

SunCache ICAT Project

June 2008 to March 2011

ARB Seminar: March 9, 2011



SunCache ICAT Project

- From RFP:

“The Innovative Clean Air Technologies (ICAT) grant program supports demonstration projects for innovative air-pollution-control technologies. The objective is to advance such technologies toward commercial application in California. ICAT seeks technologies that are not yet marketed but are substantially ready for practical demonstrations of their utility for reducing emissions in California. ICAT funds pilot demonstrations, the construction and deployment of prototypes, and practical demonstrations of technologies with the potential to be commercialized.”

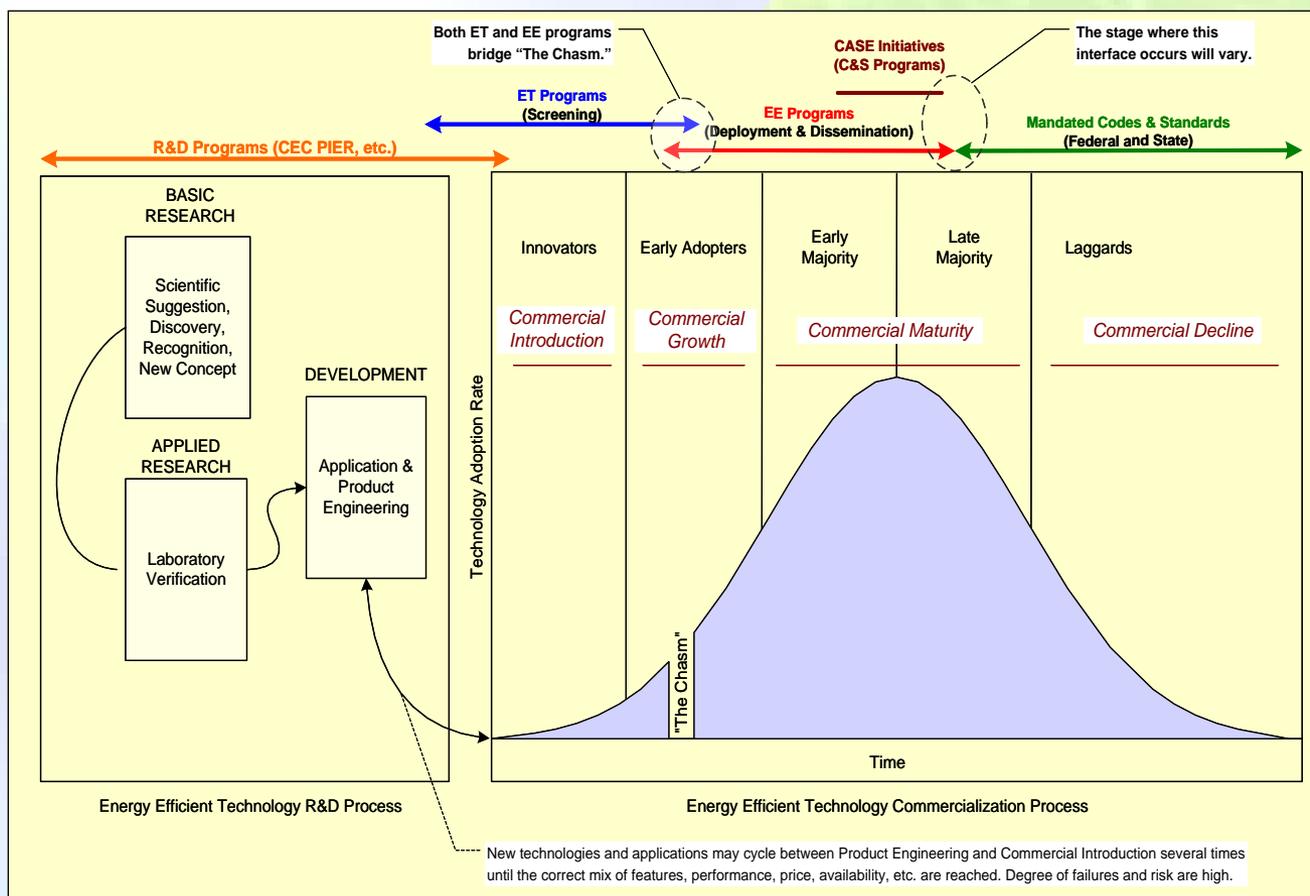


SunCache ICAT Project

• Project Goals

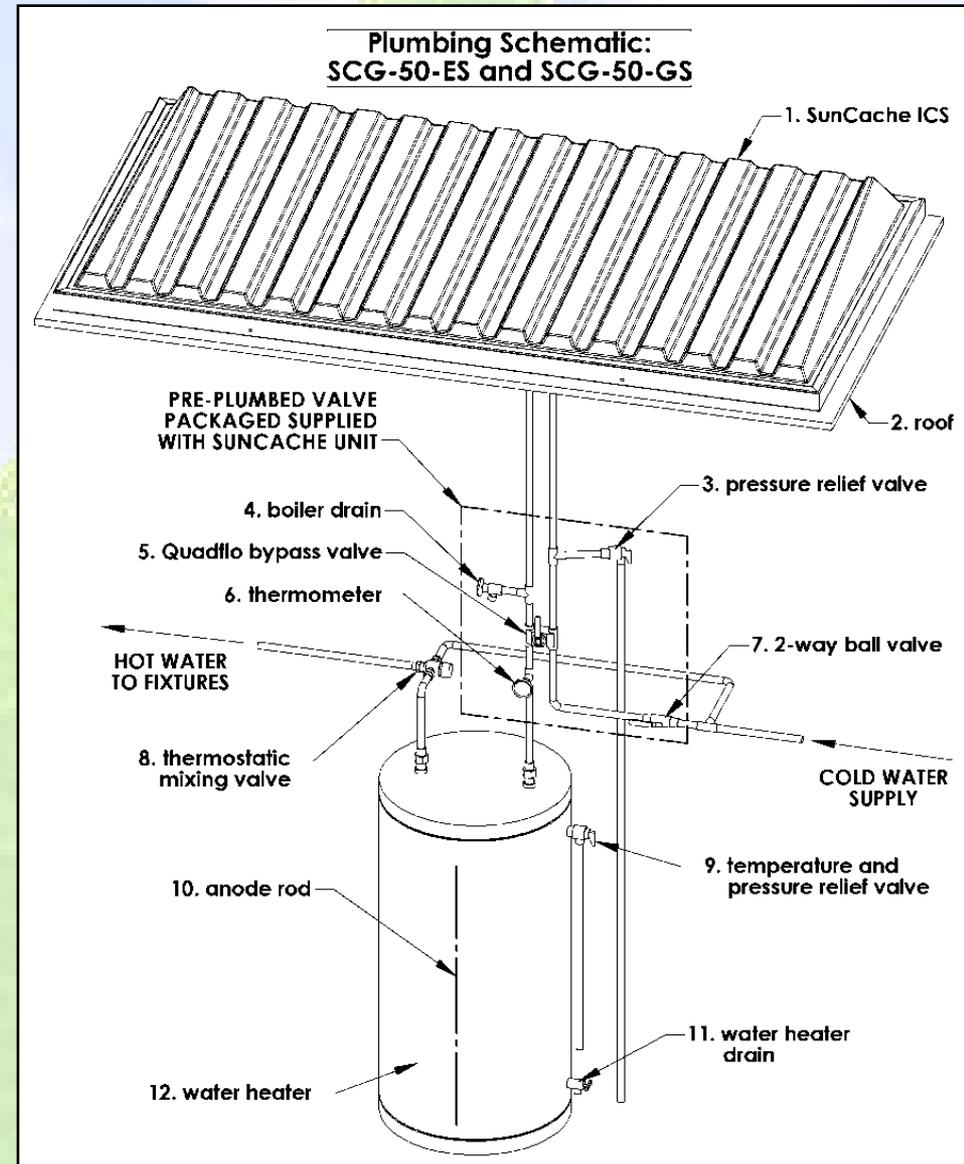
- Full-scale (80-unit) field demonstration of technology previously shown to have strong potential

- Assess real-world performance with precision field monitoring
- Encourage commercialization of an innovative technology

