STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 02/13) CALIFORNIA ENERGY COMMISSION

New Agreement EPC-14-088 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Cecelia Golden	51	916-327-1423

Recipient's Legal Name	Federal ID Number
Asetek USA, Inc.	26-3331137

Title of Project
Demonstration of Low-Cost Liquid Cooling Technology for Data Centers

Term and Amount	Start Date	End Date	Amount
	6/13/2015	3/29/2019	$ 3,552,678

Business Meeting Information

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

Proposed Business Meeting Date	6/10/2015	☐ Consent	☒ Discussion
Business Meeting Presenter	Cecelia Golden	Time Needed:	5 minutes

Please select one list serve. Select

Agenda Item Subject and Description

ASETEK, USA Inc. Proposed resolution approving Agreement EPC-14-088 with Asetek USA, Inc. for a $3,552,678 grant to demonstrate and validate the performance, reliability, cost savings and payback of a liquid cooling technology that could cut data center energy use and be easily retrofitted with minimal operational disruptions during installation.

California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
   ☒ Yes (skip to question 2) ☐ No (complete the following (PRC 21065 and 14 CCR 15378)):
   Explain why Agreement is not considered a "Project":
   Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because

2. If Agreement is considered a "Project" under CEQA:
   ☒ a) Agreement **IS** exempt. (Attach draft NOE)
   ☐ Statutory Exemption. List PRC and/or CCR section number:
   ☒ Categorical Exemption. List CCR section number: 14 CCR 15301, 15306
   ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)
   Explain reason why Agreement is exempt under the above section:

   Cal. Code Regs., tit. 14, sect. 15301 provides that projects consisting of the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, and which involve negligible or no expansion of use beyond that existing at the time of the lead agency's determination, are categorically exempt from the provisions of the California Environmental Quality Act. This project will involve installation of equipment to demonstrate liquid cooling technology at two data centers: NASA Ames Research Center and UC San Diego Supercomputer Center. There will be alterations to the existing facility plumbing and electrical to accommodate the deployment. The same cooling function is performed with the new energy efficient technology at each of the two deployment sites. All of these activities occur within existing data center facilities, with no expansion of the current footprint or use of the facility.

   Cal. Code Regs., tit. 14, sect. 15306 provides that projects consisting of basic data collection, research, and resource evaluation activities, which do not result in a serious or major disturbance to an environmental resource, are categorically exempt. The proposed project will also track the cooling function and energy savings calculations performed in each demonstration. The purpose of these demonstrations is to gather data and evaluate performance.

   ☐ b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)

Check all that apply

- ☐ Initial Study
- ☐ Negative Declaration
- ☐ Mitigated Negative Declaration
- ☐ Environmental Impact Report
- ☐ Statement of Overriding Considerations

List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)	
Legal Company Name:	Budget
The Regents of the University of California, University of California, San Diego, on behalf of San Diego Super Computer Center	$ 434,521
DOE- Lawrence Berkeley National Laboratory	$ 350,000
Romonet, Inc.	$ 30,000

List all key partners: (attach additional sheets as necessary)
Legal Company Name:
National Aeronautics and Space Administration, NASA Ames Research Center

Budget Information

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	13-14	301.001A	$3,552,678
R&D Program Area: EERO: IAW		TOTAL:	$3,552,678
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer				**Recipient's Project Manager**			
Name:	Steve Empedocles			Name:	Larry Seibold		
Address:	5285 Hellyer Ave			Address:	5285 Hellyer Ave		
City, State, Zip:	San Jose, CA 95138-1081			City, State, Zip:	San Jose, CA 95138-1081		
Phone:	650-776-7089 /	Fax:	650-745-1273	Phone:	408-998-9002 /	Fax:	408-608-1587
E-Mail:	sem@asatek.com			E-Mail:	lse@asetek.com		

Selection Process Used

- ☒ Competitive Solicitation — Solicitation #: PON-14-304
- ☐ First Come First Served Solicitation

The following items should be attached to this GRF

1. Exhibit A, Scope of Work		☒ Attached
2. Exhibit B, Budget Detail		☒ Attached
3. CEC 105, Questionnaire for Identifying Conflicts		☒ Attached
4. Recipient Resolution	☒ N/A	☐ Attached
5. CEQA Documentation	☐ N/A	☒ Attached

Agreement Manager	Date	Office Manager	Date	Deputy Director	Date

EXHIBIT A
Scope of Work

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Develop Demonstration Plan and Measurement and Verification (M&V) Plan
3		Detailed Energy Modeling
4		Facility Installations
5	X	Baseline Monitoring
6		Stage 1 Installation of Retrofit-in-Place
7		Stage 1 and 2 Testing
8		Stage 2 Pre-Installation of New Servers with RackCDU
9		Data Analysis
10		Support for User Adoption
11		Evaluation of Project Benefits
12		Technology/Knowledge Transfer Activities
13		Production Readiness Plan

