



**CALIFORNIA  
ENERGY COMMISSION**



**California Energy Commission  
March 12, 2026 Business Meeting  
Backup Materials for Institute of Gas Technology dba GTI Energy**

The following backup materials for the above-referenced agenda item are available in this PDF packet as listed below:

1. Proposed Resolution
2. Grant Request Form
3. Scope of Work

**CALIFORNIA ENERGY COMMISSION**

**PROPOSED RESOLUTION: Institute of Gas Technology dba GTI Energy**

**RESOLUTION NO: 26-0312-XX**

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

**RESOLVED**, that the CEC approves Agreement EPC-25-041 with Institute of Gas Technology dba GTI Energy for a \$1,750,000 grant. This project will demonstrate the performance and benefits of vacuum insulated glass (VIG) windows via laboratory testing, thermal modeling and field demonstration. The project will also explore improvements in VIG value propositions, address cost and durability concerns, and develop a plan for broad market adoption. The project is partnering with major VIG and window manufacturers to develop and demonstrate high-performance VIG solutions in single-family and multi-family residential buildings in Sonoma and Ventura Counties; and

**FURTHER BE IT RESOLVED**, that the Executive Director or their designee shall execute the same on behalf of the CEC.

**APPROVED AND ADOPTED** this 12th day of March 2026, by the following vote:

AYE:

NAY:

ABSENT:

ABSTAIN:

**CERTIFICATION**

The undersigned Secretariat to the CEC does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly approved and adopted by affirmative vote of the CEC at a meeting held on March 12, 2026.

Kim Todd  
Secretariat



## GRANT REQUEST FORM (GRF)

### A. New Agreement Number

**IMPORTANT:** New Agreement # to be completed by Contracts, Grants, and Loans Office.

**New Agreement Number:** EPC-25-041

### B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Jeanie Mar
3. MS-:None
4. Phone Number: None

### C. Recipient's Information

1. Recipient's Legal Name: Institute of Gas Technology dba GTI Energy

### D. Title of Project

Title of project: VIG-based Residential Retrofits to Demonstrate Enhanced Efficiency and Comfort

### E. Term and Amount

1. Start Date: 4/20/2026
2. End Date: 9/30/2030
3. Amount: \$1,750,000.00

### F. Business Meeting Information

1. Are the ARFVTP agreements \$75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 3/12/2026.
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Jeanie Mar
5. Time Needed for Business Meeting: 5 minutes.
6. The email subscription topic is: Electric Program Investment Charge (EPIC)

#### **Project Description:**

Proposed resolution approving agreement EPC-25-041 with Institute of Gas Technology dba GTI Energy for a \$1,750,000 grant and adopting staff's recommendation that this action is exempt from CEQA. This project will demonstrate the performance and benefits of vacuum insulated glass (VIG) windows via laboratory testing, thermal modeling and field demonstration. The project will also explore improvements in VIG value propositions, address cost and durability concerns, and develop a plan for broad market adoption. The project is partnering with major VIG and window manufacturers to develop and demonstrate high-performance VIG solutions in single-family and multi-family residential buildings.

### G. California Environmental Quality Act (CEQA) Compliance

#### **1. Is Agreement considered a "Project" under CEQA?**

Yes

If yes, skip to question 2.



If no, complete the following (PRC 21065 and 14 CCR 15378) and 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:

**2. If Agreement is considered a "Project" under CEQA answer the following questions.**

a) Agreement **IS** exempt?

Yes

Statutory Exemption?

No

If yes, list PRC and/or CCR section number(s) and separate each with a comma. If no, enter "None" and go to the next question.

PRC section number: None

CCR section number: None

Categorical Exemption?

Yes

If yes, list CCR section number(s) and separate each with a comma. If no, enter "None" and go to the next question.

CCR section number: Cal. Code Regs., tit. 14, § 15301 ; Cal. Code Regs., tit. 14, § 15306 ;

Common Sense Exemption? 14 CCR 15061 (b) (3)

No

If yes, explain reason why Agreement is exempt under the above section. If no, enter "Not applicable" and go to the next section.

This project fits within Cal. Code Regs. tit. 14, sect. 15301, Existing Buildings, because it involves minor retrofit alterations and installations of energy efficient windows in at least 15 existing single and multifamily residential units to improve building performance, with no expansion of capacity. These installations will be in existing, developed sites on land that are not environmentally sensitive. No historical resources or buildings will be affected. Noise and odors will not be generated by these installations in excess of existing permitted amounts. The installation will not increase traffic to these sites and will not require permits for air, water, conditional use, building expansion, hazardous waste or rezoning.

Additionally, Cal. Code Regs. tit. 14, sect. 15306, Information Collection, applies because this project also involves basic data collection, research, experimental management, and resource evaluation activities which do not result in serious or major disturbance to an environmental resource.

This project does not involve impacts on any particularly sensitive environment; any cumulative impacts of successive projects of the same type in the same place that might be considered significant; does not involve unusual circumstances that might have a significant effect on the environment; will not result in damage to scenic resources within a highway officially designated as a state scenic highway; the



project sites are not included on any list compiled pursuant to Government Code section 65962.5, and the project will not cause a substantial adverse change in the significance of a historical resource. Therefore, none of the exceptions to categorical exemptions listed in CEQA Guidelines section 15300.2 apply to this project, and this project will not have a significant effect on the environment.

b) Agreement **IS NOT** exempt.

**IMPORTANT:** consult with the legal office to determine next steps.

No

If yes, answer yes or no to all that applies. If no, list all as “no” and “None” as “yes”.

Additional Documents	Applies
Initial Study	No
Negative Declaration	No
Mitigated Negative Declaration	No
Environmental Impact Report	No
Statement of Overriding Considerations	No
None	Yes

**H. Is this project considered “Infrastructure”?**

No

**I. Subcontractors**

List all Subcontractors listed in the Budget (s) (major and minor). Insert additional rows if needed. If no subcontractors to report, enter “No subcontractors to report” and “0” to funds.