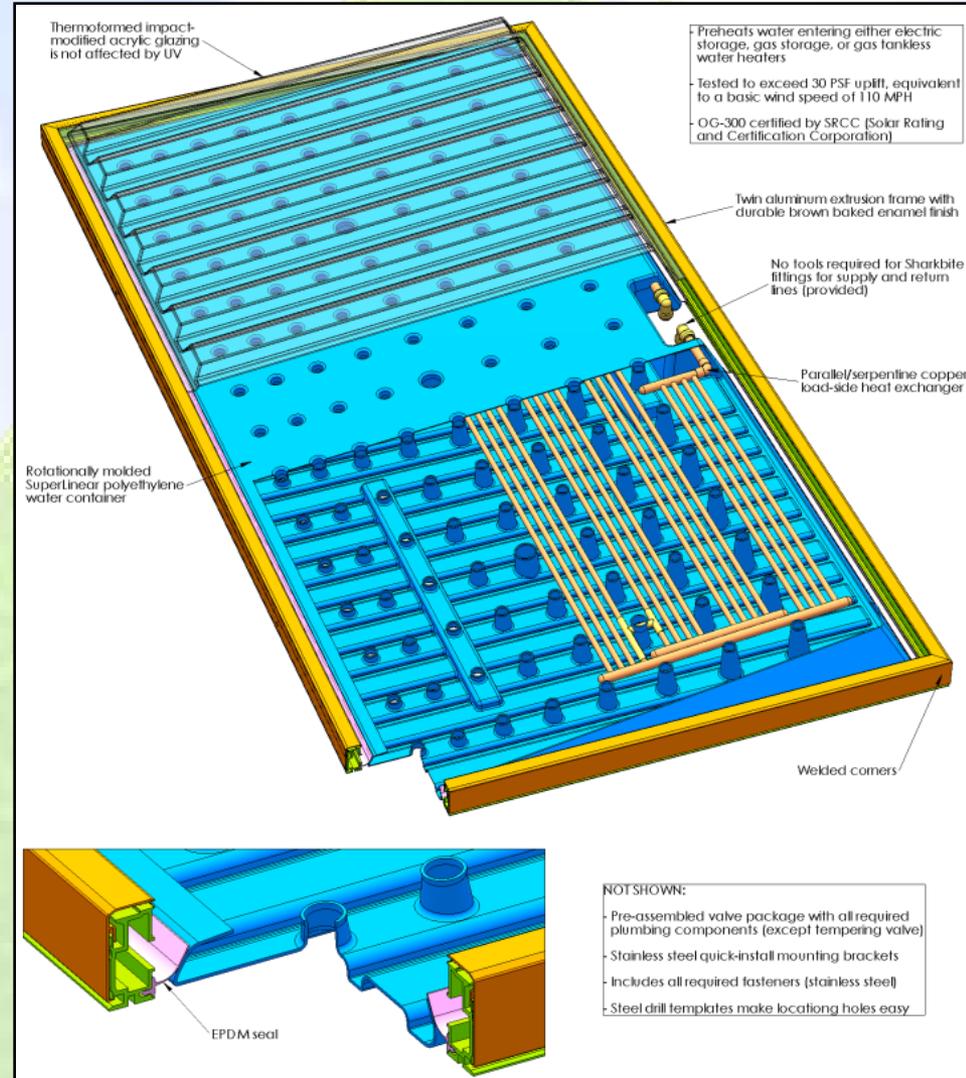


What is SunCache?

- Low cost, all-in-one, passive solar water heating (SWH) system
- Uses polymer materials extensively to reduce cost and weight
- 50 gallons of thermal storage integrated into plastic collector
- Developed by Davis Energy Group from 1999 to 2009
- \$2M total R&D budget
- \$1.5M from DOE/NREL



What is SunCache?



SunCache Advantages

- Lowest cost SWH system
- Easiest installation
 - Template set for fast, trouble-free install
 - Certified with PEX pipe
- Industry-leading maintenance interval
- Industry-leading warranty
- Excellent freeze resistance for a passive system



Davis Energy Group

- **Consulting**
 - Design Assistance/Review
 - Green Consulting
 - Title 24 Energy modeling
- **Verification**
 - LEED for Homes
 - GreenPoint Rated
 - Builders Challenge
 - HERS Testing
 - Energy Star
 - Enterprise Communities
