



**California Energy Commission
April 12, 2023 Business Meeting
Backup Materials for Agenda Item No 14c:
Skyven Technologies, Inc.**

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.

STATE OF CALIFORNIA
STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: Skyven Technologies, Inc.

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-22-012 with Skyven Technologies, Inc. (Skyven) for a \$2,971,730 grant to bring an innovative, industrial steam-generating, heat pump technology to LRIP. This new electric heat pump technology recycles industrial heat waste to aid in the production of industrial steam at temperatures and pressures that have only been achievable using traditional fossil fuel-fired boilers. Skyven has proven the efficacy of this technology in custom-engineered installations, and with this grant, seek to substantially lower installation costs by bringing a packaged, pre-engineered, family of system into LRIP. This simplified design and production process will create a commercially viable solution for electrifying industrial steam generation; and

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

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 adopted at a meeting of the CEC held on April 12, 2023.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

Liza Lopez
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-22-012

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Justin Scaccianoce
3. MS-:51
4. Phone Number: 916-931-8010

C. Recipient's Information

1. Recipient's Legal Name: Skyven Technologies, Inc.
2. Federal ID Number: 46-1550405

D. Title of Project

Title of project: Electrification of Industrial Heat with High-Temperature Steam-Generating Heat Pumps

E. Term and Amount

1. Start Date: 5/15/2023
2. End Date: 3/31/2027
3. Amount: \$2,971,730.00

F. Business Meeting Information

1. Are the ARFVTP agreements \$75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 4/12/2023 .
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Michael Ferreira
5. Time Needed for Business Meeting: 5 minutes.
6. The email subscription topic is: EPIC (Electric Program Investment Charge).

Agenda Item Subject and Description:

SKYVEN TECHNOLOGIES, INC. Proposed resolution approving EPC-22-012 with Skyven Technologies, Inc for a \$2,971,730 grant to bring an innovative, industrial-steam-generating, heat pump technology to low-rate initial production (LRIP), and adopting staff's determination that this action is exempt from CEQA. This new electric heat pump technology recycles industrial heat waste to aid in the production of industrial steam at temperatures and pressures that have only been achievable using traditional fossil fuel fired boilers. Skyven has proven the efficacy of this technology in custom-engineered installations, and with this grant, seek to substantially lower installation costs by bringing a packaged, pre-engineered, family of system into LRIP. This simplified design and production process will create a commercially viable solution for electrifying industrial steam generation. (EPIC funding) Contact: Michael Ferreira

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 ;

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.

The activity is covered by the general rule that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA.

Cal. Code Regs., tit. 14, § 15301

This project only consists of operation and minor alteration of existing structure, facilities, and mechanical equipment which involves negligible or no expansion of use beyond that existing at the time of the lead agency's CEQA determination. Skyven will be using Bay City Boiler's manufacturing facility in Fresno, CA for production of the steam generating heat pumps. All manufacturing on this project will be taking place in Bay City Boiler's existing facility and no work will be taking place outside of that facility. Please note that, while we will be using Bay City Boiler's existing facility, the steam generating heat pump equipment is too large for an "assembly line" - it will simply be manufactured in one location within the Bay City Boiler facility. Bay City Boiler's facility in Fresno has the following certifications and licensing: California C-4 and B contractors licensing, ASME/ National Board certified welding and repair programs with current R stamp certification, and AWS D1.1 Structural Steel welding



certification. In their 35,000 sq ft fabrication facility they have CNC shearing, CNC braking, CNC Plasma tables, CNC Tube Bending, saw cutting, fabrication stations and overhead cranes for large fabrication/loading. We do not anticipate any permanent changes to the facility - there will simply be a rearrangement of existing, mobile (primarily welding) equipment. The equipment assembly involves mounting and welding of compressors, pipes, pumps, valves, etc.

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. 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
Piller TSC Blower Corporation	\$ 0	\$437,800
Bay City Boiler & Engineering Co., Inc.	\$ 98,230	\$150,000

I. 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
No vendors to report	\$	\$

J. 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
No key partners to report

K. 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
Fund source	Fiscal year	List number	\$ Budget amount

TOTAL Amount: \$ 2,971,730

R&D Program Area: EDMFB: EDMF

Explanation for “Other” selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

L. Recipient’s Contact Information

1. Recipient’s Administrator/Officer

Name: Arun Gupta

Address: 1201 International Pkwy Ste 300

City, State, Zip: Richardson, TX 75081-2370

Phone: 469-708-8786

E-Mail: agupta@skyven.co

3. Recipient’s Project Manager

Name: Arun Gupta

Address: 1201 International Pkwy Ste 300

City, State, Zip: Richardson, TX 75081-2370

Phone: 469-708-8786

E-Mail: agupta@skyven.co

M. Selection Process Used

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

Selection Process	Additional Information
Competitive Solicitation #	GFO-21-304
First Come First Served Solicitation #	Not applicable
Other	Not applicable



N. 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	Enter Yes or No.
4	Recipient Resolution	Enter Yes or No.
5	Awardee CEQA Documentation	Enter Yes or No.