**Delete** any unused rows from the table.

Subcontractor Legal Company Name	CEC Funds	Match Funds
The Regents of the University of California as Manager and Operator of the Lawrence Berkeley National Laboratory	\$ 450,000	\$0
A2 Efficiency, inc.	\$ 30,000	\$0
Latino Service Providers	\$ 48,500	\$ 1,500
Mixteco/Indigena Community Organizing Project	\$ 48,500	\$ 1,500
Milgard Manufacturing LLC	\$ 0	\$ 25,000
Guardian Industries, LLC	\$ 0	\$ 25,000

**J. Vendors and Sellers for Equipment and Materials/Miscellaneous**

List all Vendors and Sellers listed in Budget(s) for Equipment and Materials/Miscellaneous. Insert additional rows if needed. If no vendors or sellers to report, enter “No vendors or sellers to report” and “0” to funds. **Delete** any unused rows from the table.



Vendor/Seller Legal Company Name	CEC Funds	Match Funds
Architectural Testing, Inc.	\$25,000	\$0
TBD - Installation Contractor	\$70,000	\$0
TBD - Installation Contractor #2	\$70,000	\$0
TBD - Evaluation	\$15,000	\$0

**K. Key Partners**

List all key partner(s). Insert additional rows if needed. If no key partners to report, enter “No key partners to report.” **Delete** any unused rows from the table.

Key Partner Legal Company Name
National Fenestration Rating Council
MI Window and Doors, LLC

**L. Budget Information**

Include all budget information. Insert additional rows if needed. If no budget information to report, enter “N/A” for “Not Applicable” and “0” to Amount. **Delete** any unused rows from the table.

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	25-26	301.001M	\$ 1,750,000

**TOTAL Amount:** \$ 1,750,000

R&D Program Area: ICMB: Buildings

Explanation for “Other” selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

**M. Recipient’s Contact Information**

**1. Recipient’s Administrator/Officer**

Name: Penny Dubernat

Address: 1700 S Mount Prospect Rd

City, State, Zip: Des Plaines, IL 60018-1804

Phone: 224-254-3262

E-Mail: pdubernat@gti.energy

**2. Recipient’s Project Manager**

Name: Kaushik Biswas

Address: 123 C St



STATE OF CALIFORNIA  
CALIFORNIA ENERGY COMMISSION

Grant Request Form  
CEC-270 (Revised 01/2024)

City, State, Zip: Davis, CA 95616-4632

Phone: 530-324-6059

E-Mail: kbiswas@gti.energy

**N. Selection Process Used**

There are three types of selection process. List the one used for this GRF.

Selection Process	Additional Information
Competitive Solicitation #	GFO-24-310
First Come First Served Solicitation #	Not applicable
Other	Not applicable

**O. Attached Items**

1. List all items that should be attached to this GRF by entering “Yes” or “No”.

Item Number	Item Name	Attached
1	Exhibit A, Scope of Work/Schedule	Yes
2	Exhibit B, Budget Detail	Yes
3	CEC 105, Questionnaire for Identifying Conflicts	Yes
4	Recipient Resolution	No
5	Awardee CEQA Documentation	Yes

**Approved By**

Individuals who approve this form must enter their full name and approval date in the MS Word version.

**Agreement Manager:** Jeanie Mar

**Approval Date:** 1/19/2026

**Branch Manager:** Anthony Ng

**Approval Date:** 1/29/2026

**Director:** Jonah Steinbuck delegated to Branch Manager

**Approval Date:** 1/29/2026

# Exhibit A Scope of Work GTI Energy

## I. TASK AND ACRONYM/TERM LISTS

### A. Task List

Task #	CPR <sup>1</sup>	Task Name
1		General Project Tasks
2	X	Laboratory Testing and Modeling to Validate Thermal Performance and Demonstrate Value Proposition Improvement
3		Field Testing and Energy Modeling to Validate Energy Savings
4	X	Techno-economic Analysis, including Life Cycle Costs
5		Market Deployment Plan
6		Community Engagement and Workforce Development
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities

### B. Acronym/Term List

Acronym/Term	Meaning
ASTM	ASTM International
CAM	Commission Agreement Manager
CBO	Community-based organization
CEC	California Energy Commission
COG	Center of Glass
CPR	Critical Project Review
CZ	Climate Zones
GHG	Greenhouse Gas
HVAC	Heating, Ventilation, and Air Conditioning
LBNL	Lawrence Berkeley National Laboratory
M&V	Measurement and Verification
MF	Multi-family
MS	Microsoft
NFRC	National Fenestration Rating Council
SF	Single-family
SHGC	Solar Heat Gain Coefficient
SQL	Structured Query Language
TAC	Technical Advisory Committee
VIG	Vacuum Insulated Glazing
V <sub>T</sub>	Visible transmittance
XML	External Interface

<sup>1</sup> 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

### GTI Energy

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

### A. Purpose of Agreement

The purpose of this Agreement is to fund the demonstration of vacuum insulated glazing (VIG) retrofits in multiple single-family (SF) and multi-family (MF) buildings in at least two California climate zones and perform testing, modeling and cost analyses, and homeowner surveys to show ratepayer benefits of reduced energy consumption and utility bills and improved comfort as barriers to broad market adoption of VIGs in residential buildings.

### B. Problem/ Solution Statement

#### Problem

With more than 14 million existing residential units in California, a variety of building decarbonization strategies and the California Building Energy Code (Title 24) are needed to reduce building sector greenhouse gas (GHG) emissions. Existing buildings are required to conform to Title 24 standards only when specific or significant renovations trigger code compliance. Building envelope retrofits are very effective in reducing heating and cooling loads and improving comfort in older existing buildings that are typically far less efficient than current codes. Existing buildings retrofits can support decarbonization and reduce energy use, energy costs and GHG emissions.

Windows are often the weakest link in the thermal envelope. High-performance windows, such as triple pane and VIG windows, are commercially available but represent less than 2% of the U.S. window market, limited by technical and cost challenges with replacing existing windows.

