



# **Benefiting from Interagency Funded I/UCRC Supplements: PSERC's Future Grid Initiative**

**Research and education to enable  
renewable energy resources**

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# Future Grid Initiative

- PSERC has embarked on an exciting and challenging research initiative to address national energy challenges associated with the evolution of the electric energy grid. The initiative is funded by **DOE's Office of Electricity Delivery and Energy Reliability** and recognized as contributing to DOE's future grid visioning process.
- A critical component of this initiative is an attempt to encapsulate the engineering building blocks required for the future grid architecture to support an increased penetration of renewable resources – **wind and solar**.

# National Energy Challenges

**Energy independence, affordability**

**Energy reliability, security, efficiency**

**Economic development  
and job security**

**Environmental concerns  
and impact of climate change**

**Aging infrastructure, technology change,  
workforce needs**

# Range of Energy Solution Options

**Renewable resource technologies**

**Energy efficiency**

**Demand resources**

**Market solutions**

**Nuclear energy technologies**

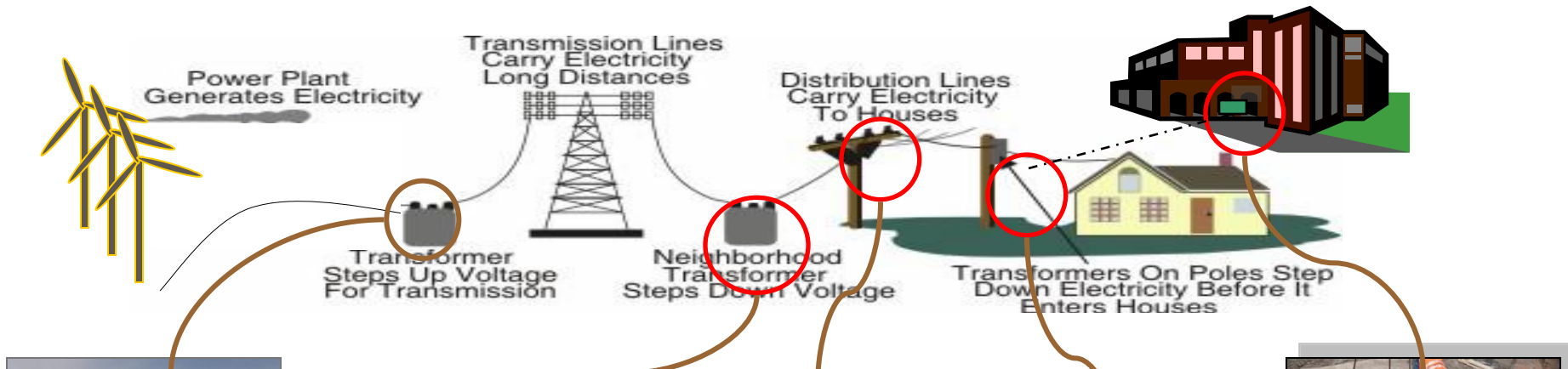
**Develop domestic resources**

**Improved asset utilization**

**Electric transportation**

**Carbon capture and storage**

**Energy storage**



*Reactive Compensation*



*Substation Batteries  
10's of MW*



*Distributed Intelligence and Control*



*Storage at Grid Edge  
10's of kW*



*Micro-grids*

# The Grid as an Enabling Technology

# Overarching Issues

- Given this set of national energy solutions, how does the electric grid infrastructure evolve to accommodate these solutions?
- What elements constitute the building blocks of this evolution?
- Given the large capital investment in the legacy grid, what steps are required to seamlessly transition from the legacy grid to accommodate the elements of the proposed building blocks?

# Drivers of the Future Grid



## Changing Generation Supply Mix

- T&D additions and changes
- Energy storage
- Enhanced control/communications
- Handling increased uncertainty

**Needed evolution/changes to support this element**

## Drivers of the evolution/changes

- Renewable resources
- Retirement of aging conventional plants
- Questions regarding nuclear additions
- Carbon regulation

# Drivers of the Future Grid

## Demand Transformation

- Expanding digital economy
- Power quality and reliability needs
- Demand flexibility
- Electric vehicles

**Needed evolution/ changes to support this element**

**Drivers of the evolution/ changes**

- Economic constraints
- Changing customer needs
- Green awareness and demand
- Need for higher reliability and efficiency



# Drivers of the Future Grid



## Complexity of Grid

- Expanding footprint
- Impact of markets
- Tighter operating limits
- Greater reliance on communication & control
- Need for advanced analytical tools

**Needed evolution/  
changes to  
support  
this  
element**

## Drivers of the evolution/ changes

- Spatio-temporal constraints
- Computational complexity
- Stochastic nature of variables
- Need to contain cost

# Drivers of the Future Grid



## Infrastructure Vulnerability

- Reduce footprint of disruptions
- Reliability of communication and control
- Reduced duration of disruptions
- Guard against malicious attacks

**Needed evolution/ changes to support this element**

## Drivers of the evolution/ changes

- Shortage of skilled personnel
- Inadequate analytical tools
- Interdependence of cyber-physical systems

# Research Supporting Objectives to Create an Enabling Grid

- Plan and operate grid with increased penetration of renewable resources while meeting any carbon regulation requirements
- Design grid architecture to support renewable penetration and transformation of demand as a resource
- Manage increased dependence on control, communication and cyber-physical systems to handle grid complexity

