



California Energy Commission Activities Related To DOE EDT Programs

Electric Distribution Transformation Program

U.S. Department of Energy

FY04 Annual Program and Peer Review

October 28, 2003

**Terry Surles, Program Director
Public Interest Energy Research Program
California Energy Commission**



California has Established a \$62M/yr Public Interest Energy Research Program (PIER)



California's Energy Future

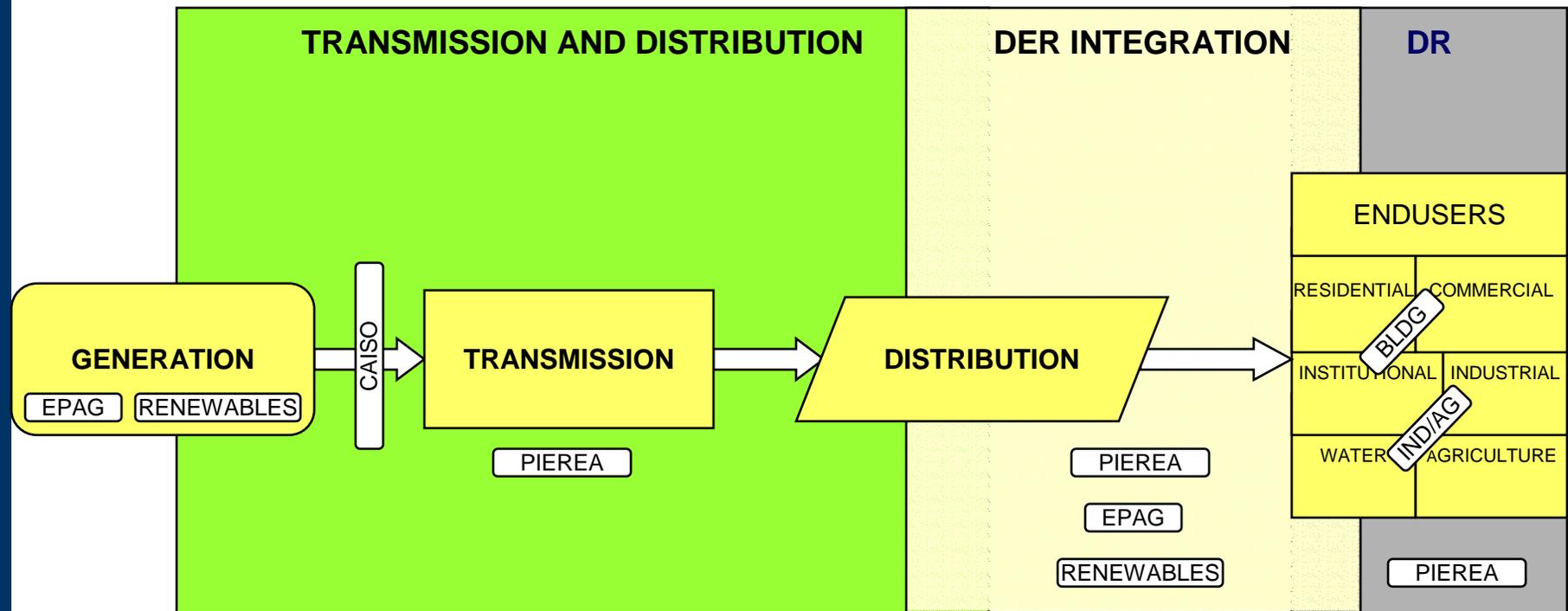
**Economy:
Affordable
Solutions**

**Quality:
Reliable and
Available**

**Environment:
Protect and
Enhance**



CEC's Systems Perspective Provides Crosscutting Coverage To Complement Other Programs





