Keys to Successful Solar Water Heating Programs

World Renewable Energy Forum 2012
Denver, CO
• Mission: To facilitate successful launch and implementation of utility solar water heating programs
414 Members

FY '12
24 New members so far

238 Industry
174 Solar Businesses
64 Industry Support

109 Utility
48 IOU's
44 Muni's
15 Coop's

8 Environmental

59 Government
18 DOE, NREL, Other
41 State, Local

New members so far
Services

- Utility Support
- Advocacy for solar thermal initiatives
- Networking and information exchange
  - Monthly teleconference
- Education and Outreach
  - Website: [www1.eere.energy.gov/buildings/ush2o](http://www1.eere.energy.gov/buildings/ush2o)
• USH₂O Forum: Keys to Successful Solar Water Heating Programs
  – California Solar Initiative Thermal Program
    • Jordan DiGiorgio, California Center for Sustainable Energy
    • Jeff Curry, Lakeland Electric
  – MassCEC Commonwealth Solar Hot Water Incentive Programs
    • Christie Howe, Massachusetts Clean Energy Center
  – The Role of Testing & Certification in Successful SWH Programs
    • Mark Thornbloom, Kelelo Engineering
    • Laurent Meillon, Capitol Solar
California Solar Initiative Thermal Program
Jordan DiGiorgio, Program Manager
California Center for Sustainable Energy
CSI-Thermal Program

$280,800,000 Incentive Budget:

- $180,000,000 for natural gas displacing SWH systems
- Up to $100,800,000 for electric and propane displacing SWH systems
- 40% of the total incentive budget is reserved for single-family residential customer SWH systems
- 60% of the total incentive budget is reserved for commercial or multifamily SWH systems.
Eligibility

- Domestic Hot Water (DHW) end uses are eligible:
  - Water used for domestic purposes (but not including space heating, space cooling, or swimming pool heating):
    - drinking, food preparation, sanitation and personal hygiene

- Currently expanding the program to “other” thermal technologies:
  - Space Heating
  - Space Cooling
  - Process Heat
  - Adsorption/Absorption Chillers
## Incentive Structure

### Natural Gas Incentives

<table>
<thead>
<tr>
<th>Step</th>
<th>Customer Class</th>
<th>$/therm Displaced</th>
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### Electric/Propane Incentives

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<th>$/kWh Displaced</th>
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</table>
Residential Application Volume

2010: $127,263
2011: $241,876
2012: $61,865

Incentives Paid
Apps Received
Commercial/ Multifamily Application Volume

*Note: MF/C Program began October 2010
Incentive Averages- Single Family Residential

<table>
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<tr>
<th>Energy Type</th>
<th>Average Incentive</th>
<th>Project Cost</th>
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<tr>
<td>Natural Gas</td>
<td>$8,791</td>
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<td>Electric/Propane</td>
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## Incentive Averages - Multi-Family/Commercial

<table>
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<th>Natural Gas</th>
<th>Project Cost</th>
<th>Average Incentive</th>
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<td>$23,901</td>
<td>$76,463</td>
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*Note: Currently no MF/C Electric or Propane projects have received incentives*
Commercial/ MF Distribution

- Apartments/Condos
- Coin-Op Laundries
- Junior High Schools
- Meal Service Restaurant
- Men's Dormitories
- Office Building without showers
- Office Buildings

www.energycenter.org
Next Developments

• Low-Income Rebate Program
  • $25M Budget
  • Offers higher rebates for qualifying low-income properties
  • Single-family rebates are 200% of regular CSI-T rebates
  • Multifamily rebates are 150% of regular CSI-T rebates

• Program Expansion to allow other thermal technologies:
  • Space Heating
  • Space Cooling
  • Process Heat
  • Adsorption/Absorption Chillers

• Launch of Statewide Marketing Campaign (April 16, 2012)!
Contact Information

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Program Manager,
Solar Water Heating Programs
California Center for Sustainable Energy
415.517.6826
jordan.digiorgio@energycenter.org

www.energycenter.org/swh
www.csithermal.com

Point Loma Nazarene University, San Diego, CA
Source: Adroit Solar

Accrediting SHW as Conventional Energy

Jeff Curry
Lakeland Electric
May 17, 2012
The Task at Hand...