# Research Supporting Objectives to Create an Enabling Grid

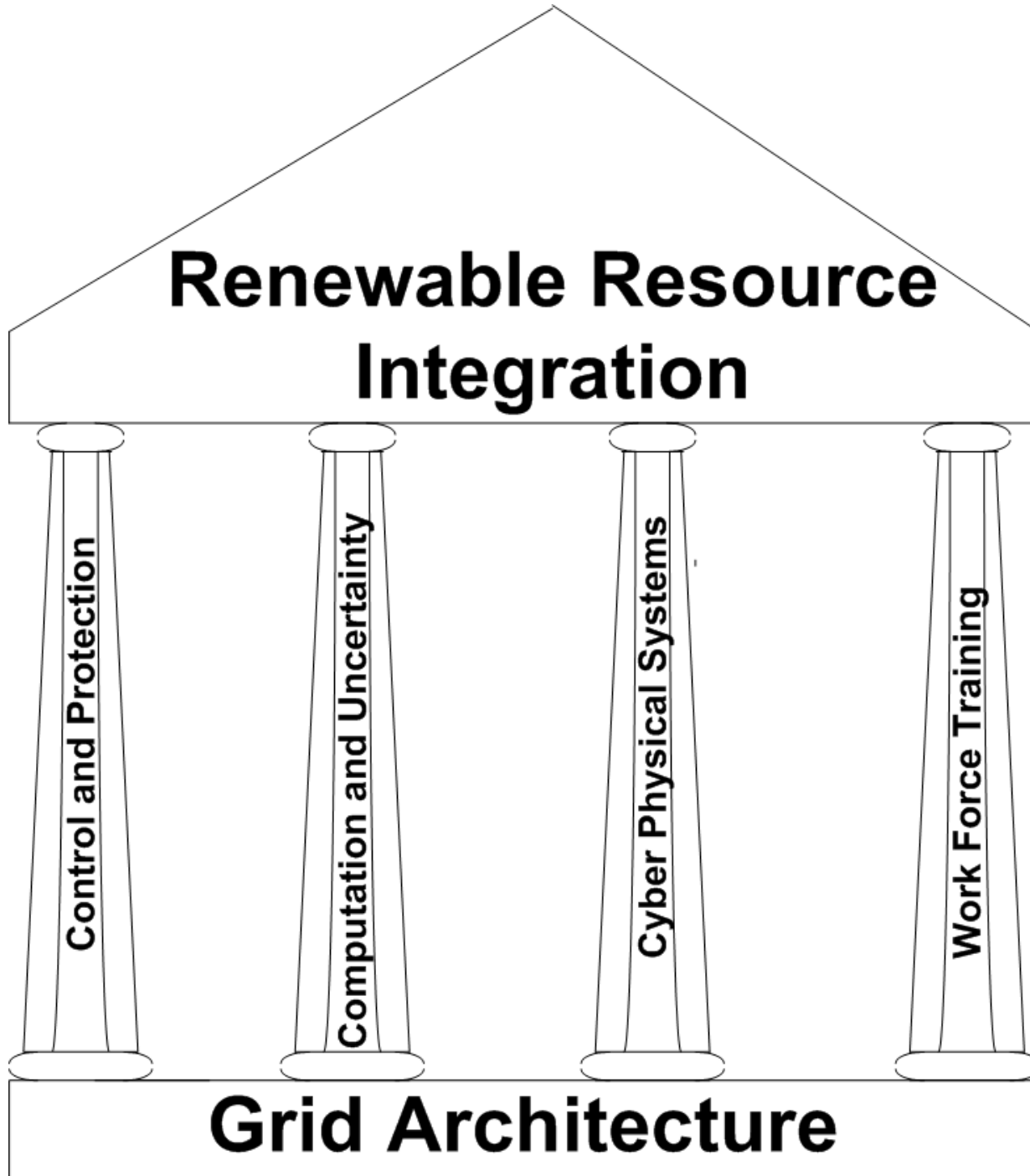
- Create analytical tools to account for increased variability and stochastic nature of elements
- Prepare for needed workforce training

# Project Objectives

- To investigate the requirements of an electric grid with high penetrations of sustainable energy systems and heavy reliance on cyber systems for sensing and communication
- To stimulate discussion among the academic, industry and government communities on what it will take to shape the future grid for the mid-twenty-first century

# Project Elements

- Six Thrust Areas (5 research, 1 workforce)
- Two White Paper Collections
  - The Information Hierarchy for the Future Grid
  - Grid Enablers of Sustainable Energy Systems
- Thirteen Universities; 40 Collaborating Researchers; Industry Advisors/Reviewers
- Public events (more in planning)
  - Dec. 7 public workshop at Berkeley
  - Webinar series on white papers
  - National forum in DC on June 27-28, 2012
  - Session at IEEE PES General Meeting



# Process Details

- Funding provided as supplement to IUCRC grant
- Interagency Agreement between NSF and DOE for \$5.8M. After overhead, \$5.513M distributed to PSERC universities.
- IAA Period: 8/30/2010 – 8/30/2015
- Particular projects identified in interactive process with academic and industry reviews



# Value to PSERC

- Research and education funding
- Visibility
- Contributing to national issues/concerns
- Participation in and facilitating national discussions
- Membership
  - Highest attendance ever occurred at last IAB meeting at which the Future Grid Initiative Workshop was held
  - New memberships
  - Strong justification for continuing membership

# General Comments

- Interagency supplemental funding provides a way to add agencies as “members” without their signing an IUCRC membership agreement.
- No need for sole source justification
- May not be need for competitive procurement process
- Increases flexibility in agency relationship
- Details at:  
<http://www.nsf.gov/eng/iip/iucrc/mipr.jsp>