#### Solution

This project will demonstrate the performance and benefits of VIGs via laboratory testing, thermal modeling and field demonstration. The project will also explore improvements in VIG value propositions, address cost and durability concerns, and develop a plan for broad market adoption. The recipient and major subrecipient, are partnering with major VIG and window manufacturers, Guardian Industries, LLC (Guardian) and Milgard Manufacturing, LLC (MITER Brands or MITER), to develop and demonstrate high-performance VIG solutions in residential buildings. Guardian has a commercially available Gen-1 VIG that achieves a center of glass (COG) thermal resistance or R-value of 12.8 h-ft<sup>2</sup>-°F/Btu. This project will demonstrate Guardian's Gen-2 VIGs can achieve a COG R-value of R15.9 and the Gen-3 hybrid VIG, with novel pillar material, can achieve a COG R-value of up to R24.

The Gen-2 and Gen-3 VIGs will be integrated into a thermally efficient vinyl window frame solution from MITER. U-factors lower than 0.2 Btu/h-ft<sup>2</sup>-°F are feasible with triple pane, argon-filled windows.<sup>2</sup> Combining Guardian VIGs with the window frame solution will result in a very high-performance window retrofit solution.

The following VIG installation methods will be demonstrated in SF and MF residential buildings:

1. Method 1: VIG windows retrofitted into the frame of existing windows. The existing sashes, spacers, and all other existing components will be removed with the exception of the existing frame. Evaluations for cost-effective improvement to the thermal performance of the existing frame will be conducted.

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<sup>2</sup> <https://www.milgard.com/energy-calculator>

## **Exhibit A Scope of Work GTI Energy**

2. Method 2: Clean changeout of the existing windows, with the entire existing window and frame being removed and replaced with new VIG units and new frames.

### **C. Goals and Objectives of the Agreement**

#### **Agreement Goals**

The goals of this Agreement are to:

- Demonstrate the thermal performance of retrofit VIG systems to achieve a U-factor of  $\leq 0.18$  Btu/hr-ft<sup>2</sup>-°F when installed in existing window frames and  $\leq 0.13$  Btu/hr-ft<sup>2</sup>-°F with a clean changeout.
- Demonstrate reduction in combined gas and electric heating, ventilation and air conditioning (HVAC) energy consumption by at least 15%.

Ratepayer Benefits:<sup>3</sup> This Agreement will result in the ratepayer benefits of lower energy costs, lower emissions and increased resilience. These benefits will result from the reduction in HVAC use due to the energy-efficient VIG window retrofits in multiple SF and MF homes in at least two California climate zones.

Technological Advancement and Breakthroughs:<sup>4</sup> 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 demonstrating reduced energy consumption and GHG emissions in residential buildings through high-performance VIG window retrofits. Laboratory and field testing and extrapolative energy modeling across all sixteen California climate zones will be performed to estimate the potential for statewide energy and GHG emission reductions with broad adoption of the VIG window retrofits. An additional key benefit is that the reduced heating and cooling loads in residential buildings will enable an easier transition to electrification of heating loads using right-sized (i.e., smaller capacity) heat pumps and reducing the upfront costs of heat pumps in existing buildings.

#### **Agreement Objectives**

The objectives of this Agreement are to:

- Advance VIG window technologies by addressing technical and cost challenges
- Test and demonstrate the field performance of advanced VIG systems
- Demonstrate reduction in combined gas and electric HVAC energy consumption
- Evaluate installation time and complexity to show reduced occupant disruption or disturbance
- Develop VIG energy model software metrics, including U-factor, solar heat gain coefficient (SHGC), visible transmittance (V<sub>t</sub>), and air leakage for Title 24 inclusion
- Accelerate VIG window uptake in the retrofit market through direct partnerships with manufacturers, suppliers, and others.
- Demonstrate Life Cycle Cost and Building-Based Emissions reductions, utilizing the tools and metrics described in Task 4 below.

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<sup>3</sup> California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission, which established the EPIC in 2011, defines ratepayer benefits as greater reliability, lower costs, and increased safety (See CPUC "Phase 2" Decision 12-05-037 at page 19, May 24, 2012, [http://docs.cpuc.ca.gov/PublishedDocs/WORD\\_PDF/FINAL\\_DECISION/167664.PDF](http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF)).

<sup>4</sup> California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

# Exhibit A

## Scope of Work

### GTI Energy

#### 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 by the dates listed in the **Project Schedule (Part V)**. All products submitted which will be viewed by the public, must comply with the accessibility requirements of Section 508 of the federal Rehabilitation Act of 1973, as amended (29 U.S.C. Sec. 794d), and regulations implementing that act as set forth in Part 1194 of Title 36 of the Federal Code of Regulations. All technical tasks should include product(s). 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 California Energy Commission’s (CEC) 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.

## **Exhibit A Scope of Work GTI Energy**

The following describes the accepted formats for electronic data and documents provided to the CEC 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.
  - Project management documents will be in Microsoft Project file format, version 2007 or later.
- **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 CEC'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, and other CEC staff relevant to the Agreement. The Recipient's Project Manager and any other individuals deemed necessary by the CAM or the Project Manager shall participate in 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., Teams, Zoom), with approval of the CAM.

The Kick-off meeting will include discussion of the following:

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
- An updated Project Schedule;
- Terms and conditions of the Agreement;
- Invoicing and auditing procedures;
- Travel;
- Equipment purchases;

## **Exhibit A Scope of Work GTI Energy**

- Administrative and Technical products (subtask 1.1);
  - CPR meetings (subtask 1.3);
  - Monthly Calls (subtask 1.5)
  - Quarterly Progress reports (subtask 1.6)
  - Final Report (subtask 1.7)
  - Match funds (subtask 1.8);
  - Permit documentation (subtask 1.9);
  - Subawards (subtask 1.10);
  - Technical Advisory Committee meetings (subtasks 1.11 and 1.12);
  - Agreement changes;
  - Performance Evaluations; and
  - Any other relevant topics.
- Provide *Kick-off Meeting Presentation* to include but not limited to:
    - Project overview (i.e., project description, goals and objectives, technical tasks, expected benefits, etc.)
    - Project schedule that identifies milestones
    - List of potential risk factors and hurdles, and mitigation strategy
  - Provide an *Updated Project Schedule, Match Funds Status Letter, and Permit Status Letter*, 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:**

- Kick-off Meeting Presentation
- Updated Project Schedule (*if applicable*)
- Match Funds Status Letter (subtask 1.7) (*if applicable*)
- Permit Status Letter (subtask 1.8) (*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 CEC 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 CEC 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 CEC.

