Solar Industrial Steam with Thermal Storage

U.S. DEPARTMENT OF ENERGY FUNDED TECHNOLOGY

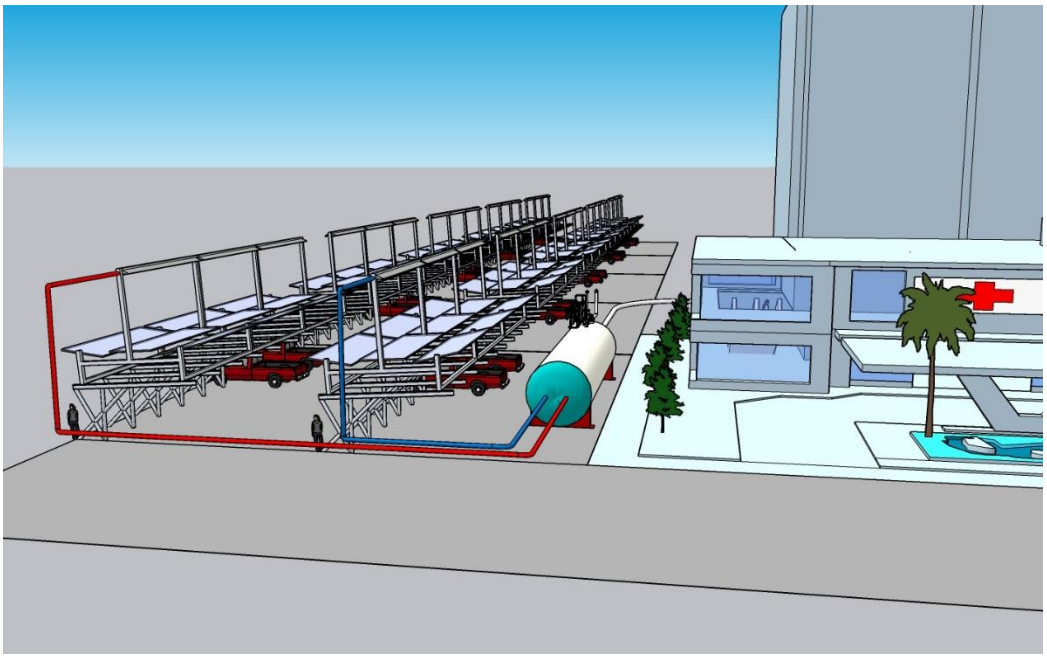
Sunvapor received a $2.5 million Award from the DOE to demonstrate the benefits the Bullet Steam Accumulator (BSA™) can bring to integrating solar steam with a commercial or industrial process

DEEP DECARBONIZATION

Industrial heating is second only to transportation in greenhouse gas emissions. Solar thermal energy provides a 4X greater efficiency than solar photovoltaics at generating steam, resulting in reduced space requirements and cost. However, without thermal energy stroage, solar energy cannot offset more than 18% of the total fuel for plants that operate through the night

HEATING AND COOLING

Sunvapor's solar steam with energy storage sytem delivers a constant flow of 100-150 psig steam for distillation, pasteurization, and sterilization. The steam can also be used for cooling without electricity using an absorption chiller.



Sunvapor is developing a novel thermal battery that stores energy from surplus heat or electricity, and discharges industrial steam. The thermal battery, called a Bullet Steam Accumulator (BSA™) has a lower specific energy cost ($/kWh) than all other energy storage technologies capable of generating 100-150 psig steam. The cost breakthrough derives from a ten-fold increase in capacity compared with the state-of-the-art. In order to exploit the larger capacity, Sunvapor has disovered, through Computational Fluid Dynamics, the design rules that govern performance optimality. The Figure above illustrates an example of how the thermal battery could be integrated into a solar boiler for a medical center that uses steam for heating and cooling.

