California Statewide Gas Emerging Technologies

Research Project Update

09/19/2022

Agenda

- Program Overview
- 2022 Research Plan
- Project Summaries
- Q&A
- Next Event

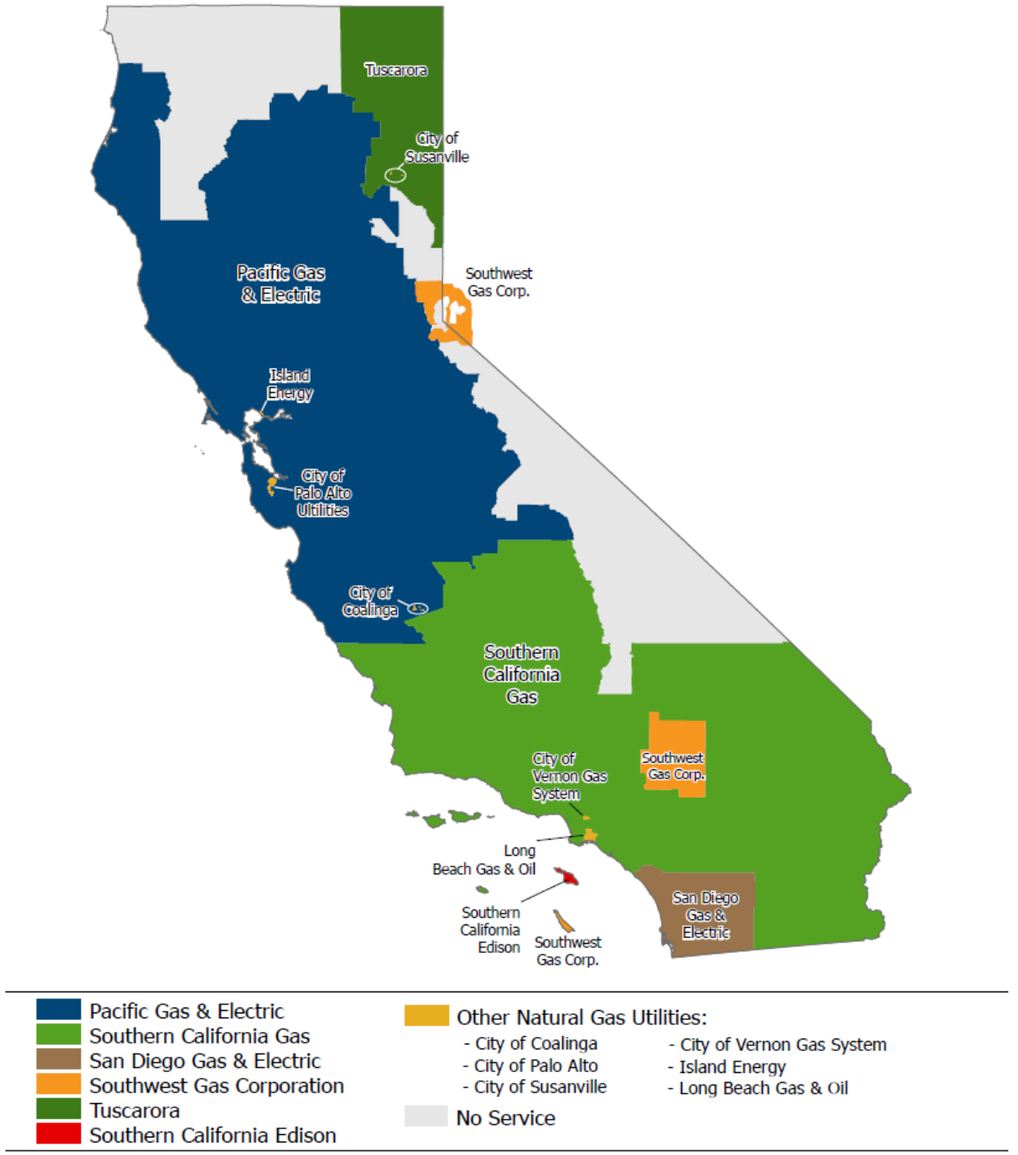
Today’s Speakers

- Paul Kyllo
- Steven Long
- Cristalle Mauleon
- Sabarish Vinod
- Saurabh Shekhadar
- Anoushka Cholakath

Program Overview

Background

- Jointly funded by Southern California Gas Company, Pacific Gas and electric, and San Diego Gas and electric
- Represents 11 million natural gas customers in California
- Program launched in 2021
- Research timeline 2022-2024



Purpose

- Scan, prioritize and evaluate commercially available energy efficiency technologies and provide necessary data and information to help drive adoption of measures into energy efficiency resource programs.

