



## Demonstration of High-Efficiency Hot Water Systems in Commercial Foodservice

Frontier Energy, Inc. (formerly Fisher-Nickel, Inc.) is a professional services firm with deep expertise in commercial kitchen energy efficiency and appliance performance testing. They are a dedicated team of engineers, technicians, culinary arts experts, educators, and energy specialists who use their expertise to encourage the commercial foodservice industry to become more sustainable in their purchasing decisions and operations.

### **Adopting Hot-Water-System-Specific Energy- Efficiency Measures in CFS**

Frontier Energy, operator of Pacific Gas & Electric Company's (PG&E's) Food Service Technology Center (FSTC) was recently awarded a Building Natural Gas Technology (BNGT) grant for its *Comprehensively Integrate Innovative Technologies and Accelerate the Adoption of Hot-Water-System-Specific Energy-Efficiency Measures in Commercial Food Service (CFS) Facilities by Demonstrating Energy Savings Beyond Water Heater Replacement* project.

### **Documenting Energy-Efficiency-**

The primary goal of this research-based demonstration project is to document the energy-efficiency of specific components in a hot water system, validating optimization techniques that will encourage the design and engineering community to adopt these measures.

### **Demonstrating Energy-Efficiency-**

The goal is to demonstrate the benefits of an optimized hot water system that uses advanced gas-fired heaters, distribution system design and controls, ultra-low-flow fixtures, and dishwashers with heat recovery.

### **Collaborative Research in the Lab and The Field-**

This objective will be realized through a collaborative research and demonstration project to measure energy use and calculate system efficiency, both in the laboratory and the field.

### **Participants-**

Two CFS facilities have been selected to demonstrate optimized hot water systems. The Counter, A full-service restaurant located in PG&E service territory and Franklin Elementary School Cafeteria in SoCalGas service territory.

The selected sites represent some of the largest hot water loads in CFS. These field site types are an ideal testbed for many efficiency measures including the use of heat recovery systems.

The Counter's optimization plan will become the basis for testing in the laboratory. The laboratory testing will provide validation of the field results and will be used to measure the energy use of individual system components.

## **Innovative High-Efficiency Equipment- Hot Water System & Commercial Kitchens-**

The design of hot water systems in commercial kitchens has not changed significantly in decades. Advancements to hot water systems have concentrated on efficiency improvements at the heater and water reduction measures at end-use fixtures, which has eroded hot water delivery performance since lower flow rates translate directly into longer wait times at the tap.

Improving the efficiency of distribution systems has been largely neglected, especially in the CFS sector. While emerging technologies and system design strategies exist to improve system efficiency and hot water delivery performance, these technologies have exhibited low market penetration and the adoption of advanced distribution system architecture is negligible.

## **Water Heaters are One of the Most Energy-Intensive Appliances in CFS Facilities-**

In a recent PIER study (Delagah, Fisher 2010), the associated CFS water heating annual gas load in California was estimated at over 340 million therms. The 85,500 CFS facilities in California with gas-fired hot water systems represent 16% of the total commercial gas load in California. Innovative and emerging technologies exist that can greatly improve the efficiency of hot water systems. Despite their availability, market penetration for high-efficiency condensing water heaters is less than 10% of an installed base of 140,000 heaters in California CFS. For instance, high-efficiency water heaters and preheating technologies, while available and mature, have low penetration rates. Similarly, high-efficiency dishwashers have a low installed base, despite their availability and maturity. Advanced distribution system designs are not mature, though the components are available.

## **Benefits for California-**

Benefits of this project accrue primarily to California ratepayers in the form of energy savings, energy cost reductions, reduced CO<sub>2</sub> and NO<sub>x</sub> emissions, job creation, and improved food safety in CFS sites. Every hot water system is different and optimization will require a different set of solutions. The annual energy savings potential in California's 85,500 CFS facilities with gas-fired hot water systems through the implementation of retro-commissioning measures and energy-efficient technologies was estimated at 123 million therms. The annual gas load would be reduced by 36% if all CFS hot water systems were optimized, for a savings of approximately \$120 million (Delagah, Fisher 2010). California would benefit by a reduction of 566 tons of NO<sub>x</sub>, and 719,550 tons of CO<sub>2</sub> annually. Cost savings and CO<sub>2</sub> emissions were calculated using CEC values in Attachment 11 (CEC 2014). NO<sub>x</sub> emissions were calculated at 0.00921 lb NO<sub>x</sub> per therm of natural gas burned (NO<sub>x</sub> Calculator 2008).

## **Education-**

Measurable energy savings will also be used to evaluate the correct level of rebate amounts provided by the utilities to incent customers to retrofit their existing hot water systems with energy-saving measures. Utilities will be able to expand or create new measures where they currently did not exist.

## **Project Team-**

Frontier Energy will lead a highly technical, primarily California-based team experienced in Energy Efficiency (EE) for the commercial foodservice industry. Frontier Energy's David Zabrowski will be the Project Manager (PM) and Amin Delagah will be the Principal Investigator (PI). Frontier Energy will be relying on support from: GTI- Project Management; PG&E ATS- Lab Demonstrations; Fisher Consultants- Technical Support; kW Engineering- Third-Party M&V.

## **Projected Completion Date: 2017 Year-End**

**Full Report** – for the projects Scope of Work:

[http://www.energy.ca.gov/business\\_meetings/2014\\_packets/2014-09-10/Item\\_09f\\_PIR-14-006\\_Fisher\\_Nickel\\_Inc.pdf](http://www.energy.ca.gov/business_meetings/2014_packets/2014-09-10/Item_09f_PIR-14-006_Fisher_Nickel_Inc.pdf)