



Sopogy – MicroCSP

July 2009

A Scalable Solar Solution for Distributed Generation,
Process Heating & Solar Air-Conditioning

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Sopogy

Incorporated in 2006, in Honolulu, Hawaii. We are a team of enthusiastic engineers out to change the world for the better. In a very short time we have innovated a NEW solar technology, which we call MicroCSP™. It is a scalable solar solution, which enables cost-effective distributed generation of electricity, process heating, and cooling in a single system. We are now busy bringing affordable electricity, drinking water, heating, and cooling to all regions of the world. Here is how it works and why it matters.

MicroCSP™

Sopogy has pioneered a new approach to Concentrating Solar Power (CSP) called MicroCSP™, a highly modular and scalable technology that is particularly suitable for distributed generation in the range of 250kW – 20 MW. Below this level, photovoltaic units have established an expensive, but flexible solution, while utility-scale CSP installations dominate power production in the > 50 megawatts range. The same system can also provide process heating to a wide range of natural gas offsetting applications such as crop drying and food preparation. Industrial processes such as biofuels production, water purifications, desalination and absorption chiller air conditioning for commercial buildings completes the tri-generation capability of MicroCSP:

Electricity, Heating, Cooling.

MicroCSP™ utilizes the same basic technological concepts as the large utility-scale CSP systems, however the smaller scale MicroCSP™ systems allow for deployment in areas where only acres or



tens of acres of land are available, rather than the hundreds or even thousands of acres required for its larger scale counterpart.

MicroCSP™ technology also incorporates several design and manufacturing innovations that dramatically reduce the cost and increase the flexibility of concentrating solar energy applications. A particularly important breakthrough has been Sopogy's development of smaller-scale parabolic-

Ship it flat-packed
(reduce shipment CO₂)



Assemble on site
(creates local jobs)



Modular/Scalable for
Distributed Generation
(No transmission issues)



trough collectors that can be built at a lower cost, using commonly available manufacturing facilities and conventional materials. The NEW lightweight “airplane wing” constructions enables Sopogy to ship the collectors unassembled in flat packs, thus greatly reducing shipping and CO2 costs to the planet. Using off-the-self sheet metal construction, our unique IP can be deployed worldwide and expand quickly without the cost of expensive NEW fabrication facilities, like those needed for Silicon PV or thin-film PV technologies.



in environments previously thought to be too harsh for solar technologies. Maintenance costs of these systems are also reduced due to both the modular nature and use of

commodity materials in the system design. As with all solar

technologies, MicroCSP™ systems provide power when valued most by the utility and the customer, which is during peak demand periods. MicroCSP™ systems can also

The modules are mounted into an array, which tracks the sun and circulates the heat transfer fluid. Because of this modular nature, MicroCSP™ arrays are suitable for installations ranging in size from a single

economically store its solar thermal energy to extend power production beyond the solar day or to shift power delivery to the period of greatest value to the customer. To accomplish the same feat, PV is forced to rely on battery storage, which is still cost prohibitive for large-scale applications. Finally, MicroCSP systems can also be paired with a back-up boiler to guarantee firm and reliable power delivery 365 days per year.



Sopogy Kona Solar Field

rooftop to a large solar field. All components are enclosed in an aerodynamic, rust-resistant housing, which makes the modules suitable for use in climates ranging from deserts to tropical environments. Arrays are rotated into a protective downward-facing position at night and during inclement weather, which makes these systems viable

MicroCSP™ System Applications

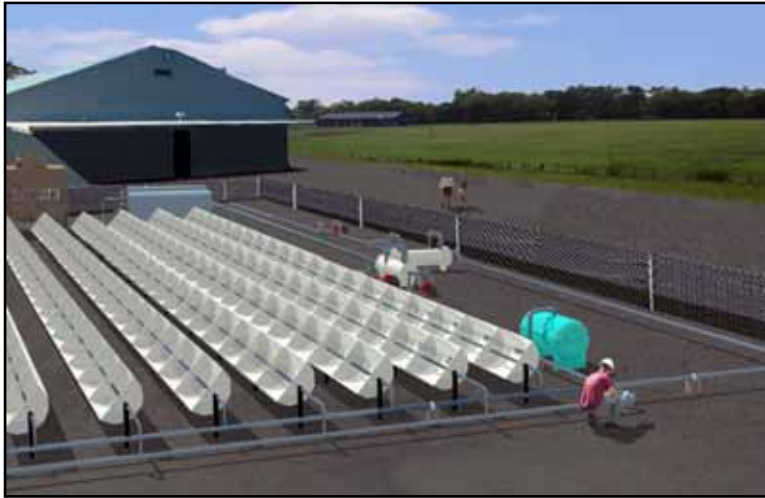
Sopogy offers modular designs that are adaptable to a specific site’s needs and conditions, which are readily deployed and site constructed. As such, MicroCSP™ provides electric utilities with new options for distributed generation applications and for displacing natural gas in existing thermal applications.

