

Overview of the Modern Grid Initiative

Presented by Steve Pullins, Modern Grid Initiative Team
Modernizing the Grid Southeast Regional Summit
August 10, 2006

Part I: Background

- One reoccurring theme that DOE has heard from industry is the need to demonstrate the integration of state-of-the-art technologies, tools, and systems in pilot-scale projects
- The goal of our effort is to create the foundation for a large, multi-year regional demonstration program
- The initiative involves a broad range of stakeholders in defining both the framework and the structure of the program
- The initiative will build on the existing technology development efforts at DOE and others

The desired outcome goes beyond a shared vision to a shared understanding and agenda.

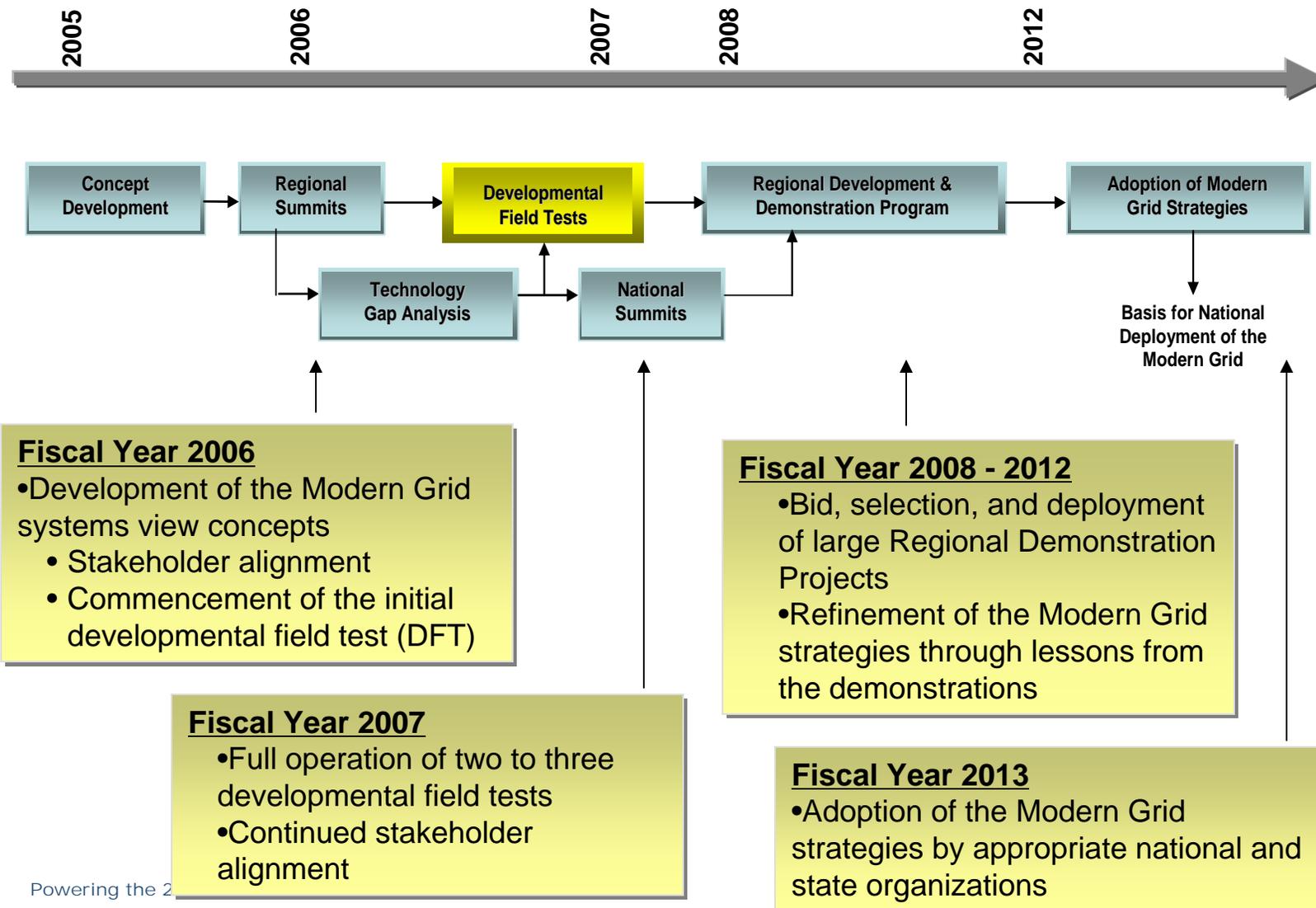


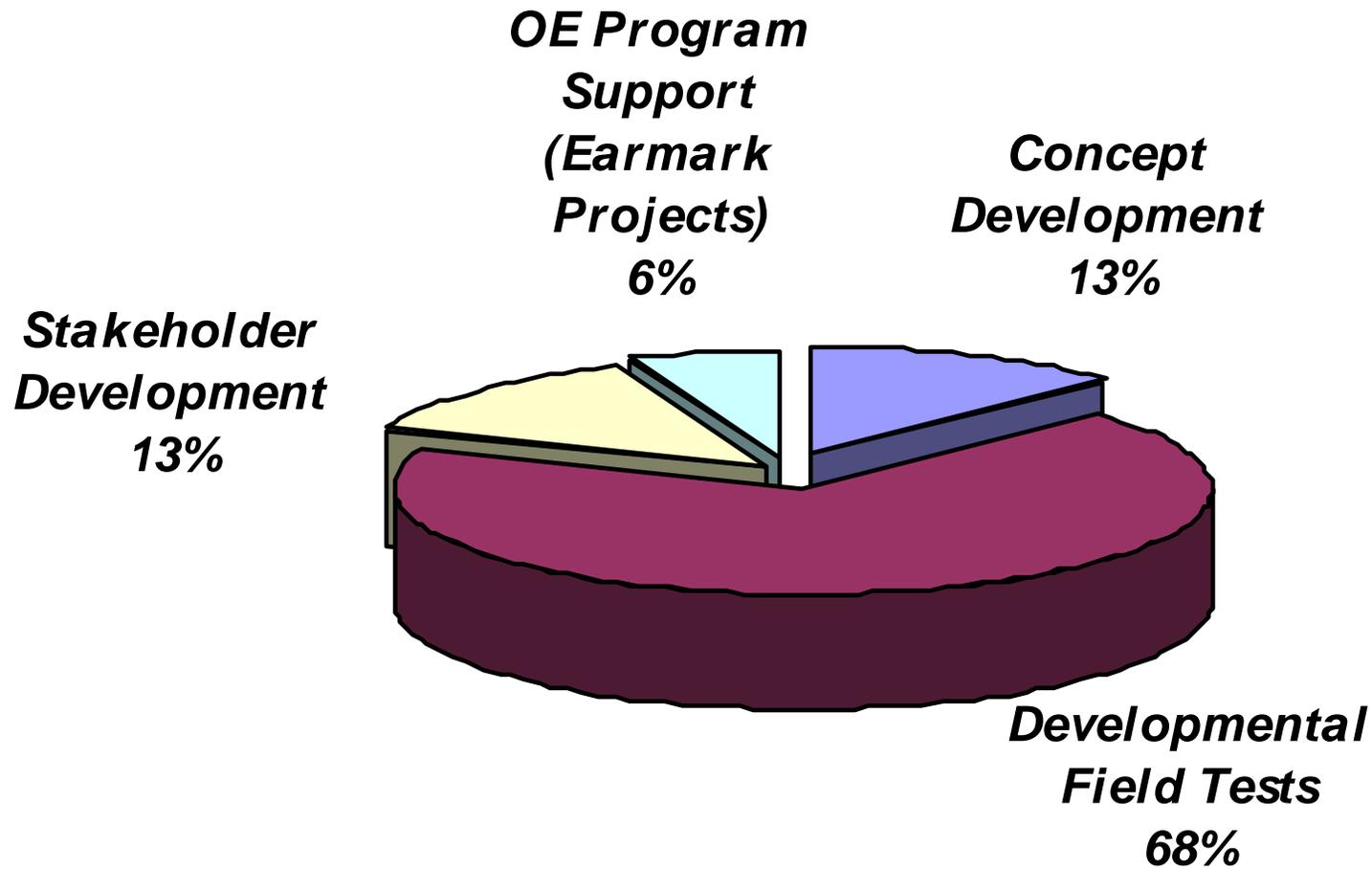
- **Approach the grid modernization issues from a:**
 - Systems perspective
 - National perspective
 - Societal perspective
 - Independent perspective
- **Develop a program plan for regional demonstrations that consider these issues more comprehensively**
 - Broad stakeholder involvement
 - Diverse geographic needs
 - Diverse network topologies
 - Broad range of potential technologies



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Modern Grid Program Timeline