B. Acronym/Term List

Acronym/Term	Meaning
CA	California
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
CPU	Central Processing Unit
GHG	Green House Gas
M&V	Measurement and Verification
NASA	National Aeronautics and Space Administration, NASA Ames Research Center
OEM	Original Equipment Manufacturer
POs	Performance Objectives
SDSC	San Diego Supercomputer Center
TAC	Technical Advisory Committee
TCO	Total-Cost-of-Ownership

[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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EXHIBIT A
Scope of Work

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the first full-scale demonstrations of an innovative direct-to-chip data center liquid-cooling technology with the potential to cut data center cooling energy by 60-80%, server energy by 5-10%, and total data center peak load by 20-30%.

B. Problem/ Solution Statement

Problem

Data centers consume 2.2% of all electricity nationally, with a disproportionate amount of this energy being used in California (CA).[2] As traditional commercial and residential building efficiency improves, and data centers continue to grow in size and power, the percentage of CA electricity consumed by this single industry is increasing. Approximately 40% of the electricity used in data centers is for cooling. Therefore, data center cooling efficiency represents one of the largest and most important energy efficiency targets for the state.

Solution

The Recipient will demonstrate at full scale, in two operational data centers, an innovative pre-commercial data center efficiency technology, called RackCDU. This technology uses direct-to-chip liquid cooling with the potential to cut data center cooling energy by 60-80%, cut server energy consumption by 5-10%, and cut total data center electricity consumption by 20-30%. RackCDU's potential large energy savings and low up-front cost could yield a payback of less than 12 months, giving it the potential for rapid adoption across the state.

C. Goals and Objectives of the Agreement

Agreement Goals

The goal of this Agreement is to validate the performance, reliability, and lifecycle cost/benefits of RackCDU in two full-scale data centers. The Recipient will monitor and verify the energy and other benefits, create awareness and acceptance of this new, pre-commercial technology across CA, and accelerate commercialization.

Ratepayer Benefits:[3] This Agreement could result in ratepayer benefits in the near term by reducing the electricity consumption in data centers through reduced cooling and server energy consumption. In the long term, this technology has the potential to cut statewide commercial electricity consumption, reduce statewide peak load, and improve grid reliability and safety.

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[2] Response to PON-14-304 by Asetek, "Demonstration of Low-Cost Data Center Liquid Cooling with 12-month Payback."

[3] 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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EXHIBIT A
Scope of Work

Technological advancement and breakthroughs that will enable CA to achieve its statutory energy goals:[4] This Agreement could lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by dramatically reducing energy consumption in data centers.

If successful, the proposed demonstrations will eliminate the most important barrier to data center energy efficiency upgrades by allowing renovation of existing data centers without disrupting operations. These upgrades will provide quantitative computational performance benefits and direct energy cost savings to data centers.

Agreement Objectives

The objectives of this Agreement are to:

- Install RackCDU as a retrofit in two CA data centers without disrupting operations;
- Study and optimize the integrated system under different operational conditions;
- Demonstrate that the RackCDU can achieve the following when compared to existing data centers:
    - 60-80% cooling energy savings
    - 5-10% server energy savings
    - 20-30% peak-load savings
    - Projected lifecycle energy cost savings and greenhouse gas (GHG) reductions of 20-30%
    - Payback of less than12 months based on energy cost savings
    - Return on Investment that is greater than five times the retrofit cost at each retrofit site.

- Quantify non-energy benefits to the data center, such as reduced computational power-capping and soft error rates;
- Demonstrate total system reliability at or above pre-retrofit levels;
- Develop RackCDU design tools and quantify the potential impact across all CA data centers;
- Communicate results of this project to other data center owners and policy-makers.

[4] 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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EXHIBIT A
Scope of Work

II. 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)**. 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

- 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.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:

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

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

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

- ***Software Application Development***
  Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
  - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
  - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
  - Visual Studio.NET (version 2008 and up). Recommend 2010.
  - C# Programming Language with Presentation (UI), Business Object and Data Layers.
  - SQL (Structured Query Language).
  - Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
  - Microsoft SQL Reporting Services. Recommend 2008 R2.
  - XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting
The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

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

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

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

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

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
- An updated Project Schedule;
- Technical products (subtask 1.1);
- Progress reports and invoices (subtask 1.5);
- Final Report (subtask 1.6);
- Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
- Any other relevant topics.