- Advance technical knowledge and market readiness of promising technologies that are not yet commercially viable but may be ready within three to five years.

- Serve the diverse needs of California's disadvantaged communities (DACs) and hard-to-reach (HTR) customers through emerging technologies.

Scanning and Screening

Planning and Prioritization

Technology Evaluation

Dissemination

Technology Transfer

→ Approach

The primary goal is to identify and research the energy efficiency characteristics of natural gas efficiency technologies and develop approaches to transfer high potential technologies into IOU measure portfolio

Program Goals

Program Metric	2022	2023	2024	Total
Number of Technology Priority Maps (“TPMs”) initiated, including one technology-focused pilot (“TFP”) TPM	1	1	0	2
Number of TPMs updated	0	1	1	2
Number of projects initiated	8	14	9	31
Number of outreach events with technology developers with products <5 years from commercialization, including new technology vendors, manufacturers, and entrepreneurs.	2	2	1	5
Number of projects initiated with cooperation from other internal IOU programs associated with each Technology-focused Pilot.	0	1	0	1
Number of TFP initiated as part of the TFP TPM.	1	0	0	1

Program Team

	Company Background	Program Role
ICF	• 10+ years supporting ENERGY STAR ET awards • 2000+ industry partnerships • 400+ technologies screened for Consumers Energy • Key Staff: Paul Kyllo, Steven Long, Aimee Church, Saurabh Shekhadar, Anoushka Cholakath	Prime Contractor responsible for ensuring that all program goals are met; technology scanning, screening and prioritization; technology evaluation and stakeholder engagement
LINCUS INCORPORATED	• 18+ years supporting CA IOU ET programs including screening, evaluation, and transfer to EE programs • Lead engineering firm for workpaper development and custom reviews for CA IOUs • Key Staff: Sabarish Vinod, Cristalle Mauleon	Technology evaluation, and measure package development; stakeholder engagement
NREL NATIONAL RENEWABLE ENERGY LABORATORY	• 40 years of clean energy research • 100% dedication to energy efficiency & renewable research • Managed by the Alliance for Sustainable Energy, LLC • Key Staff: Ramin Faramarzi, Sammy Houssainy	Laboratory testing, comprehensive impact modeling, advanced data analytics and technical support
ERI ENERGY RESOURCES INTEGRATION, LLC	• 10+ years experience supporting CA IOU ET programs • 40+ ET projects including market studies, technology assessment, measure development and workpapers • Key Staff: Eric Noller, Ethan Clifford, Benjamin House	Technology evaluation, and measure package development

Research Plan

2022 Research Plan

Goal	Objectives	Research Activities
Characterize the market for efficient water and space heating in commercial and residential buildings through higher efficiency technologies, advanced controls, and combined space and water heating technologies	• Create a high-level Market and Technology Map as it applies to California EE programs • Update the above Map with more detailed information by working with the TAG and other partners and stakeholders	• Catalog and summarize existing national research activities, available data and research results • Initiate additional research in 2022 to fill data gaps • Prioritize additional technologies for testing in 2023 and beyond based on California current EE program needs
Select water & space heating technologies to test and monitor in 2022 and beyond	• Identify gaps between existing data and what is needed to provide a solution to the EE portfolio • Develop technology-specific project plans to address gaps and position for tech transfer • Inventory technologies that are 1-3 years and 5-10 years from commercial viability	• Test technologies that are market ready but need additional intervention to be program ready • Prioritize additional technologies for further study in 2023

