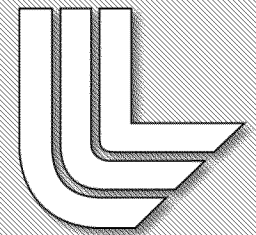


# Partnership for 21<sup>st</sup> Century Energy Systems (P21-CES)

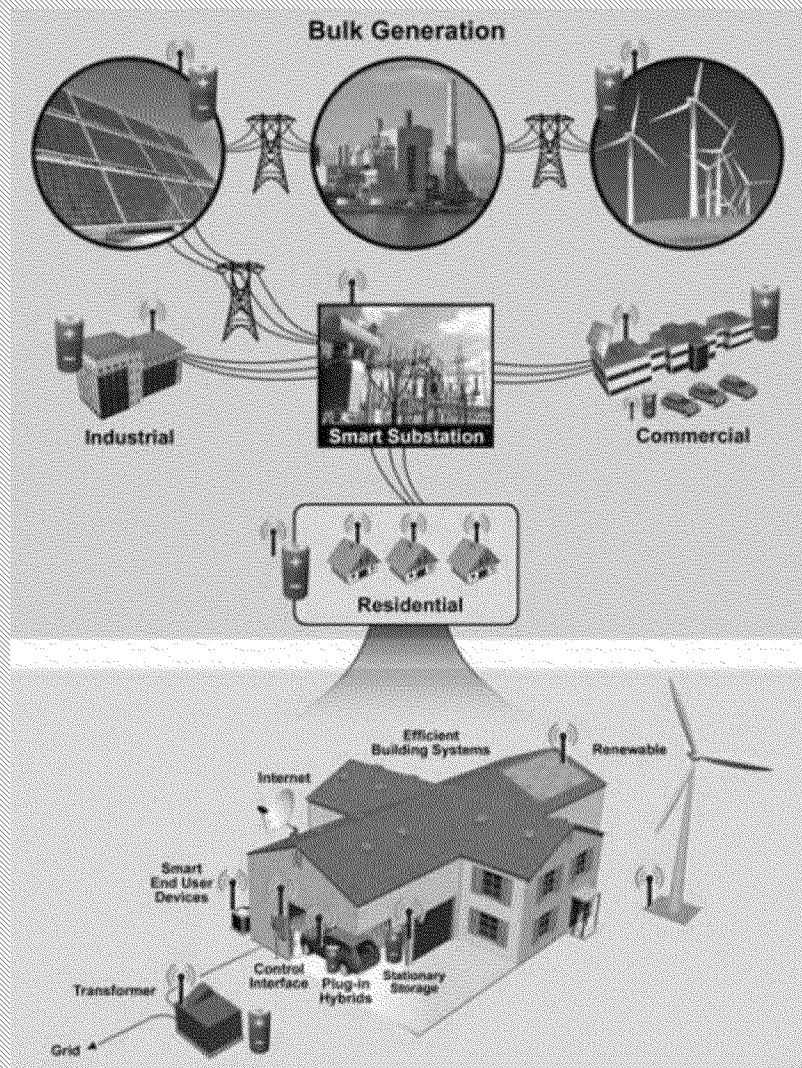
*Reducing Risk, Cost, and Uncertainty for the Future Energy System*



Jeffrey Stewart and John Grosh  
Lawrence Livermore National Laboratory  
Daniel Kammen, University of California Berkeley



