




# Solar for the Entrepreneur

Webinar

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Matt Heling  
Andrew Yip  
Pacific Gas & Electric Co.  
Solar and Customer Generation



# Objective

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- Identify the various opportunities, resources, and requirements that the solar entrepreneur needs to be familiar with to advance a product in the solar industry
  - Focus is on electric generation
  - Presented from PG&E perspective

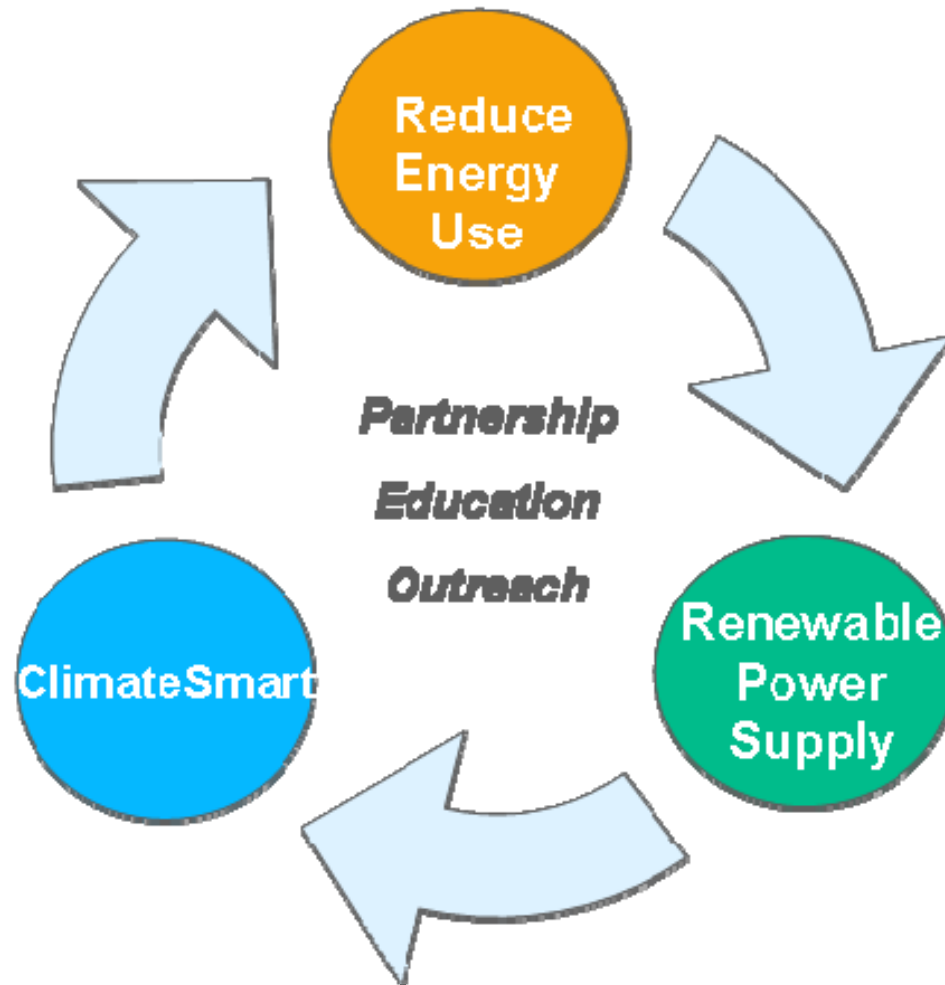
# Outline

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- Importance of Energy Efficiency
- PG&E solar programs
- PG&E solar resources
- Utility solar terminology
- Certification requirements
- Other resources