Approved By

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

Agreement Manager: Justin Scaccianoce

Approval Date: 3/2/23

Branch Manager: Anthony Ng

Approval Date: 3/2/23

Director: Anthony Ng for Jonah Steinbuck

Approval Date: 3/2/23

ATTACHMENT 5

Scope of Work Template

Skyven Technologies

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2		Basic Engineering of a Packaged System for Production
3		Detailed Engineering of a Packaged System for Production
4		Create Automated Design Software
5	X	Build and Exercise a Pilot Manufacturing Line for LRIP
6		Exercise, Validate and Qualify the Pilot Manufacturing Line
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
COP	Coefficient of Performance
CPR	Critical Project Review ¹
DFX	Design for Excellence
IOU	Investor Owned Utilities
LRIP	Low Rate Initial Production
P&ID	Process and Instrumentation Diagram
PFD	Process Flow Diagram
PSIG	Pounds per Square Inch Gauge
QRA	Quality and Reliability Assurance
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the engineering, design, and initial manufacturing necessary to bring an innovative electric industrial steam generation technology, that uses electric power to recycle industrial heat waste back into steam, from its current one-off implementations to pre-engineered and factory-produced packaged systems in low-rate initial production (LRIP).

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.

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Scope of Work Template

Skyven Technologies

B. Problem/ Solution Statement

Problem

A key barrier to achieving the State's statutory energy goals is a lack of efficient and economically attractive technologies to electrify the massive thermal energy demands associated with steam production in the industrial sector. Currently, most industrial steam is produced by natural gas fired boilers that contribute to greenhouse gas emissions. Additionally, state-of-the-art industrial heat pumps today are unable to reach the temperatures required to produce medium-pressure saturated steam required by many California industrial facilities. State-of-the-art electric boiler technologies, on the other hand, can produce medium pressure steam, but they require huge amounts of electricity, making them too expensive to operate and taxing on the State's electric power grid. This results in excessive electricity consumption, which makes these systems uneconomical to operate and adds undue strain on the State's electric power grid. Better industrial electric based steam systems are being developed but they require custom engineering and one-off field assembly, which increases cost and reduces economic viability. By creating a more universal production process, reduced cost and increased speed of delivery could make this technology an attractive alternative to natural gas.

Solution

The applicant will bring into LRIP a heat pump technology that can produce medium-pressure high-temperature saturated steam that meets industry needs. This technology has the potential to replace natural gas fired boilers and evaporative cooling towers, which would cut scope 1 (on-site) carbon dioxide emissions by electrifying steam production at operating costs comparable or lower than those of natural gas fired boilers. Additionally, bringing the production of this technology to LRIP is expected to cut capital costs of implementing the technology by 50%.

C. Goals and Objectives of the Agreement

Agreement Goals

The goal of this Agreement is to bring a family of pre-engineered, factory-assembled industrial heat pump systems into LRIP, cutting capital costs of implementing the technology by fifty percent.

Ratepayer Benefits:²

This agreement will result in the ratepayer benefits of greater electricity reliability and lower cost. The proposed project is expected to pave the path towards hundreds of electrification projects for industrial heat across California, benefitting California investor-owned utility (IOU) ratepayers in several ways.

² 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).

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First, compared with the leading alternative steam electrification technology, electric boilers, the proposed technology will consume at least three times less electricity. Total potential electricity savings in California is 188 billion kilowatt-hours. This reduced load will increase reliability and lower costs.

Second, industrial electrification supports greater grid reliability due to the baseload nature of the electrical loads. Adding baseload to the grid reduces the magnitude of the duck curve in proportion to the total grid load, leading to greater grid reliability. It also reduces curtailment of renewable generation assets during times of high renewable energy production.

Third, industrial electrification diverts the industrial energy generated from natural gas to electricity, helping fund electrical infrastructure upgrades that benefit not only industrial customers but all IOU ratepayers.

Technological Advancement and Breakthroughs:³ 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 bringing to market efficient and economically attractive technologies to electrify the massive thermal energy demands associated with industrial steam production, replacing the dependence on natural gas fired boilers. The proposed heat pump technology is one of the only electricity based technologies to be capable of producing industrial steam at the pressures and temperatures needed for most industrial processes. Compared with state-of-the-art electric boilers, the proposed technology draws three times less electricity. These technological advancements will be key to electrifying California's industrial sector.

