

GRANT REQUEST FORM (GRF)



New Agreement PIR-16-003 (To be completed by CGL Office)

ERDD	Jackson Thach	51	916-327-1625
------	---------------	----	--------------

Institute of Gas Technology dba Gas Technology Institute	36-2170137
--	------------

Demonstration and Assessment of Residential Gas Heat Pump Water Heaters in the Los Angeles Basin

2/27/2017	4/15/2019	\$ 1,084,230
-----------	-----------	--------------

ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	1/25/2017	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Jackson Thach	Time Needed:	5 minutes

Please select one list serve. NaturalGas (NG Research Program)

Agenda Item Subject and Description

INSTITUTE OF GAS TECHNOLOGY DBA GAS TECHNOLOGY INSTITUTE (GTI). Proposed resolution approving agreement PIR-16-003 with Institute of Gas Technology dba Gas Technology Institute (GTI) for a \$1,084,230 grant to advance the commercialization of a residential gas-fired heat pump water heater through field demonstration, extended-life laboratory testing, development of modeling tools, and through stakeholder outreach events. The technology will be field tested in homes in the Los Angeles Basin.

- Is Agreement considered a "Project" under CEQA?
 - Yes (skip to question 2)
 - No (complete the following (PRC 21065 and 14 CCR 15378)): Explain why Agreement is not considered a "Project":
 Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because This project consists of the replacement of an existing natural gas water heater with a gas-fired heat pump water heater and subsequent monitoring and evaluation. All activities will take place within the footprint of existing single family homes in the Los Angeles basin.
- If Agreement is considered a "Project" under CEQA:
 - a) Agreement **IS** exempt. (Attach draft NOE)
 - Statutory Exemption. List PRC and/or CCR section number: _____
 - Categorical Exemption. List CCR section number: _____
 - Common Sense Exemption. 14 CCR 15061 (b) (3)
 Explain reason why Agreement is exempt under the above section: _____
 - b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)
 Check all that apply

<input type="checkbox"/> Initial Study	<input type="checkbox"/> Environmental Impact Report
<input type="checkbox"/> Negative Declaration	<input type="checkbox"/> Statement of Overriding Considerations
<input type="checkbox"/> Mitigated Negative Declaration	

Legal Company Name:	Budget
Stone Mountain Technologies Inc.	\$ 99,000
ADM Associates, Inc.	\$ 67,900
ConsumerQuest, Inc.	\$ 75,000
Davis Energy Group, Inc.	\$ 98,000
Southern California Gas Company	\$ 98,100
Fast Water Heater Co.	\$ 62,200
Applied Research West, Inc.	\$ 65,200
VERIZON WIRELESS	\$ 1,350
FedEx Corporation	\$ 10,285

Exhibit A
Scope of Work
GAS TECHNOLOGY INSTITUTE

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR¹	Task Name
1		General Project Tasks
2	X	Field Evaluation of Gas Heat Pump Water Heater
3		Performance and Extended Life Testing
4		Model Development and Title 24 Analysis
5		Research and Quantify Market Barriers
6		Outreach
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
ACM	Alternative Calculation Method
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
DEG	Davis Energy Group
EAC	Engineering Analysis Center
GE	General Electric
GHG	Greenhouse Gas
GHPWH	Gas Heat Pump Water Heater
GWP	Global Warming Potential
HPWH	Heat Pump Water Heater
M&V	Measurement and Verification
ODP	Ozone Depletion Potential
SCAQMD	South Coast Air Quality Management District
SCG	Southern California Gas
SMTI	Stone Mountain Technologies Incorporated
TAC	Technical Advisory Committee
UEF	Uniform Energy Factor

II. PURPOSE OF AGREEMENT, PROBLEM/SOLUTION STATEMENT, AND GOALS AND OBJECTIVES

A. Purpose of Agreement

The purpose of this Agreement is to fund a field and laboratory evaluation of a pre-commercial Gas Heat Pump Water Heater (GHPWH) in residential homes and through extended laboratory

¹ Please see subtask 1.3 in Part III of the Scope of Work (General Project Tasks) for a description of Critical Project Review (CPR) Meetings.

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

lifetime testing. With data generated, the project team will extrapolate results with model development in preparation for incorporation into efficiency codes and the barriers to market entry will be assessed.

