



**SoCalGas Comments in response to July 8, 2019 Public Meeting: The Role of the Industrial Sector in Meeting California's Carbon Neutrality Goals**

## **Appendix C:**

# **SoCalGas' Research, Development, & Demonstration Programs**

## **Appendix C: SoCalGas' Research, Development, & Demonstration (RD&D) Programs**

We are sharing information from a number of our RD&D programs, but along with the other developing technology below, we highlight the first project because it has received state support from the California Energy Commission (CEC) and shows great applicability within California.

### **1. Hyperlight/Genifuel Project at San Diego State University**

This project integrates low-cost, concentrated solar thermal technology with hydrothermal processing to convert biomass to renewable gas (RG) and bio-crude. SoCalGas developed the demonstration concept and the CEC co-funding proposal to leverage resources by integrating two technologies that were previously supported by our RD&D program and were nearing commercialization. SoCalGas helped secure the demonstration site at San Diego State University, Brawley Campus, managed the project to completion, and then leveraged customer relationships to secure commercial follow-on projects.

Hyperlight Energy's concentrated-solar power technology produces steam using mirrors mounted on low-cost plastic tubes that focus sunlight on a receiver that further concentrates the sunlight to produce high-temperature steam. That steam is then used with Genifuel Corporation's hydrothermal processing technology to convert manure from rural dairies in Imperial and San Diego Counties into RG and bio-crude. This process reduces greenhouse (GHG) emissions more effectively than traditional anaerobic digestion at about half the cost.

Hyperlight Energy's first commercial solar-thermal project is being launched this year at a large California cheese manufacturing plant and two pre-commercial biomass-to-energy projects using the Genifuel technology are expected to break ground in 2020.

The following lists other technologies in which SoCalGas is working with the Gas Technology Institute (GTI) that may be applicable to industrial customers.

### **2. HeatSponge Rainmaker**

The HeatSponge Rainmaker, made by Boilerroom Equipment Inc., is technology integrated with an industrial steam boiler for generation of hot process water rather than for the usual hydronic heating application. This technology provides reliable operation with simple controls for waste-heat recovery from natural-gas combustion equipment, such as industrial and commercial boilers. The modular design allows tailoring of equipment to each application without the added cost for custom engineering and fabrication.

GTI demonstrated the system to be advantageous to the host-site and verified the potential performance, energy savings, and emissions reduction benefits of the technology. The HeatSponge Rainmaker offers an option that depending on the

application increases boiler efficiency typically in the 4-8% range with a proportional reduction in carbon dioxide (CO<sub>2</sub>) and oxides of nitrogen (NO<sub>x</sub>).

### **3. Dynamic Staged Entrainment (DSE)**

DSE burner technology offers a simple, robust design that is well-suited for applications in the commercial sector needing water heating and/or steam generation. The DSE burner consistently achieved emissions below 9 ppmv NO<sub>x</sub>, without the need for costly and complex controls such as selective catalytic reduction and/or external flue-gas recirculation (FGR), and without high levels of excess air (HEA). The technology offers a cost competitive alternative, is easy to operate, and has a simple design. Extensive evaluation of the technology (over 10,000 hours in real-world conditions) have proven the DSE burner capable of meeting low NO<sub>x</sub> levels, while operating with relatively low excess air and high efficiency levels.

- A. In comparison to HEA burners, the DSE burner is 2% more efficient and requires significantly less electric power to drive the combustion air blower.
- B. In comparison to FGR systems, the DSE burner achieves similar or improved efficiency, with even further reductions in air blower power. The GTI demonstration documented a 9% savings in fuel usage as compared to the baseline boiler.

This technology highlights the benefits of applying newer reliable boiler/burner technology while providing significant energy and cost savings.

### **4. Artic Solar<sup>1</sup>**

This technology addresses the temperature spectrum between about 212°F (100°C) and 392°F (200°C) that has been largely neglected by market leaders. This solar thermal technology uses non-imaging concentrator collectors where the concentrators are able to reflect to the receiver all of the incident radiation making the system more flexible.<sup>2</sup> Although these systems have low precision, they can be very useful for increasing the system performance at lower cost.

The technology temperature range includes a wide variety of heat-driven industrial process applications including single and double effect absorption chilling, boiler feedwater, commercial hot water heating, manufacturing processes using hot water or steam up to 350 °F, food processing, and industrial drying.

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<sup>1</sup> Artic Solar Website. Available at: <http://articsolar.com/>

<sup>2</sup> PennState Website. Solar Thermal Energy for Utilities and Industry. 4.2 Non-Imaging Concentrators. Available at: <http://www.e-education.psu.edu/eme811/node/689>

## 5. Solar Usage Now<sup>3</sup>

This technology is an advanced system that marries natural-gas water heating with solar technology. It is a product of research and development efforts to reduce the material, manufacturing, and installation costs for solar-assisted water heating systems. The system is a combination of an atmospheric storage tank, a highly efficient natural gas-fired tankless water heater, and a very efficient solar-thermal collector. The system integrates the most efficient technologies on the market into one energy efficient package. The modular design of the hot-water storage tank makes it ideal to be linked together and can replace boilers used at large commercial/public sites such as breweries, soft drink production, hotels, schools, hospitals, etc. GTI validated the ability of the system to achieve an energy cost savings of 40% and a corresponding reduction in GHG emissions in small commercial agricultural businesses.

## 6. Tri-generation Technologies

Tri-generation systems are mature technologies established in the field. For example, tri-generation solutions, developed by FuelCell Energy,<sup>4</sup> utilize fuel cell stacks configured to simultaneously generate power, hydrogen, and heat by reforming hydrogen-rich fuels including natural gas or renewable biogas. The innovative technology has several installations across commercial and industrial sectors in California and globally and has helped with cross-sectoral decarbonization efforts. One of the installations in California funded by the U.S. Department of Energy is the Fountain Valley Trigeneration Facility located at the Orange County Sanitation District which is the world's first tri-generation hydrogen energy and electrical power station to provide transportation fuel to the public and electric power to an industrial facility.<sup>5</sup> In April 2019, FuelCell Energy also announced a 1.4 MW project with the City of San Bernardino Municipal Water Department. The project will operate on anaerobic digester gas and as needed, natural gas, producing electricity and heat to support the operation of the department's water reclamation facility.

FuelCell Energy is currently developing an application for their fuel cell, which may assist the industrial sector in becoming carbon neutral. A business can divert their flue gas into a molten carbonate fuel cell, which can concentrate and separate the CO<sub>2</sub>, allowing for easier final processing prior to sequestration. The company is presently looking at oil fields as one place to demonstrate this technology, since they may already have the ability to store carbon. As sequestration further develops and industrial facilities are incentivized for sequestering or using captured carbon, this technology could spread to even capture the CO<sub>2</sub> emissions from technologies such as boilers or engines.

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<sup>3</sup> Solar Usage Now Website. Available at: <http://www.solarusagenow.com/>

<sup>4</sup> Fuel Cell Energy Website. Available at: <https://investor.fce.com/Investors/default.aspx>

<sup>5</sup> <https://www.energy.gov/sites/prod/files/2016/12/f34/fctofoountainvalleysuccessstory.pdf>