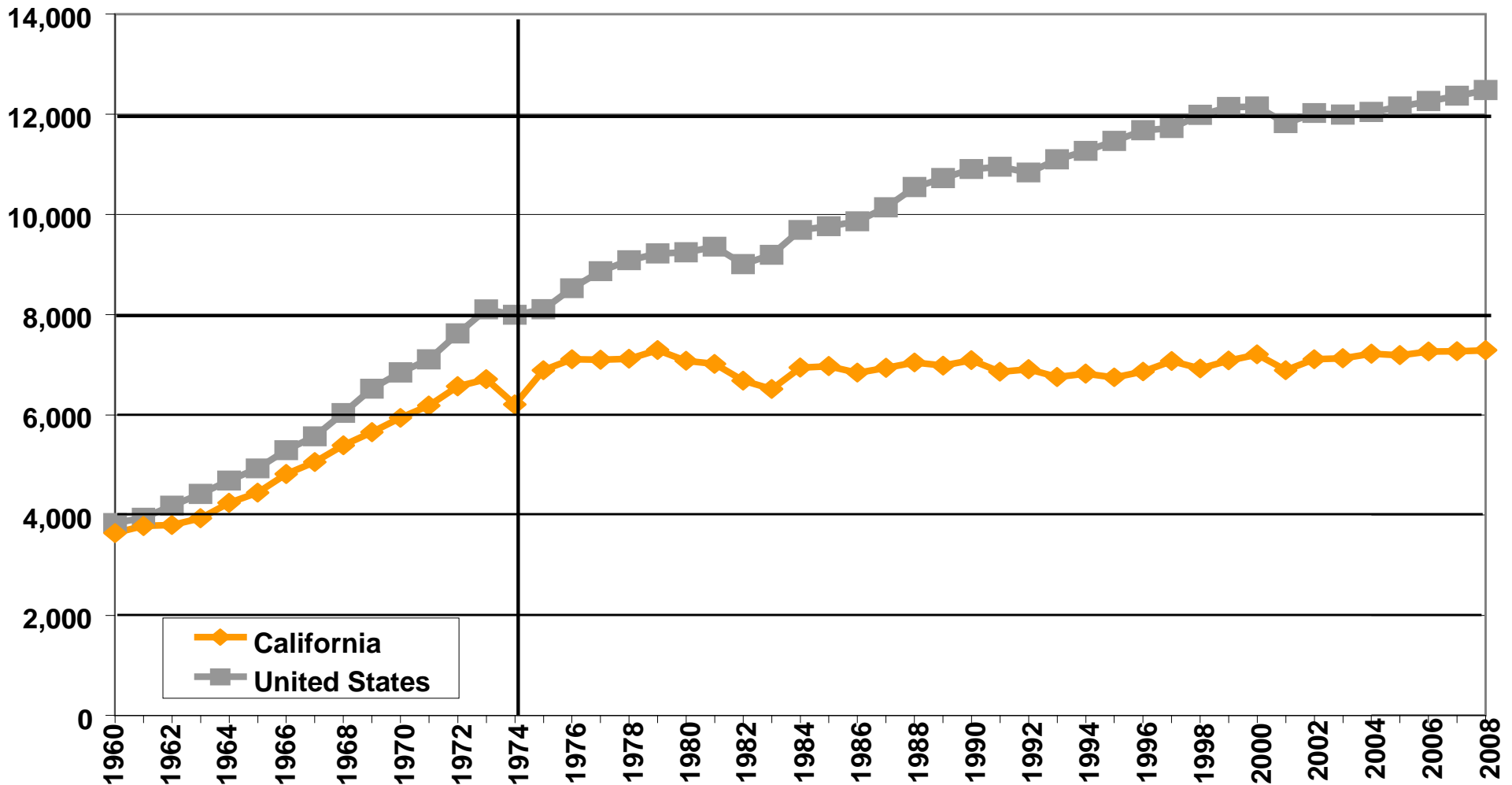
# PG&E as a Partner and Solutions Provider

