



# CALIFORNIA PERSPECTIVE ON HIGH PENETRATION PV

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MELICIA CHARLES  
ENERGY DIVISION - CPUC

# Overview of Customer-Side Solar

- Solar in California: 1,400+ MW installed PV at 130,000+ locations
  - Over 1,000 MW installed in CSI Program
- California is over 2/3rds of nation's solar market and nation's largest rebate program
- California supports solar self-generation with four interrelated state policies: Rebates, net energy metering (NEM), interconnection policies, and rate structures (e.g. tiered rates, time of use rates)



Stone Brewing Co., North County  
San Diego  
Courtesy: Stone Brewing



San Diego County Water Authority  
Courtesy: Borrego Solar

# 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 market 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 market rebate program and low income program



# CSI RD&D Program

SB1 signed in 2006 -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:**



# Funded Projects

- Grant to the Lawrence Berkeley National Laboratory, Solar Energy Research Center - \$10 million
- Three Grant solicitations conducted to-date
  - 23 projects awarded funding for a total of \$28.5 million
  - Projects leveraging over \$23 million in match funds
- Fourth Grant Solicitation in mid-2013
  - Currently assessing gaps and research needs
  - Draft solicitation for public comment in April/May 2013 (estimate)

# Target Area 1: Grid Integration

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

- Identify high value locations for distributed PV on the transmission and distribution system
- Assess impacts of large concentrations of PV in one area
- Improve solar resource models with improved temporal and spatial resolution
- Validate the predicted outputs from solar models with metered PV performance over large system populations
- Integrate solar resource modeling applications with grid operation models and planning and tools



# CPUC Funding for Grid Integration

- Research is being conducted in the following areas:
  - > Solar resource models with improved resolution
  - > Assessing impacts of high penetration PV
  - > Identifying high value locations for PV
  - > Utility models and visualization tools for high penetration PV
  - > Integration of solar resource models into grid operation models and planning tools
  - > Utility interconnection
- Total of 16 projects with grid integration research
  - > 11 projects have primary focus on grid integration
  - > 5 projects have secondary focus on grid integration
- To-date, over \$16 million allocated to research on grid integration

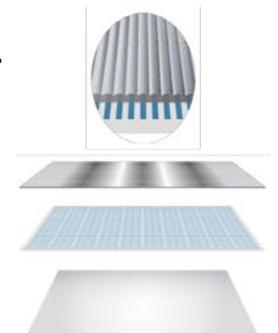
# Target Area 1: Primary Focus on Grid Integration: High Penetration PV

Project Title	Awardee	Partners	Funding	Match
Advanced Modeling and Verification for High Penetration PV	Clean Power Research	NREL, SUNI, NYSERDA, SEPA, SMUD, LIPA, SRP	\$ 976,392	\$ 543,000
High Penetration PV Initiative	Sacramento Municipal Utility District	HECO, BEW, NREL, EPRI, New Energy Options, Areva, SCS, Augustyn, SynerGEE	\$2,073,232	\$1,623,859
Analysis of High-Penetration Levels of PV into the Distribution Grid in CA	SCE / NREL	CPR, Electrical Distribution Design, Satcon, NREL	\$1,600,000	\$1,400,000
Planning and Modeling for High-Penetration PV (partial project)	SunPower Corporation	KEMA, CAISO AWST, Sandia National Lab	\$1,000,000	\$ 320,000
Improving Economics of Solar Power Through Resource Analysis, Forecasting and Dynamic System Modeling	UC San Diego	EPRI, EDSA Power Analytics, CAISO, SDG&E, NREL	\$ 548,147.54	\$ 140,839
Development and Analysis of a Progressively Smarter Distribution System	UC Irvine - APEP	PG&E	\$ 300,000	\$ 100,000
Tools Development for Grid Integration of High Penetration PV	BEW Engineering	SMUD, HECO/MECO/HELCO, PG&E, Roseville Electric	\$964,500	\$964,500
Quantification of Risk of Unintended Islanding and Re-Assessment of Interconnection	General Electric International, Consulting	PG&E	\$629,100	\$816,200
Screening Distribution Feeders: Alternatives to the 15% Rule	Electric Power Research Institute	NREL, Sandia, CPR, PG&E, SCE, SDG&E, SMUD	\$1,978,239	\$1,978,239
Integrating PV into Utility Planning and Operation Tools	Clean Power Research	CAISO, UCSD, EPRI, SUNY, SEPA	\$852,260	\$875,000
High-Fidelity Solar Forecasting Demonstration for Grid Integration	UC San Diego	SDG&E, Green Power Labs, CAISO	\$1,548,148	\$1,548,148