- Provide an *Updated Project Schedule, List of Match Funds,* and *List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

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

Recipient Products:

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

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

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EXHIBIT A
Scope of Work

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

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

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

CAM Products:

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

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Subtask 1.4 Final Meeting
The goal of this subtask is to complete the closeout of this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.
  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
    - Disposition of any state-owned equipment.
    - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
    - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
    - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
    - "Surviving" Agreement provisions such as repayment provisions and confidential products.
    - Final invoicing and release of retention.

- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices
The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

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EXHIBIT A
Scope of Work

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
  - Summarize all Agreement activities conducted by the Recipient for the preceding month, including 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.
- Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs. Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions. In addition, each invoice must document and verify:
  - Energy Commission funds received by California-based entities;
  - Energy Commission funds spent in California *(if applicable)*; and
  - Match fund 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. The CAM will review and approve the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use a Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

- Style Manual

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Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline and the Style Manual provided by the CAM.
- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy Commission internal approval. Once the CAM receives approval, he/she will provide written approval to the Recipient.
- Submit one bound copy of the Final Report to the CAM.

Products:

- Final Report (draft and final)

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

The Recipient shall:

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

  If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:
  - A list of the match funds that identifies:
    - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
    - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.

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    - A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

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

Subtask 1.8 Permits
The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

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

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

Subtask 1.9 Subcontracts
The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

The Recipient shall:

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

Products:

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

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.

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EXHIBIT A
Scope of Work

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

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

The Recipient shall:

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

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- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

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

III. TECHNICAL TASKS

TASK 2: Develop Demonstration Plan and Measurement and Verification (M&V) Plan
The goal of this task is to develop more detailed and finalized demonstration and M&V plans for each site, based on the draft M&V plans submitted by Recipient in the PON process.

Subtask 2.1 Develop and Submit Demonstration Plans for Each Site
The goal of this subtask is to develop a detailed demonstration plan for approval by the CAM prior to launching the work at each site. The sites identified as of the commencement date of this grant are:

1. San Diego Supercomputer Center (SDSC), at the University of California, San Diego, 10100 Hopkins Drive, La Jolla, CA 92093.

2. National Aeronautics and Space Administration (NASA), Moffett Field Naval Air Station, Mountain View, CA 94035.

Recipient must check with its Commission Agreement Manager or Commission Agreement Officer who will provide guidance regarding the level of Commission approval required for any proposed change in sites.

The Recipient shall:
- Develop Draft *Site Demonstration Plan* (for each site), that includes but is not limited to a discussion of the following:
    - How occupant disruption will be minimized
    - Facility preparation requirements
    - Controlled pre-testing requirements, including equipment to be tested
    - Production-load pre-installation monitoring for 3 months
    - RackCDU system installation requirements
    - Controlled-load post-installation testing requirements
    - Production-load post-installation testing for 15 months for Stage 1 and at 9 months for Stage 2 installations.
- Consider comments from CAM and demonstration sites and modify plans
- Submit final *Site Demonstration Plan*s

Products:
- Site Demonstration Plans (draft & final)

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Subtask 2.2 Develop Detailed M&V Plans
The goal of this subtask is to develop a more detailed M&V plan for each site, based on the Recipient's draft M&V plan submitted in its application to the PON.

The Recipient shall:
- Work with building engineers and data center managers to develop an M&V plan that captures the energy usage at a resolution fine enough to draw conclusions about RackCDU performance.
- Submit *M&V Plans* to CAM for approval before installation of monitoring equipment at each site.

Products:
- M&V Plans (draft and final)

TASK 3 Detailed Energy Modeling
The goal of this task is to develop and calibrate the baseline and post RackCDU energy models for each site. This task does not include developing new source code.

Subtask 3.1 Develop Baseline Data Center Energy Models
The goal of this subtask is to develop a baseline model prior to installation of the RackCDU.

The Recipient shall:
- Create Initial Baseline Energy Model (for each site) using Romonet's industry-standard data center modeling software. The model will include but is not limited to:
    - Existing server system configuration and energy use
    - Data center building envelope
    - Data center operating schedules
    - Existing Computer Room Air Conditioner and Heating, Ventilating, and Air Conditioning system requirements, operating schedules and energy use
    - Other internal electrical loads and energy use
    - Utility rate schedules
- Prepare an *Initial Baseline Energy Model Report* that describes each model and all assumptions used in its development.

Product:
- Initial Baseline Energy Model Report

Subtask 3.2 Develop RackCDU Data Center Models
The goal of this subtask is to develop a detailed data center model for each site after installation of RackCDU, calibrated against actual experimental data.