Agreement Objectives

The objectives of this Agreement are to:

- Design and engineer a packaged system of high temperature heat pumps for production capable of addressing key facility constraints.
- Create automated design software that will create output that is ready for fabrication and a performance specification for that design.
- Build, exercise and validate a pilot manufacturing line that is capable of building two heat pump systems per automated design software with different specifications.
- Maintain maximum performance of 150 psig steam pressure generated with LRIP-produced systems

³ 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.

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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 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.

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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, the Commission Agreement Officer (CAO), and any other CEC 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;
- Invoicing and auditing procedures;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);

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- Subcontracts (subtask 1.9); and
- Any other relevant topics.

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

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
 - An updated Project Schedule;
 - Technical products (subtask 1.1);
 - Progress reports (subtask 1.5);
 - Final Report (subtask 1.6);
 - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); 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 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 CEC, but they may take

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place at 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 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)

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 and the CAO of the following Agreement closeout items:
 - Disposition of any procured equipment.

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- 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* on a USB memory stick, organized by the tasks in the Agreement.

Products:

- Final Meeting Agreement Summary (*if applicable*)
- Schedule for Completing Agreement Closeout Activities
- All Final 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 Funds and in-state expenditures.

Products:

- Progress Reports
- Invoices

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

Subtask 1.6.1 Final Report Outline

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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 Product:

- Energy Commission Style Manual
- Comments on Draft Final Report Outline
- Acceptance 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, 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**)
 - 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.

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Scope of Work Template

Skyven Technologies

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 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 CEC 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.

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 CEC 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 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.

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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:
 - 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.

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- 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 each 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*)

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.
- 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 insure 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;

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- 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.
- 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.

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.

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- 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

Subtask 1.12 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 from 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

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IV. TECHNICAL TASKS

*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. **Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.*

TASK 2: BASIC ENGINEERING OF A PACKAGED SYSTEM FOR PRODUCTION

The goals of this task are to engineer a standardized baseline design for production; arrange the baseline design into standardized building blocks subassemblies, and engineer alternative building blocks; create a layout of the baseline design; and create basic engineering design deliverables.

The Recipient shall:

- Create a baseline design for product family production.
- Engineer alternative building blocks comprised of smaller lower-flow compressors that can be substituted into the baseline design to change specification while optimizing for COP, cost, and size
- Generate a preliminary layout of the baseline design that describes the arrangement and general size of equipment within the system
- Generate an *Engineering Deliverables Report*, that includes but is not limited to:
 - Preliminary process flow diagram (PFD) which describes the process flow rates, temperatures, and pressures within the system
 - Preliminary heat and mass balance
 - Preliminary process and instrumentation diagram (P&ID) which describes the general system layout and controls
 - Preliminary major equipment specifications with information about why each equipment choice was made and what alternatives were considered
 - Preliminary layout drawings
 - Preliminary electrical one-line diagram
 - Rough cost estimate (+/- 20%) with information for how it was calculated and how it compares to industry expectations and competitor products
 - Refined system specifications
 - This report will be 5-15 pages, will include graphics and figures, and will have an executive summary that is written for a non-technical audience.

Products:

- Engineering Deliverables Report – Task 2

TASK 3: DETAILED ENGINEERING OF A PACKAGED SYSTEM FOR PRODUCTION

The goals of this task are to model, calculate, dimension, and specify sub-major equipment and materials; verify systems through system-level process simulation; model, calculate, dimension, and specify remaining minor equipment and materials; complete design for excellence (DFX) and risk assessment reviews of the design; and create detailed engineering deliverables.

The Recipient shall:

- Model, calculate, dimension, and specify sub-major equipment and materials.
- Place the systems through process simulation(s) to verify that all design conditions are met.
- Model, calculate, dimension, and specify remaining minor equipment and materials.

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- Apply DFX principles to the detailed design, including design for manufacturability, testability, cost, safety, reliability, quality, installability, serviceability, sustainability, and supply chain.
- Generate an *Engineering Deliverables Report*, that includes but is not limited to:
 - Finalized 3D system models including models of all building-block sub-assemblies and how they fit together
 - Finalized PFD
 - Finalized heat and mass balance
 - Finalized P&ID
 - Finalized major, sub-major, and minor equipment and material specifications organized into building-block sub-assemblies
 - Finalized general arrangement drawing(s)
 - Finalized plan view drawing(s)
 - Finalized elevation view drawing(s)
 - Finalized electrical one-line diagram
 - Finalized panel layouts
 - Finalized wiring diagram
 - Finalized cost estimates (+0 / -10%) with information for how it was calculated and how it compares to industry expectations and competitor products
 - Finalized bill of materials
 - This report will be 5-20 pages, will include graphics and figures, and will have an executive summary that is written for a non-technical audience

Products:

- Engineering Deliverables Report – Task 3

TASK 4: CREATE AUTOMATED DESIGN SOFTWARE

The goals of this task are to create a lookup table and update the computer model.

