



Research and Development: Advancing Solar Energy in California

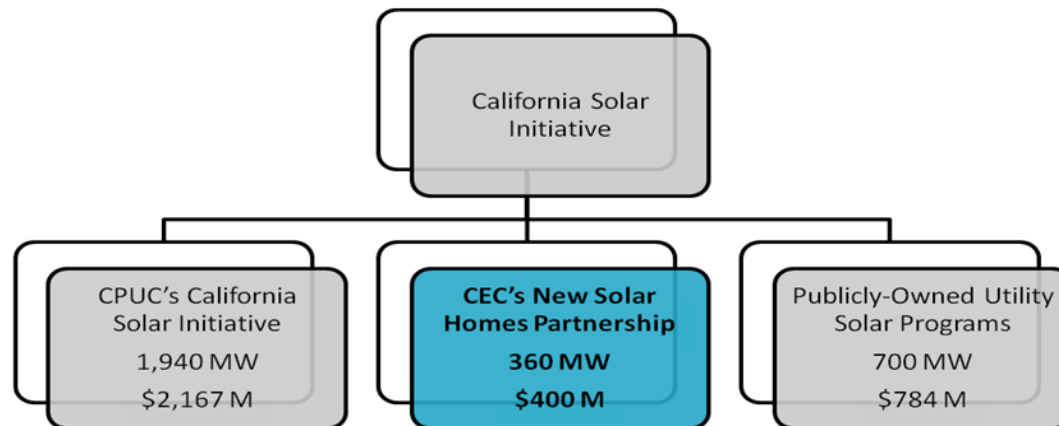
Laurie ten Hope
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Energy Research and Development Division
California Energy Commission

2014 UC Solar Research Symposium
San Francisco, CA
October 17, 2014



California's Renewable Policies Set the Stage for Research Needs

- **The California Global Warming Solutions Act of 2006 (AB 32):** Reduce greenhouse gas emissions from energy production and use
- **Renewable Portfolio Standard (SBx1-2):** 33 percent renewable electricity by 2020
- **Governor's Clean Energy Jobs Plan:** 8,000 MW new utility scale and 12,000 MW DG renewables by 2020
- **Go Solar California (SB 1):** 3,000 megawatts of new distributed solar by end of 2016 across several programs, including CSI





New Solar Homes Partnership Program

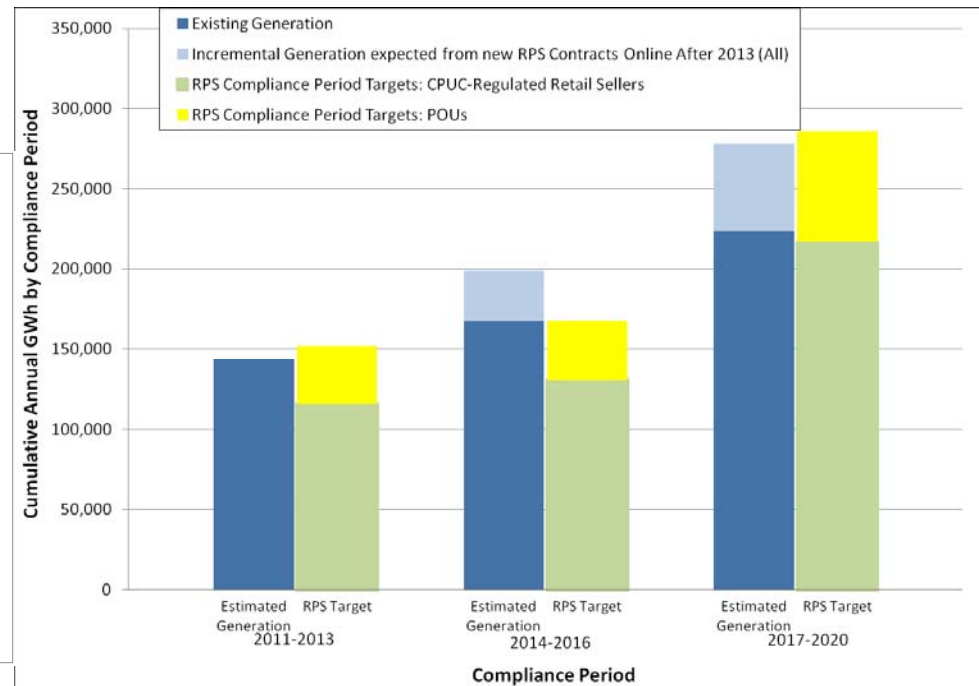
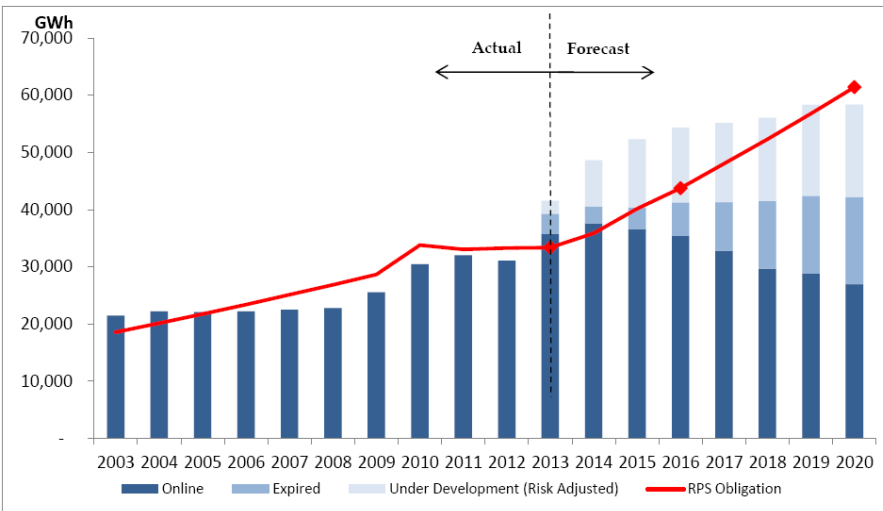