## PG&E Portfolio Solution



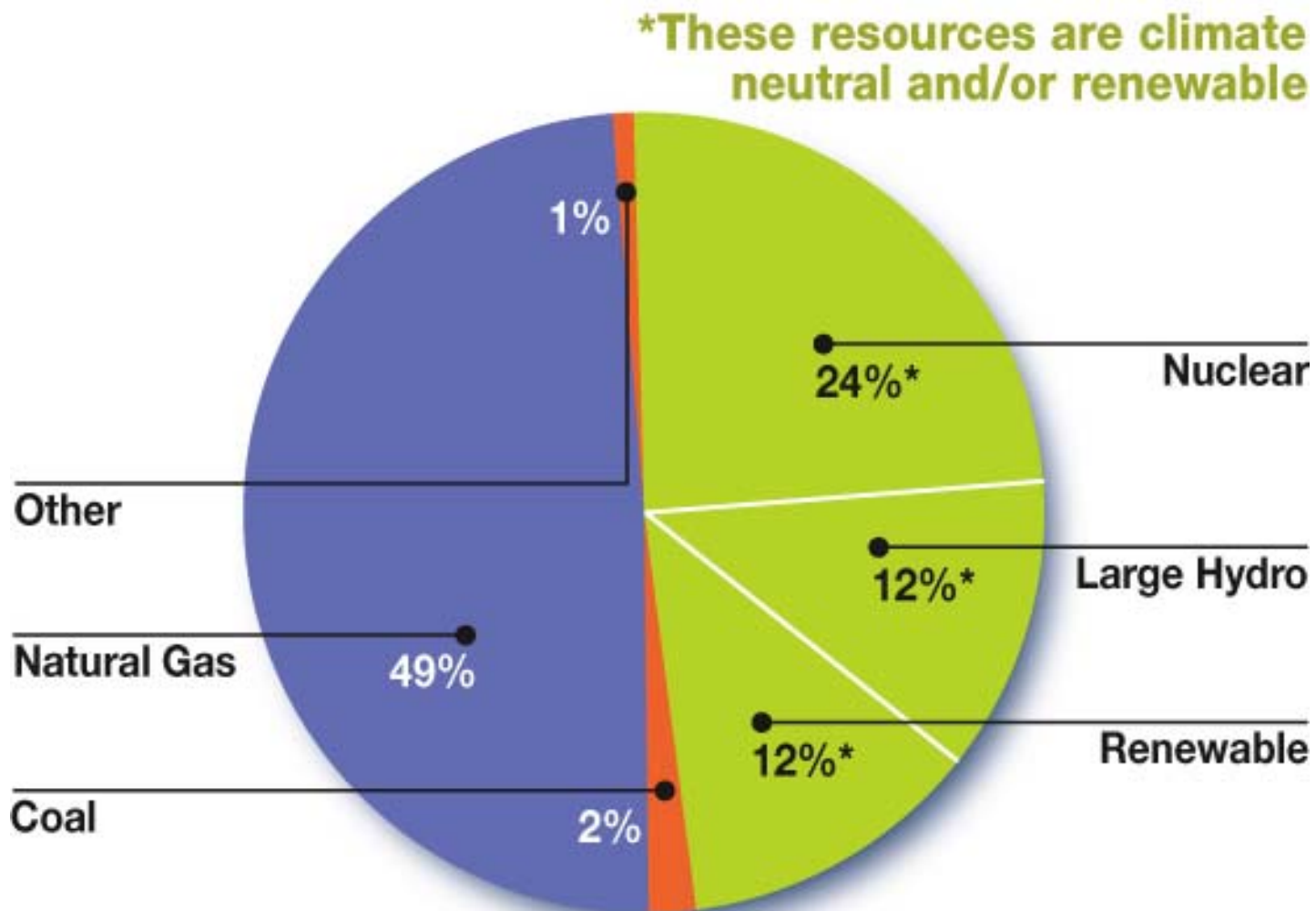
# PG&E is Committed to Energy Efficiency

Over the past 30 years, California per capita energy use has remained relatively flat compared to the 50% increase in U.S. per capita energy use.

