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SoCalGas Comments on Waste Heat Recovery Research

Additional submitted attachment is included below.

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Subject: Opportunity to Shape Waste Heat Recovery Research, Docket #:19-ERDD-01

Southern California Gas Company (SoCalGas) thanks the California Energy Commission (CEC) for seeking innovative waste heat recovery technologies to inform future research initiatives aimed at reducing natural gas use and greenhouse gas (GHG) emissions in the industrial sector. Having worked with industrial customers for many decades, SoCalGas is well positioned to assist in achieving deep decarbonization of California's industrial sector. We have extensive knowledge and long-standing relationships with our industrial customers, many years of experience in developing and implementing successful customer energy-efficiency programs; and we manage a strong research, development, and demonstration (RD&D) program with a long history of delivering new technologies that directly benefit our customers. Below, we provide responses to the six questions asked under the Research Idea Exchange docket.

1. **What California industries have large volumes of ultra-low (<250º F) or ultra-high temperature (>1,600º F) waste heat?**

Waste heat sources under 250°F are common across all industries—particularly food-processing which almost always involves water heating. Boiler stack temperatures are frequently above this criteria, unless the boiler is equipped with a stack economizer. However, process applications which send boiler condensate to drain instead of a returning it to a deaerator would qualify. Similarly, some food-processing applications send wastewater to drain at elevated temperatures in sustained large volumes where a heat exchanger can be justified. The least appealing low-temperature applications considered are waste heat obtained via drying processes (e.g. cotton, nuts, fruits, etc.) where air-to-air heat exchangers could be used to exchange heat between the warm, moist air leaving the process and the relatively cool, dry air entering the process. The drawbacks of these projects are that the size and cost of the heat exchangers are high. Also, many food-drying processes are only employed for a few weeks a year. The combination of elevated cost and limited annual run hours to recoup the capital expenditure results in an extremely challenging financial justification.

Ultra-low (<250º F) waste heat is also produced from exhaust gases exiting recovery devices in gas-fired boilers and furnaces; process steam condensate; cooling water from furnace doors, furnaces, air compressors, internal combustion engines, air conditioning, and refrigeration condensers; drying, baking, and curing ovens; as well as hot-processed liquids/solids.

Ultra-high (>1,600º F) waste heat is typically produced from steel electric-arc furnaces; aluminum reverberatory furnaces; steel heating furnaces; fume incinerators; and glass melting furnaces.

2. **What research is needed on advanced technologies or materials (including coatings) for recovering waste heat cost effectively in ultra-low heat or ultra-high temperatures?**

Research on the following is needed for recovering waste heat cost effectively in ultra-low heat or ultra-high temperatures:

- Low global warming polluting (GWP) refrigerants are required for cycles, such as Organic Rankin Cycle, capable of utilizing low-grade heat;
- Reducing equipment cost through advanced manufacturing techniques, e.g. additive manufacturing;
- Advanced heat exchange materials that reduce cost, e.g. polymer membrane heat exchangers;
- Improving system efficiencies; and
- Heat capture technology with storage potential.

3. **Should research focus primarily on the ultra-low or ultra-high temperature waste heat or, if not, what other temperature ranges?**

Ultra-low heat waste heat sources are more common, particularly from residential and commercial buildings. Utilizing waste heat in these locations could help reduce the carbon footprint of our existing building stock, which is proving difficult to decarbonize.

4. **What advanced heat recovery technology improvements are needed to increase wide spread deployment by industry?**

Improvements could come in the form of increased energy efficiency or lower equipment cost, which would accelerate the economic payback for these investments. The following advanced heat recovery technology improvements are needed to increase wide spread deployment by industry:

- Reducing capital cost/payback periods is the most critical component of increasing adoption;
- Standardizing equipment for simple retrofit of thermal applications: i.e. make the heat recovery units capable of being “bolt-on” to a furnace, oven, boiler, etc.; and
- Standardized packaging of heat recovery system with thermal application during production, i.e. all boilers come from the factory with heat recovery installed.

5. **What are the cost and technical targets that must to be met to drive customer adoption (such as minimum rate of return or minimum percent heat recovery)?**

The cost and technical targets that must to be met to drive customer adoption, include the ability to utilize waste heat in their process and cost-effectiveness.

The justification to implement a waste-heat recovery project varies depending on a variety of factors, however projects almost always have a minimum payback (return-on-investment) requirement. The following thresholds are very common: 1.) Payback ≤1 year; little to no justification required; and 2.) Payback ≤3 year required for all energy-efficiency projects[1].

Currently, end users are requiring less than three years for payback. Given a project's rate of heat recovery (Btu/hr) and current cost of energy being offset ($/Btu) a project's rate of return can be determined ($/hr). The more hours per year the equipment is operated, the faster the project can pay for itself. Some industries (primary ag-processing operations in particular) are very seasonal in nature so their season may be limited to only a few weeks per year. A system would need to run multiple shifts or high production rates to achieve this low payback.

6. **What complementary technologies and approaches can be combined to increase the value proposition of waste heat recovery systems?**

Complementary technologies and approaches that can be combined to increase the value proposition of waste heat recovery systems include:

- Thermal storage to make heat recovery systems dispatchable and
- Modify incentive programs to provide monetary incentives for installing heat recovery for power generation.

Conclusion

SoCalGas provides these comments to support California's move towards meeting our aggressive climate goals in a sensible, balanced, and cost-effective way. We can provide additional input if needed.

Sincerely,

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[1] Payback periods up to 5 years can be acceptable if there is a corporate directive behind the measure and if the size of the expenditure is viewed as substantial (i.e. cogeneration, new central plants, etc.).