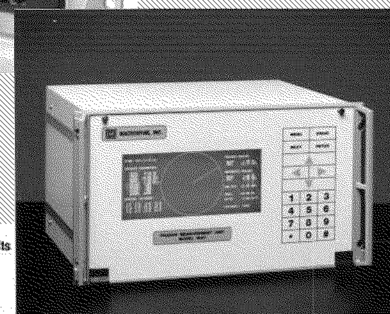
Modeling can reduce maintenance cost and system failures (e.g., 2006 heat storm)
One week- $100m+ of avoidable replacements

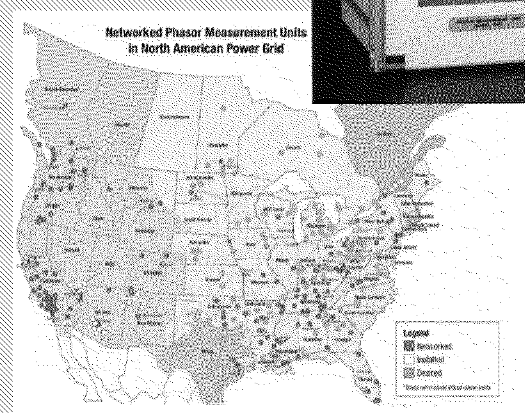
Grid Operations – Optimize real-time response for a changing grid





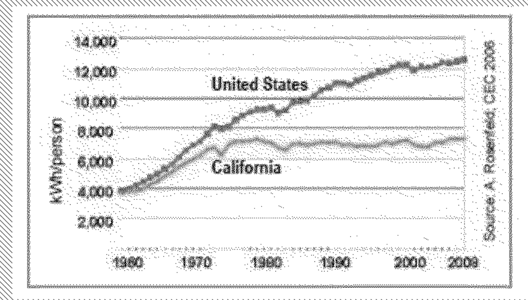
- **Need**
  - Enhance situation awareness of information flows
  - Predicting grid behavior with +100X data increase some sensors and meters
  - Modeling environmental effects on energy systems
- **Approach**
  - Extend and scale power flow models for HPC
  - Develop network / information models for sensors
  - Apply tools and expertise in data analysis
  - Integrate environmental conditions
- **Benefit**
  - Avoid unnecessary Trans mission $4m per mile and Power Stations ($500m+ each)
  - Improve reliability

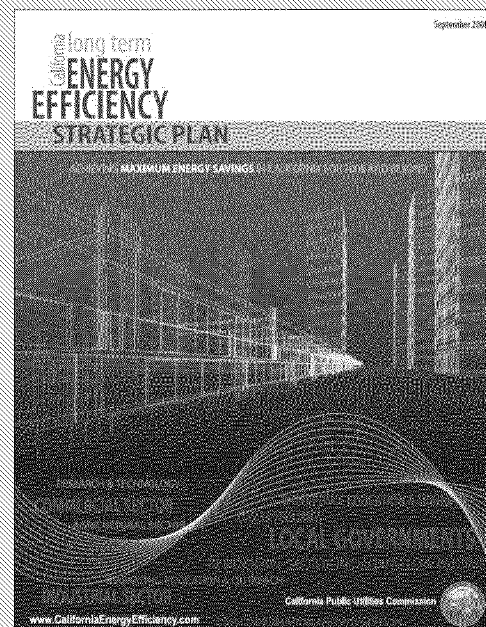




Energy Efficiency - Enhancing Energy Measurement and Validation

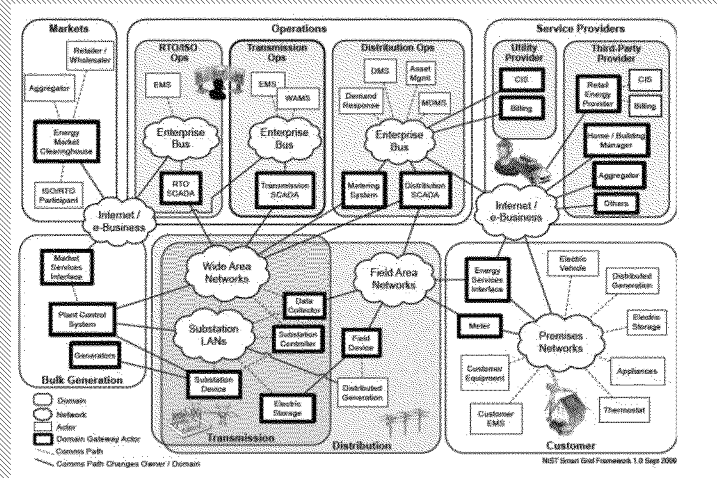
- **Need**
  - A consistent and transparent approach to estimating energy savings
  - Formal incorporation of uncertainty
  - Improved technology performance models and analysis
  - S&T capability to evaluate benefits
- **Approach**
  - Develop and apply rigorous V&V program to EM&V process
  - Iterative learning process for program improvement without retroactive penalties
- **Benefit**
  - Increase ratepayors ROI on $1.5B/yr
  - Predictable outcomes for State's energy goals
  - Reduce risk to IOUs