• Marketing & selling btu’s ?
• Accurate metering available ?
• Monetizing solar thermal honestly ?

• Justifying SHW energy as a utility service
  …is solar thermal “worthy” of this status?

• If yes… can SHW energy be adopted into S.U.P. ?
Solar Industry Practices

- Economic justification
- Meet licensing & permitting requirements
- Financing
- Technical selections
- Product ratings & certifications (SRCC)
- Field surveys & installations
- Whole system warranty
- New customer procurement
- Business plan is based on short term goals
Utility Sector Conventions

- High market penetration
- Meter reading
- Billing & Collections
- Rate Impact
- PPA’s
- Outsource Selection Processes
- Vendor Decorum
- Risk Management
- Standards & regulations
- Business plan is based on long term goals
Use Existing Utility Processes: Don’t Reinvent Anything

Cloning key elements:

• Express energy in kWh (not btu)
• Research *District Heating & Cooling* programs
• Plagiarize existing metering & billing practices
• Use PPA mechanism as a template
• Mimic utility “Tree Trimmer” contractor provisions
• Exploit customer service training programs
Lakeland Electric Solar Business Model

Participants

Non-ownership Agreement

Lakeland Electric

Retail Energy Sale

Wholesale PPA (W/SRECs)

Basic & manageable

Solar Investment Co.
Just Reassembling Old Components Into a New Creature

Any Questions?

MassCEC Divisions:
- Investments in Clean Technology
- Market Development Support
- Renewable Energy Generation
- Advance Clean Energy Technology
- Create Jobs
- Develop a Trained Workforce
- Accelerate Deployment of Clean Energy
Commonwealth Solar Hot Water Pilot Programs

- Program Objectives:
  - Collect system, market and performance data on SHW systems
  - Create a well-qualified installer base
  - Create a well-educated inspector base
  - Build market momentum and the supply chain
  - Establish long term program based on assessment of the MA solar thermal market through pilot program
Commonwealth Solar Hot Water Programs

- Three one-year pilot programs: [www.masscec.com/solarhotwater](http://www.masscec.com/solarhotwater)
  - Residential
  - Low Income
  - Commercial
- No pre-approved contractor list
  - First 2 systems must go through Design Review and Inspection
- MassCEC funding is in addition to any other available funding
- Plumbing inspector and contractor trainings
CSHW Residential Pilot Program

- $1 million budget
- Residential SHW systems (1-4 units)
  - Domestic Water and/or Space Heating
  - Displace ANY fuel type
  - No pool heating
- Rebate
  - Based on performance of collectors and # of collectors installed
  - Typically covers 13-15% of total costs
  - Capped at $3500 or 25% of total installed costs (avg rebate = $1,300)
  - Additional funding for MA manufactured components and homes affected by a natural disaster
Low-Income Solar Thermal Program

- $2 million budget
- Managed by Low-Income Energy Affordability Network (LEAN)

- Multi-family residential & nonprofit facilities serving low income residents and participants
- Program Goals:
  1. Reduce energy operating costs for owners and occupants of facilities serving low-income clientele
  2. Educate the installer industry and build the supply chain
  3. Improve bid consistency & competitiveness
  4. Identify SHW project cost reductions
CSHW Commercial Pilot Program

- $1 million budget
- For any commercial-scale or multi-family building (> 4 units)
- Two main phases of funding
  1. Pre-Design Study Grants
     - Help building owners assess the potential benefits of installing a solar thermal system
     - $350,000 allocated, up to $10,000/project
  2. Construction Rebates
     - Help system owners with the upfront capital costs of installing the solar thermal system
     - $600,000 allocated, up to $25,000 for private and $30,000 for public
- Performance Monitoring is required on all systems
Program Results (as of 4/6/2012)