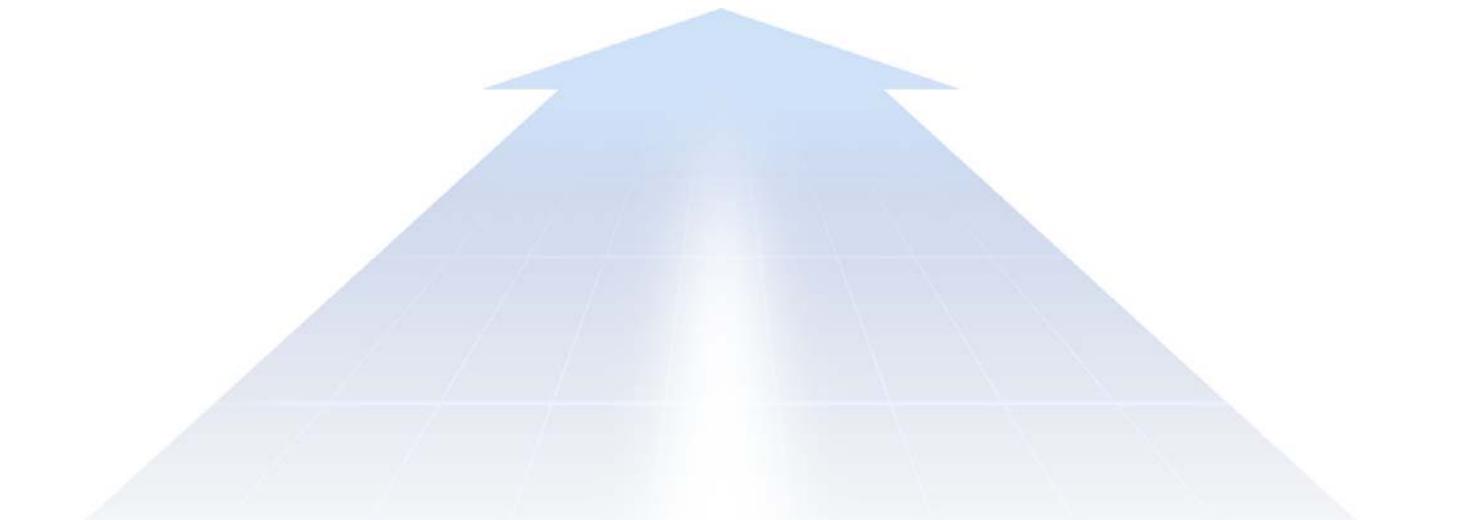
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- **Coordination of other modern grid projects**
 - West Virginia University integrated control of next generation power systems project (\$1M)
 - Hawaii Sustainable Energy Security (~\$2M)
 - New Mexico Sustainable Energy Security (~\$1M)
 - Montana State load control system reliability (\$2M)
 - University of Louisville (Genscape) Electric Grid Monitoring (\$1M)
 - Pilot Energy Cost Control Evaluation at NETL (\$2M)
 - S&C Electric Advanced Technology Center (\$1M)
 - Cleveland State Center for Research in Electric and Aerospace Tech (\$1M)
 - Nxegeen Connecticut Peak Demand Management (\$1M)
- **20 of 27 OE earmark projects appear to be directly related to the Modern Grid Initiative**



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Part II: Vision



***Revolutionize the electric system by integrating
21st century technology to achieve seamless
generation, delivery, and end-use that
benefits the nation***



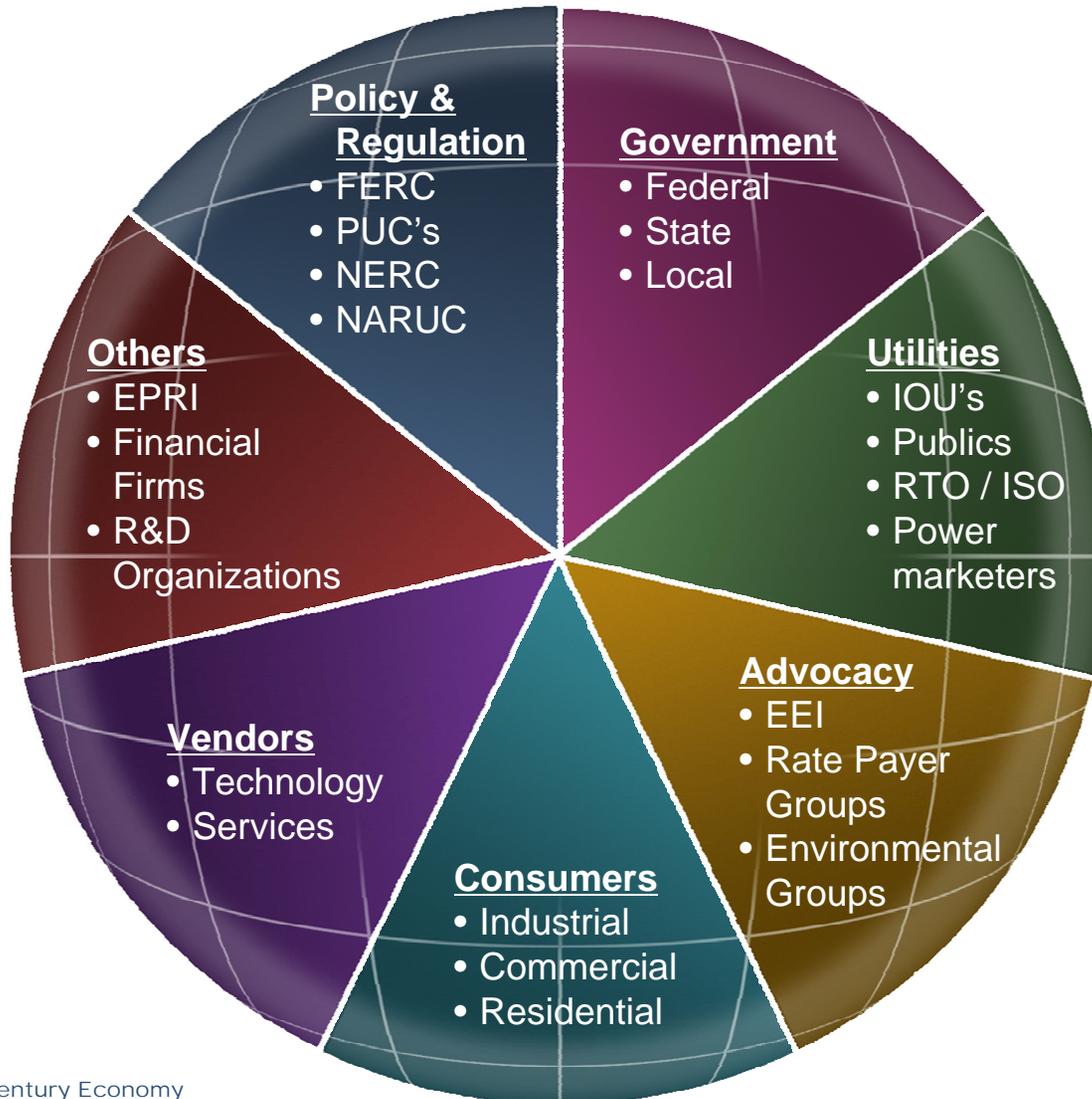
A smart, integrated grid will widely:

- Detect emerging problems and fix them before they seriously impact quality of service
- Incorporate extensive measurements, rapid communications, centralized advanced diagnostics, and feedback control that quickly returns the system to a stable state
- Have the ability to re-route power flows, change load patterns, improve voltage profiles, and take other corrective steps, within seconds of detecting a problem
- Enable loads and distributed resources to participate in operations
- Use modern tools to improve design and operation with reliability, security, efficiency, and safety as fundamental values

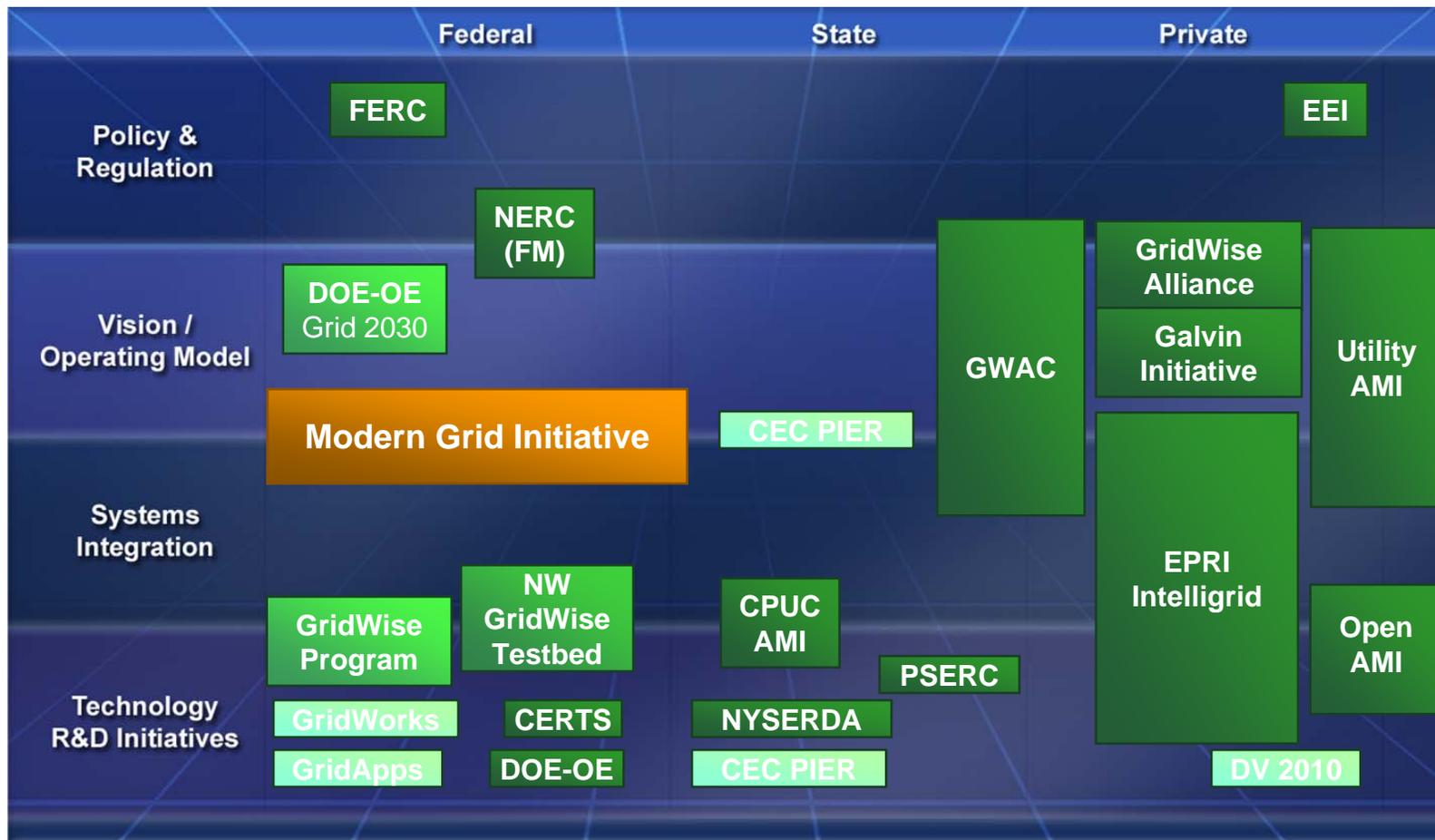


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Modern Grid Stakeholders



Developers of the Modern Grid



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Part III: Robust Trends

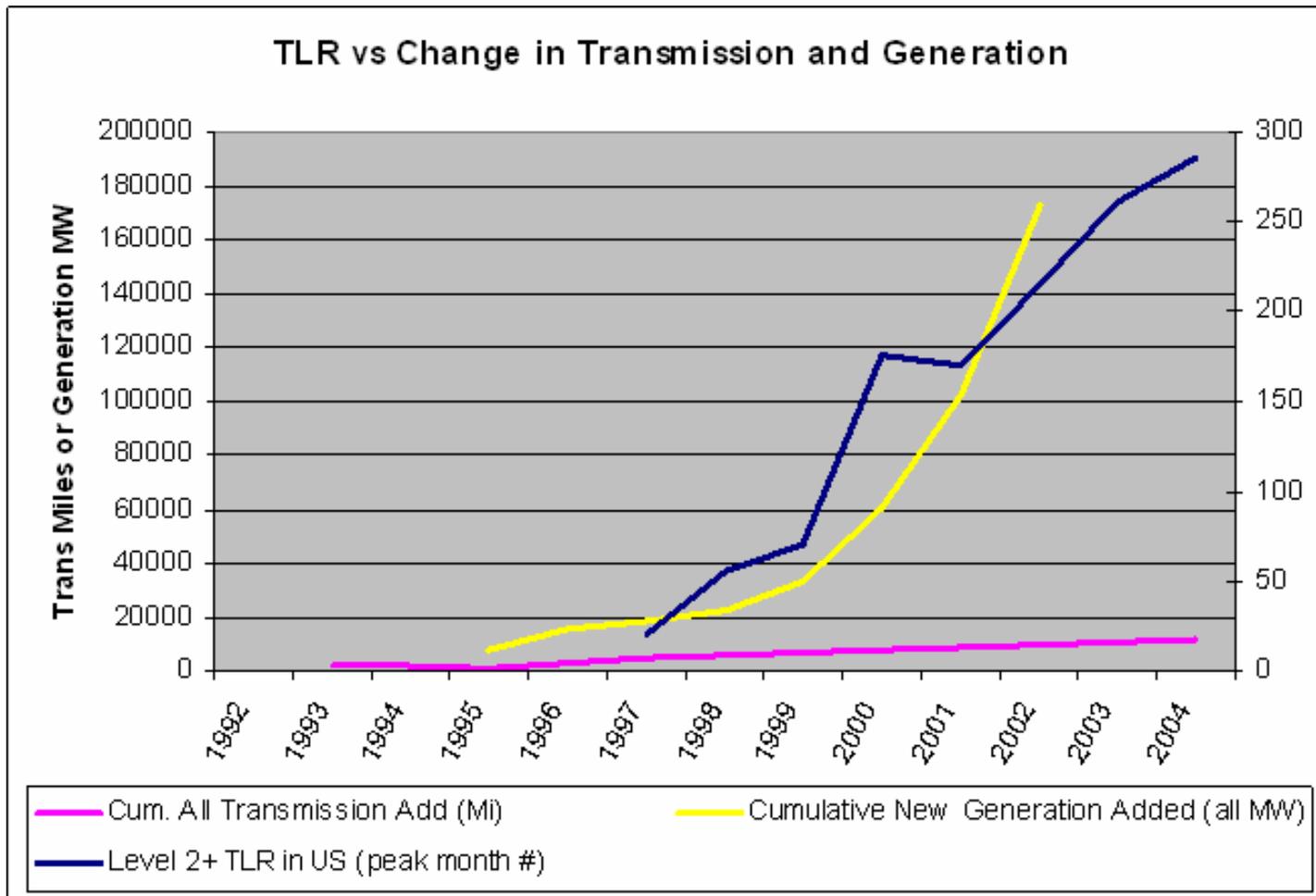
Robust trends

- Reliability failures
- Generation mix movement
- Market movement
- GDP losses – 40% premium on electricity paid by consumers
- Cannot get over the deployment hump
- Renewables growth
- 12M DG poised for grid influence
- Grid divorce