Distributed Energy Resources Integration Research Program

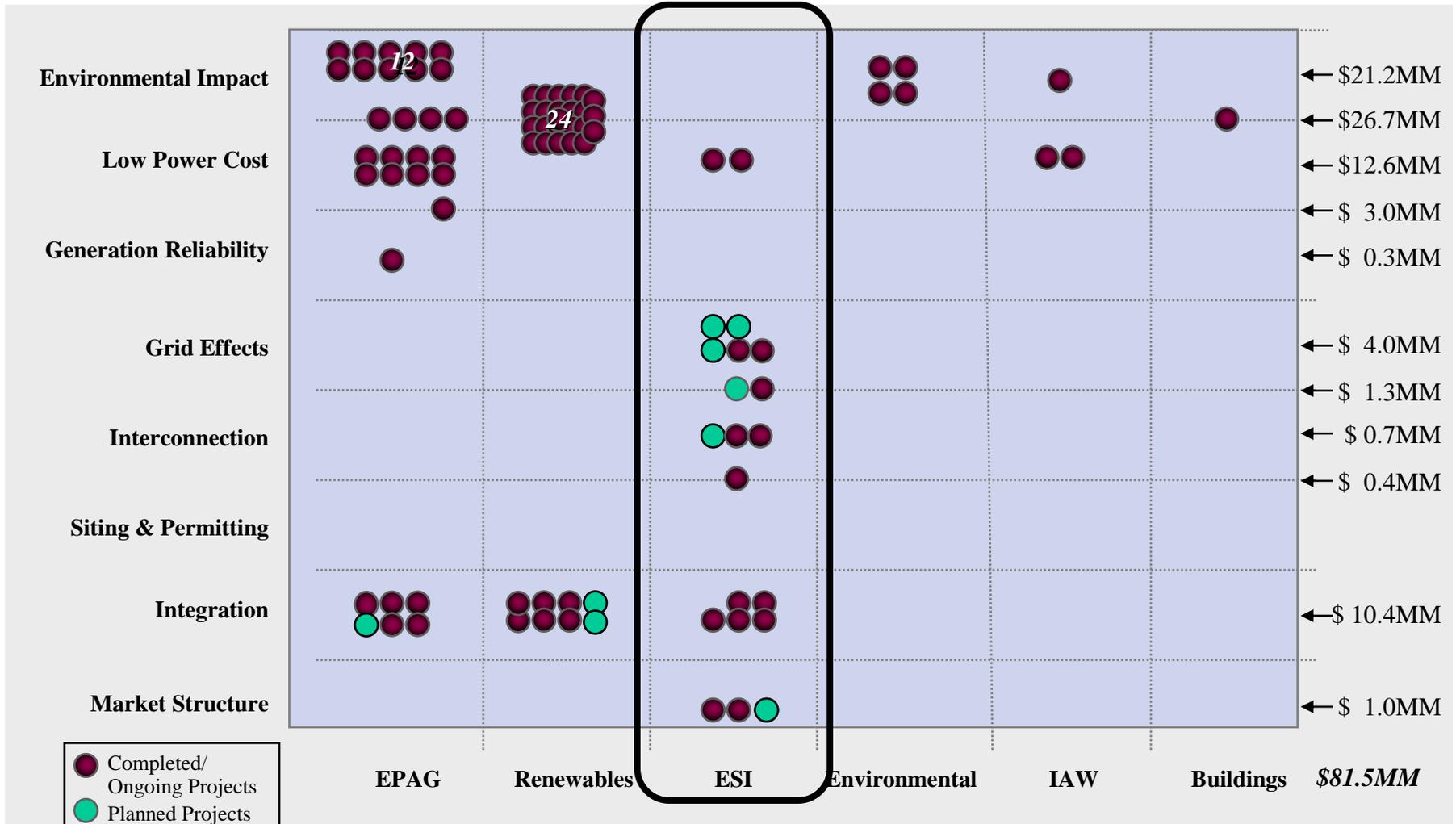


PIER DER Portfolio



76% of portfolio focused on reducing environmental impact and developing lower cost power

ESI's research complementary to DOE EDT's research activities





DER Integration Focuses On Systems Research That Links Technology And Policy



What RD&D is needed in order to enable DER to be a significant resource in California's power system?

Interconnection

Can a substantial amount of DER be interconnected in both radial and networked distribution systems?

Grid Effects

Would a high penetration of DER have adverse impacts and/or positive effects on the T&D system?

Market Integration

Can DER access robust markets or be exposed to price signals that will maximize benefits to customers and the power system?