- Awarded 240 systems ~$500,000 in rebates
  - >20,000 sq ft in collectors
  - >$3.2 mil in total project costs
  - >55 installers
  - >100 systems using MA manuf components

- Fully funded 16 large-scale systems (low-income)
  - 16,784 sq ft in collectors
  - >$1.6 mil in total project costs

System Type:
- 83% DHW
- 17% Combi

Collector Type:
- 87% Flat Plate
- <1% Evacuated Tube

Fuel Type:
- 38% Electric
- 24% Propane
- 17% Nat Gas
- 1% Oil
- 20% Other

(Charts and graphs are included to visually represent the data.)
Keys to Success

Step 1: Proper Design
- Meter Hot Water Load
- Conduct Site Assessment
- Conduct Structural Assessment

Step 2: Bidding & Contract
- Create Design Guidelines
- Efficiency & Warranty driven material specs
- Standardized bid proposal form

Step 3: Construction
- Construction Management
- Incentive Procurement
- Weekly Updates

Step 4: Performance Monitoring
- Initial Troubleshooting
- Ongoing validation
- 12 month data collection
Performance Monitoring Program

- MassCEC contributed $500-$1,500 for performance monitoring equipment
  - 40 Residential Systems
  - >20 Commercial and Low Income Systems

- Program Goals:
  - Understand actual system performance of a diverse array of systems in MA
  - Identify appropriate methods, equipment and installation practices for accurate monitoring of solar thermal production and use
  - Improve system performance (and therefore ROI) with continuous monitoring
  - Compare actual energy production with predicted energy production (SRCC and energy models)

- All project performance is internet accessible in real time
Performance Monitoring Interim Results

*Interim results collected over winter, lowest resource

Residential:
- 83% of predicted
- Typical range of 70% to 110%
- Easier monitoring installation
- Greater variability in production

Commercial:
- 94% of predicted
- Less variability in production across projects
- More complex installation
Common Performance Monitoring Issues

- Temperature sensors not wrapped
- Flow meters not correctly grounded
- Online setup only partially completed
- Internet access can be intermittent
- Installation uncertainties can supersede sensor uncertainty, so installation guidelines must be included in any “Standard” being developed
Ongoing Performance Evaluation

1. What equipment is performing best?
2. What other system parameters effect system performance?
4. How can we keep the systems performing over the long-term with continuous monitoring?
5. Does modeling or SRCC estimation accurately correspond with typical production?
6. What technical and installation hurdles exist for performance based incentives or SRECs?
Next Steps

- **Performance Monitoring:**
  - Continue collecting & validating data (12 months/system)
  - Release interim PM report fall 2012
- **Encourage other financing mechanisms**
- **Continue building contractor and inspector SHW expertise**
- **Expand support for renewable thermal**
  - MA Renewable Heating and Cooling: Opportunities and Impacts Study
  - Development of full scale CSHW Program
  - Considering pilot incentive programs for biomass thermal & high efficiency heat pumps
Thank you!

- Visit our website: [www.masscec.com/solarhotwater](http://www.masscec.com/solarhotwater)
- Sign up for our email distribution list
- Contact us at [solarhotwater@masscec.com](mailto:solarhotwater@masscec.com)
SWH Recent Growth

2009: 214,506 m² (+13%)
2010 est: 189,500 m² (-11% predicted)
2010 final: 225,375 m² (+5%)

Source: SEIA/GTM
Solar DHW: History in U.S.