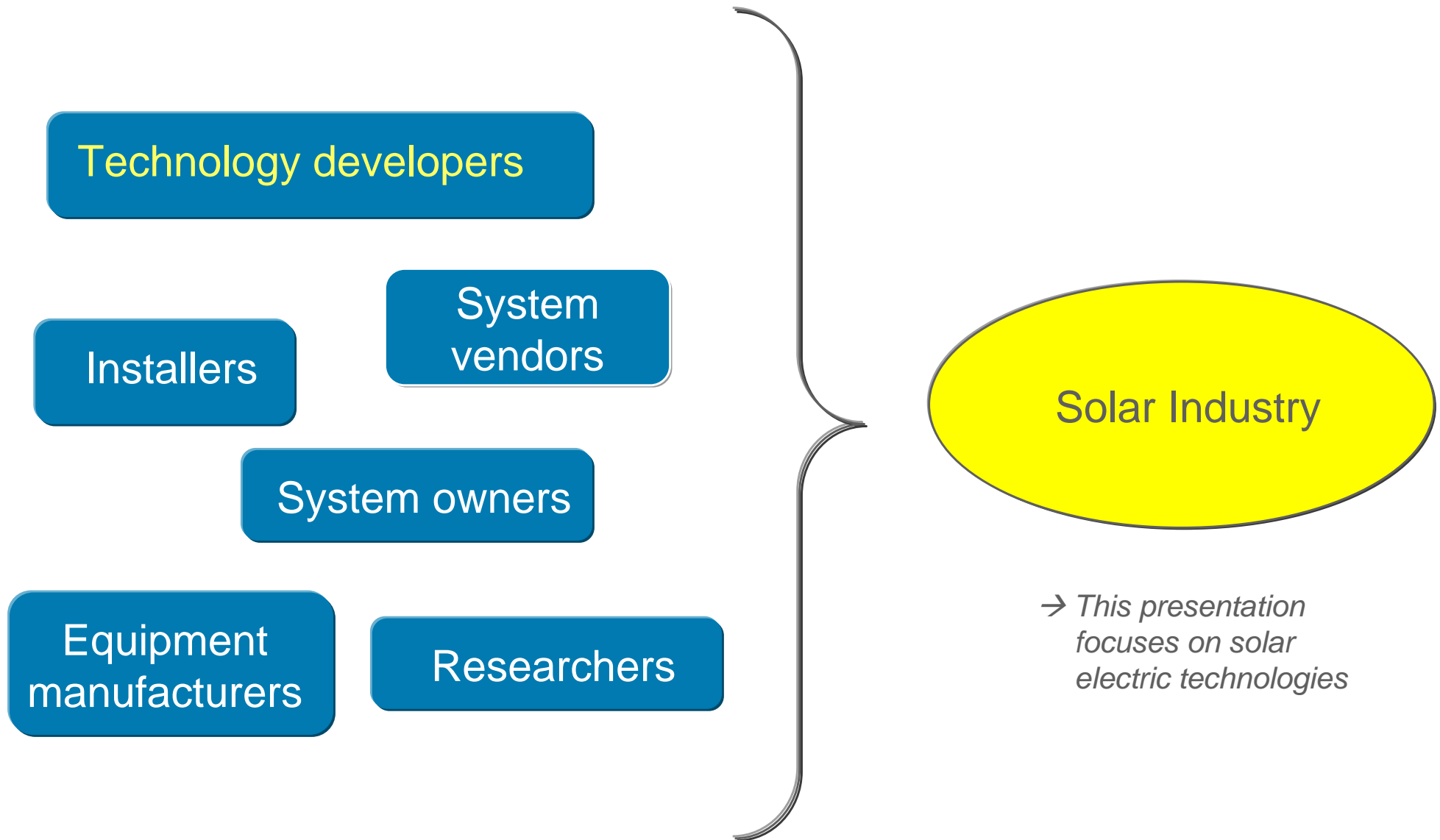


# PG&E's 2008 Electric Delivery Mix

--on average over 50% of the energy PG&E delivers comes from sources that emit almost no carbon dioxide

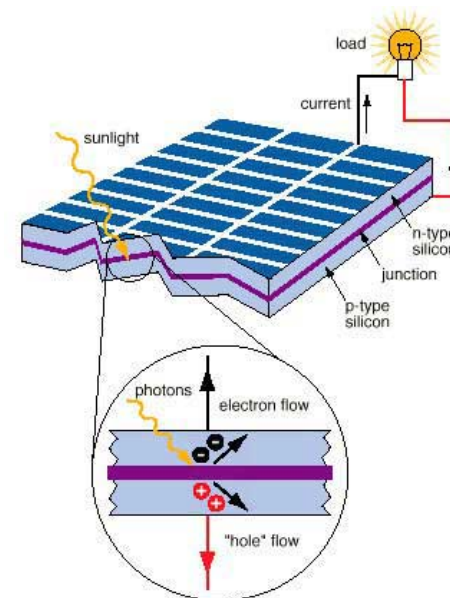


# Solar Industry - Players



# Solar Educational Opportunities

- (Other) classes at PG&E's Pacific Energy Center
  - *Basics of PV Systems for Grid-Tied Applications*
  - *PV System Site Analysis and System Sizing*
  - *Understanding Financial Analysis Methods for PV Systems*
- Other resources
  - Junior colleges
  - UC extension classes
    - *Solar Career Opportunities in California*
    - *Solar Industry Orientation for Businesses*