– a response, not control, scenario



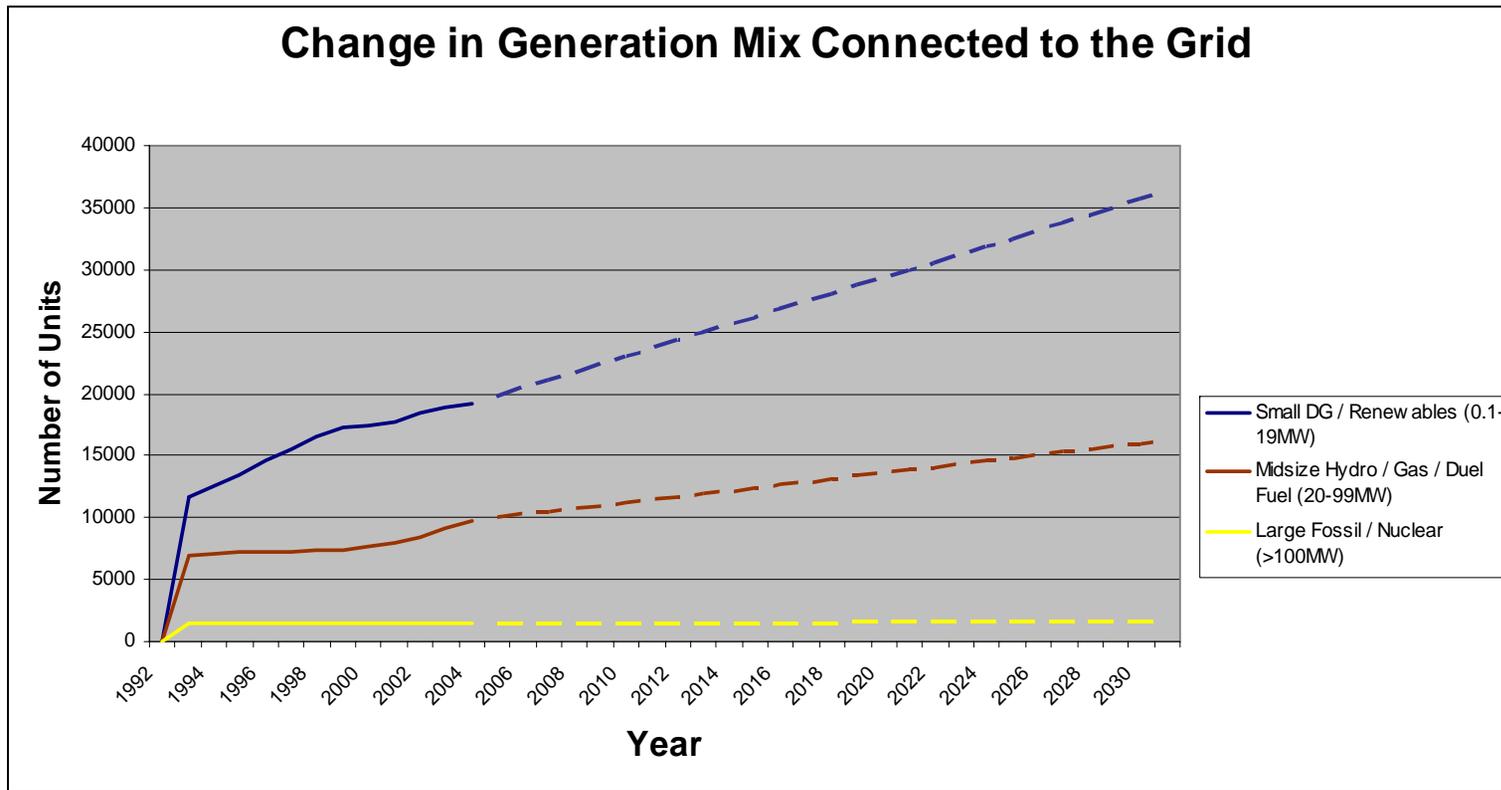
Electric Infrastructure – Growing Crisis?



Transmission problems rocketed when generation additions outdistanced transmission additions.