The Recipient shall:
- Use baseline model data, combined with existing RackCDU energy data from prior research installations, to create an Initial RackCDU Energy Model at each site after the RackCDU retrofit, including the same parameters as listed in Subtask 3.1.

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- Prepare an *Initial RackCDU Energy Models Report* that describes each model and all assumptions used in its development

Product:
- Initial RackCDU Energy Models Report

Subtask 3.3 Refine Energy Models
The goal of this subtask is to modify the baseline (Subtask 3.1) and RackCDU data center models (Subtask 3.2) based on data collected in subsequent tasks.

The Recipient shall:
- Develop Final Baseline Energy Models by using baseline monitoring data to calibrate Initial Baseline Energy Models to within 10% accuracy
- Develop Final RackCDU Energy Models by using data collected from Tasks 5 to 8 and calibrate Initial RackCDU Energy Models to within 10% accuracy
- Prepare *Final Baseline Energy Models Report* that describes each model, revisions made and the reasons for the revisions, and assumptions.
- Prepare *Final RackCDU Energy Models Report* that describes each model, revisions made and the reasons for the revisions, and assumptions.

Products:
- Final Baseline Energy Models Report
- Final RackCDU Energy Models Report

TASK 4 Facility Installations
The goal of this task is to install all facility infrastructure and monitoring hardware without disrupting data center operations.

Subtask 4.1 Permits
The goal of this subtask is to secure all permits needed at both sites.

The Recipient shall:
- Obtain and provide copies of all *Permits* needed for each site.

Product:
Copies of Permits as applicable

Subtask 4.2 Data Center Disruption Plans
The goal of this subtask is to develop a data center disruption plan that shows how operational disruptions will be minimized at each site during the project.

The Recipient shall:
- Work with the data center management team at each site to establish a plan for the facilities upgrades and server retrofits that minimizes/eliminates disruption to normal data center operations and other building activities.
- Prepare *Data Center Disruption Plan* to discuss how disruptions would be minimized or eliminated at each site.

.

EXHIBIT A
Scope of Work

Product:

- Data Center Disruption Plan

Subtask 4.3 Plumbing and Equipment Installations
The goal of this subtask is to complete installation of the external-loop water and heat-rejection systems at each site.

The Recipient shall:

- Recipient (on behalf of NASA) and SDSC will each choose a local installation contractor using a competitive process, ensuring that the budget includes payment of prevailing wage for appropriate job classifications.
- At San Diego Supercomputer Center (SDSC), install plumbing from racks to a dry-cooler installed outside the buildings, on the roof.
- At NASA, install plumbing from racks to a hybrid adiabatic/dry cooler, outside the building, on an existing cement pad.
- Prepare *Installation Completion Report* that describes the installation of the external-loop water and heat rejection systems for each site, the need for redundant recirculating pump and other industry practices implemented.

Products:

- Installation Completion Report

Subtask 4.4 Install Monitoring Hardware
The goal of this subtask is to install all necessary monitoring equipment at both sites.
The Recipient shall:

- Prepare *Monitoring Equipment Installation Report* for each site, to include but not limited to a discussion of the Installed sub-metering equipment and instrumentation to monitor the following variables:
    - Server load;
    - External-loop water flow rate
    - External-loop input and output water temperatures
    - External-loop pumps and heat-rejection plant electrical loads
    - Server “up-time”
    - Weather
    - Central Processing Unit (CPU) Load and CPU temperature
    - Soft-error rates, CPU power leakage, and CPU power capping (SDSC only)

Products:

- Monitoring Equipment Installation Report

TASK 5 Baseline Monitoring
The goal of this task is to measure baseline energy performance and non-energy performance objectives, as indicated in the Agreement Objectives section of the Scope of Work, through controlled-load testing and long-term production load testing. All subtasks processes under Task 5 to occur in approximate parallel to subtask processes under Task 4.

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EXHIBIT A
Scope of Work

Subtask 5.1 Long-Term Production Load Pre-Installation Testing
The goal of this subtask is to measure baseline data center energy consumption under standard operating conditions.

The Recipient shall:

- Monitor sites for a period of 3 months under standard production loads:
  - Stage 1 air-cooled server energy use
  - CPU load
  - CPU temperature
- At SDSC only, also measure:
  - Soft error rates
  - CPU leakage
  - CPU power capping
- Use Romonet model from Subtask 3.1 to calculate balance of data center loads from server load.
- Prepare *Baseline Monitoring Report* for both sites to include discussion of the monitoring results and calculation of data center electric loads, including the server load.

