

# High Penetration Solar Forum

March 2011



U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

## California Perspective on High Penetration PV

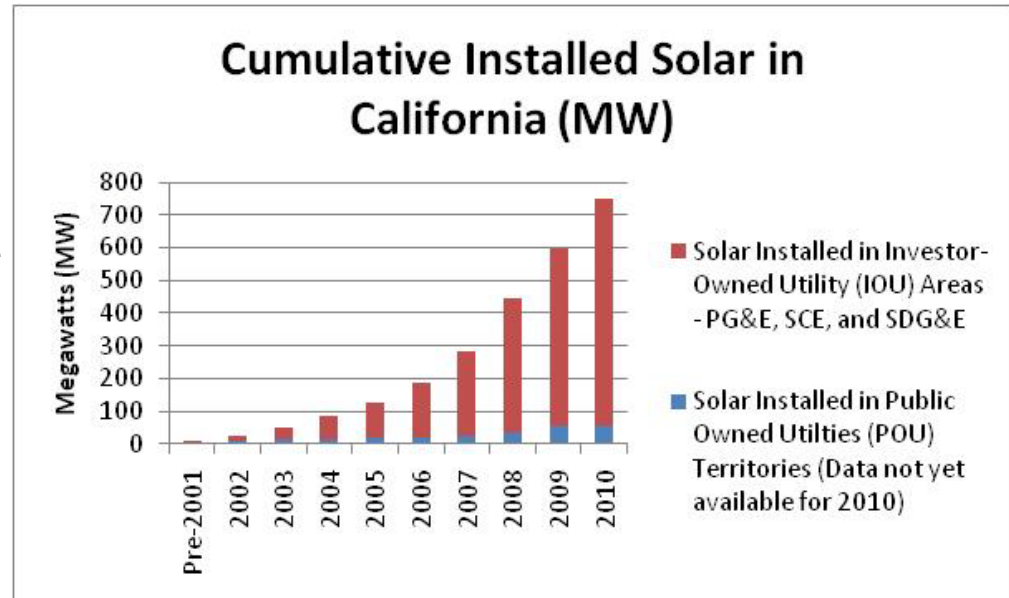
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California Public Utilities  
Commission



# 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.

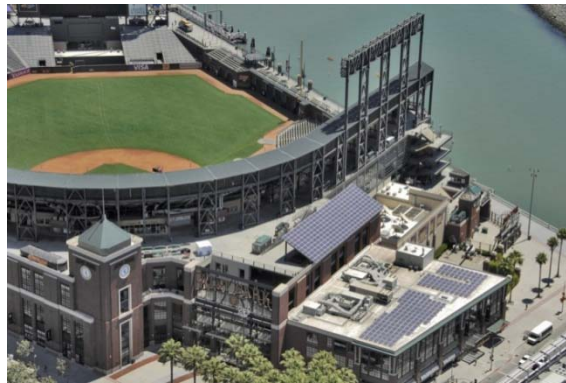
POU data based on California Energy Commission data, available through 2009 only.

# 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



March 1-2, 2011



DOE/CPUC High Penetration Solar Forum

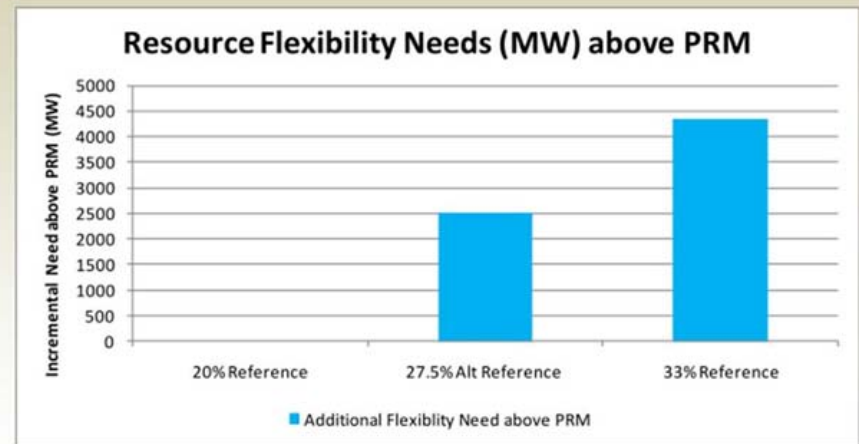


# Context for Funding:

## Installed and Growing Renewables Base in California

- Growing amount of PV on the customer-side of meter
- Growing amount of PV on the utility-side of meter
- Regardless of where solar is installed, the future growth of the PV market presents grid integration challenges for planners, utilities, and grid operators

Additional capacity (MW) of flexible resources needed above Planning Reserve Margin (PRM)



ISO 33% RPS Study of Operational Requirements and Market Impacts

Slide 24

Source: CAISO presentation of ISO Study of Operational Requirements and Market Impacts at 33% RPS – Nov 2010