# PG&E Programs for Solar Electricity

	California Solar Initiative (CSI)	Small Renewable Generation Feed-in Tariffs	Annual Renewables RFO
<b>What is it?</b>	An incentive program to reduce the cost of installing solar power systems	Under Assembly Bill 1969, PG&E must buy exported renewable electricity from eligible customers who obtain a Power Purchase Agreement with PG&E	PG&E purchases eligible renewable energy resources (ERRs) to meet CA-mandated Renewable Portfolio Standard (RPS) goals. Typically involves Power Purchase Agreements (PPAs)
<b>Opportunity for Participant</b>	As of 5/1/09: <ul style="list-style-type: none"> <li>• Residential: \$1.55/W or \$0.22/kWh</li> <li>• Commercial: \$1.10/W or \$0.15/kWh</li> <li>• Gov't/Non-profit: \$1.85/W or \$0.26/kWh</li> </ul> See <a href="http://www.csi-trigger.com/">http://www.csi-trigger.com/</a>	Exported electricity is purchased by PG&E at Market Price Referent (~\$0.10/kWh)	Can submit offers to provide capacity and energy generated by existing EERs, planned EERs, or sites for ERR development to PG&E
<b>Eligible Participants</b>	PG&E customers	PG&E customers	Interested bidders
<b>Program size</b>	Statewide: 3,000 MW PG&E: 1,800 MW?	Public/wastewater agencies: Up to 104.6 MW Other customers: Up to 104.6 MW	Varies year-to-year
<b>Eligible size range</b>	Incentives for first MW of installed capacity on systems from 1 kW – 5 MW	Renewable generators must be 1.5 MW or less.	1.5 MW or greater
<b>Additional information</b>	<a href="http://www.pge.com/csi">www.pge.com/csi</a>	<a href="http://www.pge.com/b2b/energysupply/wholesaleelectricissuppliersolicitation/standardcontractforpurchase/">http://www.pge.com/b2b/energysupply/wholesaleelectricissuppliersolicitation/standardcontractforpurchase/</a>	<a href="http://www.pge.com/b2b/energysupply/wholesaleelectricissuppliersolicitation/renewables2009/index.shtml">http://www.pge.com/b2b/energysupply/wholesaleelectricissuppliersolicitation/renewables2009/index.shtml</a>

# Opportunities with PG&E: Customer-scale Technologies

Product Stage	Idea/Concept	Pilot	Commercial
<b>Relevant PG&amp;E Programs or Departments</b>	<ul style="list-style-type: none"> <li>PG&amp;E Applied Technology Services (ATS)</li> <li>PG&amp;E Generation Interconnection Services (GIS)</li> </ul>	<ul style="list-style-type: none"> <li>PG&amp;E Applied Technology Services (ATS)</li> <li>PG&amp;E Generation Interconnection Services (GIS)</li> </ul>	<ul style="list-style-type: none"> <li>California Solar Initiative (CSI)</li> <li>New Solar Homes Partnership (NSHP)</li> <li>PG&amp;E Generation Interconnection Services (GIS)</li> </ul>
<b>Services or Opportunities Provided</b>	<ul style="list-style-type: none"> <li>Product testing, validation (ATS)</li> <li>Ensure product can interconnect safely with PG&amp;E grid (GIS)</li> </ul>	<ul style="list-style-type: none"> <li>Product testing, validation</li> <li>Ensure product can interconnect safely with PG&amp;E grid (GIS)</li> </ul>	<ul style="list-style-type: none"> <li>Incentives for commercial products (CSI, NSHP)</li> <li>Enable interconnection with PG&amp;E grid (GIS)</li> </ul>
<b>Contacts/ Resources</b>	<ul style="list-style-type: none"> <li>ATS: Brent Patera (<a href="mailto:bxpl@pge.com">bxpl@pge.com</a>, 415-973-5335)</li> <li>GIS: <a href="mailto:gen@pge.com">gen@pge.com</a>, 415-972-5676</li> </ul>	<ul style="list-style-type: none"> <li>ATS: Brent Patera (<a href="mailto:bxpl@pge.com">bxpl@pge.com</a> or 415-973-5335)</li> <li>GIS: <a href="mailto:gen@pge.com">gen@pge.com</a>, 415-972-5676</li> </ul>	<ul style="list-style-type: none"> <li>CSI: <a href="http://www.pge.com/csi/">www.pge.com/csi/</a></li> <li>NSHP: <a href="http://www.gosolarcalifornia.org/nshp/index.html">www.gosolarcalifornia.org/nshp/index.html</a></li> <li>GIS: <a href="mailto:gen@pge.com">gen@pge.com</a>, 415-972-5676</li> </ul>