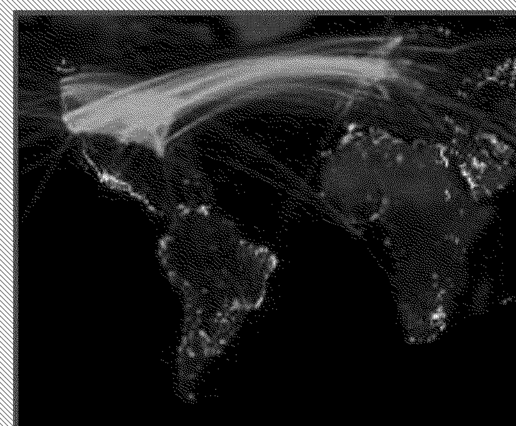


Cyber Security: Prevent, detect, and respond to intrusions and attacks

- **Needs**
  - Cyber defense is becoming increasingly more difficult with growth of SmartGrid
  - Tools for situational awareness of IT and SCADA, detecting malware, etc.
  - Understanding vulnerabilities and threat
- **Approach**
  - Develop an overarching tools strategy
  - Facilitate access to data and expertise for processing technologies and threat
  - Develop predictive models of cyber attacks on IT, smart meters, etc.
- **Benefits**
  - Improve ability to address a wide variety of relevant cyber attacks

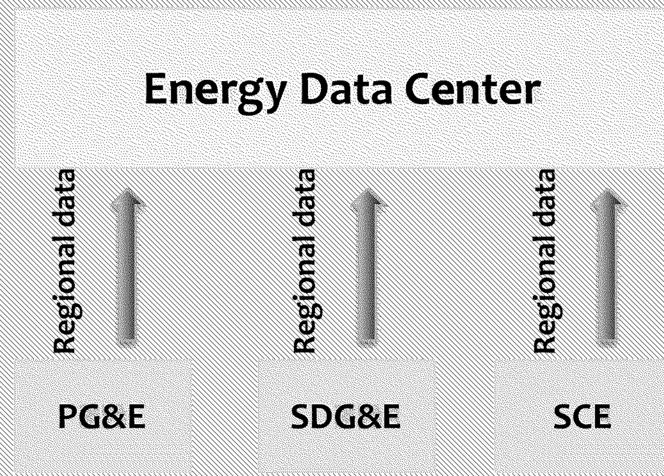


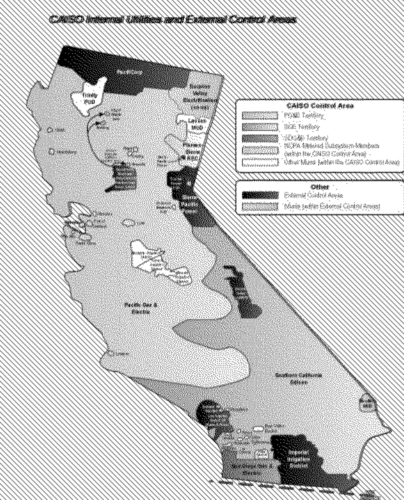
NIST Smart Grid Framework 1.0 September 2009