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 may 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 CEC, but they may take place at

## **Exhibit A Scope of Work GTI Energy**

another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

### **The Recipient shall:**

- Prepare and submit 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.
- 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* with a list of expected CPR participants in advance of the CPR meeting. If applicable, the agenda may 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. A determination of unsatisfactory progress This may result in project delays, including a potential Stop Work Order, while the CEC determines whether the project should continue.
- 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)

### **CAM Products:**

- CPR Agenda(s)
- 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 CEC 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 of the following Agreement closeout items:
  - Disposition of any procured equipment.

## **Exhibit A Scope of Work GTI Energy**

- The CEC’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 copies of *All Final Products* organized by the tasks in the Agreement.

### **Products:**

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

## **MONTHLY CALLS, REPORTS AND INVOICES**

### **Subtask 1.5 Monthly Calls**

The goal of this task is to have calls at least monthly between the CAM and Recipient to verify that satisfactory and continued progress is made towards achieving the objectives of this Agreement on time and within budget.

The objectives of this task are to verbally summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, to verify match funds are being proportionally spent concurrently or in advance of CEC funds or are being spent in accordance with an approved Match Funding Spending Plan, to form the basis for determining whether invoices are consistent with work performed, and to answer any other questions from the CAM. Monthly calls might not be held on those months when a quarterly progress report is submitted or the CAM determines that a monthly call is unnecessary.

#### **The CAM shall:**

- Schedule monthly calls.
- Provide questions to the Recipient prior to the monthly call.
- Provide call summary notes to Recipient of items discussed during call.

#### **The Recipient shall:**

- Review the questions provided by CAM prior to the monthly call
- Provide verbal answers to the CAM during the call.

#### **Product:**

- Email to CAM concurring with call summary notes.

### **Subtask 1.6 Quarterly 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.

# Exhibit A Scope of Work GTI Energy

## The Recipient shall:

- Submit a *Quarterly 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 reporting period, 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. Progress reports are due to the CAM the 10th day of each January, April, July, and October. The Quarterly Progress Report template can be found on the ECAMS Resources webpage available at: <https://www.energy.ca.gov/media/4691>
- Submit a monthly or quarterly *Invoice* on the invoice template(s) provided by the CAM.

## Recipient Products:

- Quarterly Progress Reports
- Invoices

## CAM Product:

- Invoice template

## Subtask 1.7 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. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

### Subtask 1.7.1 Final Report Outline

#### The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Energy Commission Style Manual* provided by the CAM.

#### Recipient Products:

- Final Report Outline (draft and final)

#### CAM Products:

- Energy Commission Style Manual
- Comments on Draft Final Report Outline
- Acceptance of Final Report Outline

### Subtask 1.7.2 Final Report

#### The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Energy Commission 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**)

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- 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)
- Submit a draft of the Executive Summary to the TAC for review and comment.
  - Develop and submit a *Summary of TAC Comments on Draft Final Report* received on the Executive Summary. For each comment received, the Recipient will identify in the summary the following:
    - Comments the Recipient proposes to incorporate.
    - Comments the Recipient does propose to incorporate and an explanation for why.
  - 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.
  - Incorporate all CAM comments into the *Final Report*. If the Recipient disagrees with any comment, provide a *Written Responses to Comments* explaining why the comments were not incorporated into the final product.
  - Submit the revised *Final Report* electronically with any *Written Responses to Comments* within 10 days of receipt of CAM's *Written Comments* on the Draft Final Report, unless the CAM specifies a longer time period or approves a request for additional time.

### Products:

- Summary of TAC Comments on Draft Final Report
- Draft Final Report
- *Written Responses to Comments (if applicable)*
- Final Report

### CAM Product:

- *Written Comments on the Draft Final Report*

## MATCH FUNDS, PERMITS, AND SUBAWARDS

### Subtask 1.8 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. 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.

### 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 application that led to the CEC awarding this Agreement and none have been identified at the time this Agreement starts, then state this in

## Exhibit A Scope of Work GTI Energy

the letter.

If match funds were a part of the application that led to the CEC 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.
  - If different from the solicitation application, provide 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 1.9 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:
  - 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

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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 1.10 Obtain and Execute Subawards and Agreements with Site Hosts**

The goals of this subtask are to: (1) procure and execute subrecipients and site host agreements, as applicable, required to carry out the tasks under this Agreement; and (2) ensure that the subrecipients and site host agreements are consistent with the Agreement terms and conditions and the Recipient's own contracting policies and procedures.

### **The Recipient shall:**

- Execute and manage subawards and coordinate subrecipients activities in accordance with the requirements of this Agreement.
- Execute and manage site host agreements and ensure the right to use the project site throughout the term of the Agreement, as applicable. A site host agreement is not required if the Recipient is the site host.
- Notify the CEC in writing immediately, but no later than five calendar days, if there is a reasonable likelihood the project site cannot be acquired or can no longer be used for the project.
- Incorporate this Agreement by reference into each subaward.
- Include any required Energy Commission flow-down provisions in each subaward, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subaward terms.
- Submit a *Subaward and Site Letter* to the CAM describing the subawards and any site host agreement needed or stating that no subawards or site host agreements are required.
- If requested by the CAM, submit a draft of each *Subaward* and any *Site Host Agreement* required to conduct the work under this Agreement.
- If requested by the CAM, submit a final copy of each executed *Subaward* and any *Site Host Agreement*.
- Notify and receive written approval from the CAM prior to adding any new subrecipient (see the terms regarding subrecipient additions in the terms and conditions).