# Opportunities with PG&E: Utility-scale Technologies

Product Stage	Idea/Concept	Pilot	Commercial
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<b>Contacts/ Resources</b>	<ul style="list-style-type: none"> <li>ATS: Brent Patera (<a href="mailto:bxpl@pge.com">bxpl@pge.com</a>, 415-973-5335)</li> <li>GIS: <a href="mailto:gen@pge.com">gen@pge.com</a>, 415-972-5676</li> <li>ECTP: Uday Mathur (<a href="mailto:UxM2@pge.com">UxM2@pge.com</a>, 415-973-2784)</li> </ul>	<ul style="list-style-type: none"> <li>ATS: Brent Patera (<a href="mailto:bxpl@pge.com">bxpl@pge.com</a>, 415-973-5335)</li> <li>GIS: <a href="mailto:gen@pge.com">gen@pge.com</a>, 415-972-5676</li> <li>ECTP: Uday Mathur (<a href="mailto:UxM2@pge.com">UxM2@pge.com</a>, 415-973-2784)</li> </ul>	<ul style="list-style-type: none"> <li>RFO: <a href="http://www.pge.com/b2b/energysupply/wholesaleelectricitysuppliersolicitation/renewables2009/index.shtml">www.pge.com/b2b/energysupply/wholesaleelectricitysuppliersolicitation/renewables2009/index.shtml</a></li> </ul>



# PG&E Resource – Applied Technology Services (ATS)

<p><b>What is ATS?</b></p>	<ul style="list-style-type: none"> <li>• A multidisciplinary team of 100 engineers, scientists, and technicians committed to delivering practical <b>testing, diagnostic</b> and <b>analytical</b> solutions to your most challenging engineering problems.</li> <li>• ATS services are delivered in the field or from PG&amp;E’s fully equipped San Ramon Technology Center.</li> </ul>
<p><b>ATS capabilities</b></p>	<ul style="list-style-type: none"> <li>• Electrical, Mechanical, Thermal &amp; Meteorological Disciplines</li> <li>• Performance measurement &amp; evaluation</li> <li>• Failure Analysis</li> <li>• Ultrasonic and Radiographic Imaging</li> <li>• Recommendations for technical improvement</li> <li>• Extensive experience in test development and data analytics</li> </ul>
<p><b>Solar-specific capabilities</b></p>	<ul style="list-style-type: none"> <li>• Direct Substation/Grid Attachment</li> <li>• Existing testing infrastructure including sensors, data acquisition &amp; connectivity</li> <li>• Flexible loading capabilities</li> <li>• Roof and Ground-Mounting Capacity</li> </ul>
<p><b>Benefits for solar development</b></p>	<ul style="list-style-type: none"> <li>• Quick Test Set-Up</li> <li>• Unique direct grid access</li> <li>• Experienced testing personnel</li> <li>• Confirm performance during development</li> <li>• <b>Avoid mistakes and delays</b></li> <li>• <b>Shorten Development Cycle</b></li> <li>• <b>Professional input for design enhancement</b></li> </ul>

**Example: Inverter testing**

- Wide range of inverters from industry
- Load development & grid attachment
- Test interconnection and behavior
- Established standards for inverter operation including “anti-islanding”



**Brent Patang** ([bxpl@pge.com](mailto:bxpl@pge.com))  
or 415-265-7232

# PG&E Resource – Generation Interconnection Services (GIS)

- Facilitates interconnection process
- Solar systems must be approved for interconnection by PG&E before interconnecting to the PG&E grid
  - Includes interconnections on the customer side of the meter
- Net Energy Metering (NEM)
  - Solar system production above that consumed on-site is “banked”
  - PG&E bill is “trued up” every 12 months
  - Customer can reduce utility bill, but cannot make net profit
  - PG&E NEM website: [www.pge.com/b2b/newgenerator/netenergymetering/index.shtml](http://www.pge.com/b2b/newgenerator/netenergymetering/index.shtml)
- For Net Energy Metering (NEM) projects, interconnection requirements of “Rule 21” must be met
  - Rule 21: <http://www.pge.com/tariffs/pdf/ER21.pdf> (GIS facilitates meeting these requirements)
- **Interconnecting equipment must be certified to applicable standards**
  - Example: Inverters must be certified to UL 1741
- For net export projects whose output is scheduled by the California Independent System Operator (CALISO), interconnection requirements are governed by the Federal Energy Regulatory Commission (FERC)
- GIS contact information
  - [gen@pge.com](mailto:gen@pge.com), 415-972-5676

# PG&E Resource – Emerging Clean Tech Policy (ECTP)

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- Investigates commercially viable, clean, primarily utility-scale generation technologies
  - PG&E is most directly interested in commercial-ready technologies that can be deployed today
  - If the technology/product is not commercially ready, ECTP can assist by:
    - Providing referrals to other vendors/developers who may be interested in the technology
    - Jointly participating in demonstrations, grant responses, or similar projects
  - ECTP contact
    - Uday Mathur: [UxM2@pge.com](mailto:UxM2@pge.com) or (415) 973-2784