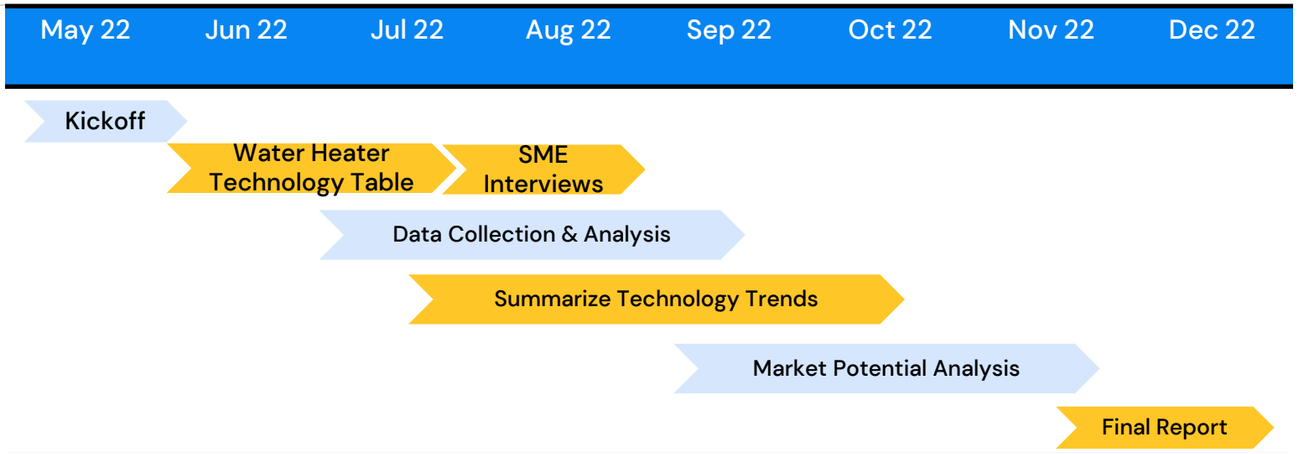
2022 Research Plan

Goal	Objectives	Research Activities
Improve the energy performance and indoor environmental conditions of residential and commercial kitchens	• Quantify market barriers preventing greater adoption of efficient equipment • Perform field studies and demonstration projects that overcome nuances specific to the commercial kitchen market • Evaluate and characterize market for high-efficiency, low-emission burners	• Conduct research to fully understand barriers to market penetration and help identify specific technical solutions to mitigate these barriers • Investigate promising new burner designs to assess their efficiency and emissions performance • Investigate advancements in heat recovery and heat transfer technologies applicable to foodservice
Improve product/operational efficiency of Industrial/agricultural process applications	• Identify technologies and controls that can provide “off the shelf” solutions for small Industrial and Agriculture. • Quantify market barriers preventing greater adoption of efficient equipment and processes • Better understand why waste heat recovery has a greater rate of adoption in Europe versus U.S./California • Identify applications/advantages for Industrial and Agricultural natural gas water pumping and current barriers	• Conduct research to fully understand barriers to market penetration and help identify specific technical solutions to mitigate these barriers • Investigate non-energy impacts such as production, reliability, and emissions for high priority technologies and end uses

Project Summaries

Project Summary

Project Name:	Research and Analyze Water Heating Technology Market & Current Trends
Project ID:	ET22SWG0001
Description:	Analyze & research natural gas water heating technology adoption trends in existing California investor-owned utilities (IOUs) offered energy efficiency (EE) incentive programs, perform market research to understand technology adoption drivers and barriers, and provide actionable recommendations to improve program success.



Expected Outcomes

1. Analysis of research data to better understand the current water heating market, available technologies and impacts on TRC/TSB, and market barriers preventing greater adoption.
2. Quantification of measure-level successes for different water heating technologies within Program Administrator EE programs.
3. Recommendations for Program Administrators to drive higher customer adoption of efficient water heating measures.