Benefits of Doing Research

- **CPUC adopts interconnection rules as revised**
- **New research focus on grid and environmental benefits will inform CEC and CPUC policy**
- **Power system paradigm shifted to decentralized structure creating benefits such as:**
 - **More Reliability and Quality**
 - **More Efficient and Cheaper**
 - **Quicker System Expansion**
 - **Improved Environmental Impact**



Current Projects



Initial program priority was interconnection

New highest priority is understanding grid effects and how that influences interconnection requirements, market design and regulations

- * **Consortium for Electric Reliability Technology Solutions (CERTs)**
 - Microgrid Concept Development
 - Standard Power Electronic Interfaces
 - Microgrid Lab Testing Preparation
 - \$1.6M with DOE \$2.8M leverage
- * **Forging a Consensus on Interconnection Requirements in California (FOCUS)**
 - Rule 21 Technical Support
 - Interconnection Monitoring Program
 - Interconnection Guidebook
 - IEEE 1547/Rule 21 Coordination
 - \$2.21M
- * **NREL Collaborative**
 - Universal Interconnect Device
 - Innovative Tariffs for DER
 - Modeling Effect of Unbalanced Loading from DG on Voltage Regulation
 - Model Anti-islanding Effects and Interconnection Implications
 - \$1.6M
- * **Distributed Utility Integration Test (DUIT)**
 - Laboratory demonstration and testing of varying levels of DER in distribution systems
 - \$2.0M with DOE \$2.2M leverage
- * **Regional Solutions - New Power Technologies**
 - Developing integrated T&D modeling tools to assess locational benefits of real and reactive power insertions into a T&D system
 - \$616k
- * **Regional Solutions – SF Coop**
 - Validate and quantify through field testing the distribution system benefits of DG, DR, CPP and Efficiency
 - \$595k
- * **Alternative Energy Systems Consulting**
 - Advanced Communications and Control Technology
 - \$550k

Partnerships with DOE



CEC Activities Have Led To Effective Partnerships And Early Successes



- * **Interconnection rule development has been successful meeting needs of regulators, developers, utilities and consumers**
 - Cost savings to consumers and utilities from simplified process estimated at \$4-16 million over 5 year period (2002-2006)
 - Interconnection cost share from industry estimated to be \$2M - \$3M
- * **DOE collaboration on microgrids, grid effects testing, interconnection and communication and control**
 - Cost share of \$5M DOE to ESI's \$3.6M
 - Cost savings to consumers unsure until penetration limits and interconnection implications understood through research results
 - Could be substantial if penetration limits found to be higher than current 15% threshold in California interconnection rule



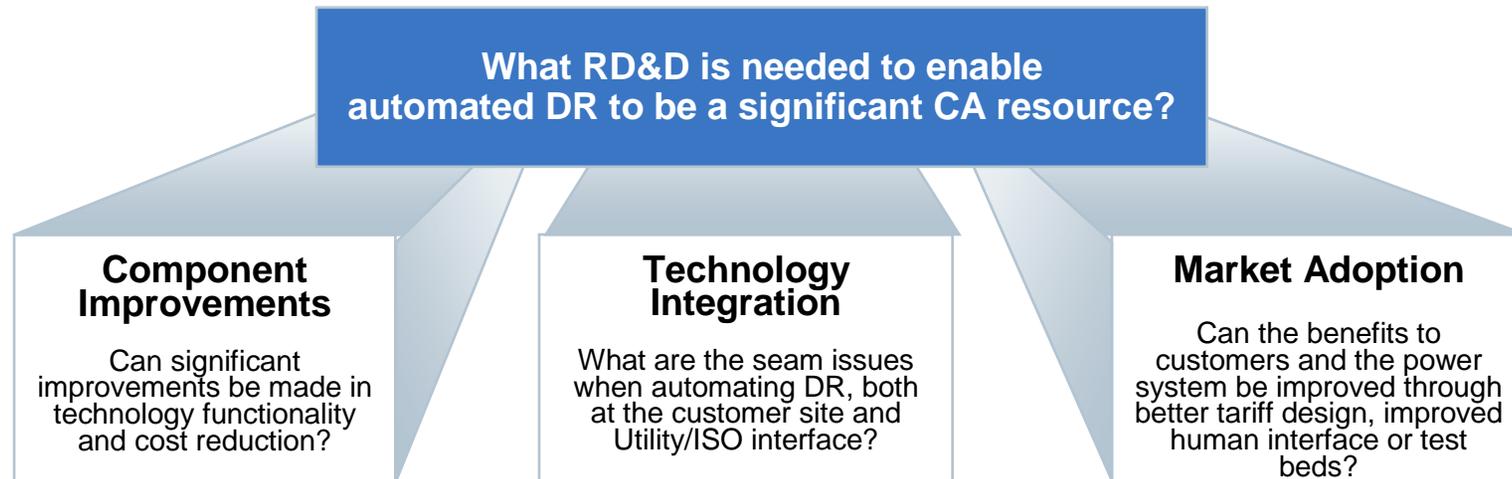
Demand Response Technology Research Program



