

Research funded by the California Solar Initiative's Research, Development, Demonstration and Deployment Program creating a sustainable solar industry by 2016

California Solar Initiative
Research, Development, Demonstration
and Deployment Program

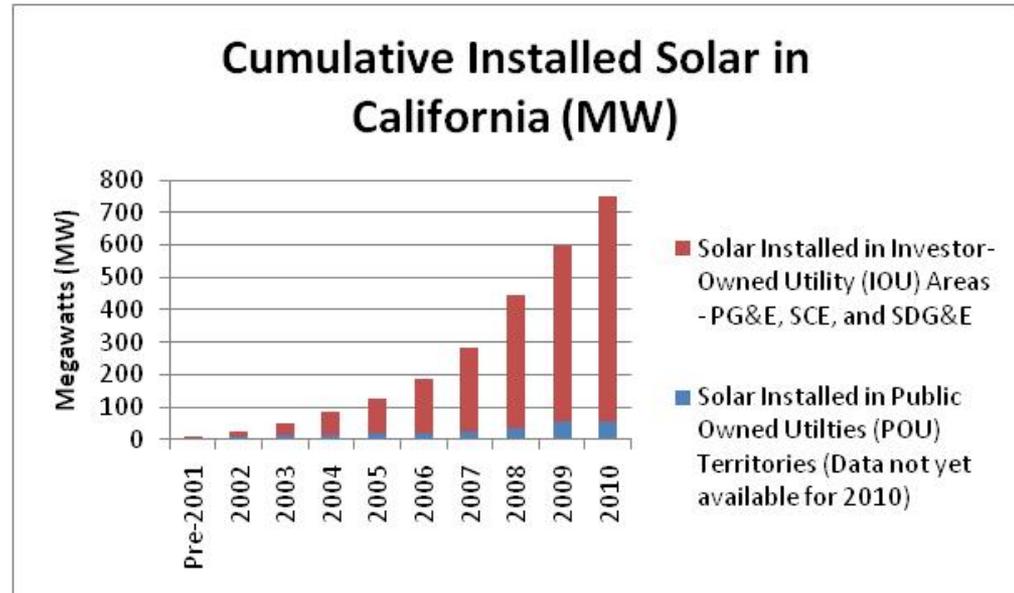


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Solar 2011, Raleigh, NC
American Solar Energy Society
May 19, 2011

California Leads the Nation in Installed Solar

- California has 750+ MW installed solar PV at 75,000+ locations
- California is over 2/3rds of the nation's solar market and the nation's largest rebate program
- California supports solar self-generation with four inter-related state policies: rebates, net energy metering, interconnection policies, and rate structures (e.g. tiered rates, time of use rates)



Date: January 7, 2011. Data Shown ONLY includes customer-side of the meter self-generation solar. Does not include RPS or wholesale-side solar projects that serve utility load.

Sources: IOU data based on CPUC collected interconnection reports, except 2010 data which is based on CSI Program Data only.

POU data based on California Energy Commission data, available through 2009 only.

California Solar Initiative (CSI)

- The CSI Program
 - Budget of \$2.167 billion (2007 - 2016) funded by electric ratepayers
 - Goal: 1,940 MW of new solar generation capacity
 - Includes general rebate program, low income programs, & **RD&D**
- The CSI-Thermal program
 - Budget of \$250 million (2010 - 2017) funded by gas ratepayers
 - Goal: 200,000 new solar hot water systems (585 million therms)
 - Includes general rebate program and low income program



CSI RD&D Program

CPUC established CSI RD&D Program in 2007

- Allocated **\$50 million** for research, development, demonstration and deployment (RD&D) projects to further the overall goals of the CSI Program

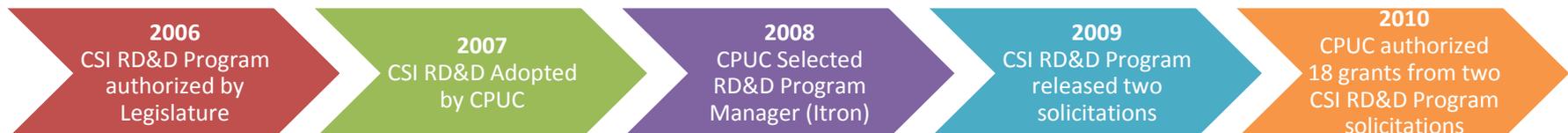
CSI RD&D Plan established:

- Research – 20%
- Development – 5-10%
- Demonstration – 45-55%
- Deployment – 5-10%

Target Areas:

- Grid-Integration: 50-65%
- Production Technologies: 10-25%
- Business Development and Deployment: 10-20%

CSI RD&D TimeLine To-Date:



Context for Funding:

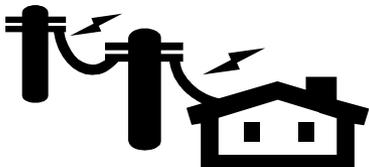
- Increasing amount of PV on the customer-side of meter
- Build a sustainable and self-supporting industry for customer-sited solar in California
 - > Support commercialization of new technologies
 - > Improve their integration
 - > Focus on supporting market and end users



Target Area 1: Grid Integration

CSI RD&D Program Plan Allocates 50-65% of the funding to:

- Recognize and address key barriers to the development of PV minigrids or central PV;
- Demonstrate economic viability of new PV system storage technologies
- Identify high value locations for distributed PV on the transmission and distribution system
- Assess impacts of large concentrations of PV in one area

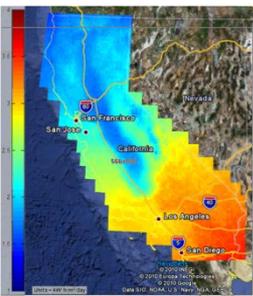


Sub Area: Planning and Modeling for High Penetration PV



Improved planning and modeling tools should:

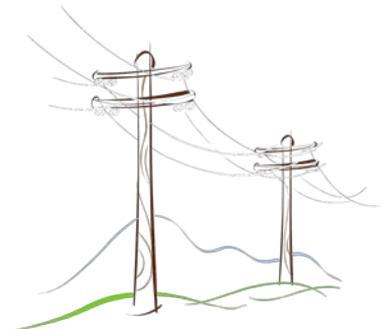
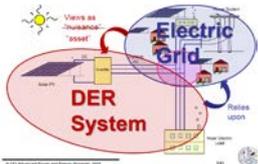
- Forecast: Solar resource models should provide capability to project energy output at higher PV penetration levels
- Validate: These predicted outputs from solar models should be validated by metering PV performance over large system populations
- Integrate: Solar resource modeling applications should be integrated with utility load or resource forecasting models
- Identify: Transmission and Distribution (T&D) models should allow for easy identification for optimal location of high penetration of PV



Sub Area: Hardware and Software Tools for High Penetration PV

Integrating PV into the utility grid will require robust grid-PV communication, control systems, and operational procedures. Specifically:

- Test: Improved monitoring and communications software and systems
- Demonstrate: Enhanced control systems and operations
- Integrate: Subsystems within the distribution system (including mini- or micro-grids)
- Assess: Optimal locations within the T&D system



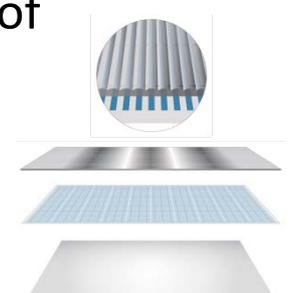
Target Area 1: Grid Integration: High Penetration PV

Project Title	Awardee	Partners
Advanced Modeling and Verification for High Penetration PV	Clean Power Research	NREL, State University of New York, New York State Energy Research and Development Authority, SEPA, SMUD, Long Island Power Authority, Salt River Project
High Penetration PV Initiative	Sacramento Municipal Utility District	Hawaiian Electric Company, BEW Engineering, NREL, SunPower, New Energy Options, Areva, Solar Consulting Services, Augustyn & Company, SynerGEE
Analysis of High-Penetration Levels of PV into the Distribution Grid in CA	SCE / NREL	CPR, Electrical Distribution Design, Satcon, NREL
Planning and Modeling for High-Penetration PV	SunPower Corporation	KEMA, CAISO AWS Truewind, Sandia National Lab
Development and Analysis of a Progressively Smarter Distribution System	UC Irvine - APEP	PG&E
Improving Economics of Solar Power Through Resource Analysis, Forecasting and Dynamic System Modeling	UC San Diego	EPRI, EDSA Power Analytics, CAISO, SDG&E, NREL

Target Area 2: Improved Solar Technologies

Testing and demonstration of new solar technologies with improved performance/reliability or lower costs:

- Improved reliability and lifetime of inverters
- Improved integration of PV inverters with smart meters
- Existing energy storage technologies capable of working with smaller solar systems
- Innovative hybrid solar technologies that enable enhanced energy value and environmental benefits
- Improving and demonstrating performance and reliability of concentrating solar technology



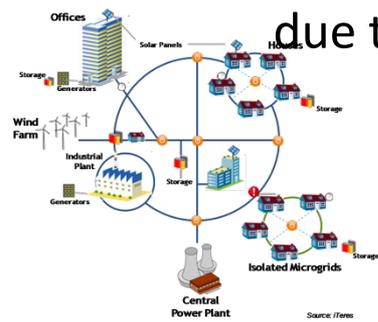
Target Area 2: Improved Solar Technologies