Business Case

Gas water heating end-use has a high opportunity for energy savings and is applicable across market segments. A high-level review of installed water heating measures from 2017 to 2021 indicated low adoption relative to the potential indicating significant barriers to adoption of efficient water heating measures. However, there are gaps in knowledge of what the barriers are to higher adoption, what the market drivers are for water heating, what are the most promising efficient water heating measures, and how the GET program can prioritize and address barriers to higher adoption.

Policy Alignment

- SB 350 Clean Energy and Pollution Reduction
- California Long Term EE Strategic Plan
- AB 32 (Global Warming Solutions Act)
- SB 1477 (Building Decarbonization)

#	Risk/Issue Description	Status	Owner	Due Date
001	Availability of technology level market data from IOUs and water heater manufacturers	Active	Cristalle Mauleon	Sep 22

ET22SWG0001 Status Update

Task	Status	Impactful Findings

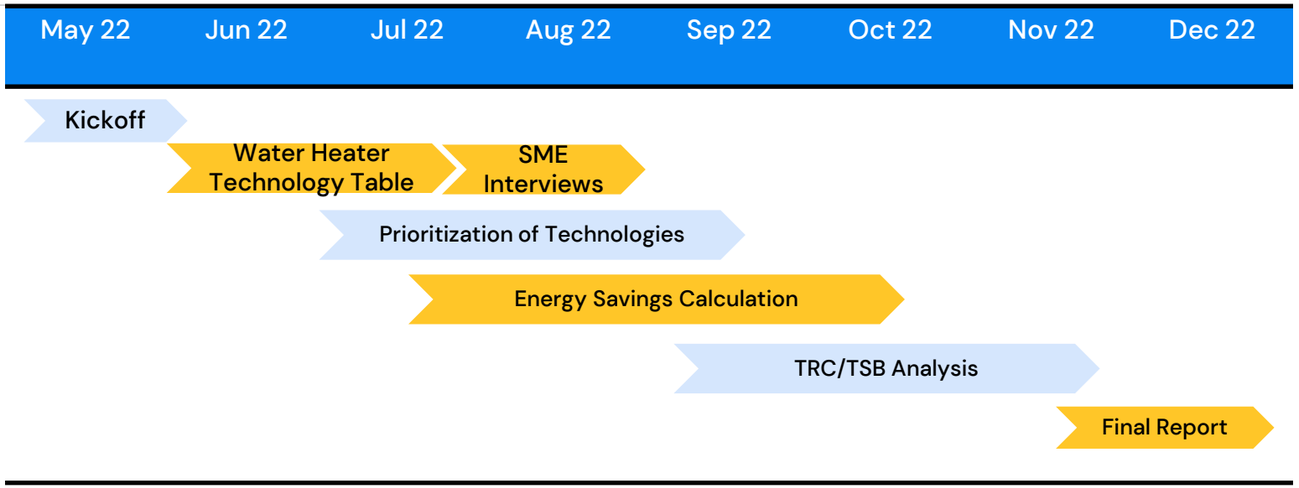
Water Heating Technology Table	Completed	• ET dominated by gas-fired heat pumps that are 1+ year from commercial availability
		  • Gas-fired internal combustion engine DX
		  • Gas-fired absorption
		  • Gas-fired adsorption
		  • Gas-fired thermal compression
		• Controls very important in this space and work still being done

Subject Matter Expert Interviews	Completed	• Highest drivers for ET adoption are
		  • Lower production cost
		  • Independent verification of performance
		  • Environmental compliance with regulations
		• Highest barriers for ET adoption are
		  • Technology cost
		  • Lack of awareness of technology by the customers
		  • Adverse regulatory environment
		  • Uncertainty in performance

Data Collection & Analysis	Completed	• Looked at statewide CEDARS claim data from 2017-2021 • Summarized by measure description
Summarize Technology Trends	Completed	• Condensing tankless water heaters have seen a large increase in adoption over the last 5 years. Costs still higher for these systems even with incentives indicating other factors are in play in decision making • High efficiency boilers and boiler controls are an opportunity for increased adoption • Solar thermal water heating is an opportunity for increased adoption
Market Potential Analysis	In Process	Performing market potential for increased adoption on • Solar thermal water heating systems • Boilers – Multifamily • High Efficiency Pool Heaters • Boiler Controls
Final Report	Expected Q4 2022	None

Project Summary

Project Name:	Evaluation of Water Heater Technologies
Project ID:	ET22SWG0002
Description:	Research emerging gas-fired water heating technologies to prioritize further study by the Statewide Gas Emerging Technologies (GET) program. This project will focus on both residential and small commercial water heating systems ready for lab or field study and will include gas storage water heaters, tankless water heaters, dual-fuel water heaters, combination space & water heating systems, and water heating controls specific to emerging technologies.