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



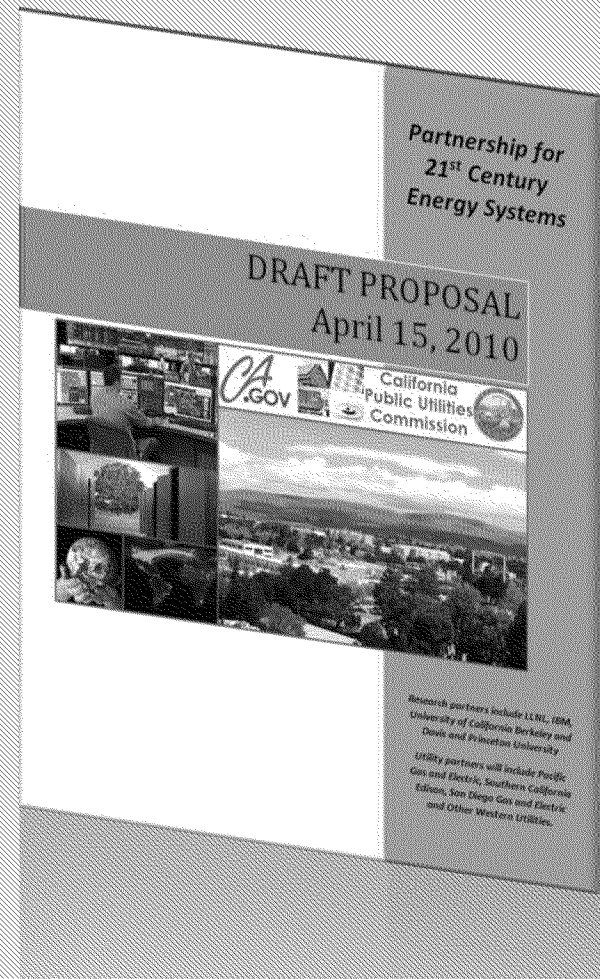
## The challenge is integration:

- 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

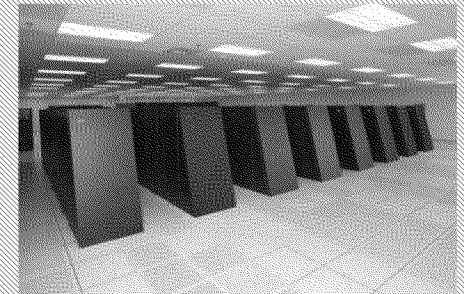
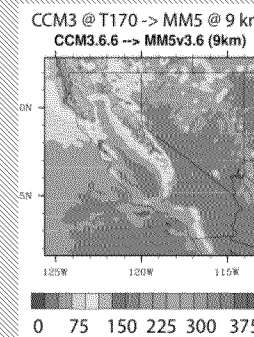
Discover risk, threats and reliability concerns before expensive investments are made



# 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

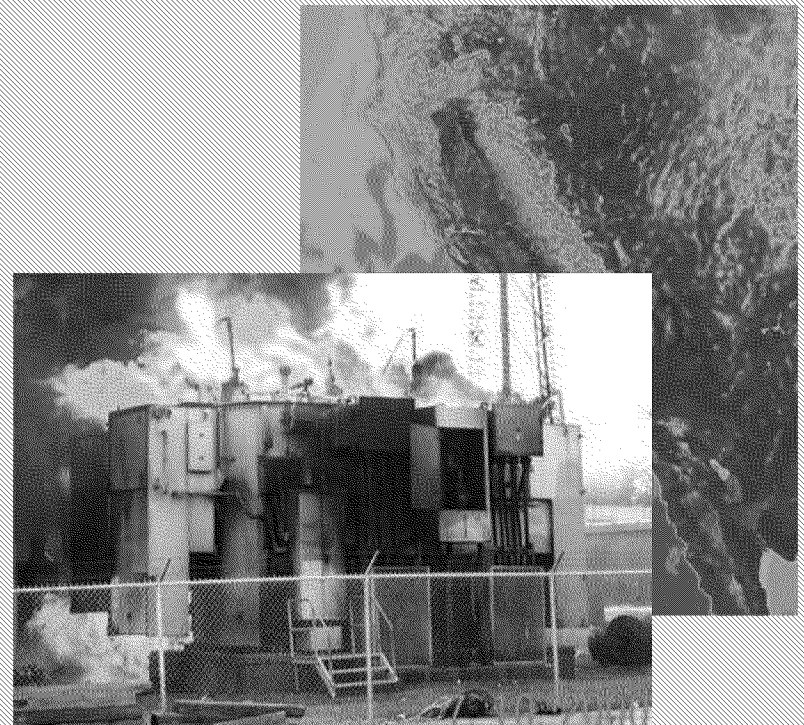
- Reducing uncertainty in technology, climate, and policy
- Current models oversimplify to achieve results in a timely manner