B. Problem/ Solution Statement

Problem

Residential gas water heating is the largest gas load in California homes and, for a state that has one in four gas water heaters sold in the U.S., it is a significant portion of the national gas water heating market. Despite this fact and that California has long been a leader in the development and adoption of novel high-efficiency technologies, there are few cost-effective options for consumers to move beyond code-minimum efficiency gas water heaters.

Following early stage research and development, including early stage field trials, the GHPWH, designed by Stone Mountain Technologies Incorporated (SMTI) with support from the Recipient and General Electric (GE), is approaching market readiness with a projected Uniform Energy Factor of 1.3. Early-stage demonstrations, with an emphasis on verifying savings, technology reliability, and on market and stakeholder feedback, are critical to the success of introducing such a new technology that is uniquely suited for the California market.

Solution

A multi-site residential GHPWH field trial and laboratory GHPWH evaluation of performance, emissions, and reliability is a critical step towards commercial introduction of this advanced technology to the gas water heating market. Additionally, the team will address three other important areas in advance market introduction of this new technology: development of modeling tools for technology evaluation by stakeholders, perform benefits and cost-effectiveness analyses in preparation for inclusion within efficiency codes, and assessing market barriers to entry. With projected therm and CO₂ emission savings of 50% or greater versus baseline gas water heating, benefits to California ratepayers are large.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Demonstrate a new class of high efficiency gas water heaters
- Assess improvements made to this generation of GHPWHs, in field and laboratory evaluations
- Through analysis and evaluation, develop analytical tools to prepare this new technology class for inclusion within critical frameworks, including: utility incentive programs, energy efficiency codes, and building energy models
- Share findings broadly to introduce the technology and solicit feedback from consumers, installation contractors, code officials, and other stakeholders

Ratepayer Benefits: This Agreement will result in the ratepayer benefit of lower energy costs through supporting the GHPWH commercialization effort and evaluating the GHPWH as a new product category, increasing the potential of such a high-efficiency technology being commercially available in the near term. As estimated in earlier-stage GHPWH field demonstrations, California ratepayers that purchase a GHPWH could expect 50% or more

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

therm savings with the lowest 10-year cost of ownership for any water heating technology over baseline, code-minimum storage water heaters. Additionally, the GHPWH emits fewer greenhouse gas (GHG) emissions than all other gas-fired options. It uses a natural refrigerant/absorbent pair, ammonia-water, using working fluids with zero Ozone Depletion Potential (ODP) and zero Global Warming Potential (GWP).

Technological Advancement and Breakthroughs: This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by supporting the evaluation, demonstration, and technology transfer of a new class of gas water heating technology, the GHPWH. The GHPWH is a breakthrough technology, which integrates a small, gas-fired, single-effect, absorption heat pump with a hot water storage tank. It has a projected Uniform Energy Factor (UEF) of 1.30, over twice that of the most common minimum-efficiency gas storage water heaters, and has previously demonstrated therm savings of 50% or more through field testing of previous generations of this technology. The GHPWH is designed by a startup company specializing in gas-fired heat pumps, SMTI, with technical support from the Recipient and major water heater manufacturers. This project will result in the aforementioned ratepayer benefits by:

- Supporting the late-stage demonstration of a pre-commercial technology, supporting stakeholders and manufacturing partners in verifying performance claims and understanding the impact of “real world” operating conditions on the technology.
- Introducing the technology to consumers, installation contractors, and the distribution network and soliciting critical feedback prior to market entry.
- Providing independent and verified estimates of energy and operating cost savings and, with active dissemination of results and findings, introducing the new technology category to relevant decision makers concerning positive market interventions (e.g., incentives) and requirements (e.g., codes and standards).

Agreement Objectives

The objectives of this Agreement are to:

- Demonstrate five “fourth generation” GHPWHs in single-family homes, using datasets to estimate annual energy, operating cost, and emissions savings.
- Quantify GHPWH energy efficiency, emissions, and reliability through performance and extended life laboratory testing.
- As a new product category, prepare stakeholders and code officials with information sharing, model development, and analysis.
- Assess and evaluate market barriers to entry for the GHPWH in California.
- Obtain valuable feedback from end users, installation contractors, and other stakeholders prior to GHPWH commercial introduction.

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below

Exhibit A Scope of Work GAS TECHNOLOGY INSTITUTE

by the dates listed in the **Project Schedule (Part V)**. Products that require a draft version are indicated by marking “**(draft and final)**” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, “**days**” means working days.