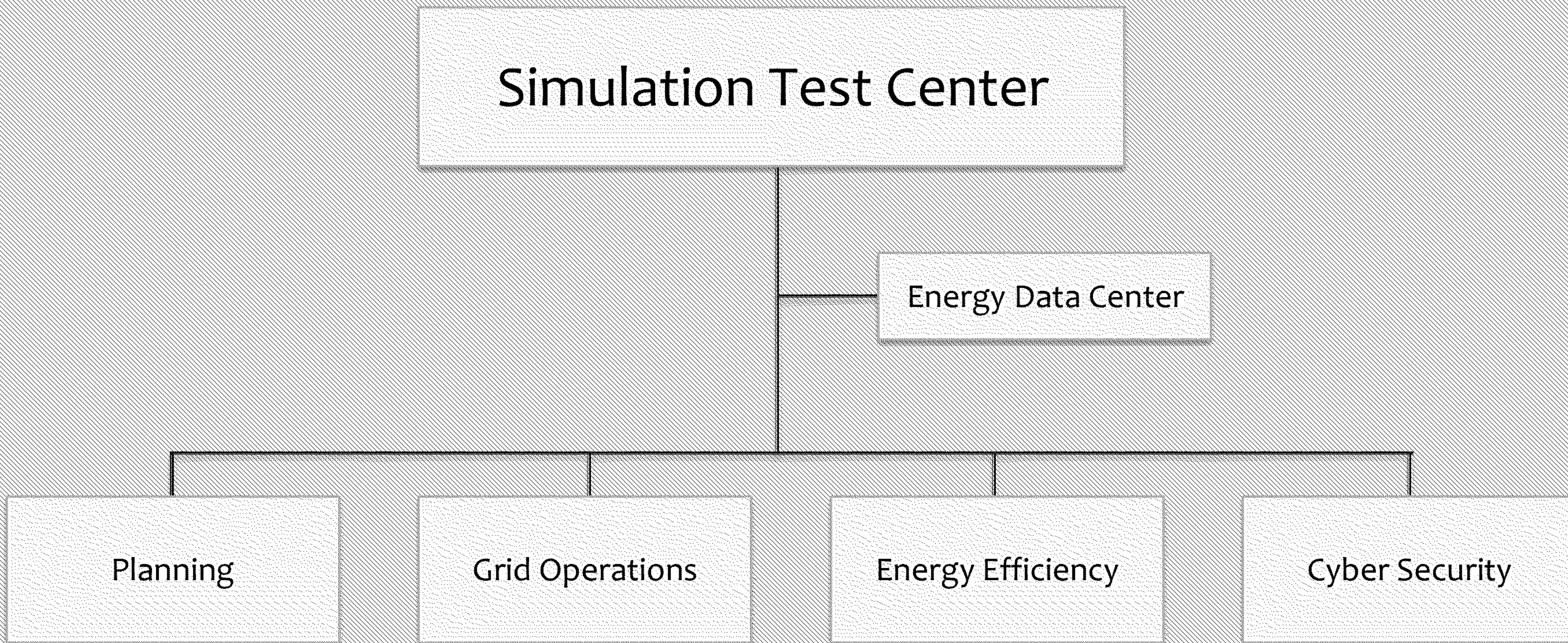
Energy Data Center – Providing computing and data for CA power

- **Need**
  - Computing facility to share and archive data from sensors, conduct systems studies, etc.
- **Approach**
  - Utilize computing, storage, expert staff at LLNL and the HPC Innovation Center
  - Warehouse data for planning studies, design experiments, and cyber security analysis
  - Leverage LLNL and IBM leadership in HPC technology, data storage, clusters, technology, real-time computing
- **Benefit**
  - Build state-wide view of grid through sharing of data on protected systems
  - Enable utilities access of state-of-the-art HPC systems for simulations and analysis





The P21-CES will create a Simulation Test Center to bring together technology teams and industry experts



The P21-CES will enable critical energy usage information to be processed, evaluated and reported to decision makers in the seconds and minutes needed to act, all under a secure environment enabled by the center's cyber security protocols.

More Focused and Leveraged Partnership than Previous State Efforts

California Institute for Climate Solutions

- $60 Million Per Year from CA-IOUs
- Funds CA Universities and CA Labs

P21-CES

- $20 Million Per Year from Ca-IOUs
- Support to partners and any University or National lab
- Improved DOE co-Funding opportunities for demonstrations and regional analysis (50/50 goal)
- Has LLNL and IBM support

Next Steps

- Identify IOU point of contact (today)
- LLNL Individual visits to each IOC (June)
- LLNL meeting with CPUC (June)
- Joint meetings with IOUs and CPUC (July/August)
- Launch Activities (Oct 2010)