- **Technology Evaluation**
 - Monitoring
 - Analysis
 - Emerging Technology Assessment
 - Codes & Standards
- **Programs**
 - Building America
 - Large Scale Residential Retrofit
 - Better Buildings
- **Product Commercialization**
 - Development
 - Licensing
 - Marketing & Sales
 - Distribution

Other Team Members

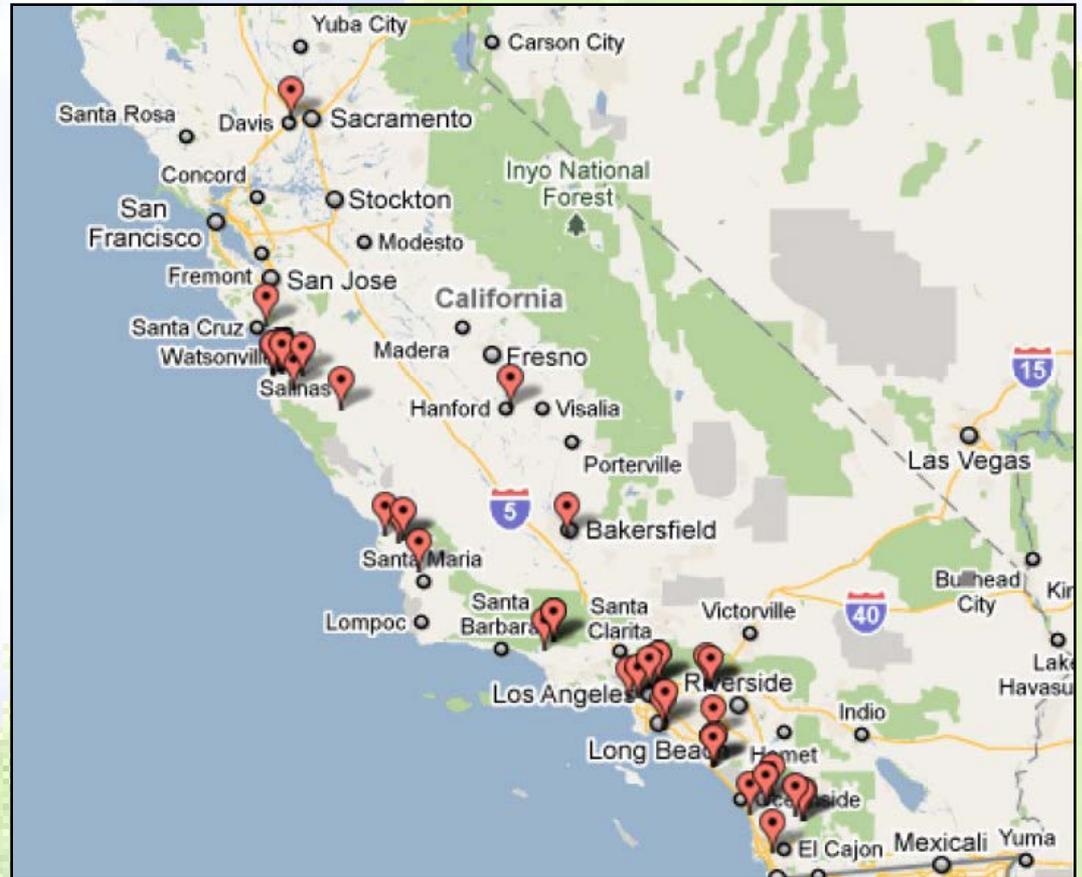
- Harpiris Energy
 - Manufactured SunCache under license from DEG
 - Firm established specifically to satisfy ICAT project
- Sempra Energy
 - SCG and SDG&E participated through the Sempra Emerging Technology program
 - Hired Information & Energy Services, Inc. for field monitoring sub-project
- Installation Contractors
 - 19 participated in ICAT program
- Property Owners
 - Received free equipment but paid for installation
 - 36 homeowners
 - 1 church
 - 1 low-income housing org
 - 1 large-scale apartment landholder