Project Title	Awardee	Partners
Improved Cost, Reliability, and Grid Integration of High Concentration Photovoltaic Systems	Amonix, Inc.	UC Irvine Advanced Power and Energy Program, NREL, SCE
Improved manufacturing and innovative business models to accelerate commercialization in California of hybrid concentrating photovoltaic/thermal tri-generation (CPV/T-3G) technology	Cogenra	Sonoma Wine Company, Patch Engineering, PG&E
Solaria: Proving Performance of the Lowest Cost PV System	Solaria Corporation	PG&E
PV and Advanced Energy Storage for Demand Reduction	SunPower Corporation	KEMA, Sandia National Laboratories, Target Stores, Prudent Energy, Ice Energy, ZBB Energy, PG&E

Target Area 3: Innovative Business Models

Models to support expansion of cost-competitive solar technologies by reducing costs or increasing value of the solar system:

- New business practices that help to lower solar system installation or operating and maintenance (O&M) costs
- Innovative virtual net metering approaches that enable greater use of solar access points
- Tariffs that reflect the time dependent value of energy storage to system owners and/or utilities
- Economic value associated with “unloading” of distribution feeders due to solar systems installed on the feeder



Target Area 3: Innovative Business Models

Project Title	Awardee	Partners
Advanced Grid-Interactive Distributed PV and Storage	Solar City	Tesla Motors, UC Berkeley, PG&E
Reducing California PV Balance of System Costs by Automating Array Design, Engineering and Component Delivery	SunLink	Pacific Earthquake Engineering Research Center, Rutherford and Chekene, Autodesk, Computers and Structures, Inc.
Innovative Business Models, Rates and Incentives that Promote Integration of High Penetration PV with Real-Time Management of Customer Sited Distributed Energy Resources	Viridity Energy	UC San Diego, Energy & Environmental Economics (E3), SDG&E

Cross-cutting: Integration of EE/DR/ES with PV

- Loading order – 2003 Energy Action Plan & IEPR 2003
 - Energy efficiency and conservation
 - Demand Response
 - Renewable generation
- Market tools to present combination of EE and PV decision
- Path towards Zero Net Energy with combination of :
 - Energy Efficiency
 - Demand Response
 - Energy Storage
 - Renewable generation

Crosscutting: Integration of Energy Efficiency, Demand Response and Energy Storage with PV

Project Title	Awardee	Partners
Low-Cost, Smart-Grid Ready Solar Re-Roof Product Enables Residential Solar Energy Efficiency Results	ConSol	General Electric, SDG&E
Beopt-CA (EX): A Tool for Optimal Integration of EE/DR/ES+PV for California Homes	DEG / NREL	PG&E, NREL, E3, SunPower
Specify, Test and Document an Integrated Energy Project Model	kW Engineering	Solarnexus, Save Energy 123
West Village Energy Initiative: CSI RD&D Project	UC Davis	UC Davis Energy Institute, Chevron Energy Solutions, PG&E

Funded Projects

- Grant to the Lawrence Berkeley National Laboratory, Solar Energy Research Center - \$10 million
- Two Grant solicitations conducted to-date
 - 17 projects awarded funding just over \$ 23 million
 - Leveraging over \$ 17 million in match funds
- Third solicitation – to be announced in May 2011

California Solar Initiative Research, Development, Demonstration and Deployment Program



Focus Areas	Project Title	Awardee	Grid Integration				Solar Technologies				Business Models				Integration of EE/DR/ES + PV				
			Solar Resource model	Forecasting model	T&D model	Advanced Communication	CPV	Storage	Tracking	Tri-generation	Tariff and incentive design	Regulatory concerns	Design automation	Reducing BOS costs with	Energy Efficiency	Demand Response	Retrofit application	Community level solar	Design tools
Grid Integration: High Penetration PV	Advanced Modeling and Verification for High Penetration PV	Clean Power Research																	
	Planning and Modeling for High-Penetration PV	SunPower Corporation																	
	Improving Economics of Solar Power Through Resource Analysis, Forecasting and Dynamic System Modeling	University of California San Diego																	
	Development and Analysis of a Progressively Smarter Distribution System	University of California Irvine - APEP																	
	Analysis of High-Penetration Levels of PV into the Distribution Grid in CA	Southern California Edison/ NREL																	
	High Penetration PV Initiative	Sacramento Municipal Utility District																	
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Cross-cutting: Integration of Energy Efficiency, Demand Response, Energy Storage and PV	Beopt-CA (EX): A Tool for Optimal Integration of EE/DR/ES+PV for California Homes	Davis Energy Group/ NREL																	
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QUESTIONS