# Solar Technology Terms & Concepts:

## STC vs. PTC

- STC and PTC are types of PV module ratings
  - Both are meant to represent PV module power output under “maximum” sunlight conditions
  - Like the nameplate rating of a conventional power plant
  - Example: A given PV module rated at 135 W (STC)

STC (Standard Testing Conditions)	PTC (PVUSA Testing Conditions)
Stands for <i>Standard Testing Conditions</i>	Stands for <i>PVUSA Testing Conditions</i>
More “ideal” testing conditions	More “realistic” testing conditions
Produces comparatively higher Wattage rating	Results in comparatively lower Wattage rating
Typically ~5% higher than PTC rating	Typically ~5% lower than STC rating
Typically used by vendors (higher value)	Typically used in output modeling/projection (more realistic)

# Solar Technology Terms & Concepts:

## *Capacity Factor*

- The **capacity factor** (CF) is the *average* power output of a system over a given period of time relative to the “maximum” (or rated) power output
  - Also represents the *total energy* output of a system over a given period of time relative to the “maximum” energy output
  - $CF = \text{actual production} / \text{“ideal” (rated) production}$
  - A CF of 0.20 means that on average, the system produces 20% of its rated power output
    - ~Typical PV capacity factor
  - Function of hours of operation and output level while operating
  - Typically calculated on annual basis

### PV example

- Assume that a 10-kW PV system produces 15,000 kWh in one year
- If the 10-kW system were to operate at full capacity throughout that same year, it would produce  $10 \text{ kW} \times 8,760 \text{ hrs/yr} = 87,600 \text{ kWh/yr}$
- Capacity factor =  $15,000 / 87,600 = 0.171$  (dimensionless)
  - On average, the system operates at **17.1%** of its rated capacity

# Solar Technology Terms & Concepts:

## *Dispatchability*

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- **Dispatchability** refers to the degree to which the utility can control the output of a power generation device
  - Utilities tend to prefer dispatchable power generation because it can be relied upon
  - Less backup power (“spinning reserves”) must be kept on standby
  - Dispatchability is one area that PV is less attractive to a utility than other (conventional) power generation



### Dispatchable

- Natural gas peakers
- Combined cycle power plants
- Hydropower

### Intermittent

- Wind turbines
- Photovoltaics

# Product Certification Requirements

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- Product certification
  - Equipment must be certified by an NRTL capable of testing to the applicable standards
  - List of NRTLs
    - <http://www.osha.gov/dts/otpca/nrtl/index.html#nrtls>
- CSI eligibility
  - To be listed as CSI-eligible, manufacturer must submit NRTL certification *plus* other required documents/documentation
  - Additional information and required paperwork available online
    - <http://www.gosolarcalifornia.org/equipment/index.html>
- Product validation
  - Additional performance testing and validation is available through PG&E's Applied Technology Services (ATS)
  - Contact PG&E's Brent Patera at [bxpl@pge.com](mailto:bxpl@pge.com) or (415) 973-5335 for more information

# CSI – Equipment Certification Requirements

	PV Module	Other Solar Technology	Inverter	Meter
<b>Applicable Standard</b>	UL 1703	Full safety certification with follow-up service or listing by a NRTL	UL 1741 + performance testing by UL 1741-certified NRTL	For performance based incentives, must be +/- 2% accurate; +/- 5% otherwise
<b>Capable NRTLs</b>	UL, CSA, Intertek	Depends on technology and applicable standard(s)	UL, CSA, Intertek, MET Laboratories, TUV America, TUV Rhineland of North America	--
<b>Additional Notes</b>	Beginning 7/1/09, additional performance testing by an ILAC affiliated laboratory is also required	If existing standards do not apply, may require development of new test protocol	In addition to CEC equipment application form, manufacturer must also submit the <i>weighted inverter efficiency form</i>	Beginning 1-1-10, 5% meters must be <b>certified</b> to 5% accuracy
<b>For additional information</b>	<a href="http://www.gosolarcalifornia.ca.gov/equipment/documents/PV_ELIGIBILITY_PROCEDURE.PDF">http://www.gosolarcalifornia.ca.gov/equipment/documents/PV_ELIGIBILITY_PROCEDURE.PDF</a>	<a href="http://www.gosolarcalifornia.ca.gov/equipment/documents/OSEGT_ELIGIBILITY_PROCEDURE.PDF">http://www.gosolarcalifornia.ca.gov/equipment/documents/OSEGT_ELIGIBILITY_PROCEDURE.PDF</a>	<a href="http://www.gosolarcalifornia.ca.gov/equipment/documents/INVERTER_ELIGIBILITY_PROCEDURE.PDF">http://www.gosolarcalifornia.ca.gov/equipment/documents/INVERTER_ELIGIBILITY_PROCEDURE.PDF</a>	<a href="http://www.gosolarcalifornia.ca.gov/equipment/documents/METER_ELIGIBILITY_PROCEDURE.PDF">http://www.gosolarcalifornia.ca.gov/equipment/documents/METER_ELIGIBILITY_PROCEDURE.PDF</a>

