

SOLAR THERMAL PROGRAMS

The advancement of renewable energy is crucial to reducing the demand for conventional fossil fuels while also reducing carbon emissions. A key challenge, however, is integrating renewable energy solutions – such as solar thermal – in a cost-effective way for homes, commercial businesses, and manufacturing facilities.

GTI's Solar Thermal Emerging Technologies programs are addressing these challenges, with a goal of bringing practical, clean, high-efficiency solar thermal energy technologies to end use markets. This includes advancements of:

- Traditional lower temperature solar thermal (less than 200°F) for hot water or space heating.
- Newer higher-temperature (over 200°F) systems for steam generation, absorption cooling, process heating, and other value-added uses.

PROJECTS & DEVELOPMENTS

Lower-Temperature Solar-Assisted Natural Gas Water Heating for Homes

Solar thermal water heating is not a new technology, having been around for more than a century. But it's now being coupled with the most advanced natural gas water heating systems and the latest computer controls to create a very dynamic and reliable renewable application. Advanced “hybrid systems” – ones that use solar thermal energy along with natural gas or propane – are becoming available to the marketplace. These systems can reduce energy consumption by up to 40% – with lower capital and installation costs.



Solar-assisted gas water heating has evolved around the world during the past decade, driven by high energy costs, energy supply concerns, and to lower carbon emissions. This newer technology has begun to make inroads in U.S. markets. Research is needed to ensure these systems are able to meet the price and performance that consumers and commercial businesses require for an

acceptable payback, while also addressing climate requirements and building codes and standards.



Natural gas water heaters are widely used in homes and business. Water heaters comprise about 40% of residential natural gas consumption, second only to space heating at 44%. In California, for example, natural gas-fired water heaters constitute over 80% of the 12 million households and 2,100 million therms consumed per year.

An average household could see its annual natural gas usage for water heating drop from 204 to 122 therms, or 40%, with a corresponding reduction in greenhouse gases, from a solar-assisted water heater system.

These systems can also be integrated into homes that use hot water radiant heating for space conditioning, providing a pathway for solar thermal energy to help heat a home.

GTI, under sponsorship from Utilization Technology Development (UTD), is developing a residential hybrid gas-solar hot water system that will reduce materials, manufacturing, and installation costs for these systems. The major components of the system include evacuated tube solar collectors, a polyethylene hot water storage tank, and a condensing tankless water heater.

The result is a highly efficient hot water delivery system designed to meet the reliability and performance needs of most residential hot water single- and multi-family applications.

In addition, the implementation of a drainback solar collector can expand the market to Northern regions where freeze protection is required. The system is a pressure-free and environmentally friendly solar installation, completely eliminating ethylene glycol or other heat exchange fluids.

GTI is working with Solar Usage Now, a supplier of residential and commercial solar thermal technologies, to expand the pathway for bringing affordable hybrid

solar thermal/natural gas systems to the residential market.

Lower-Temperature Solar-Assisted Natural Gas Water Heating for Commercial and Industrial Customers

In the commercial and industrial sector, a dramatic increase in market penetration for solar-assisted water heating is possible. The GTI/Solar Usage Now hybrid solar thermal/natural gas hot water system designed for residential use is also suitable for commercial hot water applications up to 195°F. The result is a highly efficient hot water delivery system designed to meet the reliability and performance needs of hot water systems for commercial buildings and industrial users.

The system has the potential for energy cost savings of 40% and a corresponding reduction in greenhouse gases. These systems can be linked together to supply hot water, provide for heat large buildings, or – coupled with absorption cooling products – can provide space cooling.

System capacity can be handled using a modular approach, with as many as eight tanks combined together. This could, for example, satisfy a 400 room hotel.

In the food processing industry, there are several attractive applications for hybrid solar thermal/natural gas systems, including wineries, breweries, juice and soft drink manufacturers, and others. Most large wineries have tanks with capacities ranging from 500 to 3,000 gallons, while smaller wineries may use conventional storage tanks that are less than 199 gallons.



Using a hybrid solar thermal/natural gas hybrid hot water system with expandable modular hot water storage tanks and solar thermal panels can be a cost-effective approach to integrating a renewable energy source.

Higher-Temperature Solar Thermal/Natural Gas Systems for Industrial, Commercial, and Institutional Customers

GTI is also addressing applications that combine solar thermal with natural gas boilers, heaters, and absorption chillers. These use the latest developments in medium- to high-temperature solar collectors ranging between 200°F and 400°F.

GTI is teaming with partner companies on a solar thermal technology based on an evacuated tube solar collector coupled with an external non-imaging reflector in a low complexity, non-tracking system that can be either roof or land mounted. This combination enables what is known as External Compound Parabolic Concentrator (XCPC) to cost-effectively achieve temperatures up to 400°F at an impressive 50% efficiency.

This medium temperature technology can be used for a wide variety of compelling heat-driven industrial/commercial process applications including boiler feedwater, absorption chilling, industrial drying, and commercial hot water.

GTI is seeking host sites to demonstrate this technology. A successful pilot installation at a leading industrial/commercial company may have a strong impact on speeding market adoption of solar thermal technology. More high profile installations are needed to demonstrate feasibility, reliability, and economic viability in a real-world setting.

SOLAR THERMAL ENERGY FACILITIES

GTI is located on an 18-acre site near O'Hare International Airport, in the Chicago suburb of Des Plaines, Illinois. About half of GTI's 280,000-square-foot headquarters building is dedicated to modern laboratory and research facilities. This includes a dedicated Combined Heat and Power (CHP) and Renewable Energy Laboratory which contains a variety of low to medium-temperature solar thermal technologies and associated end use equipment such as tank and tankless water heaters, boilers, and other technologies that can enable investigation of integrated or hybrid energy systems using solar thermal. The lab is fully instrumented and has advanced data acquisition systems.



FOR MORE INFORMATION

David Cygan, Solar Thermal Program Manager
847-768-0524; david.cygan@gastechnology.org