- Incentives for solar on new residential construction
- Goal of 360 MW by 2016
- 36,000 systems (~88 MW) installed, reserved, or under review



Renewable Energy in California's 2013 Electricity Mix

California's 2013 Electricity Mix



Renewable Electricity Generation

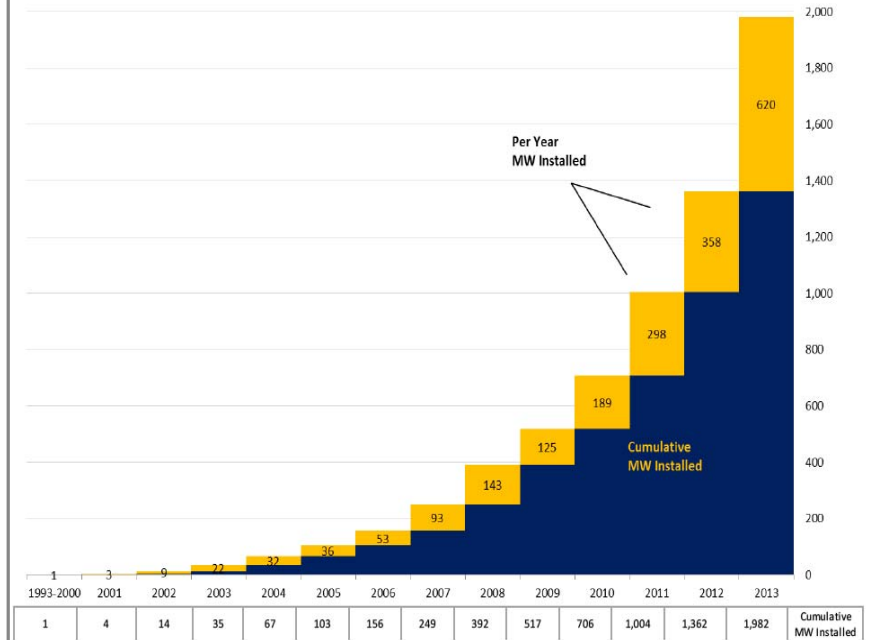
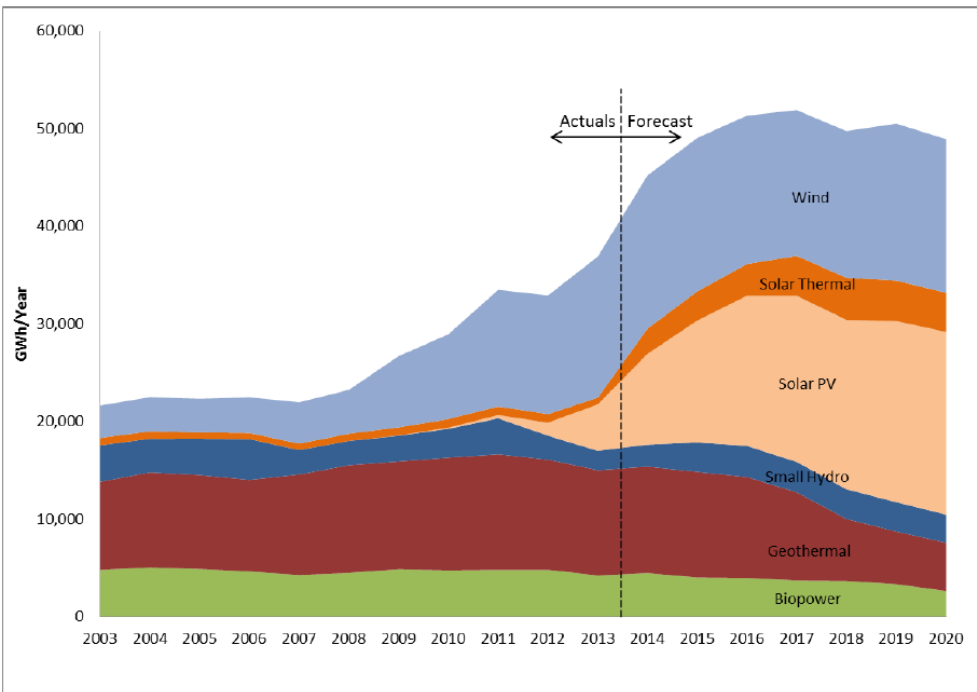
- Targeting 33% renewable by 2020; actual was ~19% in 2013
- Near pace to achieve 33% by 2020 RPS Goal