Tasklist

Task	Description	Performed By
1. Recruit Sites	Recruit field test sites for 80 SunCache ICS collectors, with a goal of 20-40 collectors installed on one or more multi-unit sites	DEG
2. Train Installers	On-site training of at least 4 installation firms in Southern California	DEG
3. Fabricate Prototypes	Prepare pilot production facility and fabricate 80 production-spec SunCache ICS systems, ship to field sites	Harpiris Energy
4. Installation	Install 80 SunCache collectors on single family and multi-unit residential buildings, obtain building permits	Various installation firms with support from DEG
5. Monitoring	Monitor 8 SunCache systems: 6 SFH and 2 multi-unit	Energy & Information Services, Inc. (SCG/SDGE subcontractor)
6. Analyze and Report	Analyze field data, draw conclusions, draft final report	DEG

Task 1: Recruit Sites

- Press release
- Word-of-mouth
- Google AdWords campaign
- Craigslist
- Multi-unit focus



Task 2: Train Installers

- 19 separate firms participated
 - Old-school solar thermal installers
 - Residential plumbers
 - Home energy contractors
 - Commercial plumbers
 - Plus a few DIYs



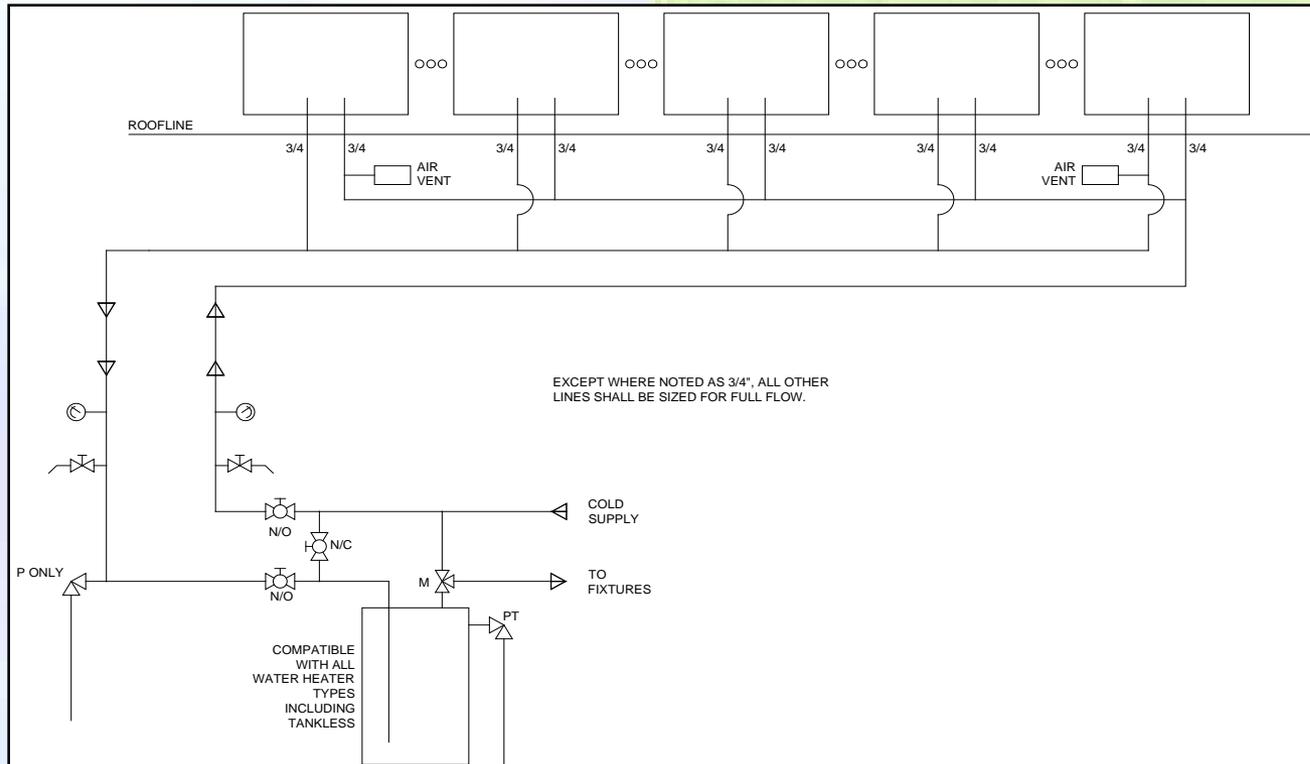
Task 3: Fabricate Prototypes

- 6/23/2008: Harpiris Energy LLC formed
- 6/24/2008: DEG-Harpiris SunCache license agreement signed