Power Generation and Hybrid Designs

MicroCSP™ can meet a variety of power needs for an assortment of small-to-medium applications. In particular, this technology fills the solar electricity gap between the 250 kW and 20 MW generating capacity. MicroCSP™ systems offer the utility an

option of installing these small, stand-alone units as distributed generation applications to meet rising loads in a fast-growing area, rather than having to build a large power plant or new transmission lines.

For customers with both power and process heat needs on site, a hybrid MicroCSP™



system can be installed to meet this dual

Process Heating System

power-and-heat generation requirement. Hybrid systems can greatly improve the return-on-investment by lowering the payback period to as low as 3 years. This is due to economies of scale in which adding process heat to a power generation systems is only incrementally more cost, but it results in substantial additional energy savings. Such systems would entail a secondary loop coming off of the power-generating unit to utilize the heat remaining in the working fluid. Secondary applications could include water heating, agricultural drying or other functions that require heat up to 220° F.



Thermal Energy Applications

Significant opportunities exist for MicroCSP™ to provide high temperature thermal heat in the range of 200-350°F to supplement existing process heat needs. The market for such natural gas offsets is particularly promising in rural industrial sectors—to include agriculture, biofuels and food processing operations. Applications such as crop or product drying, dehumidification, disinfection and desalination are prime candidates for using heat from MicroCSP™ systems. In addition, many industrial and commercial facilities could use this technology to offset their use of natural gas for water heating and absorption cooling systems. Utilities could also benefit by using these systems to supply heat to the “bottoming” steam cycle in a combined-cycle generating plant, thus increasing the plant’s overall efficiency and offsetting its own use of natural gas.

Given the current high cost of natural gas, commercial customers could substantially save on their energy bills by incorporating a MicroCSP™ system into their existing process heat operations. By retrofitting an industrial facility with solar thermal collectors over just one acre of land, a customer could significantly reduce their natural gas bill by upwards of \$300K per year and realize a payback of investment in as little as three years.

Air Conditioning

MicroCSP™ can also be combined with absorption chillers to produce air conditioning systems that displace electric load. Air conditioning can be designed to cascade in the same solar array as either power generation or process heat, with ample thermal heat to drive at least two processes. This makes MicroCSP™ appealing to those with more than one on-site power need. An example of such a

project might involve supplementing an existing 100-ton electrical air conditioning system at a large retailer with a 100-ton MicroCSP™ system. By providing savings on the current electricity cost, the new solar installation could provide a simple payback in as little as four years.

Opportunities to displace natural gas

The need to find renewable energy substitutes for natural gas is rapidly becoming more urgent. Natural gas accounts for about one-quarter of total energy consumption in the United States and demand for this resource is expected to continue growing steadily into the foreseeable future. At the same time, however, domestic reserves are shrinking and prices have been rising steadily. Over the last decade, the price of natural gas in the U.S. has more than doubled from about \$3 per million Btu (MMBtu) or less, to the \$6-8/MMBtu range, with much higher spikes.