1974 – 2000’s: glazed flat plate collectors
2000’s – today: flat plate, evac. tubes
Lesson Learned:
No certifications = No Rules

- No consistency of system design
- No comparability of system energy production
- No quality standards or adherence to codes
- No oversight of component substitution
“Without certification, the Lakeland program wouldn’t have happened.”
- Jeff Curry

- **Without certification:**
  - Collector performance unknown; accurate comparison impossible
  - “Buyer beware”; Common errors repeated; no best practices, lessons learned
  - No consistent basis for incentive calculation

- **With certification:**
  - Collector testing & rating standardized, independent; “apples to apples”
  - System design criteria established; consistent & thorough design review
  - System performance modeled by location
• National certification & rating program
• Independent, third-party non-profit entity
• Provide stakeholders with performance listing of inherently reliable products
• Certify solar hot water & pool collectors and systems
Early History

- 1970’s - State certification programs
- 1980 - SRCC established
- 1984 – End of US federal tax credit
- 1990 – SRCC begins work on OG-300
- 1992 – OG-300 implemented
- 1992 to 2005 – SRCC certification required for a few incentive programs
Recent History

- 2005 - US ITC federal tax credit reinstated
- 2006 - ‘exponential’ industry growth begins
- 2009 - ITC extended, CA AB1470, Energy Star lists SWH
- 2010 - Collector testing backlog resolved
- 2011 - System cert backlog resolved
Status:
No backlog, Lots of choice

Qtr: 2Q10  1Q12
- OG100: >350   >950
- OG300: >850   >2000
- Participants: >120   >200
- Test Labs: 14   18
Benefits to Stakeholders

Solar equipment manufacturers benefits:

1. the ability to have a product certified only once;

2. national recognition and/or reciprocity of the certification;

3. a reliable means for judging product durability and performance on a relative standard basis.
Benefits to Stakeholders

The solar contractor benefits:

1. certification provides product credibility;
2. provides one with a standard of comparison to be used in sales literature;
3. provides a defense against unethical competition and false claims.
Benefits to Stakeholders

The solar consumer benefits:

1. a measurement of quality;
2. a measurement of performance;
3. third-party independent corroboration;
4. A standardized method to compare solar equipment and thereby determine the “best buy”.

Benefits to Stakeholders

The utility and government entities benefit:

1. a rational basis for tax credit qualifying regulation & incentive calculation;
2. a basis for setting codes and standards;
3. A variety of documents & services are provided for program managers who are implementing solar energy programs.
Thank You!
The Colorado Solar Thermal Roadmap

Realizing the Economic & Business Opportunity Ahead
STAC’s *Colorado Solar Thermal Roadmap* was unveiled in Denver on January 24, 2012.

Available online:

www.coseia.org/insights/thermal.html

www.cres-energy.org/pubs/solarthermalroadmap.pdf
What is STAC?

- Founders (pg. ii of Roadmap)
  - RJ Harrington, Policy Director, COSEIA
  - Ron Horstman, President, RWH Ventures, Inc
  - Neal Lurie, Executive Director, COSEIA
  - Laurent Meillon, Director, Capitol Solar Energy, LLC
  - Leslie Martel Baer, Energy Intersections
  - Becky English, Principal, Rebecca English and Associates
  - Leslie Glustrom, Director of Research and Policy, Clean Energy Action
  - Tony Frank, Executive Director, CRES
  - Ron Larson, Founder, CRES
  - Charlie Montgomery, Energy Organizer, Colorado Environmental Coalition
  - Mike Wilson, Energy Consultant, Earth Energy Solutions

- Stakeholders (pg. 22)

- Process
For those of us invested in preserving the planet for our children and grandchildren, the mission is clear: We must continue to prove that green energy is America's greatest job creator of the 21st century. Since 2003, this sector has added jobs twice as quickly - and at a higher median wage - than other fields. And the private and public sector have the opportunity to bolster this growth further by collaborating to drive down costs, eliminate barriers to innovation, and provide creative financing structures to expand solar market.

—President Bill Clinton
Letter to COSEIA
February 7, 2012
Colorado Governor’s Energy Office applied for an NREL Technology Assistance Program (TAP) Grant to STAC.