## ▪ 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

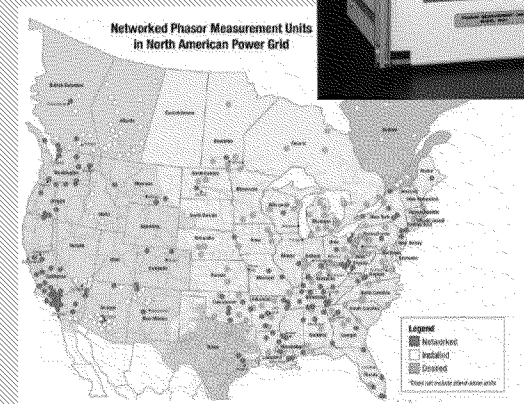
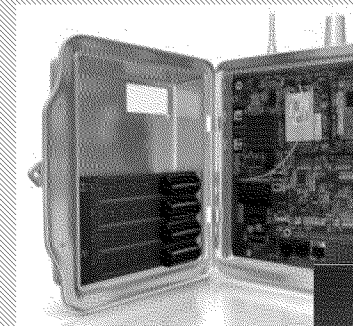
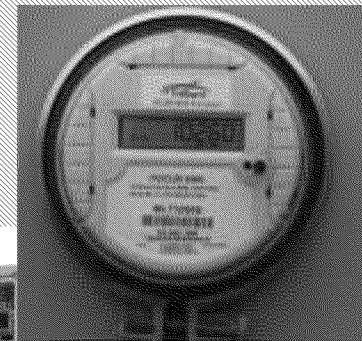
- Enhance situation awareness of information flows
- Predicting grid behavior with +100X data increase some sensors and meters
- Modeling environmental effects on energy systems

## ▪ 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 Transmission \$4m per mile and Power Stations (\$500m+ each)
- Improve reliability



# Energy Efficiency - Enhancing Energy Measurement and Validation

## ▪ Need

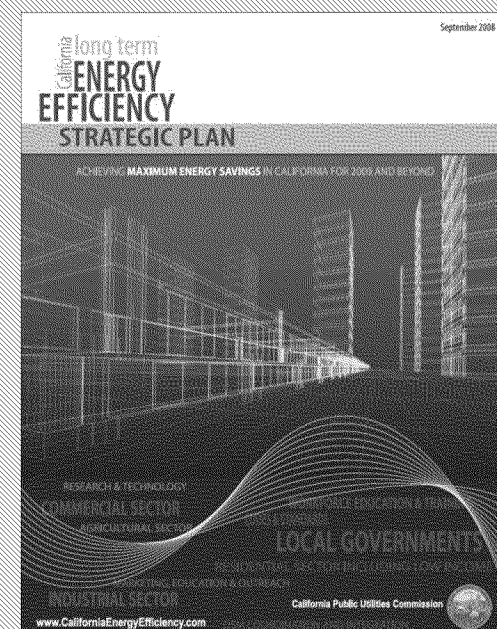
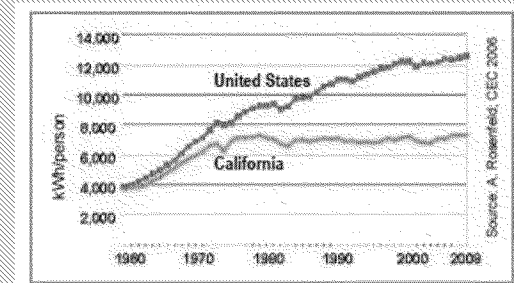
- A consistent and transparent approach to estimating energy savings
- Formal incorporation of uncertainty
- Improved technology performance models and analysis
- S&T capability to evaluate benefits