The Recipient shall:

For products that require a draft version, including the Final Report Outline and Final Report

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Consider incorporating all CAM comments into the final product. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product.
- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

For products that require a final version only

- Submit the product to the CAM for acceptance. The CAM may request minor revisions or explanations prior to acceptance.

For all products

- Submit all data and documents required as products in accordance with the following:

Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**

Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the Energy Commission’s software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Documents intended for public distribution will be in PDF file format.
- The Recipient must also provide the native Microsoft file format.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

Exhibit A Scope of Work GAS TECHNOLOGY INSTITUTE

- **Software Application Development**

Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:

- Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
- Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
- Visual Studio.NET (version 2008 and up). Recommend 2010.
- C# Programming Language with Presentation (UI), Business Object and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

Any exceptions to the Electronic File Format requirements above must be approved in writing by the CAM. The CAM will consult with the Energy Commission's Information Technology Services Branch to determine whether the exceptions are allowable.

MEETINGS

Subtask 1.2 Kick-off Meeting

The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

- Attend a "Kick-off" meeting with the CAM, the Commission Agreement Officer (CAO), and any other Energy Commission staff relevant to the Agreement. The Recipient will bring its Project Manager and any other individuals designated by the CAM to this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The administrative portion of the meeting will include discussion of the following:

- Terms and conditions of the Agreement;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

The technical portion of the meeting will include discussion of the following:

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
 - An updated Project Schedule;
 - Technical products (subtask 1.1);
 - Progress reports and invoices (subtask 1.5);
 - Final Report (subtask 1.6);
 - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
 - Any other relevant topics.
- Provide an *Updated Project Schedule*, *List of Match Funds*, and *List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

- Designate the date and location of the meeting.
- Send the Recipient a *Kick-off Meeting Agenda*.

Recipient Products:

- Updated Project Schedule (*if applicable*)
- Updated List of Match Funds (*if applicable*)
- Updated List of Permits (*if applicable*)

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

The goal of this subtask is to determine if the project should continue to receive Energy Commission funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient, and may include the CAO and any other individuals selected by the CAM to provide support to the Energy Commission.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

- Prepare a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

The CAM shall:

- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* and a *List of Expected CPR Participants* in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a *Schedule for Providing a Progress Determination* on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

CAM Products:

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- Progress Determination

Subtask 1.4 Final Meeting

The goal of this subtask is to complete the closeout of this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
 - Disposition of any state-owned equipment.
 - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.

Exhibit A
Scope of Work
GAS TECHNOLOGY INSTITUTE

- The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
 - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
 - "Surviving" Agreement provisions such as repayment provisions and confidential products.
 - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
 - Prepare a *Schedule for Completing Agreement Closeout Activities*.
 - Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

- Final Meeting Agreement Summary (*if applicable*)
- Schedule for Completing Agreement Closeout Activities
- All Draft and Final Written Products

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
 - Summarize progress made on all Agreement activities as specified in the scope of work for the preceding month, including accomplishments, problems, milestones, products, schedule, fiscal status, and an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions, including a financial report on Match Fund and in-state expenditures.

Products:

- Progress Reports
- Invoices

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

Subtask 1.6 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use the Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM. (See Task 1.1 for requirements for draft and final products.)

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

- Style Manual
- Comments on Draft Final Report Outline
- Approval of Final Report Outline

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Style Manual, and Final Report Template provided by the CAM with the following considerations:
 - Ensure that the report includes the following items, in the following order:
 - Cover page (**required**)
 - Credits page on the reverse side of cover with legal disclaimer (**required**)
 - Acknowledgements page (optional)
 - Preface (**required**)
 - Abstract, keywords, and citation page (**required**)
 - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
 - Executive summary (**required**)
 - Body of the report (**required**)
 - References (if applicable)
 - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
 - Bibliography (if applicable)
 - Appendices (if applicable) (Create a separate volume if very large.)
 - Attachments (if applicable)

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

- Ensure that the document is written in the third person.
- Ensure that the Executive Summary is understandable to the lay public.
 - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
 - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
 - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
- Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
- Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- Include a brief description of the project results in the Abstract.

- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

Products:

- Final Report (draft and final)
- Written Responses to Comments on the Draft Final Report

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

Exhibit A Scope of Work GAS TECHNOLOGY INSTITUTE

The Recipient shall:

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state this in the letter.