The Contribution of Solar Energy is Increasing

RPS Quarterly Report

CSI Annual Report
(Not RPS)



Data is through December 31, 2013. It includes CSI, NSHP, ERP and SGIP data, but not POU or RPS data.



Challenges and Opportunities

Issues and Challenges	Program Opportunities
<ul style="list-style-type: none">• Intermittency and impact on the grid• Flattening the “duck curve”• Costs• Planning, permitting, and environmental issues• Transmission infrastructure needs• Controllability and operational risk management, decisions and coordination	<ul style="list-style-type: none">• California Solar Initiatives• New Solar Homes Partnership• Research and Development<ul style="list-style-type: none">– Public Interest Energy Research– Electric Program Investment Charge



Renewable Energy Research Solutions

- Advanced Generation Technologies
- Research to Reduce PV “Soft Costs”
- Solar Forecasting and Modeling
- Energy Storage
- High-Penetration Solar Community Demonstrations
- Solar Resource Assessments



PIER Research - Advanced Solar Energy Generation to Reduce Costs

- Concentrating Photovoltaics (CPV)

Cool Earth Solar

PIER - \$1,726,438

Match - \$1,025,822

- Demonstrating an innovative inflatable plastic tube optic and novel tracker system to reduce materials costs for CPV



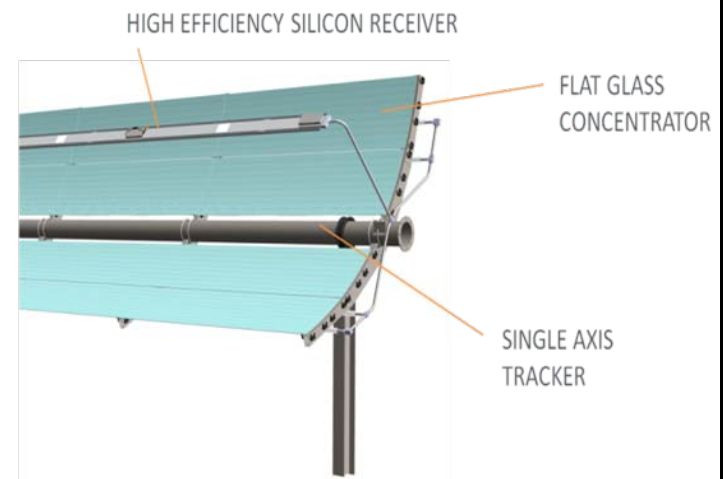
- Hybrid PV/Thermal (PV/T)