## ▪ Approach

- Develop and apply rigorous V&V program to EM&V process
- Iterative learning process for program improvement without retroactive penalties

## ▪ Benefit

- Increase ratepayers 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

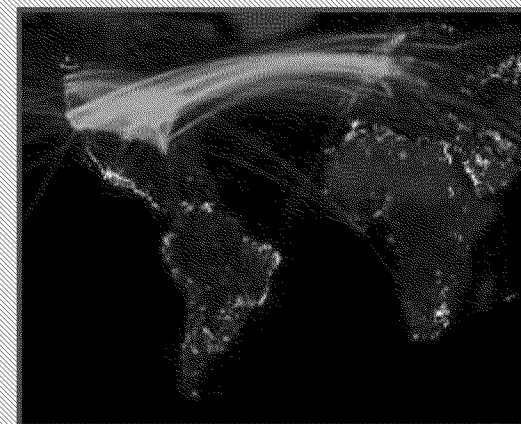
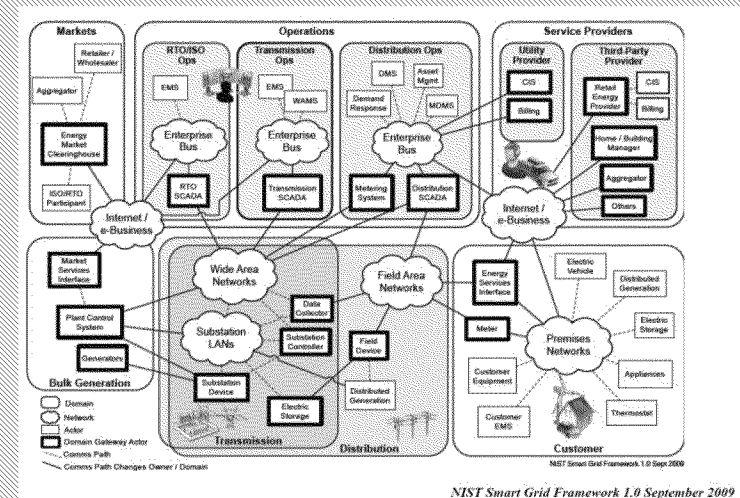
- Cyber defense is becoming increasingly more difficult with growth of SmartGrid
- Tools for situational awareness of IT and SCADA, detecting malware, etc.
- Understanding vulnerabilities and threat

## 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



# Energy Data Center – Providing computing and data for CA power

## ▪ Need

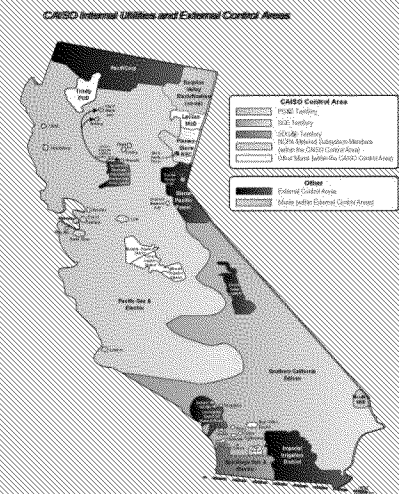
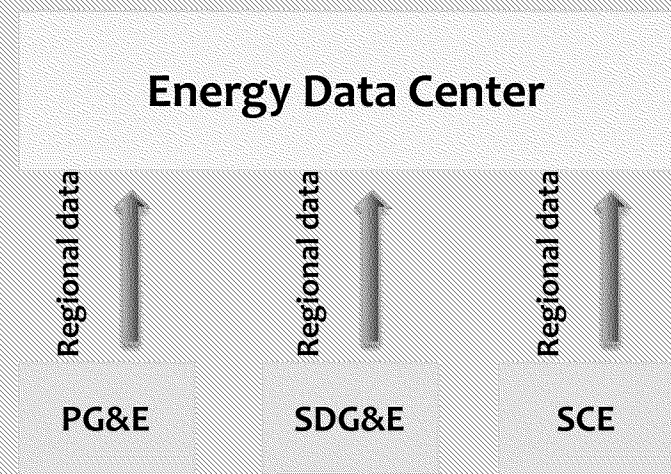
- Computing facility to share and archive data from sensors, conduct systems studies, etc.