NREL Validated the conversion (pg. 9):
- 0.7 kW\text{th} capacity per square meter of solar thermal panel in Colorado
- 1,298 kWh\text{th} annual energy consumption offset per 1 kW\text{th} capacity of solar thermal
Identifying the Opportunity

U.S. Solar water heating performance in kWh/year (energy saved using a glycol solar system with a selective surface collector; pg 1).

Source: Danny Parker, Florida Solar Energy Center
Other Opportunities

- Thermally driven cooling and other cooling methods (pg. 3, 18)
- Biochar: a complementary technology (pg. 3)
- Economies of scale, equipment cost reductions (pg. 17)
- New technologies such as PV/ST combined system (below left)
- Thermally driven electric power production
The map and computations are conservative and NREL vetted

The opportunity for ST is large—both from an energy perspective and economic perspective

There is plenty of room for ST growth in many applications, both in Colorado and abroad
2008 total solar hot water/heating capacity added by the top 10 countries: 28 GW\textsubscript{th} (pg. 4). Source: REN21
Jobs Across the Value Chain

- Research & Development
- Engineering
- Manufacturing
- System Design
- Installation
- Business Management & Executives
- Indirect Jobs
Industry Veterans on ST Training

- New entrants need rigorous training and certification
- Mathematics and physics really do matter
- The industry must figure out how to fund this training and education
- We need to transfer knowledge
- State could alter insurance rules to support more on-site training
More Than Gas: Energy Sources for Heat

Fuels used in Colorado to heat water and building space in 2009. Source: EIA
Working with Existing Programs

- Renewable Energy Standard: Sect. 124
- Public Utilities Commission: Sect. 123
- Demand Side management Program
  - Not Working !!!
- GEO & ARRA Programs
  - Great Start
  - Too short to cause market transformation
Innovative Policies

- Stand-alone thermal standard
- Inclusive Renewable Energy Standard
- Building codes, net-zero homes
- State target with tax credits, rebates
- Free-market systems such as FITs… (remove uncertainty & red tape)
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<th>Year</th>
<th>Annual Installed Capacity (MW$_{th}$)</th>
<th>Total Solar Thermal Installed Capacity (MW$_{th}$)</th>
<th>Annual Revenue</th>
<th>Total Jobs</th>
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<td>2010</td>
<td>5</td>
<td>150</td>
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The Advantages

- >50% of buildings’ energy
- Easy retrofit
- 5–30 yr payoff (coal = 60 yr)
- Stores energy on-site
- New apps: cooling, electricity
- Cost reduction innovations
- CSP power plants
- Free, eternal fuel
- Clean fuel, no external costs
- Local; improves import-export
- 2/3rd local labor content

The Obstacles

- Lack of consumer awareness
- Lack of financing mechanism
- Glaring state policy gap
- Zoning & permitting red-tape
- Newly-accessible cheap natural gas

11 advantages clearly outweigh 5 obstacles!
We need a stable business environment!

A shared need across all Energy Decision Makers - renewable and traditional, big and small

“With the current ARRA / GEO solar thermal program, I should be investing $100,000 in marketing and staff training right now. We’d be fools to do that with incentives ending in a few months”

— Bruce Padgett, Founder, Capitol Solar Energy

I build power plants that last 40 years. I need as much clarity as possible about what the rules are going to be. The clearer the roadmap, the better able I am to make good decisions that will still be good a decade from now, or three decades from now.

— CEO, Duke Energy
Questions & Answers

Laurent Meillon, Part-owner, Capitol Solar Energy LLC
COSEIA Treasurer, Board Member, CRES Policy Committee Member
Tel: (303) 623 2542    Email: Laurent@capitolSolarEnergy.com

Find the Roadmap online:
www.coseia.org/insights/thermal.html
www.cres-energy.org/pubs/solarthermalroadmap.pdf