Demand Response Focuses On Creating Cost Effective Infrastructure



We are developing technologies and strategies to improve resiliency and efficiency of CA's power delivery system



Benefits of Doing Research

- Near-term R&D support for CPUC dynamic tariff initiatives and CAISO load response programs
- Long-term development to enable deployment of cost-effective Demand Response infrastructure:
 - Mitigate market power and minimize the effects of contingencies
 - Defer investments in central power plants and T&D upgrades
 - Supports energy efficiency initiatives
 - Tariffs can improve the state's load shape (use of energy)



Current Projects



Short-term goals: establish a baseline for automated DR in CA, study other successful DR programs, and support the CAISO's R&D needs

Long-term goals: create disruptive technologies that can enable flexible demand responsive policy initiatives in times of crisis

* **Demonstrations and Case Studies**

- Improve understanding of the status of automated DR in buildings
- Quantify savings of automated systems
- Identify technology gaps
- \$446k

* **Enabling Technologies Development**

- Leverage DoD/DARPA funding
- 10 x 10 improvements
- Totally integrated systems
- Apply new technology to old jobs
- Explore ways to integrate legacy systems with emerging technology
- \$3.0M

* **Market Information Development**

- Access customer response to tariffs based on day-ahead wholesale market prices in NY
- \$265k

* **CAISO Support**

- Understand why responsive load has been an underutilized resource for addressing power system adequacy and reliability
- \$125k

* **Communications and Controls Scoping Study**

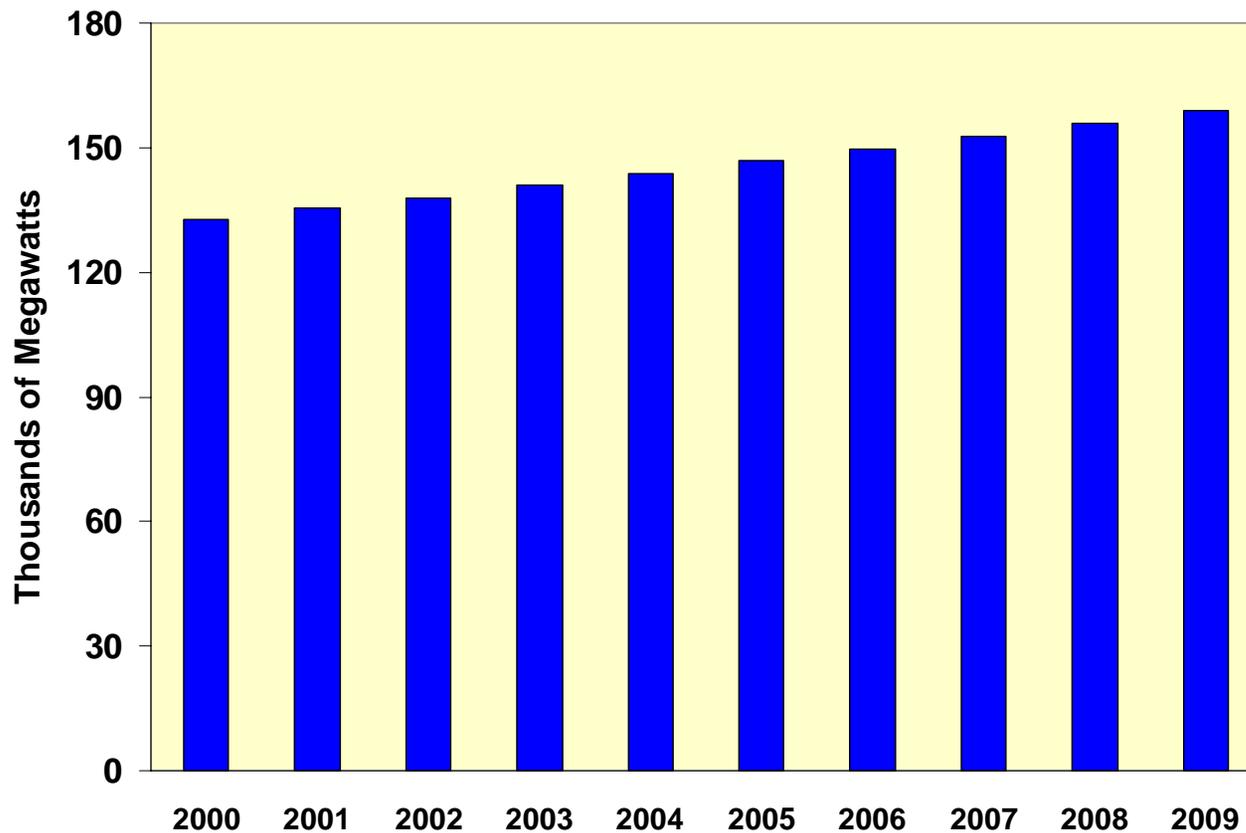
- Understand CEIDS, DOE and others existing C&C research objectives
- Determine best place to collaborate to meet California's needs
- \$40k