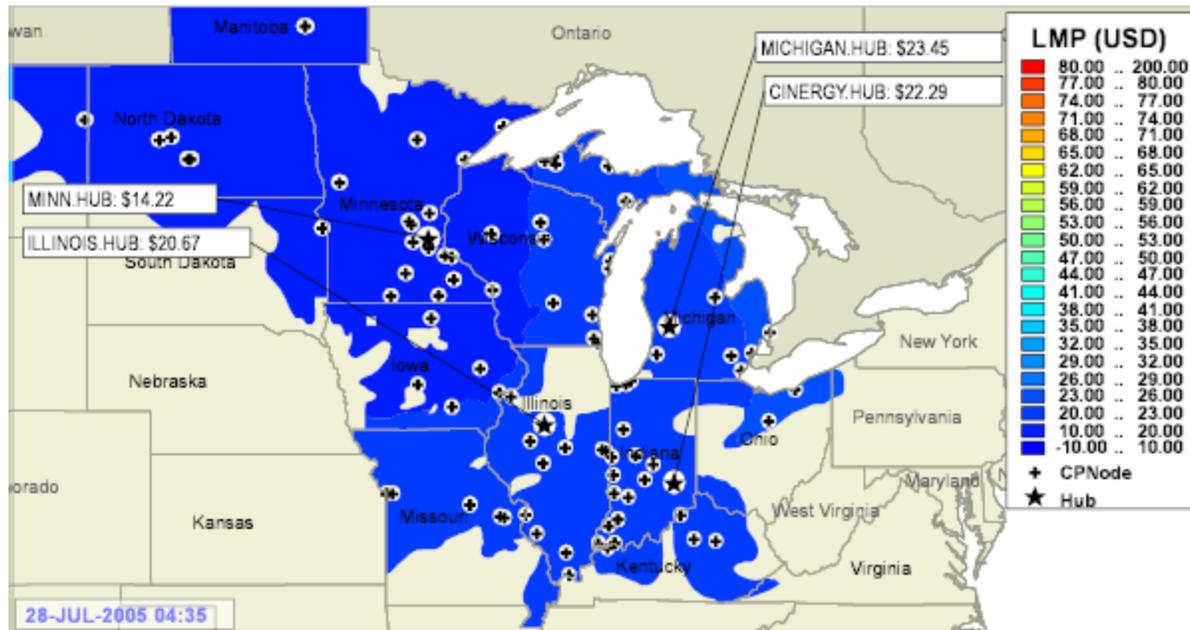
Generating Nodes on the Grid



Exponential increase



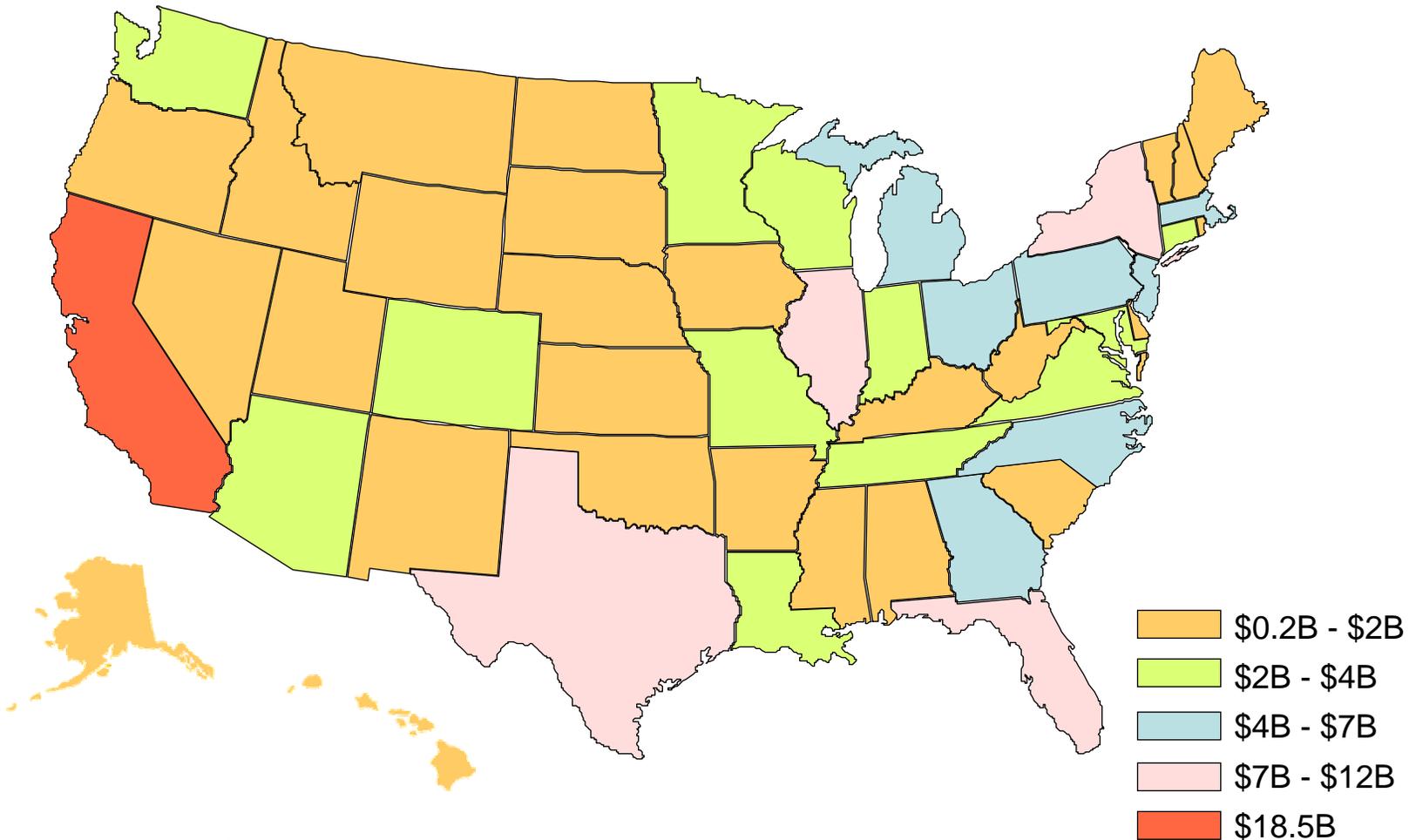
Electricity Market Paradigm Shift



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Annual Business Losses from Grid Problems