# 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
- Improved performance, reliability and bankability of concentrating solar technology



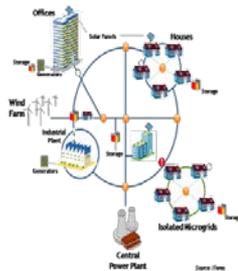
## Target Area 2: Improved Solar Technologies

Project Title	Awardee	Partners	Funding	Match
Improved Cost, Reliability, and Grid Integration of High Concentration Photovoltaic Systems	Amonix, Inc.	UC Irvine Advanced Power and Energy Program, NREL, SCE	\$2,139,384	\$3,157,000
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	\$1,467,125	\$2,773,304
Solaria: Proving Performance of the Lowest Cost PV System	Solaria Corporation	None	\$1,217,500	\$1,217,500
PV and Advanced Energy Storage for Demand Reduction	SunPower Corporation	KEMA, Sandia National Lab, Ice Energy, ZBB Energy, PG&E, Kohl's, UCSD	\$1,475,000	\$727,990

# 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	Funding	Match
Advanced Grid-Interactive Distributed PV and Storage	Solar City	Tesla Motors, UC Berkeley, PG&E	\$1,774,657	\$931,187
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.	\$996,269	\$927,031
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	\$1,660,000	\$840,000
Solar Energy and Economic Development Fund (SEED)	Strategic Energy Innovations	Optony, Inc	\$300,000	\$300,000

# Cross-Cutting: Integration of EE/DR/ES with PV

Tools and demonstration projects that address the integration of energy efficiency (EE) with demand response (DR), energy storage (ES) and PV

## ■ Policy Drivers:

- CSI goal of 3000 MW distributed solar
- Big Bold Energy Initiative:  
Residential ZNE by 2020 and Commercial by 2030
- California Energy Efficiency Strategic Plan
- Integrated Energy Policy Report 2011 – supporting ZNE
- AB 32
- 33% RPS requirement

## ■ Achieving Zero Net Energy through Integrated Demand-side Management (IDSM)



# Cross-Cutting:

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

Project Title	Awardee	Partners	Funding	Match
Specify, Test and Document an Integrated Energy Project Model	kW Engineering	Solarnexus, Save Energy 123	\$942,500	\$250,000
Beopt-CA (EX): A Tool for Optimal Integration of EE/DR/ES+PV for California Homes	DEG / NREL	PG&E, NREL, E3	\$985,000	\$329,416
Low-Cost, Smart-Grid Ready Solar Re-Roof Product Enables Residential Solar Energy Efficiency Results	BIRAenergy (formerly Consol)	General Electric, SDG&E	\$999,999	\$932,500
West Village Energy Initiative	UC Davis	UC Davis Energy Institute, Davis Energy Group, E3, PG&E, GE	\$2,120,000	\$1,060,000

# CSI RD&D Future Funding Opportunities

- Looking for feedback from Hi Penetration Solar Forum attendees and other stakeholders 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 2013 (estimate)
- Release Fourth Program Solicitation in mid-2013 (estimate)

## Contact Information:

Melicia Charles

Supervisor, Customer Generation Programs

Energy Division

California Public Utilities Commission

(415)355-5502

melicia.charles@cpuc.ca.gov

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## Q & A AND DISCUSSION