Transmission and Distribution System Research Program



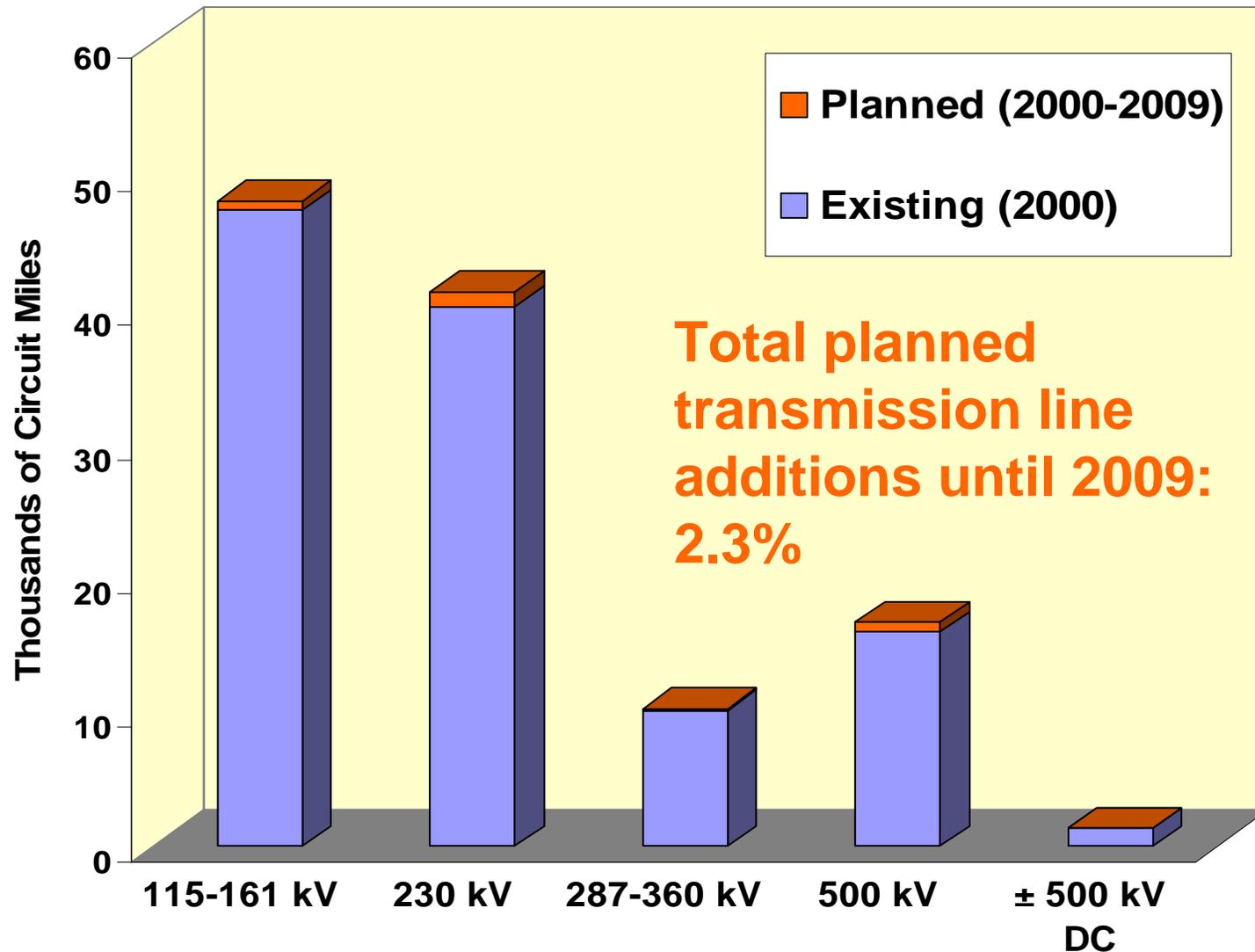
WSCC Projected Peak Load Growth 2000 - 2009