### **Products:**

- Subaward and Site Letter
- Draft Subawards (*if requested by the CAM*)
- Draft Site Host Agreement (*if requested by the CAM*)
- Final Subawards (*if requested by the CAM*)

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- Final Site Host Agreement (*if requested by the CAM*)

### **TECHNICAL ADVISORY COMMITTEE**

#### **Subtask 1.11 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.
- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate, to the extent the TAC members feel is appropriate, on behalf of the project in its effort to build partnerships, governmental support, and relationships with a national spectrum of influential leaders.
- Ask probing questions that ensure a long-term perspective on decision-making and progress toward the project's strategic goals.

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

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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 1.12.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- 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 1.12 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* for each TAC Meeting that include any recommended resolutions of major TAC issues.

### **The TAC shall:**

- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate on behalf of the project in its effort to build partnerships, governmental support and relationships with a national spectrum of influential leaders.
- Ask probing questions that ensure a long-term perspective on decision-making and progress toward the project's strategic goals.
- Review and provide comments to proposed project performance metrics.
- Review and provide comments to proposed project Draft Technology Transfer Plan.

### **Products:**

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

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#### Subtask 1.13 Project Performance Metrics

The goal of this subtask is to finalize key performance targets for the project based on feedback from the TAC and report on final results in achieving those targets. The performance targets should be a combination of scientific, engineering, techno-economic, and/or programmatic metrics that provide the most significant indicator of the research or technology's potential success.

#### The Recipient shall:

- Complete and submit the project performance metrics section of the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task, to the CAM.
- Present the draft project performance metrics at the first TAC meeting to solicit input and comments from the TAC members.
- Develop and submit a *TAC Performance Metrics Summary* that summarizes comments received from the TAC members on the proposed project performance metrics. The *TAC Performance Metrics Summary* will identify:
  - TAC comments the Recipient proposes to incorporate into the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
  - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Develop and submit a *Project Performance Metrics Results* document describing the extent to which the Recipient met each of the performance metrics in the *Final Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
- Discuss the *Project Performance Metrics Results* at the Final Meeting.

#### Products:

- TAC Performance Metrics Summary
- Project Performance Metrics Results

### III. TECHNICAL TASKS

#### TASK 2: Laboratory Testing and Modeling to Validate Thermal Performance and Demonstrate Value Proposition Improvement

The goal of this task is to perform independent laboratory testing and numerical analysis to evaluate the thermal performance of VIG window systems prior to field installation to verify that the targeted energy performance goals can be met. This task will also demonstrate innovations leading to value proposition improvements of VIGs.

#### Subtask 2.1 Laboratory Testing and Modeling

The goals of this subtask are to 1) test and verify the thermal performance of individual VIG units and the whole VIG window retrofit assemblies, 2) evaluate condensation risk, and 3) calculate the U-factor, SHGC, and visible transmittance ( $V_T$ ) of the whole product.

#### The Recipient shall:

- Develop a *Laboratory testing and Modeling Plan* that includes four types of assemblies:
  - VIG only
  - VIG installed in a new sash with improved components
  - VIG installed in a frame resulting in a window that fits in the old frame (Method 1)
  - VIG installed in a frame resulting in a window that fully replaces old window, including frame (Method 2)

## **Exhibit A Scope of Work GTI Energy**

- Coordinate with subrecipient and manufacturers to design and develop VIGs and VIG retrofit assemblies for testing.
- Measure the R-values of VIGs following ASTM C518 test method to validate claimed performance and calculate U-factor using NFRC 100 standard procedure incorporated into Lawrence Berkeley National Laboratory's (LBNL) WINDOW Program.
- Replicate field installation in laboratory setting and install retrofit window solutions following Methods 1 and 2 in LBNL's Infrared Thermography chamber and measure temperature field and heat flow distribution through the window systems. Measure the condensation level on the warm side of each unit.
- Model VIG performance in LBNL WINDOW software tool.
- Model window system, incorporating VIG in THERM software tool and calculate whole product U-factor, SHGC and  $V_T$  in LBNL WINDOW, according to NFRC 100 and 200.
- Calculate Condensation Index and validate against measurements of the level of condensation.
- Compare results from testing to modeling results from WINDOW and THERM.
- Assist and communicate with National Fenestration Rating Council (NFRC) to update any modeling requirements and or software modification, as appropriate.
- Prepare *Laboratory Testing and Modeling Report*, which includes but is not limited to:
  - Performance results from lab test implementation
  - Performance results from modeling including condensation
  - Evaluation of lab and modeling results
  - Summary of NFRC communications and results
- Prepare and submit a CPR Report #1.
- Attend the CPR meeting per subtask 1.3.

### **Products:**

- Laboratory Testing and Modeling Plan (Draft and Final)
- Laboratory Testing and Modeling Report (Draft and Final)
- CPR Report #1

### **Subtask 2.2 Aging and durability testing**

The goal of this subtask is to work with an external accredited testing laboratory to perform aging, structural and durability testing.

#### **The Recipient shall:**

- Evaluate VIG durability, stability, longevity, and mechanical strength using standard testing procedures approved for use with VIG window technology. Evaluations must include seal longevity according to ASTM International (ASTM) standards, including accelerated aging tests. Products must pass ASTM durability test ASTM 2190 (along with associated standards ASTM 2188 and 2189), which is the standard IGU durability test. This means that VIG meets at least IGU durability requirements.
  - If the new ASTM VIG durability standard is ready either in final draft form or is fully published during the period of performance of the technical tasks 2, 3 and 4 (and prior to the development of the Draft Final Report), a retest using the VIG durability standard will be completed. LBNL is involved in the development of the new ASTM VIG durability standard and will coordinate their input with this agreement. Guidelines for future updates will be provided to the ASTM standards organization to address increased service life.

## **Exhibit A Scope of Work GTI Energy**

- Coordinate with an accredited testing laboratory to perform accelerated aging and structural testing following ASTM test methods.
- Develop a set of recommendations for updating testing requirements for accelerated aging (durability) and structural performance.
- Develop a procedure to identify vacuum loss and report to the ASTM.
- Propose recommendations for remedies in case of seal failure or other causes of vacuum loss.
- Prepare *Aging and Durability Testing and Recommendations Report* which includes but is not limited to:
  - Accredited testing laboratory results
  - Recommendations for updating testing requirements for accelerated aging (durability) and structural performance.
  - Procedure(s) to identify vacuum loss
  - Recommendations for remedies for seal failure or other causes of vacuum loss.