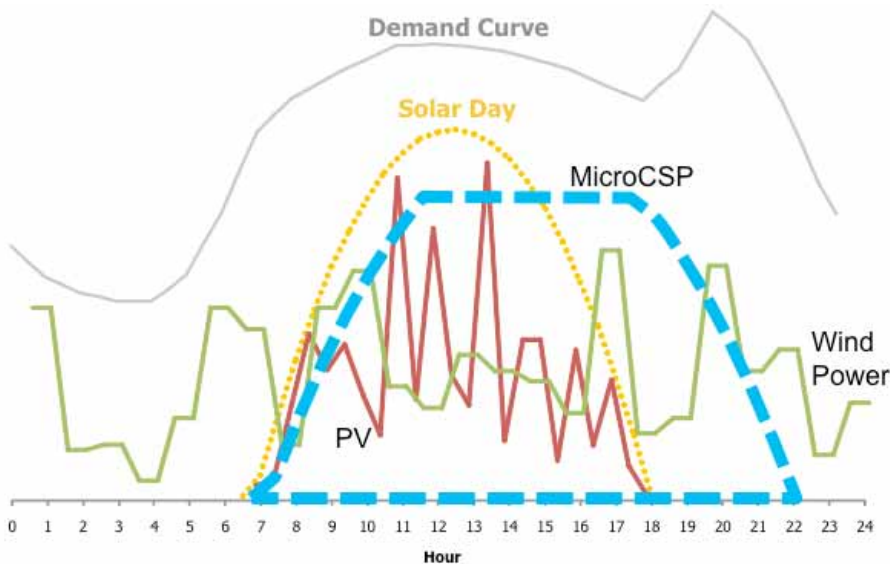
Further perspective on such forecasts is provided by an analysis from the Electric Power Research Institute (EPRI), which

and that a ceiling price will be set by the cost of fuel oil and distillate in the range of \$7-12/MMBtu.

Solar thermal energy could potentially play this role by directly displacing gas in numerous applications. The industrial sector accounts for the greatest proportion of natural gas use in the United States (32%), followed by the electric power (29%), residential (20%), and commercial (13%) sectors. Opportunities to displace natural gas are particularly promising in the industrial sector—which includes the agriculture and food industries, according to EIA accounting methods. In addition, many industrial and commercial facilities currently use natural gas for water heating and absorption cooling systems, which could also be done using solar thermal energy.

MicroCSP™ could also be used by the electric power industry to supply heat to the “bottoming” steam cycle in a combined-cycle generating plant, thus increasing the plant’s overall efficiency.

¹ EPRI Journal, summer 2006, pp. 25-26



Firm & Extendable Power

With the addition of storage and back-up boiler options, thermal energy can be dispatched during periods of inclement weather or nightfall. CSP systems will collect energy during the day, indicated by the blue dashed line in the figure. PV (red) and Wind Power (green) are both intermittent due to the lack of cost-effective electricity storage. MicroCSP, on the other hand, utilizes inexpensive heat storage in fluid tanks. Thus enabling

firm and extendable energy beyond the solar day.

The dashed yellow area illustrates the period that the thermal energy reaches the design set point and can be converted to power. During hot summer months, the peak of the

emphasizes the effect on natural gas prices of electric utilities’ ability to shift between gas and other fuels¹. In particular, EPRI concludes that the cost of coal will establish a floor price for natural gas in the range of \$5.5-6/MMBtu for the foreseeable future,

solar day, may also coincide with the highest energy load. Thus, the kWh delivered during this period has a higher value to the utility than one generated and used off-peak, because it is the most expensive kWh for the utility to generate, when compared to the less expensive base-load power. In many cases, utilities will pay higher rates for kWh delivered on-peak than off-peak. Conversely, they will charge higher customer rates for kWh used during peak periods improving the economics for not utilizing utility power during their peak periods.

Utilities will fire up gas-fired power plant units to meet the peak demand. They frequently use inefficient combustion turbines (CT) to meet these short-term loads. Utilities pay customers incentives to avoid using power during peak periods, either directly or through a time of use rate structure. When the value of the power is high enough to the utility, then the use of back up boilers may be economically warranted. The small box in Figure 1 shows that the energy derived from the CSP system can be supplemented to follow the utilities' load curve. A back up boiler system (e.g. bio-diesel) will benefit the utility by offsetting the peak demand with renewable energy that is less expensive than CT generated fuel intensive peaking units.



Website: www.sopogy.com

Custom Scalable Solutions

Whatever energy problem you are trying to solve, whether it be process heat, electric power, air conditioning, or a combination of applications, we at Sopogy will design a unique solution that fits your needs. Sopogy has partnered with project managers, financiers and major equipment manufacturers in order to provide you a seamless solution. Please contact Sopogy today to take your first step to low-cost clean energy solutions.

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