Products:

- Baseline Monitoring Report

Subtask 5.2 Short-Term Controlled-Load Testing
The goal of this subtask is to measure total data center energy consumption under specific CPU loads at each site to provide quantitative inputs to modeling and analysis.

The Recipient shall:

- Perform controlled-load performance testing using LINPAC ("CPU exercising software")
- Monitor and calculate same parameters as Subtask 5.1 under fixed CPU Loads of 25%, 50%, 75%, and 100%.
- Run each test for 2 hours at each load.
- Prepare *Baseline Production and Controlled Load Energy Data Report* for both sites
- Prepare *CPR report* and attend CPR meeting as discussed in Subtask 1.3

Products:

- Baseline Production and Controlled Load Energy Data Report
- CPR Report

TASK 6 Stage 1 Installation of Retrofit-in-Place
The goal of this task is to retrofit existing servers with RackCDU without disrupting data center operations at both sites.

Subtask 6.1 Rack Extension Installation and Liquid Interconnect and Internal Loop Installation
The goal of this subtask is to install RackCDU extensions onto all racks at both sites and interconnect them to the external-loop and water loop so that they are prepared for liquid-cooled server installation. Retrofit all servers at both sites with internal cooling loops without disrupting data center operations.

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EXHIBIT A
Scope of Work

The Recipient shall:

- Install RackCDU rack extensions to every other rack at both sites, while keeping all air-cooled servers in operation.
- Prepare *Verification Report* when both sites are running on liquid cooling, to include discussion of the installation of the RackCDU extensions, and their interconnection to the external-loop and water loop and any disruptions of data center operations.

Products:

- Verification Report

TASK 7 Stages 1 and 2 Monitoring, Verification, Performance and Production Testing
The goal of this task is to provide independent monitoring and verification of the RackCDU systems at each site, using the M&V plan developed in subtask 2.1

Subtask 7.1 Monitoring and Verification of Performance Testing
The goal of this subtask is to monitor and verify the performance of the RackCDU at each site.

The Recipient shall:

- Evaluate the impact of, and optimize, external-loop water flow rate and dry-cooler fan speed against total data center energy savings and select optimum flow rate for long-term testing;
- Evaluate impact of, and optimize, adiabatic set-point temperature on data center efficiency and water consumption and set optimum set-point temperature for long-term testing;
- Study server performance (CPU temperature, power leakage, power-capping, and soft-error rates) against facility water temperature;
- Perform controlled CPU load testing to provide detailed cooling and server energy savings data to calibrate RackCDU Romonet model in Task 3;
- Perform long-term production load monitoring to validate all findings and models against actual full-scale energy savings.
- For **SDSC Site**
    - Quantify the impact of external-loop water flow rate and dry cooler fan speed on total data center efficiency
    - Set systems at both sites to optimum conditions for RackCDU testing
    - Use LINPAC model to provide a controlled artificial CPU load of 100%
    - Run a design-of-experiments measuring server energy as a function of external-loop flow rate and dry cooler fan speed.
    - Compare liquid-cooled server energy and cooling energy to baseline.
    - Use Romonet model to calculate total data center energy consumption under each condition and identify the optimum flow rate and fan speed to balance increased cooling savings with increased pump and fan energy.
    - Select optimum flow rate and fan speed to maximize energy efficiency data center-wide for long-term production load testing.
- For **NASA Site**,
    - Quantify the impact of set-point temperature for a hybrid adiabatic/dry-cooler on total data center efficiency and water consumption
    - Select and fix the set point at NASA to optimize overall system performance

.

  - Use LINPAC model to provide a controlled artificial CPU load of 100% at NASA (only).
  - Measure server load, server energy, external-loop flow rate and external-loop water inlet/outlet temperatures.
  - Compare to baseline as a function of adiabatic set-point temperature.
  - Use Romonet model to calculate total data center energy consumption.
  - Calculate expected annual water usage at each set point, based on historical monthly wet-bulb/dry-bulb temperatures and compare to air-cooled condition.
  - Select optimum adiabatic set point to maximize energy efficiency on a data center-wide basis while minimizing annual water consumption.
  - Measure annual water consumption compared to pre RackCDU installation
- Utilize collected data and prepare *Site Test Results Report* for both sites that includes a discussion of all the items identified in Subtask 7.1.

Products:
- Site Test Results Report

Subtask 7.2 Computational Performance Testing for SDSC
The goal of this subtask is to quantify the computational performance improvements of the SDSC data center.