Cogenra

PIER - \$525,000

Match - \$155,659

- Developing MaxSun system that uses high-efficiency PV with active cooling water circulated through the receiver to produce temperatures up to 120 C





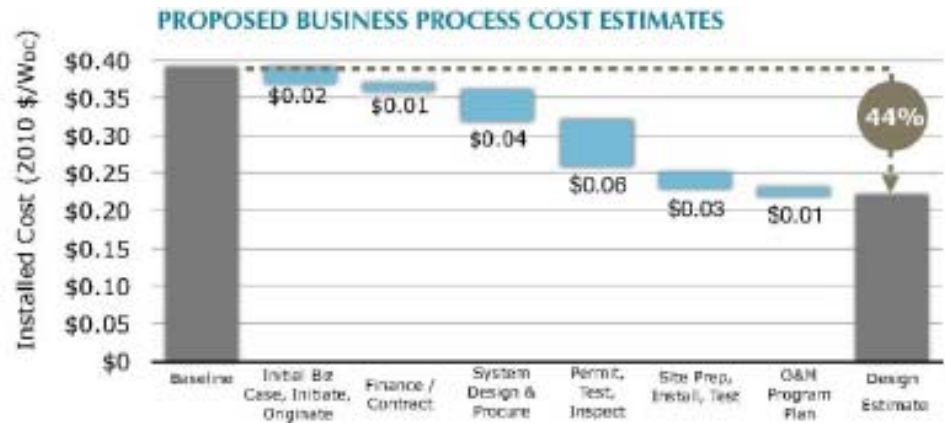
PIER Research - PV “Soft Cost” Reductions

SolarTech

Enabling Photovoltaic Markets in California Through Building Integration, Standardization and Metering in the Carbon Economy

PIER - \$747,253

Match - \$698,705



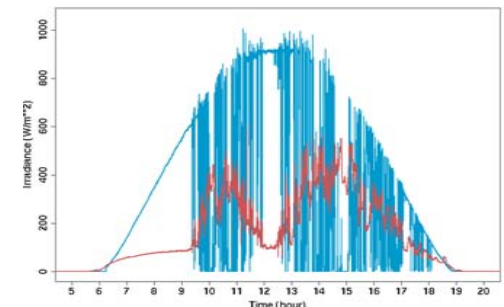
- Analyzed market opportunities to reduce non-hardware installed costs for PV systems. Including an evaluation of industry best practices, building integrated PV opportunities, permitting process improvements, and innovative financial models and market mechanism to facilitate PV deployment.
- Identified up to 17 cents/kWh in potential business process “soft cost” reductions for solar PV projects, a reduction of ~44% compared to current standards.



PIER Research - Solar Forecasting and Modeling

Research to increase understanding of solar intermittency on power generation and potential grid impacts of distributed and utility-scale solar

- UC San Diego
 - Sky Imager technology for near-term forecasts
- Clean Power Research
 - High-resolution solar forecasts based on Satellite cloud motion vectors for mid-term forecasts
- AWS Truepower
 - Advanced Numerical Weather Prediction models for long-term forecasts and integrated ensemble forecast using all three approaches