- 6/25/2008: DEG signs ARB ICAT contract
- 10/1/2008: Harpiris begins sub-leasing at SunOptics in Sacramento, SunCache production begins
- 8/5/2009: Harpiris signs solar tank R&D grant contract with CEC
- 10/1/2009: Harpiris production moves to Salinas



Task 4: Installation

- 9/25/2008: First ICAT SunCache install in Davis
- 3/11/2010: 40 unit ICAT MF install in Hanford
- 5/11/2010: 80th ICAT SunCache install in Salinas

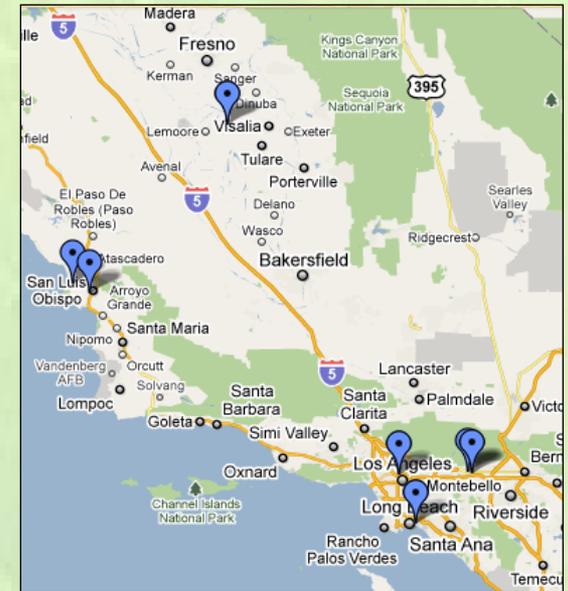
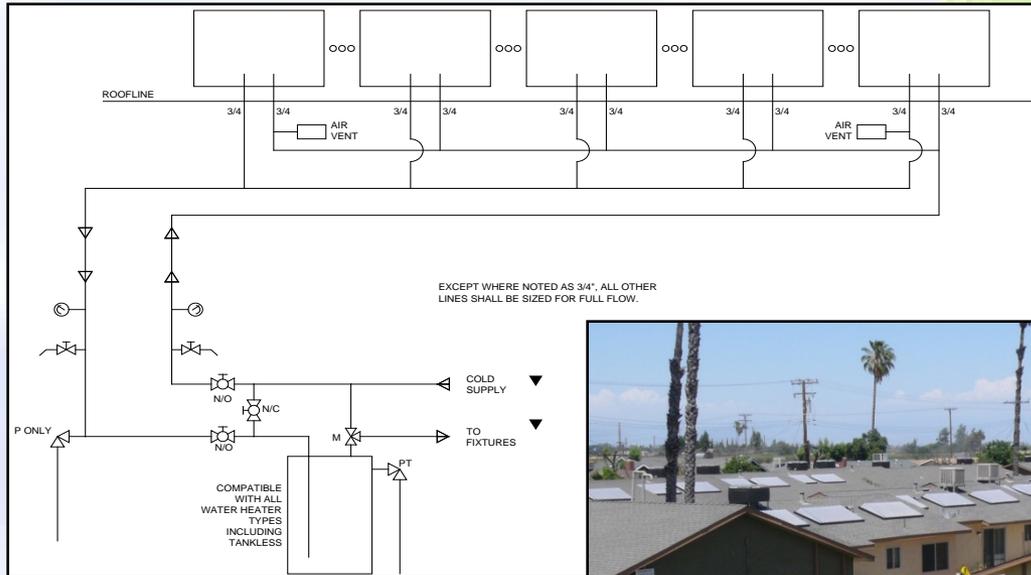


Task 5: Monitoring

• Site selection

- Mix of SFH and multi-family
- Streamlined sites for economy
- Detailed sites include backup use
- Over budget, but Sempra came through big

#	City	Type	Number of Occupants	Measurement Scheme	Commissioning Date
1	Los Osos	Single Family Residence	4	Streamlined	5/27/10 11:00 AM
2	San Luis Obispo	Single Family Residence	2	Streamlined	5/27/10 3:30 PM
3	Claremont	Single Family Residence	2	Streamlined	6/2/10 2:00 PM
4	Claremont	Single Family Residence	3	Detailed	6/2/10 7:00 PM
5	Long Beach	Single Family Residence	2	Streamlined	6/10/10 11:30 AM
6	Los Angeles	Single Family Residence	3	Streamlined	6/14/10 11:00 AM
7	Hanford	Multi-Family Residence	Unknown	Detailed	8/18/10 4:00 PM
8	Hanford	Multi-Family Residence	Unknown	Streamlined	6/7/10 9:00 PM