### **Products:**

- Aging and Durability Testing and Recommendations Report (Draft and Final)

### **Subtask 2.3 Demonstration of VIG Value Proposition Improvements**

The goals of this subtask are to evaluate innovations in VIGs and VIG windows for 1) thermal performance improvements, 2) materials, processes, and durability improvements, and 3) lower labor, installation, and production costs. This task will evaluate how design, manufacturing and installation refinements strengthen the value proposition of VIGs by identifying key cost and performance drivers.

### **The Recipient shall:**

- Work with subrecipient, Guardian and MITER (or other manufacturing partners) to evaluate and demonstrate innovations leading to improved value proposition of VIGs.
- Evaluate thermal performance improvements from innovative pillar designs to improve the thermal resistance of VIGs.
- Evaluate process and durability improvements with novel sealing materials and systems.
- Evaluate improvements in VIG equipment for producing VIG components and optimization of components such as framing materials, spacers, glass edge, and other hardware to improve thermal performance and reduce costs.
- Evaluate cost-effectiveness of strategies to improve the existing frame left in place.
- Perform paper study, cost modeling and analysis, through a systematic review of relevant literature and data, to evaluate the impacts of these improvements on future material and installation costs, assuming broad market adoption of VIGs.
- Identify and analyze major issues that contribute to value proposition of VIGs. Perform analyses to determine how these factors impact thermal performance, durability, life cycle cost, payback, and aesthetics.
- Prepare *VIG Innovations and Value Proposition Improvement Report* that includes but is not limited to:
  - Evaluation results of thermal performance improvements, process and durability improvements, equipment, and optimization improvements
  - Paper study evaluation on cost modeling and analysis
  - Evaluation of issues impacting value propositions of VIGs

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#### Products:

- VIG Innovations and Value Proposition Improvement Report (Draft and Final)

#### **TASK 3: Field Testing and Energy Modeling to Validate Energy Savings**

The goal of this task is to independently field test and demonstrate lower heating and cooling building energy consumption compared to the existing conditions and the Title 24 compliant requirements.

#### **Subtask 3.1 Field Test Planning and Product Acquisition**

The goals of this subtask are to 1) filter and secure suitable sites, 2) initiate pre-retrofit performance monitoring, and 3) administer qualitative occupant surveys to capture living experience and operational insights. The detailed measurement and verification (M&V) plan will be further refined during project execution according to actual building conditions.

#### **The Recipient shall:**

- Prepare a *Field Demonstration and M&V Plan*, which includes but is not limited to:
  - Instrumentation and sensor selection and placement
  - Approaches for pre- and post-retrofit data collection and processing from the demonstration sites
  - Strategy for measuring/evaluating and assessing the impact of the retrofit on thermal comfort, noise, building resilience, and HVAC sizing needs pre- and post-retrofit.
- Secure 7 SF units and at least 8 units in 2 MF buildings in at least 2 different California climate zones (CZ), excluding CZ 5, 6, and 7. Backup SF and MF sites for each installation method will also be secured. Site totals and combinations may be modified subject to written CAM approval.
- Commission field data acquisition systems for M&V of heating and cooling building energy consumption, thermal comfort, existing window thermal performance, air leakage rate for the selected windows, and noise levels.
- Develop site-specific web data dashboards to assist with real-time data collection and GTI internal Quality Assurance/Quality Control.
- Install pre-retrofit monitoring equipment and prepare a *M&V Commissioning Report* which includes but is not limited to:
  - Summary of secured sites for demonstration
  - Summary of M&V equipment to be installed
  - Description of M&V installation and commissioning challenges
- Provide independent M&V to measure existing energy consumption and comfort for 12 months for pre-retrofit data or shorter subject to written CAM approval.
- Prepare a *Pre-Retrofit Occupant Comfort Report* which includes but is not limited to:
  - Pre-retrofit evaluation of and occupant feedback on comfort (thermal, noise and building resilience)
  - Pre-M&V data analysis summary
  - A copy of the Pre-Retrofit Occupant Survey/questions asked to occupants
- Design VIG window retrofit systems for the demonstration sites in coordination with Guardian and MITER Brands. Guardian will supply the VIGs to MITER for integration into the window systems, which will then be shipped to the demonstration sites for installation.
- Prepare a *VIG Window Systems Design and Acquisition Report* which includes but is not limited to:
  - VIG Window Systems Designs
  - Design and acquisition challenges and lessons learned

## **Exhibit A**

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#### **Products:**

- Field Demonstration and M&V Plan (Draft and Final)
- M&V Commissioning Report (Draft and Final)
- Pre-Retrofit Occupant Comfort Report
- VIG Window Systems Design and Acquisition Report (Draft and Final)

#### **Subtask 3.2 Installation and Field Testing**

The goals of this subtask are to install advanced VIG systems via two installation methods and test their actual field performance. During execution, the research team will determine the number and locations of windows to be retrofitted for each method based on site-specific constraints. Once the VIG installations are complete, the existing data-acquisition system will monitor building energy consumption and comfort for a 12-month post-retrofit period or shorter subject to written CAM approval.

#### **The Recipient shall:**

- Coordinate with the owners, host site property managers and occupants for installation.
- Work with Guardian and MITER Brands (or other manufacturing partners) to identify local retrofit installers for the demonstration sites in the two California demonstration CZs.
- Install advanced VIG systems via two installation methods in the selected buildings, recording time and motion details at multiple intervals to characterize installer efficiency at the beginning, middle, and near the end of the installation.
- Perform post-retrofit M&V of heating and cooling building energy consumption, thermal comfort, window thermal performance, air leakage rate for the selected windows, and impact on noise level.
- Prepare a *Post-Retrofit Occupant Comfort Report* which includes but is not limited to:
  - Post-retrofit evaluation of and occupant feedback on comfort (thermal, noise and building resilience)
  - Post-M&V data analysis summary
  - A copy of the Post-Retrofit Occupant Survey/questions asked to occupants
- Deliver an *Installation Findings Presentation* to the research team, sponsors, and TAC.
- Prepare a *VIG Retrofit Windows Installation Report* which includes but is not limited to:
  - The installation process, challenges, and barriers, and solutions identified to inform future VIG installations to reduce installation time and costs and occupant disruption
  - *The Installation Findings Presentation*.
- Work with manufacturing partner Guardian (or other manufacturing partners) to develop a *VIG Fault Detection User Guide* for building owners, property managers, occupants and installers.