If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:

- A list of the match funds that identifies:
 - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
 - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its
 - owner and provide a contact name, address, telephone number, and the address where the property is located.
 - A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

- Match Funds Status Letter
- Supplemental Match Funds Notification Letter (*if applicable*)
- Match Funds Reduction Notification Letter (*if applicable*)

Subtask 1.8 Permits

The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

- A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
- The schedule the Recipient will follow in applying for and obtaining the permits.

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

- Permit Status Letter
- Updated List of Permits (*if applicable*)
- Updated Schedule for Acquiring Permits (*if applicable*)
- Copy of each Approved Permit (*if applicable*)

Subtask 1.9 Subcontracts

The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

- Subcontracts (*draft if required by the CAM*)

Exhibit A Scope of Work GAS TECHNOLOGY INSTITUTE

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
 - Technical area expertise;
 - Knowledge of market applications; or
 - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

The TAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter;
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives);
- Public interest market transformation implementers;
- Product developers relevant to the project;
- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.

Exhibit A
Scope of Work
GAS TECHNOLOGY INSTITUTE

- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

Subtask 1.11 TAC Meetings

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

The Recipient shall:

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

Products:

- TAC Meeting Schedule (draft and final)
- TAC Meeting Agendas (draft and final)
- TAC Meeting Back-up Materials
- TAC Meeting Summaries

Exhibit A
Scope of Work
GAS TECHNOLOGY INSTITUTE

IV. TECHNICAL TASKS

TASK 2 Field Evaluation of Gas Heat Pump Water Heater

The goals of this task are to (1) finalize residential field host sites, (2) specify and procure the field data acquisition systems for fault detection and diagnosis and independent measurement and verification (M&V), (3) install field data acquisition systems and perform baseline monitoring of the existing water heating equipment, (4) prepare the GHPWH prototypes for field testing and ship to host sites, (5) install and monitor prototypes for 12 months including hardware troubleshooting as needed, and (6) prepare datasets for analysis and review.

The Recipient shall:

- Finalize selection of five residential field test sites, following interviews and site inspections.
- In conjunction with the independent M&V contractor, develop a data acquisition specification to meet the parallel goals of M&V of energy savings and other benefits and prototype fault detection and diagnosis. Prepare and issue a summary of the field test plan in the *Field Demonstration Execution and Monitoring Plan*.
- Procure data acquisition hardware package and prepare for installation, and ship to installation contractor.
- With installation contractor, install data acquisition systems at the residential sites, including preparation of infrastructure (plumbing, electrical, etc.) for the eventual installation of GHPWH prototypes.
- Prepare an end user and installation contractor survey instrument for pre/post GHPWH installation.
- Commission data acquisition system for monitoring of baseline (existing) water heater for a period of at least two months.
- Collect and summarize data during baseline monitoring phase, collect the pre-installation survey responses from end users and installation contractors. Prepare and issue a *Baseline Field Demonstration Monitoring Report*.
- Build five (5) GHPWH prototypes, proving field-worthiness with limited laboratory testing and prepare for shipment from Tennessee.
- Ship five (5) GHPWH prototypes to installation contractor warehouses in the Los Angeles Basin. Inspect prototypes and repair as needed, deliver prototypes to residential sites, and install on-site, using existing prepared plumbing/electrical connections. Modify site instrumentation as needed and shift to GHPWH monitoring phase.
- Commission GHPWH prototype and test fault detection and diagnosis system, modifying and repairing as needed.
- Initiate GHPWH monitoring period, collecting data for 12 months. Troubleshoot GHPWH remotely and, on an as-needed basis, perform site repairs to prototype and/or data acquisition hardware.
- Halfway through the GHPWH monitoring period, prepare a *CPR Report* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.
- De-commission the GHPWH prototypes and associated equipment, remove from sites and ship back to manufacturer for teardown analysis. Set up second baseline monitoring

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

for the site water heating with the high efficiency water heaters and original A/C equipment and monitor energy usage for up to 3 months. Collect and summarize data during second baseline monitoring phase to compare baseline and prototype energy data. Collect post-installation survey responses from end users and installation contractors.

- Summarize GHPWH data collected and survey results in *GHPWH Field Demonstration Monitoring Report* that includes a review of prototype performance compared to baseline, reliability, end user satisfaction, contractor feedback, and whether the units have demonstrated 50% or more natural gas savings compared to baseline equipment.