Results

- Lower than expected

- Early field testing:
 - 68-73 therms/year

- SRCC projections:
 - 55-60 therms/year
 - Based on 64.3 gal/day

- ICAT savings:
 - 18-40 therms/year
 - 26-53 gal/day

- Less affected by geography than by HW usage

Monthly Natural Gas Savings by Site (therms)										
Month	# days	Hanford 1300	Hanford 1295	Claremont	Los Osos	San Luis Obispo	Long Beach	Los Angeles	SF AVERAGE	MF AVERAGE
June-10	varies	n/a	101.7	2.6	2.3	2.2	2.2	3.9	2.6	101.7
July-10	31	n/a	127.4	2.9	1.9	2.0	2.5	5.5	3.0	127.4
August-10	31	38.3	142.4	1.9	2.2	1.7	3.3	6.2	3.0	142.4
September-10	30	88.3	106.3	2.2	1.5	1.8	3.5	1.7	2.2	106.3
October-10	31	52.4	74.4	1.2	0.7	1.2	3.0	2.4	1.7	74.4
November-10	30	26.7	32.1	0.8	4.1	0.9	3.8	1.3	2.2	32.1
December-10	31	9.0	11.9	0.8	2.5	0.5	4.0	0.5	1.6	11.9
January-11	31	4.4	6.9	0.9	5.4	1.6	4.4	1.9	2.8	6.9
		36.5	75.4	1.7	2.6	1.5	3.3	2.9	2.4	75.4

Monthly Hot Water Consumption by Site (gallons)									
Month	# days	Hanford 1300	Hanford 1295	Claremont	Los Osos	San Luis Obispo	Long Beach	Los Angeles	AVERAGE
June-10	varies	n/a	31388.1	727.6	815.8	1099.3	682.8	1117.1	5,972
July-10	31	n/a	33207.0	840.2	853.6	1091.0	908.1	1529.2	6,405
August-10	31	17079.0	40928.1	574.7	884.8	827.4	1037.6	1889.5	9,032
September-10	30	40062.0	37429.0	758.7	586.8	876.5	1126.9	724.1	11,652
October-10	31	39118.0	48366.0	836.3	700.4	1018.9	1092.9	1989.2	13,303
November-10	30	51353.0	54731.0	831.4	2746.4	935.3	1310.1	1707.4	16,231
December-10	31	52132.0	55150.0	947.1	2697.5	962.3	1479.2	1771.8	16,449
January-11	31	56634.0	69076.0	921.2	3076.1	1318.0	1541.2	2231.3	19,257
		42,730	46,284	805	1,545	1,016	1,147	1,620	12,287

Unit Cost & Payback by Site (therms)							
Month	Multi Family Combined	Claremont	Los Osos	San Luis Obispo	Long Beach	Los Angeles	SF AVERAGE
Avg. Monthly Therms NG Saved	111.9	1.7	2.6	1.5	3.3	2.9	2.4
Estimated unit Cost		\$ 1,800	\$ 1,800	\$ 1,800	\$ 1,800	\$ 1,800	\$ 1,800.00
Estimated Installation Cost		\$ 3,299	\$ 1,653	\$ 1,825	\$ 1,500	\$ 1,000	\$ 1,855.46
Total Estimated Cost	\$ 37,700	\$ 5,099	\$ 3,453	\$ 3,625	\$ 3,300	\$ 2,800	\$ 3,655.46
Annual Est. Therms NG Saved	1343	20	31	18	40	35	28.7
Annual Est. \$ Saved	\$ 1,345	\$ 21	\$ 32	\$ 19	\$ 41	\$ 36	30.0
Simple Payback (years)	28.0	241.4	107.3	190.2	80.0	77.0	139.2

Emissions Reductions

	Hanford 1300	Hanford 1295	Claremont	Los Osos	San Luis Obispo	Long Beach	Los Angeles	SFH Average	Conversion Factor
NG Savings	36.5	75.4	1.7	2.6	1.5	3.3	2.9	2.4	N/A
CO2 Equivalent Reduction	87.86	181.49	4.09	6.26	3.61	7.94	6.98	5.78	2.407 lbCO2E/therm
CO Reduction	0.142	0.293	0.007	0.010	0.006	0.013	0.011	0.009	0.00388 lb/therm
NOx Reduction	0.333	0.688	0.016	0.024	0.014	0.030	0.026	0.022	0.00912 lb/therm
SOx Reduction	0.00212	0.00439	0.00010	0.00015	0.00009	0.00019	0.00017	0.00014	0.0000582 lb/therm
TOG Reduction	0.0391	0.0807	0.0018	0.0028	0.0016	0.0035	0.0031	0.0026	0.00107 lb/therm
Particulate Reduction	0.0270	0.0558	0.0013	0.0019	0.0011	0.0024	0.0021	0.0018	0.00074 lb/therm