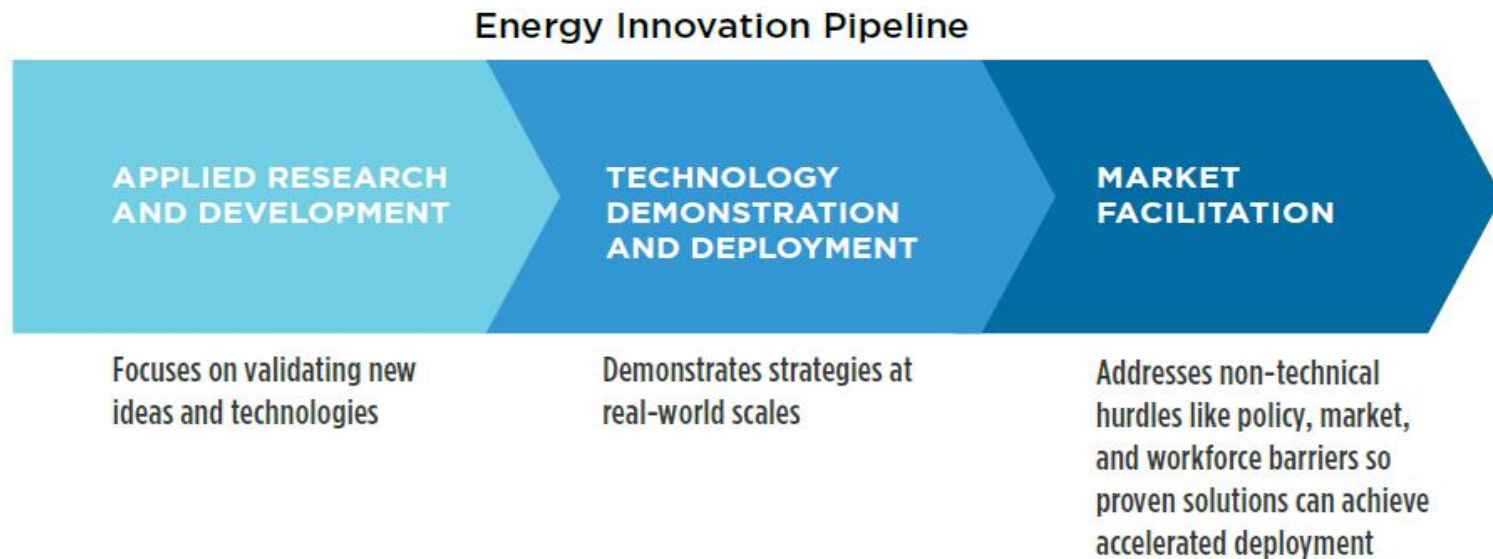




Current Energy Commission Solar Energy R&D Investment Programs

❖ Electric Program Investment Charge (EPIC)

- Funds technologies in each stage of the innovation pipeline – from feasibility to commercialization.



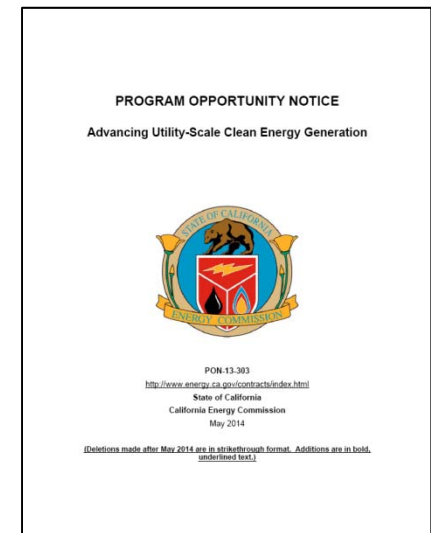
❖ Natural Gas Research, Development & Demonstration Program

- Supports R&D resulting in efficient and clean use of natural gas, including solar thermal/heating systems



Electric Program Investment Charge (EPIC) Solar R&D – First Awards

- Advancing Utility Scale Clean Energy Generation (PON-13-303)
 - Group 1: Thermal Energy Storage for Concentrating Solar Power
 - 8 proposals received
 - 2 projects recommend for funding
 - Group 2: Solar and Wind Forecasting and Modeling
 - 8 proposals received
 - 4 projects recommended for funding
 - Group 3: Geothermal Energy Generation Facilities
 - 2 proposals received
 - 1 project recommended for funding



“Research on clean energy generation will be targeted at filling knowledge gaps and technology needs to deploy and integrate emerging utility-scale renewable energy technologies in a stable, secure, and environmentally friendly way.” – 1st EPIC Investment Plan

- Notice of Proposed Award (NOPA) was posted on 9/26/2014, available at: <http://www.energy.ca.gov/contracts/#nopa>



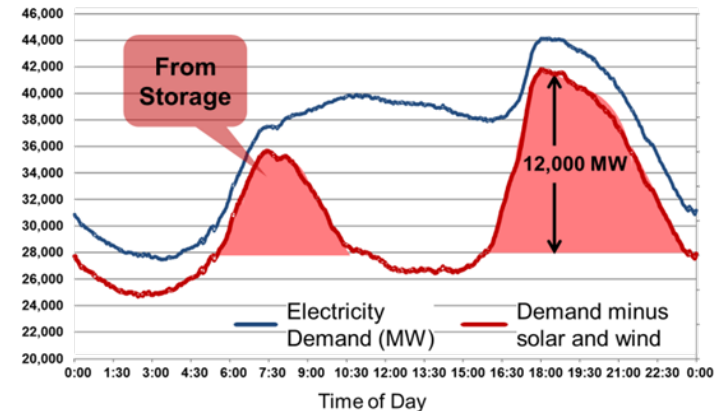
EPIC - Thermal Energy Storage for CSP

Systems Integration of Containerized Molten Salt Thermal Energy Storage in Novel Cascade Layout