## ▪ Approach

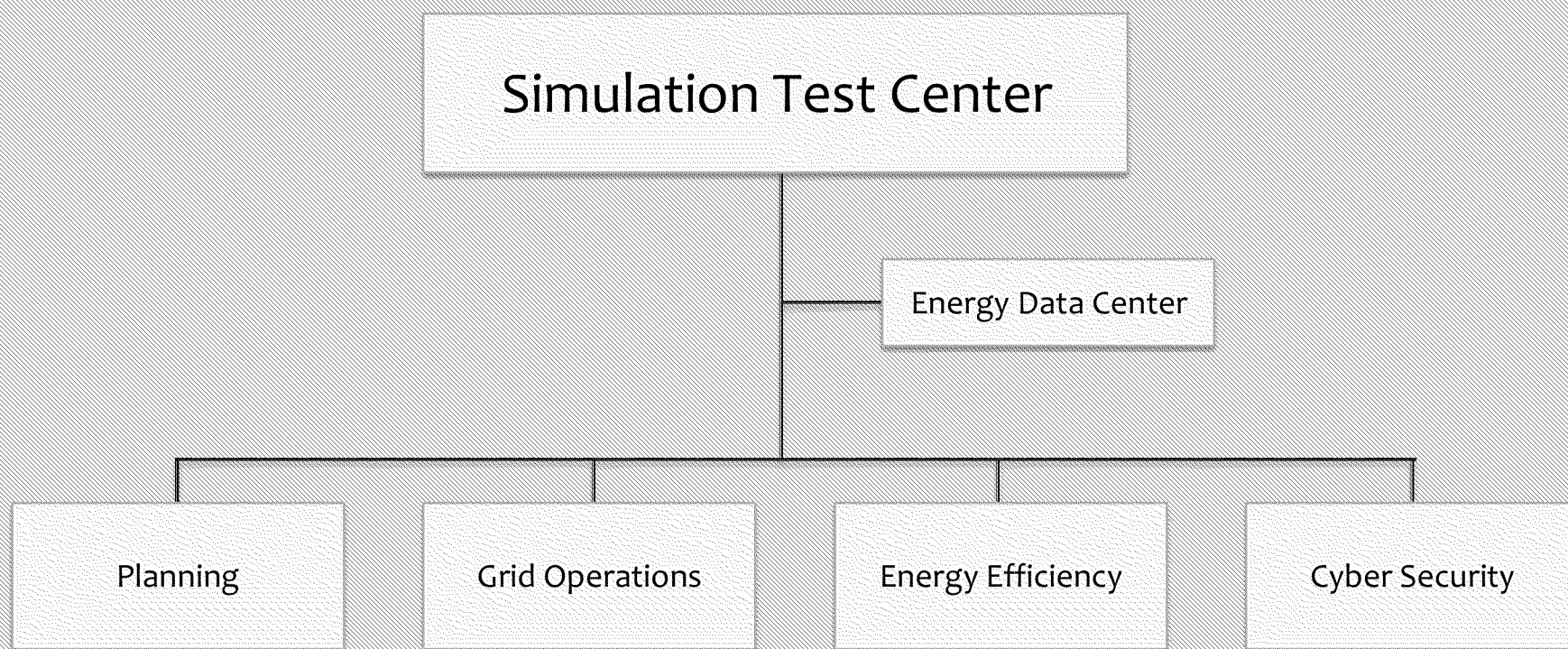
- Utilize computing, storage, expert staff at LLNL and the HPC Innovation Center
- Warehouse data for planning studies, design experiments, and cyber security analysis
- Leverage LLNL and IBM leadership in HPC technology, data storage, clusters, technology, real-time computing

## ▪ 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)