CSI equipment eligibility website: <http://www.gosolarcalifornia.org/equipment/index.html>

# Internet Resources

Website	Notes	Link
<i>PG&amp;E – Solar Energy</i>	PG&E's Solar Energy webpage is a portal to the various PG&E solar programs, including incentives, classes, information, and other resources.	<a href="http://www.pge.com/solar/">www.pge.com/solar/</a>
<i>Go Solar California!</i>	A "one-stop shop" for information on rebates, tax credits, and incentives for solar energy systems in California. The website is a joint production of the California Public Utilities Commission and the California Energy Commission.	<a href="http://www.gosolarcalifornia.org/">www.gosolarcalifornia.org/</a>
<i>Solar Electric Power Association (SEPA)</i>	SEPA is a nonprofit membership organization dedicated to facilitating solutions for the use and integration of solar electric power by utilities, electric service providers, and their customers.	<a href="http://www.solarelectricpower.org/">www.solarelectricpower.org/</a>
<i>California Solar Energy Industries Association (CALSEIA)</i>	CALSEIA supports the widespread adoption of solar thermal and photovoltaic systems by educating consumers, supporting solar legislation and conducting business in a professional and ethical manner.	<a href="http://calseia.org/">calseia.org/</a>
<i>Solar America Cities</i>	The U.S. Department of Energy's Solar America Cities program has engaged over 180 organizations, including municipal, county, and state agencies, solar companies, universities, utilities, and non-profit organizations who have made a commitment to power their cities with solar energy.	<a href="http://www.solaramericacities.energy.gov/">www.solaramericacities.energy.gov/</a>
<i>U.S. DOE Solar Technologies Program</i>	The Solar Energy Technologies Program focuses on developing cost-effective solar energy technologies that have the greatest potential to benefit the nation and the world. Website includes educational materials and links.	<a href="http://www1.eere.energy.gov/solar/">www1.eere.energy.gov/solar/</a>
<i>National Renewable Energy Laboratory (NREL) - Solar</i>	NREL is the nation's primary laboratory for renewable energy and energy efficiency research and development (R&D). NREL's mission is to develop renewable energy and energy efficiency technologies and practices, advance related science and engineering, and transfer knowledge and innovations to address the nation's energy and environmental goals. The NREL solar website contains a variety of valuable solar information and tools.	<a href="http://www.nrel.gov/solar/">www.nrel.gov/solar/</a>
<i>North American Board of Certified Energy Practitioners (NABCEP)</i>	NABCEP's goal is to develop voluntary national certification programs that will promote renewable energy; provide value to practitioners; promote worker safety and skill; and promote consumer confidence. The website provides information on obtaining employment certifications in the solar industry.	<a href="http://www.nabcep.org/">www.nabcep.org/</a>

## Other Useful Information for the Solar Entrepreneur

For...	Resource	Notes	Link
Those interested in becoming <b>PV installer</b>	North American Board of Certified Energy Practitioners (NABCEP)	Offers certification for energy practitioners	<a href="http://www.nabcep.org/">www.nabcep.org/</a>
Those interested in running a <b>PV installation business</b> (PV contractor)	California State Licensing Board (CSLB)	Issues contracting licenses	<a href="http://www.cslb.ca.gov/">www.cslb.ca.gov/</a>
<b>General solar information</b> for California	Go Solar California! – Industry Information	Information for builders, developers and installers	<a href="http://www.gosolarcalifornia.org/industry/index.html">www.gosolarcalifornia.org/industry/index.html</a>

# Your Thoughts

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- Suggestions for future content?
- Opinions on content and delivery?
- Topics to emphasize or de-emphasize?
- How can we provide a better service?



**Feedback is welcomed!**

**[mgh9@pge.com](mailto:mgh9@pge.com)**

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# Questions?

Matt Heling

(415) 973-6996

[mgh9@pge.com](mailto:mgh9@pge.com)

# Solar Contracting – Licensing Requirements

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- CSLB
- Getting listed as a CSI approved solar contractor