#### **Products:**

- Post-Retrofit Occupant Comfort Report
- VIG Retrofit Windows Installation Report
- VIG Fault Detection User Guide

#### **Subtask 3.3 Performance Evaluation and Model Validation**

The goals of this subtask are to evaluate how the VIG window retrofit affects building performance and to quantify energy savings and cost-effectiveness for advanced VIG systems. The research team will compare post-retrofit data with pre-retrofit measurements to quantify changes in window thermal performance, the overall energy and peak demand savings, noise, and comfort. Using laboratory test data, field monitoring results, and owner-supplied building information, the team will

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develop calibrated building energy models to estimate energy cost savings and GHG emission reductions for each advanced VIG installation method across all California CZs.

### **The Recipient shall:**

- After at least six months of post-retrofit monitoring, provide a *Preliminary Performance Presentation* of the results to the research team, sponsors, and TAC, inclusive of quantitative (data collection and analysis) and qualitative (host/contractor surveys) methodologies.
- At the conclusion of the monitoring period, decommission field data acquisition systems.
- Develop calibrated building models to evaluate the energy and cost savings and GHG emissions of the window retrofit in all CZs. Ensure methodologies provided under the “COMMON GROUP REQUIREMENTS” in the GFO-24-310 solicitation manual are used for this evaluation.
- Develop an *Advanced Windows Performance Validation Report* that includes but is not limited to:
  - VIG window performance data for two installation methods,
  - Energy efficiency and emissions reduction projections relative to pre-retrofit conditions,
  - Cost effectiveness, operational energy cost savings and GHG emission reductions
  - Detailed site service and troubleshooting logs
  - Post-Retrofit Occupant survey results and
  - *Preliminary Performance Presentation*.

### **Products:**

- Advanced Windows Performance Validation Report (Draft and Final)

### **TASK 4: Techno-economic Analysis, including Life Cycle Costs**

The goal of this task is to quantify the 30-year life cycle cost-effectiveness of each VIG installation method across California’s 16 CZs, using life cycle cost analysis to show the VIG retrofits’ net benefits and payback.

### **The Recipient shall:**

- Document as-built material and installation costs of the VIG retrofits. Use data from industry and literature to generate material and installation costs of Title 24-compliant window retrofits for comparison with the VIG retrofits.
- Estimate the initial cost and the 30-year cost of ownership for both VIG installation methods (Method 1 and Method 2).
- Use the Life Cycle Cost Effectiveness Methodology provided in the GFO-24-310 solicitation manual to provide a cost-effectiveness analysis for 1) the current high cost of VIG windows and 2) the mature future market for VIG windows assuming product costs based on mass-scale product availability of the novel VIG window technologies.
- Use CEC-approved software (e.g., CBECC-Res, EnergyPlus) to develop calibrated building-energy models for each case and quantify annual energy savings across all 16 California CZs by comparing the VIG retrofits to existing windows and Title 24-compliant windows, while assuming no change in maintenance costs between pre- and post-retrofit conditions.
- Evaluate HVAC sizing changes for the existing windows and VIG retrofits. Calculate the cost reduction in the HVAC equipment replacement cost due to reduced heating and cooling loads with VIG retrofits and impacts of reduced HVAC capacity on the 30-year cost-effectiveness.

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- Coordinate with window manufacturers, installers, and utility or program partners to validate cost inputs and assumptions used in the life cycle cost analysis.
- Prepare a *Techno-Economic Analysis Report* that includes but is not limited to:
  - Documented material and installation costs for VIG retrofits
  - Initial cost and 30-year cost of ownership (both installation types)
  - Modeling results from the 16 CZs
  - 30-year life cycle net present value analysis, simple payback and life cycle cost-effectiveness analysis
  - Impacts on HVAC sizing requirements and capital costs post retrofit
- Prepare and submit a CPR Report #2.
- Attend the CPR meeting per subtask 1.3.

### **Products:**

- Techno-Economic Analysis Report (Draft and Final)
- CPR Report #2

### **TASK 5: Market Deployment Plan**

The goal of this task is to outline strategies to overcome technical and cost barriers and enable increased adoption of VIG window retrofits.

#### **The Recipient shall:**

- Analyze market issues and develop strategies to increase the adoption of VIGs.
- Engage additional manufacturers through the TAC and technology transfer activities.
- Identify market transformation initiatives targeted towards energy efficiency and GHG emission reduction by driving market adoption of selected technologies and practices.
- Identify and evaluate energy efficiency incentive programs and financing strategies.
- Provide ready-to-use materials to easily be incorporated into a guide for consumers and building professionals.
- Develop energy model software metrics, including U-factor, SHGC,  $V_T$ , and air leakage that may be incorporated into Title 24 and communicate with the CEC Efficiency Division's Building Standards Branch.
- Provide a market overview of VIG products, including available manufacturers, availability, and any relevant market characteristics.
- Support development of specifications of the VIG-based retrofit window solutions for NFRC certification.
- Work closely with major subrecipient, and VIG window manufacturers to develop a *Market Deployment Plan* that would help transform VIG products from a niche option to a mainstream solution.
- Prepare a *Market Analysis and Deployment Strategies Report* that includes but is not limited to:
  - Market issue analysis and VIG adoption strategies
  - Identified market transformation initiatives including incentive programs and financing strategies
  - Consumer and building professional guide that includes ready to use materials
  - Market overview of VIG products
  - Lessons learned from project demonstrations
  - Status of VIG retrofit solution specifications for NFRC certification
  - *Market Deployment Plan*

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### **Products:**

- Market Analysis and Deployment Strategies Report (Draft and Final)

### **TASK 6: Community Engagement and Workforce Development Plan**

The goals of this task are to: 1) engage broader community members, including the demonstration site owners/occupants, to understand their priorities and perceptions related to high-performance window retrofits, 2) create an awareness campaign, and 3) develop a workforce and education plan. The community engagement and awareness campaign work will be led by the partner community-based organizations (CBO) Latino Service Providers and Mixteco/Indigena Community Organizing Project (or other CBOs as approved by the CAM).