The Recipient shall:
- Monitor the following computational performance parameters:
  - CPU leakage
  - CPU power capping
  - Soft error rates
  - CPU core- and case-temperature for each data point
- Compare these values to the baseline values from Subtask 5.2 at the same CPU load.
- Utilizing workload characterization and statistical modeling, analyze measured data to determine energy efficiency improvements.
- Identify optimum system set points for each performance parameter.
- Potentially adjust optimum external-loop set points to maximize some or all of these parameters during long-term production load testing, based on discussions with data center staff.
- Use data collected to prepare *Matrix of Computational Performance Parameters Report* to include a discussion of all the items listed in Subtask 7.2.

Product:
- Matrix of Computational Performance Parameters Report

Subtask 7.3 Controlled Load and Production Load Testing
The goal of this subtask is to repeat all controlled-load testing from Task 5.2, for the liquid-cooled racks operating under the optimum external-loop water settings, to provide a quantitative comparison of improved performance from liquid cooling versus air cooling. Perform long-term performance testing under standard production loads at both sites, in order to quantify whole data center efficiency improvements under full operational conditions.

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The Recipient shall:

- Repeat the measurements of Subtask 5.2 under the optimal external-loop flow/set-point conditions from Subtask 7.1 at each data center.
- Repeat testing conducted in Subtask 5.1 under optimum liquid-cooling conditions determined in Subtask 7.1 for 15 months.
- Use collected data and prepare a *Controlled Load and Production Load Testing Report* for each site to include a discussion of all the items listed in Subtask 7.3.

Products:

- Controlled Load and Production Load Testing Report

Subtask 7.4 Stage 2 Controlled Load and Production Load Testing
The goals of this subtask are to collect controlled-load and production load RackCDU energy data on Stage 2 (Task 8) servers.

The Recipient shall:

- Once the Stage 2 servers have been installed in each site, repeat all controlled-load testing from Subtask 7.1 on the Stage 2 servers before they are put into operation.
- Combine Stage 2 servers with Stage 1 (Task 6) servers and continue production load testing from Subtask 7.2 for 9 months.
- Prepare *Stage 2 Controlled Load and Production Load Testing Report* based on data collected at both sites and includes a discussion of the data collection and results of testing.

Products:

- Stage 2 Controlled Load and Production Load Testing Reports

TASK 8 Stage 2 Pre-Installation of New Servers with RackCDU
The goal of this task is to preinstall new servers with RackCDU at both sites.

Subtask 8.1 Stage 2 Internal Loop and Server Installations
The goals of this subtask are to pre-install internal cooling loops in all Stage 2 servers and to install and commission all Stage 2 servers at both sites.

The Recipient shall:

- At NASA, demonstrate RackCDU on new servers, with internal cooling loops pre-installed, prior to delivery to the data center
- At SDSC:
  - SDSC will purchase new servers and select Original Equipment Manufacturer (OEM) server vendor (TBD) to preinstall cooling loops.
  - Recipient will supply internal cooling loops to OEM for pre-installation onto new servers
  - OEM will ship new server to SDCS site after preinstallation of cooling loops
- Prepare *Stage 2 Internal Loop and Server Installation Repor*t for both sites to include a discussion of the installations at each site and the total data center energy performance under increased computational (electrical) load.

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- Prepare an *Internal Loop and Server Analysis Report* for both sites that discusses all work completed in Subtask 8.1.

Products:
- Stage 2 Internal Loop and Server Installation Report
- Internal Loop and Server Analysis Report

TASK 9 Data Analysis
The goal of this task is to quantify and determine whether all key performance objectives (POs) described in Section C of the Scope of Work, Goals & Objectives of the Agreement, have been met.

Subtask 9.1 Performance Analysis
The goal of this subtask is to quantify and determine whether the POs for each site have been met.

The Recipient shall:
- Analyze all data for each site.
- Prepare a *Performance Data Analysis Report* for each site that analyzes each of the performance objectives and determines whether the objectives were met based on monitored data collected for Stage 1 and 2 installations. The report should discuss energy consumption, daily usage patterns, day types grouped by use or computational load profiles. Daily and hourly data will be analyzed and correlated to local weather data, occupancy and other preferences through regression analysis. For periods with abnormal energy consumption, the amount of variation will be determined using mean and standard deviation. Outlier data will be identified using the generalized extreme studentized deviate procedure. Changes in reliability will be quantified through use of statistical average and standard deviation analysis.

Products:
- Performance Data Analysis Report

Subtask 9.2 User Surveys
The goal of this subtask is to quantify user feedback about RackCDU, specifically regarding impact on data center operations (i.e., “ease of use,” impact on reliability) and overall acceptance of the technology from both sites.