**Total
expected
peak load
growth
until 2009:
20%**

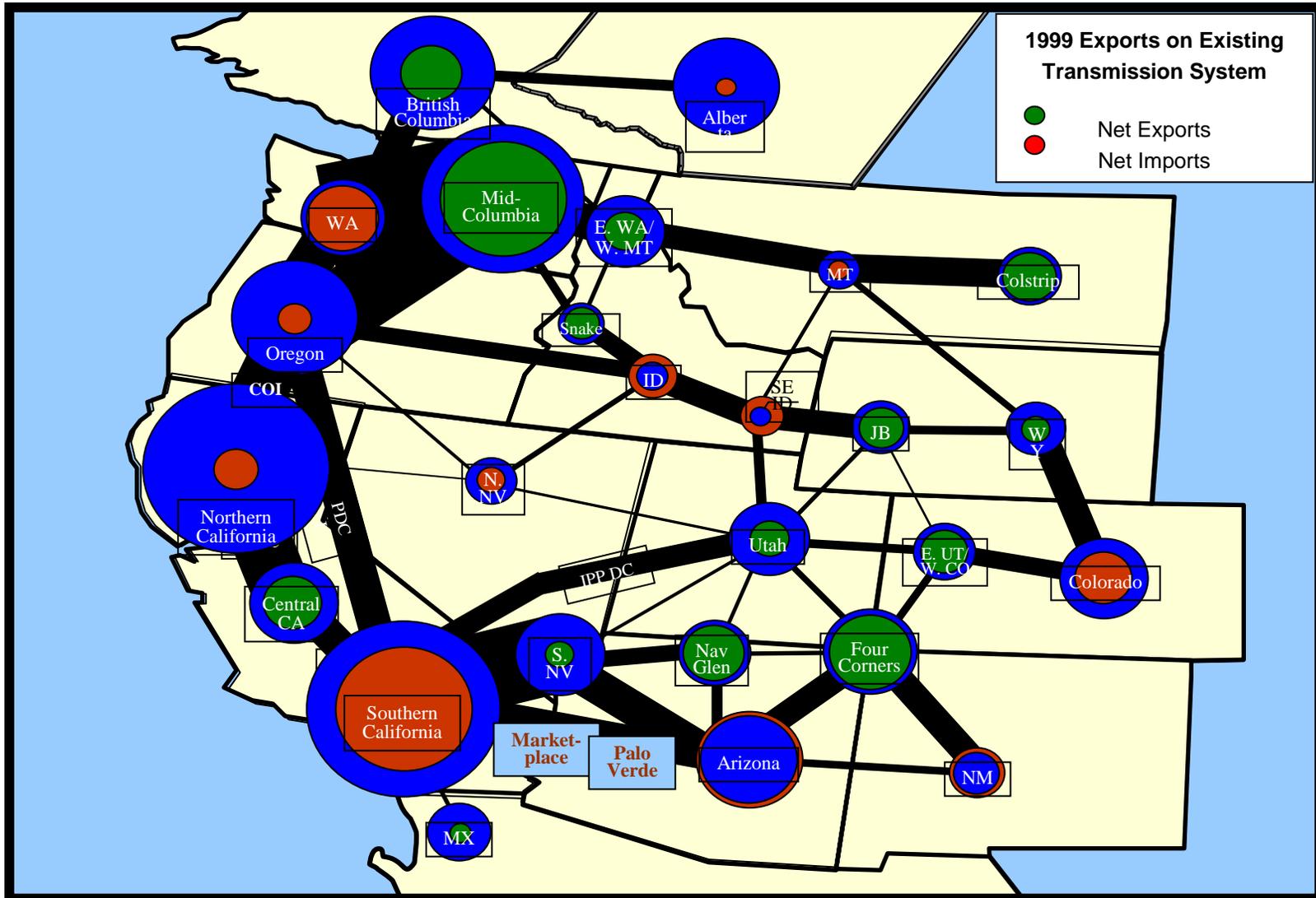


WSCC Transmission (Existing/Planned)