Monthly CO2e Reduction by Site (pounds)								
Month	# days	Hanford 1300	Hanford 1295	Claremont	Los Osos	San Luis Obispo	Long Beach	Los Angeles
June-10	varies	n/a	1190.2	30.0	27.2	25.7	25.2	45.5
July-10	31	n/a	1491.1	33.9	22.0	23.4	29.4	64.3
August-10	31	448.3	1665.8	21.7	25.9	19.8	38.4	72.2
September-10	30	1033.6	1243.8	25.5	17.4	21.6	41.2	20.3
October-10	31	613.5	871.0	14.6	8.7	13.8	34.6	27.6
November-10	30	312.3	375.5	9.8	47.5	10.1	44.2	15.7
December-10	31	105.3	139.6	8.8	28.7	5.4	46.7	6.0
January-11	31	52.0	81.0	10.3	63.5	18.5	51.6	22.1
AVERAGE		687.4			28.0			

- Emissions factors provided by ARB

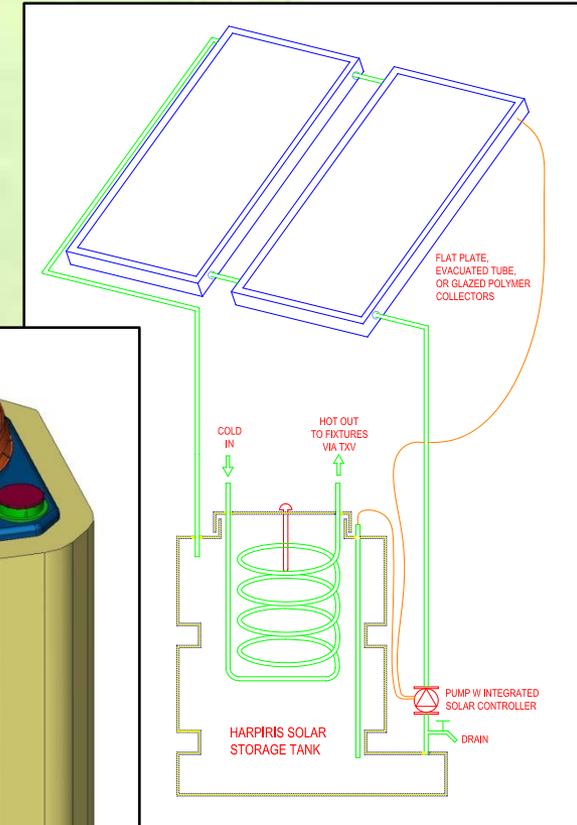
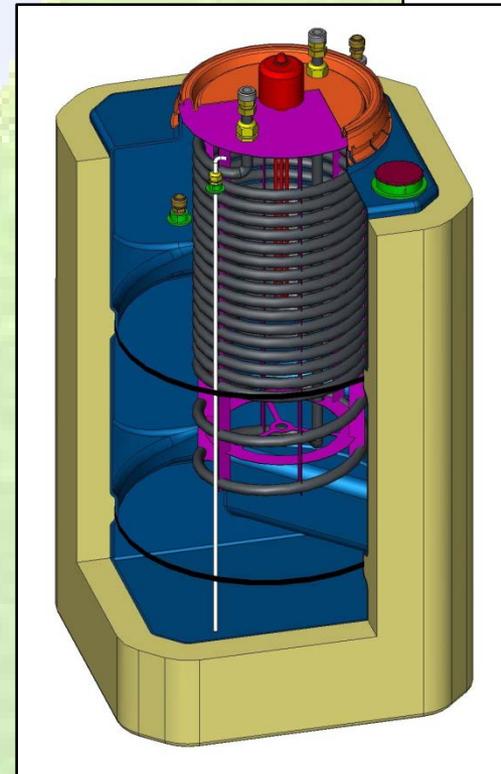
SunCache Production Ceases

- Mid-2009: Harpiris Energy ends SunCache production
- Disappointing sales
- Low performance
- Strong competition
- Production problems

What's Next: Harpiris Solar Storage Tank

- 125 gallon rotationally molded polyethylene tank with 75' stainless steel heat exchanger for potable water
 - Corrosion-free
 - Innovative shape
 - 3" thick PUR foam with R value >20
 - Works with all solar thermal collectors
 - Flat plate, evacuated tube, glazed polymer
- Optional pre-installed Taco solar pump
 - Pump has integrated solar controller
 - Just add collectors, connect to potable system, and plug in pump