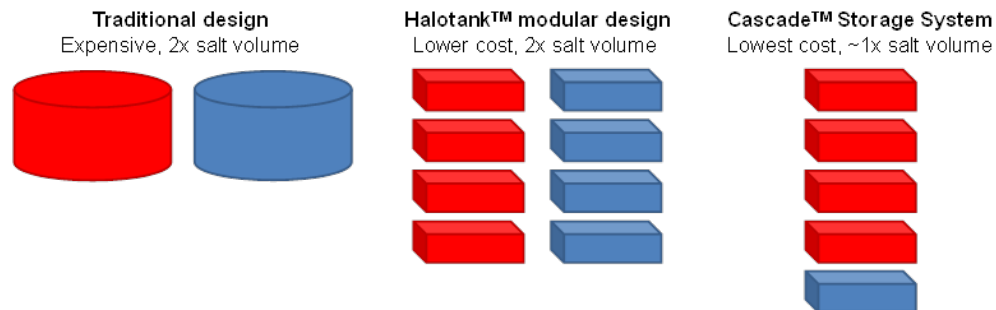
Recipient: Halotechnics

EPIC: \$1,500,000

Match: \$19,038



- Project plans to integrate and pilot test a modular thermal energy storage system in a cascaded tank layout to enable low-cost grid-scale thermal energy storage for CSP and support grid operations





EPIC - Thermal Energy Storage for CSP

Low-Cost Thermal Energy Storage for Dispatchable Concentrating Solar Power

Recipient: UC Los Angeles

EPIC: \$1,497,024

Match: \$300,000



- Develop an innovative low-cost TES system for CSP systems using elemental sulfur in a single-tank thermal battery design to eliminate molten salt and reduce costs
- Will also develop a cost model for system and market analyses



EPIC - Solar Forecasting and Modeling

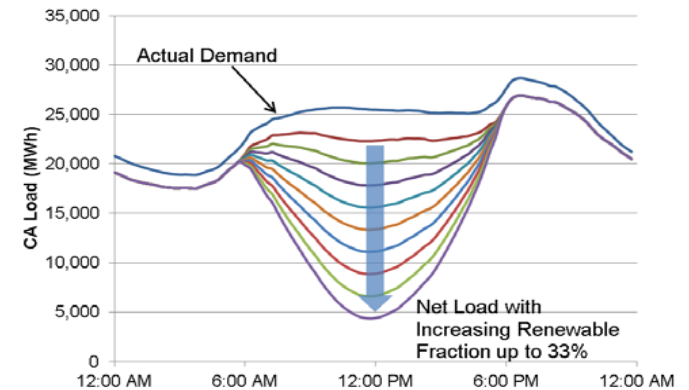
Improving Solar & Load Forecasts: Reducing the Operating Uncertainty Behind the Duck Chart

Recipient: Itron

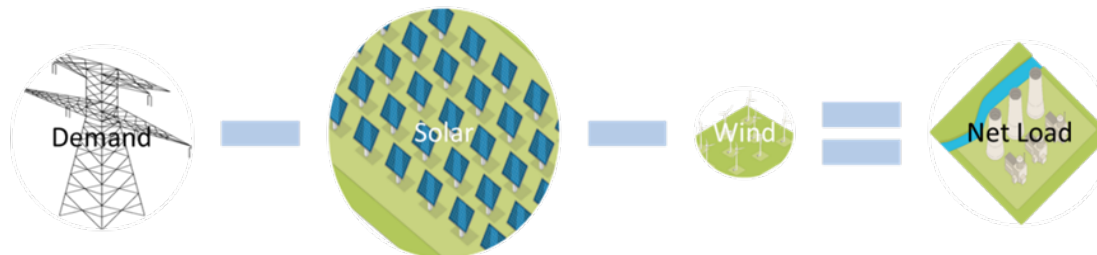
Subcontractor: Clean Power Research

EPIC : \$998,926

Match: \$450,000



- High-fidelity solar forecasts will be refined and integrated with existing wind forecasts to generate advanced net load forecasts.
- Goal is to reduce the operating uncertainty for California Independent System Operator (CAISO) system and scheduling errors, translating to significant cost savings.