The Recipient shall:

- Create a lookup table that matches ranges in key specifications (e.g. steam pressure, steam mass flow) with specific combinations of building blocks that are designed to work together.
- Add the lookup table from to the Recipient's existing computer model, such that the model calculates the parameters needed in the lookup table, then uses the lookup table to select real components sub-assemblies, and then re-runs the performance analysis with those specific components
- Generate a *Design Software Report* demonstrating the use and outputs of the software
 - This report will be no longer than 15 pages, include graphics and figures as appropriate, and have an executive summary that is written for a non-technical audience

Products:

- Design Software Report

TASK 5: BUILD A PILOT MANUFACTURING LINE FOR LRIP

The goals of this task are to generate manufacturing drawings and assembly instructions; build an assembly plan; build a plan for quality control, test, qualification, and validation of the assembly line; procure or fabricate tools, equipment, fixtures, and jigs required for manufacturing assembly; and build a pilot manufacturing line.

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None of the products in this task shall contain proprietary design, testing, assembly, and construction information. This proprietary information shall not be provided to the CEC under these tasks or otherwise under this Agreement. The terms and conditions give the CEC certain rights to obtain all data and information produced under this Agreement. Both parties agree that such rights do not apply to proprietary design, testing, assembly, and construction information. The CEC shall only have a right to send personnel to Recipient's location to view such information if needed. On any such visit, no notes or other documents will be taken or obtained by the CEC. The Recipient shall only provide publicly available information in all of its products under this Agreement.

The Recipient shall:

- Generate manufacturing drawings from the detailed engineering drawings and 3D models generated in Task 3.
- Build a *Detailed Assembly Plan*. This plan will break the work instructions down into work stations, where each station completes a portion of the assembly. The plan will include human resource requirements for each work station, as well as equipment, tools, fixtures, and jigs needed at each work station.
- Build a *Quality Control and Test Plan*, which includes incoming material and component test, sub-assembly test, and final test. Equipment and utilities required for such tests will be mapped out. The QC plan will also include a means of verification that the tests are being run and documented properly, and may involve specific data requirements, photo evidence, and/or independent third party verification.
- Procure or fabricate tools, equipment, fixtures, and jigs required for manufacturing assembly.
- Construct LRIP manufacturing line.
- Generate an *LRIP Construction Report* that documents the construction of the manufacturing line for LRIP
 - This report will be no longer than 15 pages, include graphics and figures as appropriate, and have an executive summary that is written for a non-technical audience.
- Prepare a CPR Report #1 in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Detailed Assembly Plan
- Quality Control and Test Plan
- LRIP Construction Report
- CPR Report #1 (draft and final)

TASK 6: EXERCISE, VALIDATE AND QUALIFY THE PILOT MANUFACTURING LINE

The goals of this task are to exercise the LRIP manufacturing line; qualify incoming components; qualify sub-assemblies; qualify the manufacturing process and the final assembly.

None of the products in this task shall contain proprietary design, testing, assembly, and construction information. This proprietary information shall not be provided to the CEC under these tasks or otherwise under this Agreement. The terms and conditions give the CEC certain rights to obtain all data and information produced under this Agreement. Both parties agree that such rights do not apply to proprietary design, testing, assembly, and construction information. The CEC shall only have a right to send personnel to Recipient's location to view such

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information if needed. On any such visit, no notes or other documents will be taken or obtained by the CEC. The Recipient shall only provide publicly available information in all of its products under this Agreement.

The Recipient shall:

- Exercise the LRIP manufacturing line by building two heat pumps systems of different specifications within the product family.
- Qualify incoming components according to the quality control and qualification plan build. Any components that fail qualification will be rejected and the supplier will be asked to replace the components.
- Qualify sub-assemblies according to the quality control and qualification plan.
- Qualify the manufacturing process and the final assembly. This includes implementing operational controls (e.g. manufacturing procedures and recipes) with the visibility, documentation, and routine verification required to ensure that appropriate processes are being followed. The final system will also be qualified by running through a variety of operating conditions.
- Generate a *Qualification Report* that documents the results of performance validation and qualification of the manufacturing line and resulting product family. Include an executive summary that is written for a non-technical audience.
- Generate a *Quality and Reliability Assurance (QRA) Report* that documents the QRA measures implemented, and QRA results on the first systems build on the LRIP line. Include an executive summary that is written for a non-technical audience.
- CPR report #1 (draft and final)

Products:

- Qualification Report
- Quality and Reliability Assurance Report

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

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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), 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*

TASK 8: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

The goal of this task is to ensure the learning that resulted from this project is captured and disseminated so that similar efforts build on the lessons learned.

The Recipient shall:

- Develop and submit a *Project Case Study Plan* that outlines how the Recipient will document the planning, establishment, and operation of the project. 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 project's development.
 - 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 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 (draft and final)*
- 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 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.

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Products:

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

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.