# 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
- Adopted the “CSI RD&D Plan”

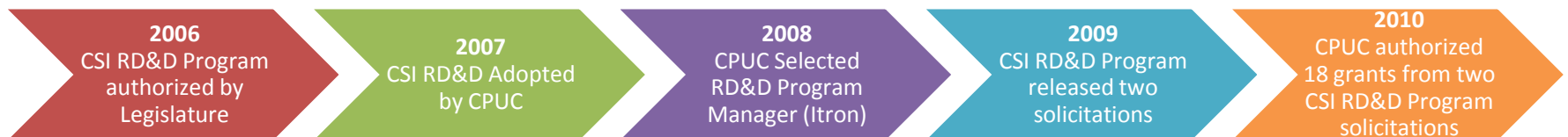
## CSI RD&D Plan established:

- Goals and objectives
- Allocation guidelines for project funding
- Criteria for solicitation, selection and project funding

## Three Target Areas Established for Program Funding:

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

## CSI RD&D TimeLine To-Date:



# Target Area: Grid Integration

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

- Identify and address key barriers to the development of PV minigrids or central PV;
- Demonstrate economic viability of new PV system storage technologies
- High value locations for distributed generation (DG) PV on transmission and distribution (T&D) are identified and the impacts/benefits of large concentrations of DG PV in one location on transmission and distribution are assessed.

# Sub Areas: Planning and Modeling for High Penetration PV

## Needs and issues to help develop better planning and modeling tools:

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

# Sub Areas: 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. These needs include:

- Testing improved monitoring and communications software and systems
- Testing/demonstrating improved control systems and operations
- Integrated subsystems within the distribution system (including mini- or micro-grids)
- Assessing optimal locations within the T&D system



# 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

# Target Area 1: Grid Integration: High Penetration PV

Project Title	Awardee	CSI Funding	Match Funding	Partners
Advanced Modeling and Verification for High Penetration PV	Clean Power Research	\$976,392	\$543,000	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	\$2,073,232	\$1,623,859	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	\$1,600,000	\$1,400,000	CPR, Electrical Distribution Design, Satcon, NREL
Planning and Modeling for High-Penetration PV	SunPower Corporation	\$1,000,000	\$320,000	KEMA, CAISO AWS Truewind, Sandia National Lab
Development and Analysis of a Progressively Smarter Distribution System	UC Irvine - APEP	\$300,000	\$100,000	PG&E
Improving Economics of Solar Power Through Resource Analysis, Forecasting and Dynamic System Modeling	UC San Diego	\$548,148	\$140,839	CEC, EPRI, EDSA Power Analytics, CAISO, SDG&E, NREL
<b>Total</b>		<b>\$6,497,772</b>	<b>\$4,127,698</b>	

# Target Area 2: Improved Solar Technologies

Project Title	Awardee	CSI Funding	Match Funding	Partners
Improved Cost, Reliability, and Grid Integration of High Concentration Photovoltaic Systems	Amonix, Inc.	\$2,139,384	\$3,157,000	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	\$1,467,125	\$2,773,304	Sonoma Wine Company, Patch Engineering, PG&E
Solaria: Proving Performance of the Lowest Cost PV System	Solaria Corporation	\$1,217,500	\$1,217,500	PG&E
PV and Advanced Energy Storage for Demand Reduction	SunPower Corporation	\$1,875,000	\$937,990	KEMA, Sandia National Laboratories, Target Stores, Prudent Energy, Ice Energy, ZBB Energy, PG&E
<b>Total</b>		<b>\$6,699,009</b>	<b>\$8,085,794</b>	

# Target Area 3: Innovative Business Models

Project Title	Awardee	CSI Funding	Match Funding	Partners
Advanced Grid-Interactive Distributed PV and Storage	Solar City	\$1,774,657	\$931,187	Tesla Motors, UC Berkeley, PG&E
Reducing California PV Balance of System Costs by Automating Array Design, Engineering and Component Delivery	SunLink	\$996,269	\$927,031	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	\$1,660,000	\$840,000	UC San Diego, Energy & Environmental Economics (E3), SDG&E
<b>Total</b>		<b>\$4,430,926</b>	<b>\$2,698,218</b>	

# Crosscutting:

## Integration of Energy Efficiency, Demand Response and Energy Storage with PV

Project Title	Awardee	CSI Funding	Match Funding	Partners
Low-Cost, Smart-Grid Ready Solar Re-Roof Product Enables Residential Solar Energy Efficiency Results	ConSol	\$999,999	\$932,500	General Electric, GAF, SDG&E
Beopt-CA (EX): A Tool for Optimal Integration of EE/DR/ES+PV for California Homes	DEG / NREL	\$985,000	\$329,416	PG&E, NREL, E3, SunPower, CEC letter of support
Specify, Test and Document an Integrated Energy Project Model	kW Engineering	\$942,500	\$250,000	Solarnexus, Save Energy 123
West Village Energy Initiative: CSI RD&D Project	UC Davis	\$2,500,000	\$1,245,000	UC Davis Energy Institute, Chevron Energy Solutions, PG&E
<b>Total</b>		<b>\$5,427,499</b>	<b>\$2,756,916</b>	

# CSI RD&D Future Funding Opportunities

- Looking for feedback from Hi Penetration Solar Forum attendees on remaining needs and issues related to grid integration of high penetration PV
- Portfolio Review to identify gaps and remaining needs for Solar RD&D
- Draft solicitation document out for public review and comment in Spring 2011
- Release Third Solicitation in late Spring 2011

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# **QUESTIONS?**