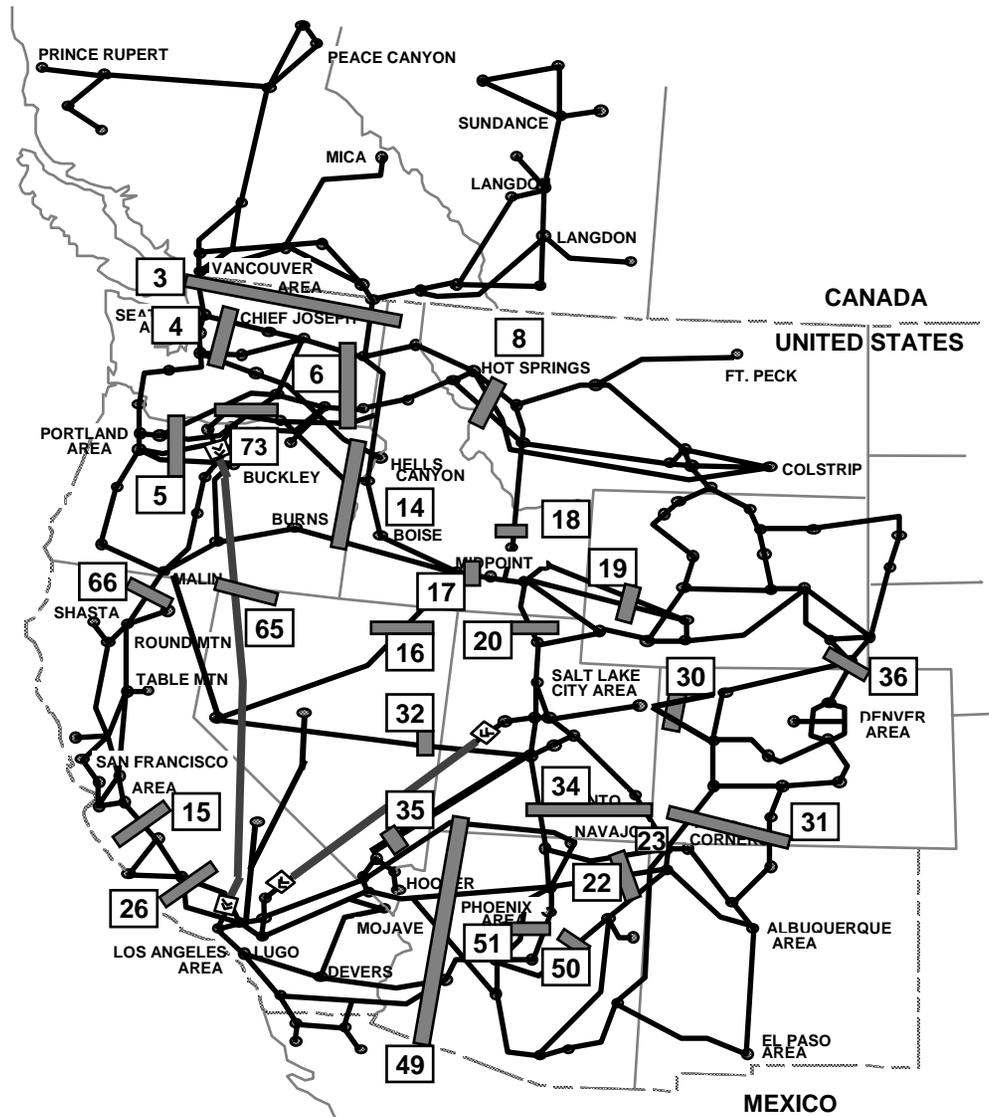


WSCC Imports and Exports





WSCC Transmission Constrained Paths





Cost of Congestion

- **Path 15:**
\$ 222 million additional energy and ancillary service cost between 9/99 and 12/00 (CAISO)
- **Rolling blackouts in bay area (June 2000):**
\$ 1 million / minute lost economic output for high-tech firms (EPRI)



CEC Transmission Program Is In The Final Stages Of Re-focus To Better Address California Issues



What R&D is needed to improve the reliability and adequacy of the transmission system?

Existing Component Optimization

How can the existing transmission infrastructure be improved to increase and enhance system performance and adequacy?

New Capacity Additions

How can innovative transmission equipment expand capacity capabilities while protecting the environment?

System Operations

How can real-time grid data and performance tools improve grid reliability, capability and security?

Planning Tools

How can the development of transmission expansion planning tools and approaches help integrate engineering, cost, locational and environmental values into planning?

Benefits of Doing Research

- Develop planning tools that will expedite the building of new transmission infrastructure.
- Reduce the probability of catastrophic outages in the state.
- Reduce congestion that increases the cost of power to California ratepayers.



CERTS Is An Excellent Example Of Effective, Productive Collaborations Between CEC And DOE



* Consortium for Electric Reliability Technology Solutions (CERTS)

• Tools

- VAR Management
- System frequency regulation monitoring
- Dispatcher's synchronized phasor measurement

• Activities

- Prototype real time system to complement analytical and predictive capabilities in CAISO's current WAM
- Develop specs for loop flow prediction and assessment tool
- Validate and improve stability nomograms for near-real time use
- Develop potential thermal overload information tools
- \$7M with DOE \$10M leverage

* The Valley Group

- Path 15 – demo of dynamic ratings for overhead lines