### **The Recipient shall:**

- Work with the CBOs to conduct 3-4 focus groups throughout the project timeline to capture comprehensive feedback from demonstration site participants and community members.
  - Hold two focus groups with demonstration site occupants/homeowners (6 months post-retrofit and 12 months post-retrofit) to assess comfort improvements, energy savings experiences, and overall satisfaction with the VIG technology.
  - Hold 1-2 focus groups with broader community members, including potential future adopters, local contractors, and property managers, to understand barriers to adoption and gather input on preferred communication channels and messaging strategies.
- Prepare a *Focus Group and Awareness Campaign Plan* that includes but is not limited to:
  - Develop and distribute educational materials (fact sheets, case studies featuring demonstration sites, and video testimonials from participating homeowners)
  - Host 2 community information sessions or workshops
  - Create social media content that highlights energy savings and comfort improvements, and present findings at relevant community meetings and events. The campaign will leverage existing community networks and partnerships to amplify messaging about VIG benefits, focusing on cost savings, improved comfort, and environmental benefits relevant to disadvantaged and low-income communities
  - Detailed timeline and methodology for conducting 3-4 focus groups, and
  - Comprehensive awareness campaign strategy including target audiences, key messages, communication channels, and success metrics
- Prepare a *Focus Group Key Takeaways and Input Summary Report* that includes but is not limited to:
  - Documented feedback from demonstration site participants on comfort improvements, energy bill reductions, and installation experience
  - Community perspectives on VIG technology barriers, benefits, and preferred information sources
  - Contractor and installer feedback on installation challenges and training needs
  - Documentation of increased community awareness and interest in high-performance window retrofits
  - Recommendations for improving technology adoption and scaling awareness efforts to support broader VIG market development and increased demand in disadvantaged communities

## **Exhibit A**

### **Scope of Work**

### **GTI Energy**

- Explore engagement with disadvantaged business enterprises and introduce them to workforce development opportunities related to high-performance window retrofit products, including VIGs.
- Work with VIG and window manufacturers and CBOs to develop a *VIG Workforce and Education Plan* for contractors, installers, and users for how to use the new technology and will include a *VIG Best-Practices Installation Guide*.

#### **Products:**

- Focus Group and Awareness Campaign Plan
- Focus Group Key Takeaways and Input Summary Report
- VIG Workforce and Education Plan (Draft and Final)
- VIG Best-Practices Installation Guide (Draft and Final)

#### **TASK 7: EVALUATION OF PROJECT BENEFITS**

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

#### **The Recipient shall:**

- Complete the *Initial Project Benefits Questionnaire*. The Initial Project Benefits Questionnaire shall be initially completed by the Recipient with 'Kick-off' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Complete the *Annual Survey* by January 31st of each year. The Annual Survey includes but is not limited to the following information:
  - Technology commercialization progress
  - New media and publications
  - Company growth
  - Follow-on funding and awards received
- Complete the *Final Project Benefits Questionnaire*. The Final Project Benefits Questionnaire shall be completed by the Recipient with 'Final' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Respond to CAM questions regarding the questionnaire drafts.
- Complete and update the project profile on the CEC's public online project and recipient directory on the [Energize Innovation website \(www.energizeinnovation.fund\)](http://www.energizeinnovation.fund), and provide *Documentation of Project Profile on EnergizeInnovation.fund*, including the profile link.
- If the Prime Recipient is an Innovation Partner on the project, complete and update the organizational profile on the CEC's public online project and recipient directory on the [Energize Innovation website \(www.energizeinnovation.fund\)](http://www.energizeinnovation.fund), and provide *Documentation of Organization Profile on EnergizeInnovation.fund*, including the profile link.

#### **Products:**

- Initial Project Benefits Questionnaire
- Annual Survey(s)
- Final Project Benefits Questionnaire
- Documentation of Project Profile on EnergizeInnovation.fund
- Documentation of Organization Profile on EnergizeInnovation.fund

## **Exhibit A Scope of Work GTI Energy**

### **TASK 8: Technology/Knowledge Transfer Activities**

The goal of this task is to ensure the technological learning that resulted from the demonstration(s) is captured and disseminated to the range of professions that will be responsible for future deployments of this technology or similar technologies.

#### **The Recipient Shall:**

- Develop and submit a *Project Case Study Plan* that outlines how the Recipient will document the planning, construction, commissioning, and operation of the technology or system being demonstrated. The Project Case Study Plan should include:
  - An outline of the objectives, goals, and activities of the case study.
  - The organization that will be conducting the case study and the plan for conducting it.
  - A list of professions and practitioners involved in the technology's deployment.
  - Specific activities the recipient will take to ensure the learning that results from the project is disseminated to those professions and practitioners.
  - Presentations/webinars/training events to disseminate the results of the case study.
- Present the draft *Project Case Study Plan* to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the draft *Project Case Study Plan*. This document will identify:
  - TAC comments the Recipient proposes to incorporate into the final *Technology Transfer Plan*.
  - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Submit the final *Project Case Study Plan* to the CAM for approval.
- Execute the final Project Case Study Plan and develop and submit a Project Case Study.
- When directed by the CAM, develop presentation materials for a CEC sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California CEC.
- 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.

#### **Products:**

- Project Case Study Plan (Draft and Final)
- Summary of TAC Comments
- Project Case Study (Draft and Final)
- High Quality Digital Photographs

### **IV. PROJECT SCHEDULE**

Please see the attached Excel spreadsheet.