EPIC – Solar Forecasting and Modeling

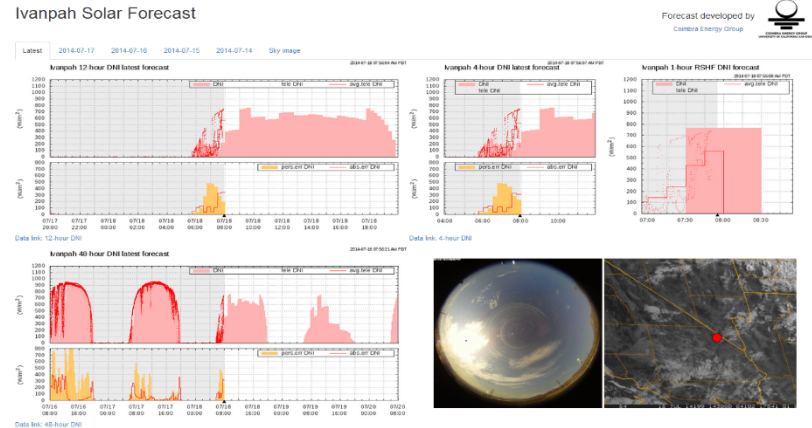
High-Fidelity Solar Power Forecasting Systems for the Ivanpah Solar Plant and California Valley Solar Ranch

Recipient: UC San Diego

Subcontractor: NRG Energy

EPIC: \$999,898

Match: \$764,019



- Develop and validate a new generation of solar forecasting tools to accurately predict Direct Normal Irradiance (DNI) and power generation out to 72 hours ahead for Ivanpah Solar Thermal Plant (392 MW) and California Valley Solar Ranch PV Plant (200 MW)
- Primary goal is to reduce uncertainties associated with operation, regulation and scheduling of Ivanpah



EPIC – Solar Forecasting and Modeling

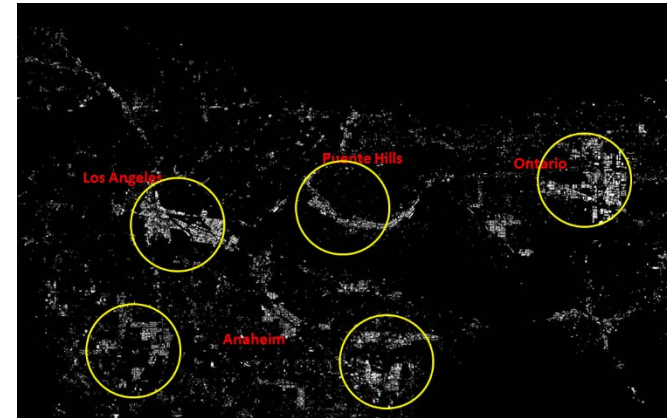
Solar Forecast Based Optimization of Distributed Energy Resources in the LA Basin and UC San Diego Microgrid

Recipient: UC San Diego

Subcontractors: UCLA, SDG&E, Strategen,
Olivine, KnGrid

EPIC: \$999,984

Match: \$999,984



- High-fidelity solar forecasting will be integrated with the operation of distributed energy resources across LA Basin warehouse areas and at the UC San Diego microgrid, and to evaluate the benefits and potential use cases.
- Project supports DG deployment in disadvantaged communities within the areas affected by SONGS and OTC closures



Current Solar Funding Opportunity

Advancing Cleaner, Less Costly, More Reliable Distributed Generation to Enable Customer Solutions and Zero-Net Energy Communities (PON-14-303)

- 2 Solar-related project groups:
 - **Evaluate Advanced Inverter Functionality and Interoperability to Enable High-Penetration Distributed Photovoltaics (PV)**
 - **Develop Advanced Distributed PV Systems**
- Proposals due on November 13, 2014 by 3:00 PM
- See Energy Commission Contracts website for more info and updates:
<http://www.energy.ca.gov/contracts/epic.html#PON-14-303>