Expected Outcomes

1. Inventory of emerging water heating technologies equipment types, manufacturers, and specific technology considerations (e.g., workforce training needs).
2. Identification of market gaps that exist in high priority technologies.
3. Technology specific market barriers for high priority technologies.
4. Identification of technologies recommended for further study.

Business Case

Gas water heating has a high opportunity for therm savings and touches many market segments and customer types. This project will give the GET program a better understanding of emerging technologies in the water heating end-use and their potential in California. Measure potential will be calculated based on information that is publicly available and where information is not available, it will be based on engineering judgement. This project will also guide where emerging technology funds should be spent and will feed into the 2023 Research Plan.

Policy Alignment

- SB 350 Clean Energy and Pollution Reduction
- California Long Term EE Strategic Plan
- AB 32 (Global Warming Solutions Act)
- SB 1477 (Building Decarbonization)

#	Risk/Issue Description	Status	Owner	Due Date
001	Availability of calculation tools required to calculate potential energy savings from nascent technologies	Active	Cristalle Mauleon	Oct 22
002	Availability of reliable equipment cost required for TRC/TSB calculations	Active	Cristalle Mauleon	Nov 22

ET22SWG0002 Status Update

Task	Status	Impactful Findings
Water Heating Technology Table	Completed	• AQMD requirements are very impactful to ET water heating technologies • Codes & Standards are not well aligned to gas-fired absorption water heaters

Subject Matter Expert Interviews	Completed	• Highest drivers for ET adoption are
		  • Lower production cost
		  • Independent verification of performance
		  • Environmental compliance with regulations
		• Highest barriers for ET adoption are
		  • Technology cost
		  • Lack of awareness of technology by the customers
		  • Adverse regulatory environment
		  • Uncertainty in performance

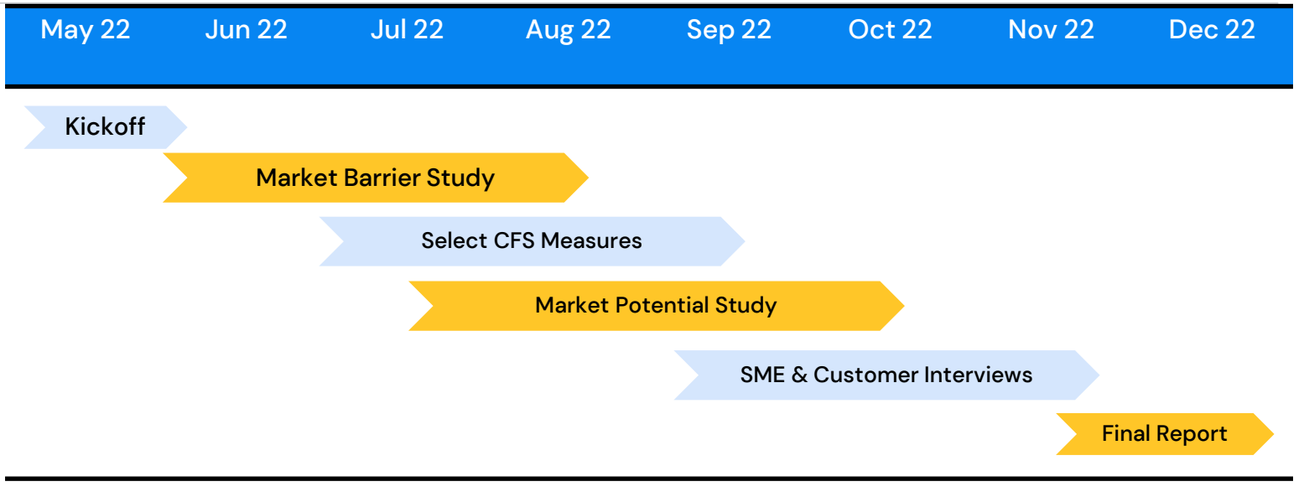
Prioritization of Technologies	Completed	• Prioritized Technologies are
		  • Absorption Heat Pump Water Heater & Combi (DHW & SHW)- Commercial
		  • Internal Combustion Engine Heat Pump Water Heater & Combi - Commercial
		  • Adsorption Heat Pump Water Heater – Residential
		  • Thermal Compression Heat Pump Combi – Commercial & Residential