* Engineering Data Management, International

- Real time rating measurement using sensors and software
- \$499k

* W.B. Goldsworthy

- Composite reinforced aluminum conductor
- \$1.1M

* EPRI

- High temperature/low sag 3M conductor demo
- Field demos with EPRI and PG&E on SLiM

• PEER

- \$4 M project with PG&E for developing and deploying new hardened technology



CEC Is Moving Forward With New Transmission Research Program



- * **Transmission Capacity Expansion Planning Tools**
 - Analysis and Selection of Planning Tools
 - Research to improve forecasting and value DR, emissions, congestion, etc.
- * **Actual System Condition Measurements vs Worst Case Scenario to increase thermal and stability limits**
 - Tools and protocols to integrate real-time ratings into CAISO, utility and WECC operations
 - Evaluate whether the use of real time ratings can increase the capability of lines to wind generation in California
- * **Will Work Closely with California utilities and Others to Develop Programs with Clear Pathways to Implementation**
- * **California Energy Commission in the E2I Consortium for Electric Infrastructure to Support Digital Society with Support from California IOUs**



Electricity Systems Technology Development Should Be Related to Critical Infrastructure Protection

- ★ New Distributed Generation Technologies
- ★ Electricity Storage
- ★ Better Understanding of Energy/Water Interdependencies
- ★ Distributed Energy Resources Integration
- ★ Transmission and Distribution Systems



CEC Will Continue to Develop Programs Complementary With DOE Activities



- CERTs – Microgrids and transmission has complement between fundamental and application R&D
- DUIT – Tag team approach on Grid Effects of DER phases R&D
- NREL – Collaborative on Interconnection, Grid Effects and Market Integration
- Energy Storage – Support for value proposition solicitation
- Distributed Generation – Standardized evaluation and testing (with ASERTTI)
- Distributed Technologies – Wind, microturbines, ARICE, biomass
- Joint Planning with DOE/OTDS