The Recipients shall:
- Prepare Likert-style surveys regarding day-to-day data center operations, including:
    - Impact on maintenance and operations
    - Ease-of-use
    - Staff productivity
    - Overall “acceptance”
    - User comfort (e.g., from reduced fan noise)
    - User satisfaction
    - User acceptance of the technology
- Prepare *Data Center Survey Package* and conduct surveys with data center operators.

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  - Pre-Installation Survey: prior to servers in production (Stage 1)
  - Post-Installation Survey: 3 months after servers in production (Stage1).
  - End-of-Project Survey: final quarter of production load testing.
  - Prepare *Data Center Survey Package*
- Create *Statistical Analysis of User Survey Data Report* from each site, to include but not limited to:
  - Results from each survey
  - Correlation between environmental/operational variables and occupant feedback from surveys using standard parametric statistical analysis to assess significant changes in each parameter.

Products:
- Data Center Survey Package
- Statistical Analysis of User Survey Data Report

Subtask 9.3 Total Cost of Ownership and GHG Assessment
The goal of this subtask is to assess the impact of RackCDU and the total cost of ownership (TCO) and estimate GHG emission reductions.

The Recipient shall:
- Prepare a *TCO Methodology Memo* describing the methodology and all the inputs and assumptions to be used in the calculation, such as those listed in the TCO Analysis Report, and obtain concurrence from the CAM and TAC members.
- Calculate the expected TCO for each site, with and without RackCDU, using calibrated Romonet models from Subtask 3.3.
- Create *TCO Analysis Report* for each site, to include but not limited to a discussion of the following:
  - RackCDU initial hardware costs
  - RackCDU installation costs
  - Lifetime internal loop costs for server refresh over a 20-year period
  - Capital and infrastructure cost savings due to the use of RackCDU
  - Facilities energy costs
  - Server maintenance costs
  - Facilities maintenance costs
  - Hardware lifetimes
  - Operator training costs
- Prepare *Lifecycle GHG Analysis Memo* describing the methodology used to determine GHG emission reductions for each site include all the inputs and assumptions used in the calculation and obtain concurrence from the CAM and TAC members.
- Create *Lifecycle GHG Analysis Report* for each site that provides an estimate of the GHG emission reductions associated with using the RackCDU versus the standard system, including all assumptions and factors used in the calculation.

Products:
- TCO Methodology Memos (draft and final)
- TCO Analysis Report
- Lifecycle GHG Analysis Memos (draft and final)
- Lifecycle GHG Analysis Report

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EXHIBIT A
Scope of Work

Subtask 9.4 Total Cost, Energy, and GHG Savings Potential for California
The goal of this subtask is to estimate the statewide potential of RackCDU based on the data from Subtasks 9.1 and 9.3.

The Recipient shall:

- Estimate CA data center stock based on available industry reports and industry maps.
- Use the baseline and RackCDU performance characteristics from Subtasks 9.1 and 9.3 to generate three different representative data center model types (large, medium, and small size) using optimized Romonet models from Subtask 3.3. These models should represent all CA data center stock, including impact of regionally different climate zones and electricity costs
- Generate a *RackCDU Retrofit Summary Report* to discuss the following:
    - Market potential for each representative data center type (large, medium and small),
    - Definition of each type, including performance characteristics needed for each to meet the agreement objectives listed in Section C of the Scope of Work (e.g., 60-80% cooling energy savings, 12 month simple payback, ROI greater than 5 times the investment).
- Generate a *California Statewide Adoption Summary Report* to discuss:
    - Total potential impact of existing RackCDU installations across all of CA (energy savings, cost- savings, GHG emission savings)
    - Total statewide potential, assuming various levels of penetration and performance characteristics in determining overall statewide energy savings, cost savings and GHG emission reductions. Provide justification for all assumptions used in determining energy and cost savings and GHG reductions.
    - Estimated cost for each type of datacenter (large, medium and small), payback and ROI assuming statewide conversion/replacement
    - Potential barriers and recommendations for overcoming the barriers to achieving the penetration levels identified.
    - Database where existing RackCDU installations can be found.

Products:

- RackCDU Retrofit Summary Report
- California Statewide Adoption Summary Report

TASK 10 Support for User Adoption
The goal of this task is to support and develop educational documents and outreach to stakeholders.

Subtask 10.1 Develop Guidance and Evaluation Documents
The goal of this subtask is to generate guidance documents that can be used by data center owners and operators to assess the impact of RackCDU in their own data centers.

The Recipient shall:

- Prepare *Romonet Add-Ins Availability Plan* to discuss the plan for making the standard modeling software program available to data center operators and others to assess the potential of using the RackCDU in their installations.