Energy Savings Calculation	Completed	• Methodology
		  • Followed DEER Water Heater Calculator methodology with changes as needed
		  • Used combination of loads from DEER Water Heater Calculator & DEER Prototype Models
		  • Used best available data on COP as a function of Outside Air Temp
		• Gaps
		  • No modeling software has ability to model gas-fired heat pump water heater
		  • DEER prototype models do not include DHW loads – DHW and SHW needed to properly model combi systems
		  • DEER Water Heater Calculator needs revisions to accommodate gas-fired heat pump water heater
		  • More performance data needed on all technologies
		  • More installation configuration data needed on all technologies
		  • More cost data needed on all technologies

Market Potential Analysis	In Process	Performing market potential on high priority technologies
Final Report	Expected Q4 2022	None

Project Summary

Project Name:	Research and Analyze Commercial Foodservice Technologies
Project ID:	ET22SWG0003
Description:	Research technology adoption trends of commercial food service (CFS) equipment, market adoption barriers, and performance data of installed EE equipment. The goal is to provide recommendations to increase adoption and recommend technologies for further field testing. This project will examine equipment that uses hot water including convection ovens, steamers, fryers, combination ovens, conveyor ovens, griddles, conveyor broilers, rack ovens, steam tables and dishwashers.



Expected Outcomes

1. Identification of specific barriers impacting adoption of CFS equipment and additional data/information required to inform strategies on how to overcome the barriers specific to technologies selected for further research.
2. Recommendations for further study and/or potential projects/pilots in CFS.

Business Case

Food service represents the third highest end-use for natural gas savings potential in California. The achievable incremental potential is estimated to be less than 5% of the economic potential. Since economic potential represents the savings that meet cost-effectiveness threshold, it is important to understand the factors that keep the achievable potential low. This project will help the GET program identify the optimal approaches to overcome underlying barriers to increase adoption of EE CFS measures.

Policy Alignment

- SB 350 Clean Energy and Pollution Reduction
- California Long Term EE Strategic Plan
- AB 802 Building Benchmarking
- AB 32 (Global Warming Solutions Act)
- SB 1477 (Building Decarbonization)

#	Risk/Issue Description	Status	Owner	Due Date
001	Availability of data collected as part of a previous ET study on steam tables	Active	Sabarish Vinod	Jul 22
002	Customer willingness to participate in market study and provide experience with equipment	Active	Sabarish Vinod	Nov 22

ET22SWG0003 Status Update

Task	Status	Impactful Findings

Market Barrier Study	Completed	• Most recent substantive study on CFS operations is from 2015
		• CFS market has undergone many changes due to COVID-19 pandemic
		• Barriers
		  • Fragmented market with diverse supply channel and end uses
		  • Lack of readily available supply which may be exacerbated by supply chain issues from COVID-19 impacts
		  • Increased cost of EE equipment
		  • Lack of customer awareness of EE equipment advantages and performance
		• Manufacturers concentrate more efforts with large chains, but this leaves out a large number of independent restaurants

Commercial Foodservice Measure Selection	Completed	• Selected Measures for Deeper Study
		  • Griddle
		  • Underfired Broiler
		  • Automatic Conveyor Broiler
		  • Steam Tables