Carport-mounted concentrating solar collectors heat water from a lower (blue) temperature to a higher (red) temperature. Surplus heat that exceeds the immediate steam demand is stored for several hours until demand exceeds the heat collected, whereupon the steam is discharged (white) to the boiler room. The inclusion of energy storage enables deeper decarbonation for facilites that operate through the night. The thermal battery provides buffering benefits even for conventional boiler systems where there is a variable load. A sudden surge in demand can result in wasted product when the natural gas boiler cannot ramp quickly enough. A drop in demand can result in venting steam to the environment. These problems are avoided with BSA™.

Powered by SunShot
U.S. Department of Energy

SUNVAPOR
RENEWABLE PROCESS HEAT

Case Study

OWN FACILITY OR PURCHASE STEAM

The host customer can choose to own the solar steam facility or purchase steam under a Heat Purchase Agreement (HPA). A third-party project investor owns the facility in a HPA. The HPA can provide surety in the cost of energy in an uncertain future for fossil fuel prices.

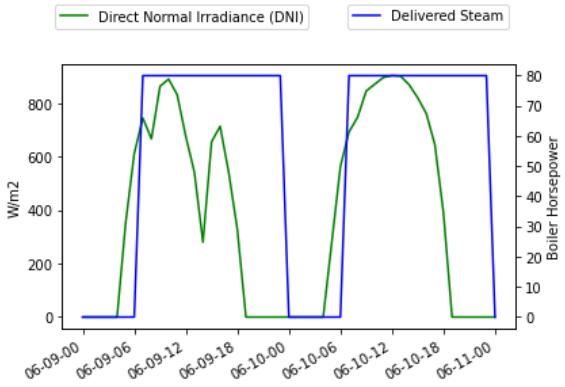
TURNKEY SOLUTION

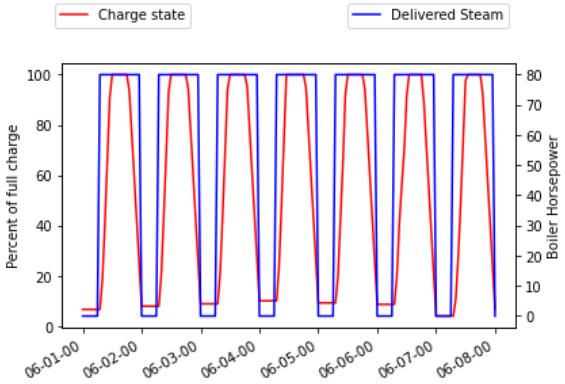
Sunvapor, with its contractors, delivers the complete project, including engineering, permitting, construction , commissioning, measurement & verification, operations & maintenance.

ABOUT SUNVAPOR

Sunvapor is a technology and project developer that delivers deep decarbonization solutions to commercial and industrial customers. Sunvapor has been awarded four grants from the U. S. Department of Energy and two from the California Energy Commission for innovations related to solar energy generation and storage.

For more information:
www.sunvapor.net





We have taken as a Case Study the same solar field we are constructing for California Custom Processing, an almond processor in Madera, California. However, for this Case we assume a constant steam demand of 80 BHP (2,640 pounds per hour) and we have added one 30,000-gallon BSA™ to meet that demand 46% of the time with solar energy. The upper Figure shows the variation in the solar resource (Direct Normal Irradiance) and simulated steam production over two days in June, 2018. The BSA™ enables a constant production of steam through cloud event (dips in the DNI) and extends the generation of steam well after sunset, approaching midnight.

The lower Figure shows the simulated state of charge, and steam production, during the first week of June, 2018. The BSA™ thermal battery undergoes seven complete charging and discharging cycles during the week shown. The full storage capacity of one 30,000-gallon BSA™ is 4.6 MWh, or 9.2 tons of steam. During the week shown, steam is generated from the sun for 17 hours each day. For the remaining 7 hours, solar steam may be augmented with natural gas. The fraction of steam generated from solar energy will vary over the year, with the annual average being 46% for this Case, and the total gas savings is about 132,000 therms.

Host Requirements

- Land, rooftop, or carport area of at least 1 acre
- Annual consumption at least 75,000 therms of steam
- Reduction of greenhouse gas emissions from operations is a Corporate Sustainability Goal

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