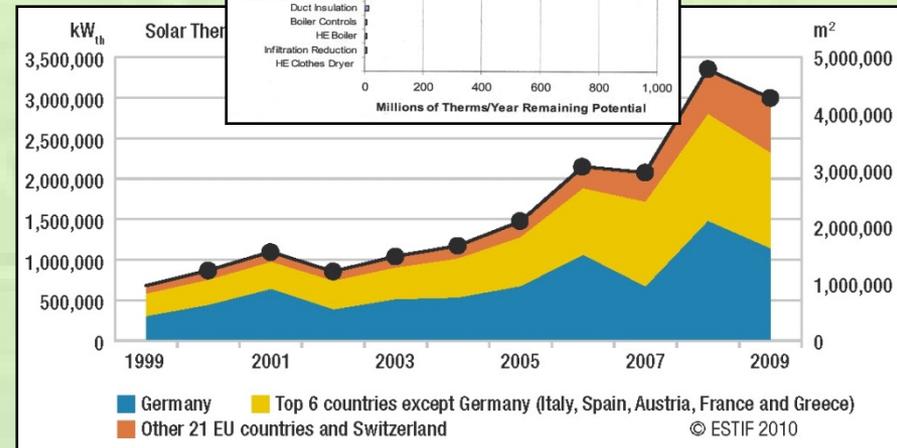
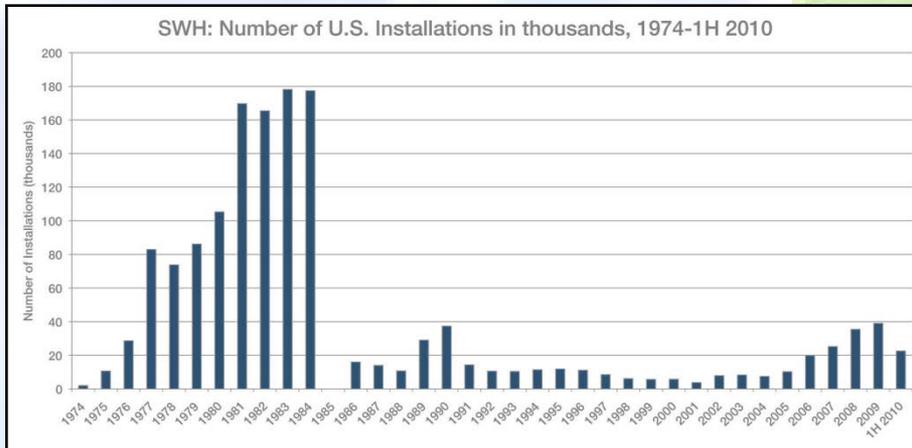
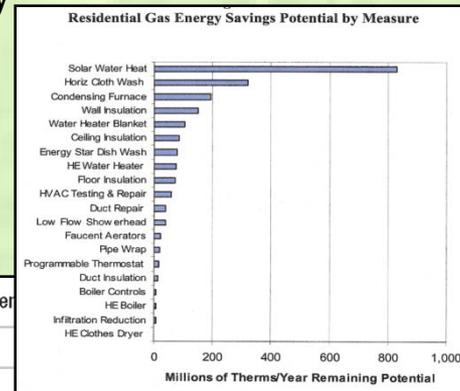
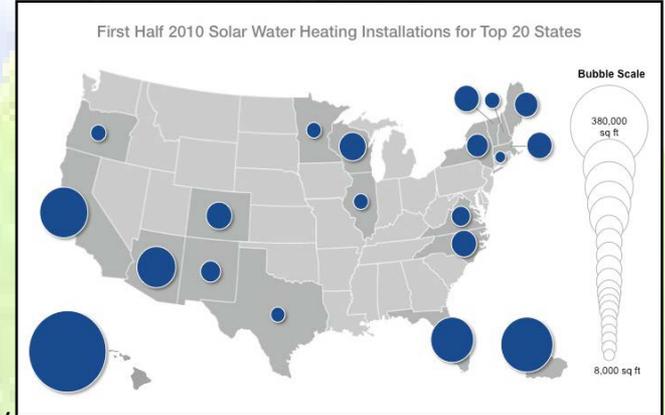
Tank	Harpiris TT-125	Glass-lined steel wrap-around tanks from Rheem & A.O. Smith		European steel and US SS tanks
Capacity	125 gallon	80 gallon	120 gallon	60-120 gallon
Heat Exchanger Surface Area	25 ft ²	12 ft ²	15 ft ²	15-50 ft ²
Standard Warranty	15 years	6 years		2-15 years
Optional Warranty	Lifetime	10 years		Lifetime
Distributor Price	\$600	\$601	\$825	\$2,000+
Dealer Price	\$850	\$850	\$1,050	\$2,000-\$4,000



Solar tank R&D funded by a \$284,500 Building Energy Research Grant from the California Energy Commission

Solar Water Heating Market

- U.S. market has tripled since 2005
- U.S. SWH growth will continue thanks to strong incentives
 - Federal solar tax credit authorized through 2016
 - New \$350M SWH incentive in CA through 2017
 - Combine to cover >50% of the cost of our systems
 - Currently just 25% the size of 1980s U.S. market
- >80% of U.S. SWH installs use glass-lined steel tanks made by water heater giants A. O. Smith, Rheem, and Bradford-White
- European market moving to combi (water+space) systems
- No gas efficiency measure comes close to SWH



Project Funding

Organization	Project Contribution
Air Resources Board	\$235,000
Sempra ET	\$50,000 cash
	\$80,000 IES subcontract
Homeowners	\$123,500
Davis Energy Group	\$50,000 (estimated)
TOTAL	\$538,500