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- Create *Guidance and Evaluation Documents Package*, to include but not limited to:
    - Overview of RackCDU technology
    - Case studies
    - Installation methodologies
    - Facilities engineering designs
    - Romonet Add-In/other software assessment tool availability
    - TCO analysis tools
    - Best practices
    - Lessons learned

Products:

- Romonet Add-Ins Availability Plan
- Guidance and Evaluation Documents Package

Subtask 10.2 Engage Other CA Data Centers and Create Awareness

The goal of this subtask is to engage and educate CA Data Center Owners and Operators about RackCDU.

The Recipient shall:

- Meet with at least 30 data center owners and operators, and data center facility energy managers.
- Evaluate how RackCDU could be implemented at each site, and quantify the impacts
- Collect feedback from the site visits and determine whether additional data or adjustments are needed
- Introduce data center operators to Asetek's Certified Installer network and identify points of contact for all OEM server vendors to ensure access to the RackCDU technology,
- To the extent permitted, list data center owners, operators, and facility energy managers contacted, including their contact information, name of institution (e.g., data center), and outcomes
- Establish *Outreach Summary Report* on assessment and feedback from outreach opportunities to include:
    - Third-Party Presentation Materials
    - Public Presentations
    - List of data center owners/operators contacted, including name of institution and outcomes (e.g., technical and economic feasibility to implement the RackCDU, and decision to implement, and reasons why not)

Products:

- Outreach Summary Report

TASK 11 Evaluation of Project Benefits

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

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EXHIBIT A
Scope of Work

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:

  - For Product Development Projects and Project Demonstrations:
    - Published documents, including date, title, and periodical name.
    - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
    - Greenhouse gas and criteria emissions reductions.
    - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
    - A discussion of project product downloads from websites and publications in technical journals.
    - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
    - Additional Information for Product Development Projects:
      - Outcome of product development efforts, such as copyrights and license agreements.
      - Units sold or projected to be sold in California and outside of California.
      - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
      - Investment dollars/follow-on private funding as a result of Energy Commission funding.
      - Patent numbers and applications, along with dates and brief descriptions.
    - Additional Information for Product Demonstrations:
      - Outcome of demonstrations and status of technology.
      - Number of similar installations.
      - Jobs created/retained as a result of the Agreement.

  - For Information/Tools and Other Research Studies:
    - Outcome of project.
    - Published documents, including date, title, and periodical name.
    - A discussion of policy development. State whether the project has been cited in government policy publications and/or technical journals, and if it has been used to inform regulatory bodies.

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

- Respond to CAM questions regarding responses to the questionnaires.

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

Products:

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

TASK 12 Technology/Knowledge Transfer Activities

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

The Recipient shall:

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes, but not limited to:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - A website link to CEC project findings and reports generated, including summary of project results
  - At least three public presentations to CA Investor Owned Utilities, industry conferences, such as the Silicon Valley Leadership Data Center Summit.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.
  - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
  - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
  - The number of website downloads or public requests for project results.
  - Additional areas as determined by the CAM.

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- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

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

TASK 13 Production Readiness Plan

The goal of this task is to determine the steps that will lead to the manufacturing of technologies developed in this project or to the commercialization of the project's results.

The Recipient shall:

- Prepare a *Production Readiness Plan*. The degree of detail in the plan should be proportional to the complexity of producing or commercializing the proposed product, and to its state of development. As appropriate, the plan will discuss the following:
  - Critical production processes, equipment, facilities, personnel resources, and support systems needed to produce a commercially viable product.
  - Internal manufacturing facilities, supplier technologies, capacity constraints imposed by the design under consideration, design-critical elements, and the use of hazardous or non-recyclable materials. The product manufacturing effort may include "proof of production processes."
  - The estimated cost of production.
  - The expected investment threshold needed to launch the commercial product.
  - An implementation plan to ramp up to full production.
  - The outcome of product development efforts, such as copyrights and license agreements.
  - Patent numbers and applications, along with dates and brief descriptions.
  - Other areas as determined by the CAM.

Products:

- Production Readiness Plan (draft and final)

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

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RESOLUTION NO: 15-0610

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: ASETEK USA, INC.

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

RESOLVED, that the Energy Commission approves Agreement EPC-14-088 from PON-14-304 with **Asetek USA, Inc.** for a **$3,552,678** grant to demonstrate and validate the performance, reliability, cost savings and payback of a liquid cooling technology that could cut data center energy use and be easily retrofitted with minimal operational disruptions during installation; and

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

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on June 10, 2015.

AYE: [List of Commissioners]
NAY: [List of Commissioners]
ABSENT: [List of Commissioners]
ABSTAIN: [List of Commissioners]

Harriet Kallemeyn,
Secretariat