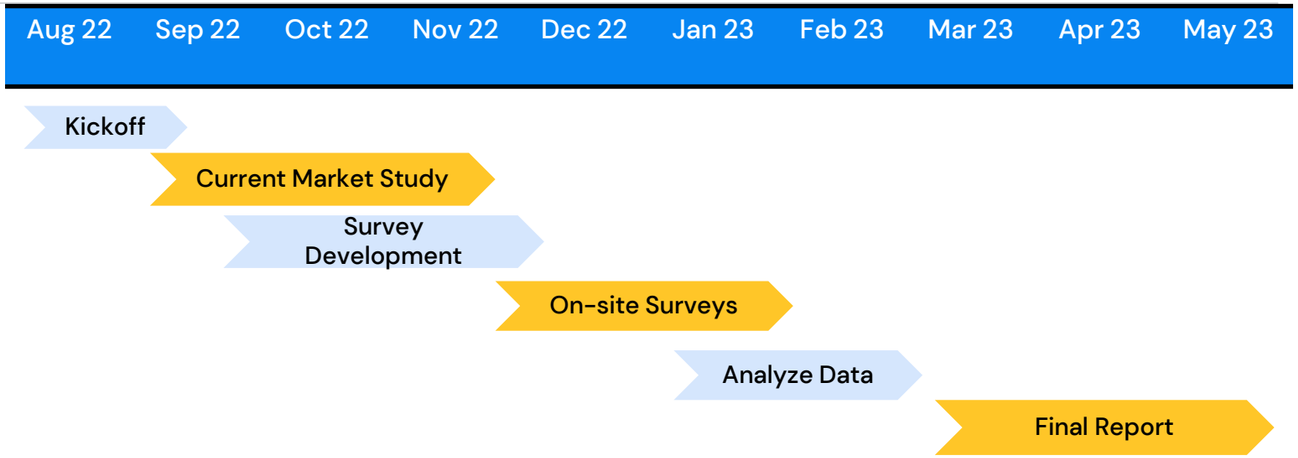
Market Potential	Completed	• Griddle has highest market potential at 1.8 million therms @ 5% penetration rate • Underfired broiler is second with 478k therms @ 5% penetration rate

Subject Matter Expert Interviews	Completed	• Highest Drivers for EE Adoption
		  • Improved performance of EE equipment
		  • Labor savings of EE equipment
		  • Increased capacity of EE equipment leading to increased sales
		• Highest Barriers to EE Adoption
		  • High premiums for EE equipment
		  • Current supply-chain issues
		  • Lack of customer awareness
		• One manufacturer noted that they are reluctant to invest in developing new gas-fired EE CFS equipment until future codes and standards are more predictable especially in California

Customer Interviews	Expected Q4 2022	None
Final Report	Expected Q4 2022	None

Project Summary

Project Name:	Boiler Related EE Measure Assessment Study
Project ID:	ET22SWG0004
Description:	Observe specific measures for enhancing the energy efficiency (EE) of boilers in CA IOU territory. This study will investigate the potential for add-on and maintenance EE measures for the boiler portion of the heating, hot water or process heating part of the system. Additionally, determine if and which boiler related energy efficiency measures have significant potential to be developed into a new statewide deemed measure, a new hybrid approach or a full custom measure.



Expected Outcomes

1. Identify a short list of boiler related measures that are viable for further development when market, savings, cost effectiveness , and potential barriers are considered. These viable measures could then be queued up for future development as deemed or hybrid custom measures.

Business Case

Boilers are a significant portion of the MF hot water heating load. These are often used in commercial buildings for process heat & food processing. Current program offerings for boilers primarily consist of condensing boiler retrofits & related system measures. There is 3.5 times the technical potential for boiler retrofits than for boiler retrofit measures. 80% of gas savings measures are related to boilers and heat recovery for Food processing. In chemical processing, energy efficiency measures are related to boilers and heat recovery. Condensing boilers show potential, but less expensive measures are readily adopted by the market.

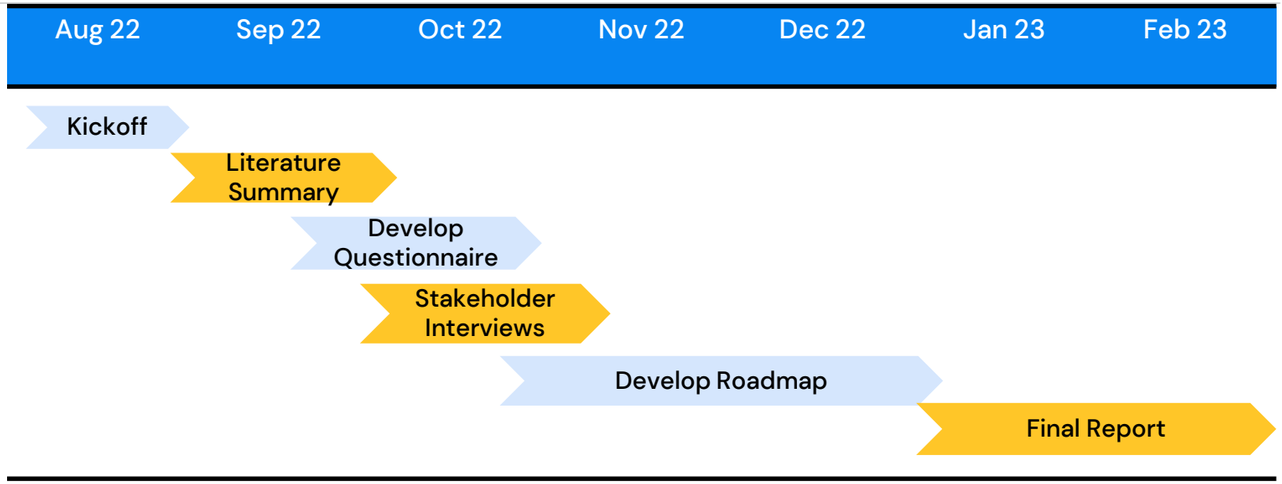
Policy Alignment

- SB 350 Clean Energy and Pollution Reduction
- California Long Term EE Strategic Plan
- AB 758 (Comprehensive EE in Existing Buildings Law)
- AB 32 (Global Warming Solutions Act)

#	Risk/Issue Description	Status	Owner	Due Date
001	Customer outreach and data participation to draw reasonable conclusions	Active	Saurabh Shekhadar	Feb 23

Project Summary

Project Name:	Hydrogen Readiness Labeling of Gas Appliances
Project ID:	ET22SWG0005
Description:	The project will explore the feasibility and approach to develop a framework for labeling process in CA (and potentially in the USA) to provide a uniform means to label gas appliances for use with hydrogen blended natural gas. This would allow consumers to understand if their appliances could be used for future potential changes to the natural gas fuel mix to address climate change. The project will look at the UK model and other related topics such as energy consumption impacts.



Expected Outcomes	Business Case	Policy Alignment
1. Propose a process that has input from multiple stakeholders that outlines those steps and considerations that would be required to implement a hydrogen labeling program.	Hydrogen blends will be added to the natural gas networks in a few years at low levels. The levels are expected to increase as hydrogen becomes readily available, and the implications of doing so are fully understood. Currently, there are no means for customers to understand the implication of this transformation. Labeling would indicate the future potential impact of the fuel supply transformation for the equipment's functionality, and potential impacts on energy consumption. Labeling will allow customers to make educated decisions based on cost and future energy efficient equipment with natural gas-hydrogen blends.	• California Long Term EE Strategic Plan • SB 1477 (Building Decarbonization)

#	Risk/Issue Description	Status	Owner	Due Date
001	Gathering feedback and information from appropriate stakeholders to develop recommendations	Active	Anoushka Cholakath	Oct 22

→ Q&A

Save the Date

Next Event

- Date: November 7, 2022
- Time: 9–11am PST
- Topic: 2023 Annual Research Plan
- Purpose: Solicit industry input on planning efforts for 2023 research activities

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Additional Resources

Website Links

Gas Emerging Technologies Program: www.cagastech.com

Electric Emerging Technologies Program: www.calnext.com

Emerging Technologies Coordinating Council: www.etcc-ca.com

Emerging Technologies Reporting website: www.ca-etp.com

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