Current Funding Opportunities

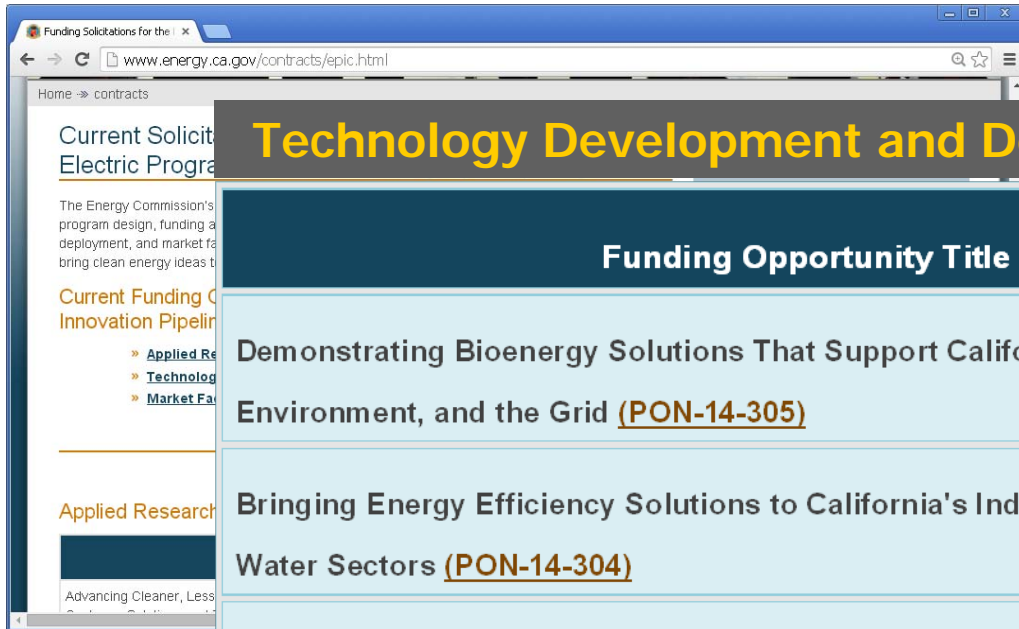


Applied Research and Development Solicitations

Funding Opportunity Title	Funding Amount
Advancing Cleaner, Less Costly, More Reliable Distributed Generation to Enable Customer Solutions and Zero-Net Energy Communities (PON-14-303)	\$19,500,000
Solicitations that Closed Within the Past 3 Months	
Advancing Utility-Scale Clean Energy Generation (PON-13-303)	\$9.5 million
Developing Advanced Energy Storage Technology Solutions to Lower Costs and Achieve Policy Goals (PON-13-302)	\$6 million
Developing a Portfolio of Advanced Efficiency Solutions: Technologies and Approaches for More Affordable and Comfortable Buildings (PON-13-301)	\$25 million



Current Funding Opportunities



Technology Development and Deployment Solicitations

Funding Opportunity Title	Funding Amount
Demonstrating Bioenergy Solutions That Support California's Industries, the Environment, and the Grid (PON-14-305)	\$27 million
Bringing Energy Efficiency Solutions to California's Industrial, Agriculture and Water Sectors (PON-14-304)	\$27.3 million
Demonstrating Secure, Reliable Microgrids and Grid-Linked Electric Vehicles to Build Resilient, Low-Carbon Facilities and Communities (PON-14-301)	\$26.5 million

Market Facilitation Solicitations

Funding Opportunity Title	Funding Amount
Analysis of Social, Cultural, and Behavioral Aspects of Achieving Energy Efficiency Potential (Phase 1: Residential Sector) (PON-14-306)	\$1 million



Proposed EPIC 2015-2017 Triennial Investment Plan

Applied Research and Development

- **Clean Generation**

- **Strategic Objective 3.** Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.
- **Strategic Objective 4.** Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.
- **Strategic Objective 5.** Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Technology Demonstration and Deployment

- **Strategic Objective 14.** Taking Microgrids to the Next Level: Maximizing the Value to Customers.



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Opportunity Title	Funding Amount
Generation (PON-13-303)	\$9.5 million
Technology Solutions to Lower Costs and	\$6 million
Efficiency Solutions; Technologies and Comfortable Buildings (PON-13-301)	\$25 million
on and Deployment Solicitations	
g Opportunity Title	Funding Amount
that Support California's Industries, the Environment.	\$27 million
California's Industrial, Agriculture and Water	\$27.3 million
grids and Grid-Linked Electric Vehicles to Build communities (PON-14-301)	\$26.5 million

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Thank You!

Any Questions?

Laurie ten Hope

Deputy Director

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