Primen Study: \$150B annually for power outages and quality issues



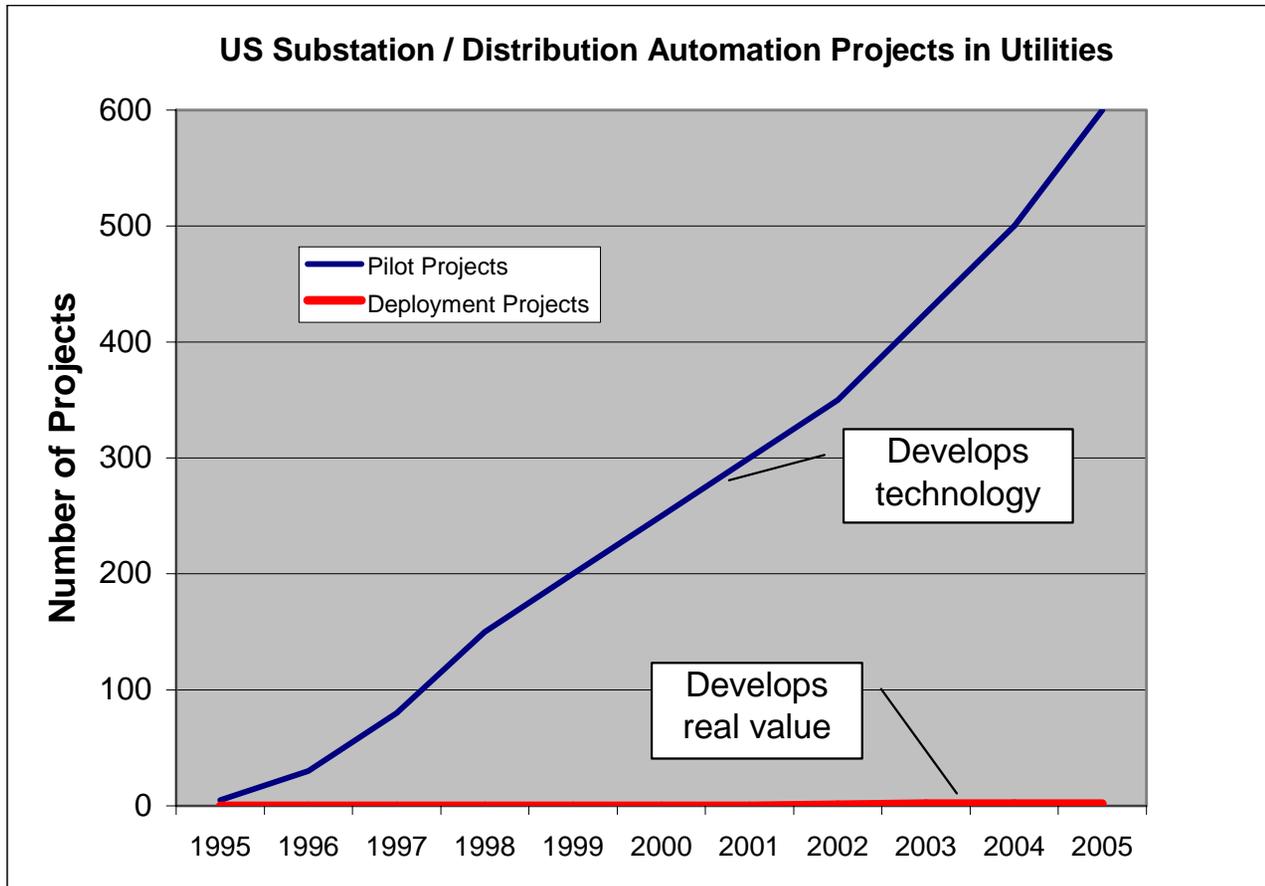
Powering the 21st Century Economy



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Do we have "Pilot-itis"?

Example:



Pilot = <5% deployment into the field (substations and feeders).

Deployment = >25% deployment into the field.



- **Utility downsizing has reduced senior staff**
- **Experienced staff in the power industry is aging**
- **Enrollment in power engineering at universities is small**
- **Complexity of modern grid requires skills in advanced power system and IT**
- **Perceived value of technical skills has been reduced over the past 15 years**
- **Fundamental understanding of the power systems has been replaced by advancements in technology**



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Part IV: Systems Perspective
of the Modern Grid

- **A fully modern grid will be broadly judged by its reliability, security, safety, quality and cost of service to the consumer, and by its impact on the environment and economy**
- **These key goals, or success factors, must be evaluated with respect to a variety of power system conditions and processes**
- **It is from this interdependency of goals that the “systems view” of the Modern Grid forms**



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The “Systems View” perspective takes a holistic and objective approach to a subject, including technical, economic, regulatory, political, and societal aspects. It includes the complete recognition of the power system as one integrated machine having many interdependent parts, a recognition that solutions can come from a wide and diverse range of sources, the desire to identify key ingredients needed to reach the desired end state and to develop those ingredients in the right sequence, and a development approach that optimizes the total system rather than the individual parts. A “Systems View” also takes account of the full range of costs and benefits to society associated with the provision of reliable power.



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- Self Heals (detects, analyzes, responds & restores)
- Motivates and Includes the Consumer
- Resists Attacks
- Provides Power Quality for 21st Century Needs
- Accommodates Renewable Energy and Storage
- Enables Markets
- Optimizes Assets and Operations Efficiently

- Metrics
- Integrated Control
 - Control
 - Measurement
 - Communication
 - Improved Interface

- Performance
- Congestion costs
 - Massive blackout probability
 - SAIFI
 - Restoration time
 - CAIDI
 - Peak to average load ratio
 - Capacity use

Key Technologies



Addressing Key Technology Gaps