Products:

- Field Demonstration Execution and Monitoring Plan
- Baseline Field Demonstration Monitoring Report (draft and final)
- CPR Report
- GHPWH Field Demonstration Monitoring Report (draft and final)

TASK 3 Performance and Extended Life Testing

The goal of this task is to perform extensive laboratory testing of one GHPWH prototype at the Southern California Gas (SCG) Engineering Analysis Center (EAC), including measurement of performance, energy efficiency, emissions, and reliability. These tests give the team an opportunity to compare results from “as-installed” to controlled laboratory performance and investigate GHPWH reliability via accelerated life testing.

The Recipient shall:

- Work with subcontractors to develop and draft a *GHPWH Experimental Test Plan*.
- Procure the requisite instrumentation, controls, and data acquisition hardware per the test plan requirements.
- Direct subcontractor to build a GHPWH test stand at the EAC facility.
- Direct subcontractor to build a sixth GHPWH prototype, proving lab-worthiness with limited laboratory testing and prepare for shipment from Tennessee.
- Ship one GHPWH prototype to the SCG EAC facility and supervise its installation on the test stand. Commission the GHPWH and, as-needed, repair the prototype.
- Initiate the experimental test plan, comprised of:
 - Short term tests: Simulated Use Tests using standard (U.S. Department of Energy) and field-derived draw patterns, Emissions test for criteria air pollutants focusing on NO_x and CO, and Steady State rating points to determine operating Coefficients of Performance.
 - Long term tests: Accelerated Operating Life Tests over the duration of the Task 2 Field Evaluation. Perform periodic spot tests to assess degradation of estimated efficiency and emission tests.
- Summarize laboratory GHPWH results and issue a *GHPWH Experimental Test Report*.

Products:

- GHPWH Experimental Test Plan
- GHPWH Experimental Test Report (draft and final)

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

TASK 4 Model Development and Title 24 Analysis

The goals of this task are to use field and laboratory results, in conjunction with data from previous and complementary efforts, to develop a user-friendly spreadsheet based modeling tool to estimate the performance and energy savings of a GHPWH versus other water heating options and serve as a design sizing tool. Another goal is to perform a “Title 24 Analysis” wherein the impact of including GHPWHs as a product category is assessed against the current prescriptive Title 24 water heating options, including statewide energy impacts, cost-effectiveness estimates, and GHG/water impacts.

The Recipient shall:

- Aggregate early findings from Task 2 and Task 3 and develop a framework for a user-friendly GHPWH modeling tool. The tool is intended to support comparative analyses of water heating technology categories and provide an estimate of annual operating efficiency and energy savings based on installation type, hot water usage, and California Climate Zone.
- Test GHPWH modeling tool against current and prior datasets and review. Refine as needed and issue a *GHPWH Sizing and Performance Model*.
- Using the data gathered at the close of Tasks 2 and 3, perform a “Title 24 Analysis.” Evaluate the relative cost effectiveness of the GHPWH in comparison to other competing water heater technologies and other energy efficiency measures commonly used to exceed the 2016 Title 24 performance level. Combine performance data and estimated costs developed as part of the research effort, with detailed CBECC-Res (California Building Energy Code Compliance for Residential) modeling and measure cost data available, issue a *GHPWH Title 24 Analysis Report*.
- Develop a framework for GHPWH integration in the Residential Alternative Calculation Method (ACM). With the 2016 ACM, the water heating methodology has been completely reconfigured with a disaggregated hot water draw schedule and very sophisticated modeling of electric HPWHs. Using data from Task 3 and in support of integrating the GHPWH within the ACM, prepare an *ACM Implementation Strategy White Paper*.

Products:

- GHPWH Sizing and Performance Model (Draft and Final)
- GHPWH Title 24 Analysis Report (draft and final)
- ACM Implementation Strategy White Paper

TASK 5 Research and Quantify Market Barriers

The goal of this task is to survey and quantify market barriers to broad GHPWH adoption in the Los Angeles Basin, once commercialized. Barriers considered include real and perceived barriers to consumer adoption and contractor recommendation (home performance contractors, HVAC, and plumbing contractors included).

The Recipient shall:

- With input from the manufacturing partners and the Recipient, develop consumer and contractor surveys to develop a better understanding of barriers to GHPWH adoption in the Los Angeles Basin.

Exhibit A
Scope of Work
GAS TECHNOLOGY INSTITUTE

- Perform quantitative research through a survey of 500 contractor professionals (plumbers, HVAC, home energy improvement) and 1,000 homeowners, within the Los Angeles Basin. This is to gain quantifiable understanding of numerous factors that will support the advancement of GHPWHs. For contractor professionals, this includes (but is not limited to) profit margin requirements, technical and safety concerns, staff training such as customer segments and volumes, suggested pricing, incentive management, and sales and marketing support needs. For homeowners, this includes (but is not limited to) price and economics sensitivity, feature preferences, installation concerns, marketing message tests, awareness of alternatives, and transactional dynamics.
- Perform qualitative research through moderated focus groups with a focus on Los Angeles Basin, with some regional variety. Target groups will include contractors (plumbers, HVAC, home performance contractors) and homeowners. Participants will be screened to include only decision-makers regarding product or supplier selection.
- Summarize results and analysis of the surveys in a *Market Barriers to GHPWH Adoption in the Los Angeles Basin* report.

Products:

- Market Barriers to GHPWH Adoption in the Los Angeles Basin report (draft and final)

TASK 6 Outreach

The goals of this task are to (1) educate prospective GHPWH consumers, installation contractors, and other affected stakeholders through a series of workshops to introduce the GHPWH technology and summarize project findings and (2) develop educational content and materials for contractors and utility ratepayers.

The Recipient shall:

- Work with project partners to host at least two (2) public GHPWH workshops, with one hosted at the SCG EAC facility (second location to be determined), inviting installation contractors, code officials, end users, and other interested parties to learn about the GHPWH technology, review project results, and solicit feedback on this new product category. Prepare *Workshop Presentation and Written Materials* for public use and make available online.
- Prepare and publish two sets of publicly available educational materials:
 - *Installation Contractor Educational and Training Materials*, prepared in digital form and published online for general use.
 - *Ratepayer GHPWH Technology Snapshot*, prepared in digital form and made available to California Investor Owned Utilities for linking to their websites.

Products:

- Workshop Presentation and Written Materials (draft and final)
- Installation Contractor Educational and Training Materials
- Ratepayer GHPWH Technology Snapshot

Exhibit A
Scope of Work
GAS TECHNOLOGY INSTITUTE

TASK 7 Evaluation of Project Benefits

The goal of this task is to report the benefits resulting from this project.

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*, (2) *Mid-term Benefits Questionnaire*, and (3) *Final Meeting Benefits Questionnaire*.
- Provide key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
 - For Product Development Projects and Project Demonstrations:
 - Published documents, including date, title, and periodical name.
 - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
 - Greenhouse gas and criteria emissions reductions.
 - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
 - A discussion of project product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
 - Additional Information for Product Development Projects:
 - Outcome of product development efforts, such copyrights and license agreements.
 - Units sold or projected to be sold in California and outside of California.
 - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
 - Investment dollars/follow-on private funding as a result of Energy Commission funding.
 - Patent numbers and applications, along with dates and brief descriptions.
 - Additional Information for Product Demonstrations:
 - Outcome of demonstrations and status of technology.
 - Number of similar installations.
 - Jobs created/retained as a result of the Agreement.
 - For Information/Tools and Other Research Studies:
 - Outcome of project.
 - Published documents, including date, title, and periodical name.
 - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.

Exhibit A

Scope of Work

GAS TECHNOLOGY INSTITUTE

- The number of website downloads.
 - An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
 - An estimate of energy and non-energy benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
 - A discussion of project product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

Products:

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

TASK 8 Technology/Knowledge Transfer Activities

The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

The Recipient shall:

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
 - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
 - A description of the intended use(s) for and users of the project results.
 - Published documents, including date, title, and periodical name.
 - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
 - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
 - The number of website downloads or public requests for project results.
 - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.

Exhibit A
Scope of Work
GAS TECHNOLOGY INSTITUTE

- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop(s) on the project.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- High Quality Digital Photographs
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: GAS TECHNOLOGY INSTITUTE

RESOLVED, that the State Energy Resources Conservation and Development Commission (Energy Commission) adopts the staff CEQA findings contained in the Agreement or Amendment Request Form (as applicable); and

RESOLVED, that the Energy Commission approves Agreement PIR-16-003 from GFO-16-502 with Institute of Gas Technology dba Gas Technology Institute (GTI) for a \$1,084,230 grant to advance the commercialization of a residential gas-fired heat pump water heater through field demonstrations, extended-life laboratory testing, development of modeling tools, and stakeholder outreach events. The technology will be field tested in homes in the Los Angeles Basin; and

FURTHER BE IT RESOLVED, that the Executive Director or his/her designee shall execute the same on behalf of the Energy Commission.

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on January 25, 2017

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat