

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement EPC-15-011 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	David Chambers	43	916-327-2356

Recipient's Legal Name	Federal ID Number
LightSail Energy	27-0498127

Title of Project
Isothermal Compressed Air Energy Storage with Solar and Load Forecasting Integration

Term and Amount	Start Date	End Date	Amount
	2/1/2016	3/29/2019	\$ 1,200,276

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

Proposed Business Meeting Date	12/9/2015	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	David Chambers	Time Needed:	5 minutes

Please select one list serve. EPIC (Electric Program Investment Charge)

Agenda Item Subject and Description

LIGHTSAIL ENERGY. Proposed resolution approving Agreement EPC-15-011 with LightSail Energy for a \$1,200,276 grant to accelerate commercialization of Isothermal Compressed Air Energy Storage (I-CAES) technology. LightSail Energy will pilot test an ICAES system for use in integrating renewable energy and providing grid support. This Agreement aims to provide ratepayer benefits of greater electricity reliability, lower costs, and lower GHG emissions by using energy storage to support increased use of renewable energy, while simultaneously reducing strain on the electric grid. (EPIC funding) Contact: David Chambers. (Staff presentation: 5 minutes)



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 15303; 14 CCR 15304; 14 CCR 15306; 14 CCR 15301

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

Explain reason why Agreement is exempt under the above section:

Cal. Code Regs., tit. 14, sec. 15303 provides that projects which consist of construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure, are categorically exempt from the provisions of CEQA. This project consists of the construction of a small enclosure and installation of one Isothermic Compressed Air Energy Storage (I-CAES) unit with air tanks to analyze a commercial sized I-CAES unit providing real-time information on the performance and operational characteristics of the I-CAES in a real world setting. Specifically, compressor/expander, custom-designed carbon composite high-pressure air tanks, along with balance of plant (BOP) components such as power electronics and smart inverters, which will be installed in an existing microgrid, is approximately the size of a shipping container, 40ft long by 8ft wide by 8ft tall. Therefore, the project falls within section 15303 and will not have a significant effect on the environment.

Cal. Code Regs., tit. 14, sect. 15304 provides that projects which consist of minor public or private alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees except for forestry and agricultural purposes are categorically exempt from the provisions of CEQA. In this project, minor alterations to land would occur for the installation of electrical connections to the switchgear station and a concrete pad. Specifically, trenching approximately 30-feet long by 3-feet deep will be dug for an electrical system. Surface will be restored and no trees will be removed. Therefore, the project falls within section 15304 and will not have a significant effect on the environment.

Cal. Code Regs., tit. 14, sec. 15306 provides that projects which consist of basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. These may be strictly for information gathering purposes, or as part of a study leading to an action which a public agency has not yet approved, adopted, or funded. In this project, information collection would occur by collecting the I-CAES storage performance data and analysis (e.g. store of intermittent solar energy and supply power for load following).

Cal. Code Regs., tit. 14, sec. 15301 provides that projects which consist 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 involves installation of compressor/expander, custom-designed carbon composite high-pressure air tanks, and similar plant components such as power electronics and smart inverters at an existing microgrid. The existing microgrid includes a fuel cell, solar and cogeneration plant, transformers, and electrical switchgear. The installation of new equipment at the existing microgrid will not result in any expanded capacity; there is no new generation being added. Rather, this project targets energy storage. Therefore, the project falls within section 15301 and will not have a significant effect on the environment.

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

Check all that apply

Initial Study

Environmental Impact Report

Negative Declaration

Statement of Overriding Considerations

Mitigated Negative Declaration

List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION



Legal Company Name:	Budget
The Regents of the University of California, on behalf of the San Diego campus	\$ 389,876
Olivine, Inc.	\$ 95,000
Energy and Environmental Economics, Inc (E3)	\$ 99,000
Robert D. Caldwell	\$ 25,000

List all key partners: (attach additional sheets as necessary)

Legal Company Name:

Budget Information			
Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	14-15	301.001B	\$1,200,276
			\$
			\$
R&D Program Area: ESRO: ETSI		TOTAL:	\$1,200,276
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer				Recipient's Project Manager			
Name:	M. Travis O'Guin			Name:	M. Travis O'Guin		
Address:	914 HEINZ AVE			Address:	914 HEINZ AVE		
City, State, Zip:	BERKELEY, CA 94710-2717			City, State, Zip:	BERKELEY, CA 94710-2717		
Phone:	510-981-8088	Fax:	- -	Phone:	510-981-8088	Fax:	- -
E-Mail:	toguain@lightsailenergy.com			E-Mail:	toguain@lightsailenergy.com		

Selection Process Used	
<input checked="" type="checkbox"/> Competitive Solicitation	Solicitation #: PON-13-302
<input type="checkbox"/> First Come First Served Solicitation	

The following items should be attached to this GRF	
1. Exhibit A, Scope of Work	<input checked="" type="checkbox"/> Attached
2. Exhibit B, Budget Detail	<input checked="" type="checkbox"/> Attached
3. CEC 105, Questionnaire for Identifying Conflicts	<input checked="" type="checkbox"/> Attached
4. Recipient Resolution	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached
5. CEQA Documentation	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached

Agreement Manager	Date	Office Manager	Date	Deputy Director	Date

Exhibit A
Scope of Work

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR¹	Task Name
1		General Project Tasks
2		Design, Development, and Testing of Prototype
3	X	Site Design & Construction and Load Analysis
4	X	Pilot Project Testing
5		CAISO Energy Storage Market Study
6		Solar and Load Forecasting Integration with Energy Storage
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities
9		Production Readiness Plan

A. Acronym/Term List

Acronym/Term	Meaning
BOP	Balance of Plant
CAES	Compressed air energy storage
CAISO	California Independent System Operator
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
GHG	Greenhouse Gas(es)
I-CAES	Isothermal Compressed Air Energy Storage
PV	Photovoltaic
Recipient	LightSail Energy
TAC	Technical Advisory Committee
UCSD	University of California – San Diego

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

Exhibit A
Scope of Work

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

A. PURPOSE OF AGREEMENT

The purpose of this Agreement is to pilot test an isothermal compressed air energy storage (I-CAES) system at the University of California – San Diego (UCSD), or other site approved in writing by the Commission Agreement Officer (CAM), and will be used for renewable energy integration and load following as well as grid services and support.

B. PROBLEM/ SOLUTION STATEMENT

Problem

As renewable energy continues to flourish in California, the electric grid is expected to become increasingly strained due to the intermittent nature of renewable energy as well as the increased ramping requirements it places on the grid. Renewable energy resources, such as solar photovoltaic (PV), represent a valuable resource for meeting California's Renewable Portfolio Standard and greenhouse gas reduction goals. However, the intermittent nature of renewable energy can cause additional strain on the grid as operators are forced to use more fast-responding and inefficient "peaker" plants to compensate for the intermittent production.

Energy storage is a promising solution to this dilemma. However, there are significant barriers to energy storage use including: high capital costs, lack of information regarding performance, and limited operational experience. This project will develop and pilot test an I-CAES system and demonstrate a path that will help to meet goals in the California Energy Commission Strategic Plan; specifically increasing grid reliability and lowering energy costs.

Solution

This project includes pilot testing an I-CAES system connected to a solar PV array and end-user load. The storage unit will be used to "firm-up" the PV generation so that electric power can be used when needed and reduce intermittency as well as provide load-following. Furthermore, the Recipient will create and conduct a California Independent System Operator (CAISO) market simulation modeling new resources using the I-CAES system to better understand the value of the technology to end users and the CAISO markets. The Recipient will perform a ratepayer analysis to determine the costs and benefits of the storage unit to California ratepayers.

The proposed project will design, develop, install, test, and analyze a commercial sized I-CAES pilot unit consisting of a compressor/expander, custom-designed carbon composite high-pressure air tanks, along with balance of plant (BOP) components such as power electronics and smart inverters.

The project will also provide real-time information on the performance and operational characteristics of the I-CAES in a real-world setting. This information will be used in creating a strategy to lower the capital cost, enhance load following of I-CAES and reduce the impact of renewable intermittency on the grid.

Exhibit A
Scope of Work

C. GOALS AND OBJECTIVES OF THE AGREEMENT

Agreement Goals

The goals of this Agreement are to:

- Reduce intermittency of renewable energy on the grid;
- Reduce peak load requirements from the grid;
- Reduce cost of energy storage, specifically I-CAES;
- Increase grid efficiency and reduce overall greenhouse gas (GHG) emissions;
- Increase grid reliability; and
- Reduce costs to California ratepayers.

Agreement Objectives

The objectives of this Agreement are to:

- Obtain real-time performance data on I-CAES installed at a customer site;
- Identify opportunities for improving performance (i.e. roundtrip efficiency) and lowering costs of I-CAES, both capital costs and installation costs and develop a clear and tangible strategy for meeting these targets;
- Assess and quantify the potential of I-CAES to reduce peak load at an end-user facility;
- Analyze and quantify the benefits of solar forecasting in energy storage operation;
- Understand how energy storage can be used to increase renewable penetration while also increasing grid reliability and efficiency;
- Determine value of I-CAES on wholesale power markets in California; and
- Determine the potential net benefits of deploying I-CAES to California ratepayers.

Ratepayer Benefits:² This Agreement will result in the ratepayer benefits of greater electricity reliability, lower costs, and lower GHG emissions by using energy storage to support increased use of renewable energy, while simultaneously reducing strain on the electric grid.

Furthermore, this agreement will provide valuable data on I-CAES, an emerging storage technology, operating in a real-world environment. This data can be used to improve performance and lower costs of I-CAES, leading to a more efficient California electrical grid. Results from this project can be used to support future implementation of PV plus energy storage into the California grid. This directly furthers the state in its goals to produce 33% of electrical energy from renewable sources, reduce GHG emissions, and provide safe, reliable, and low cost energy to ratepayers.

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).

Exhibit A

Scope of Work

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 advancing the development of I-CAES, a technology with the potential to be the lowest-cost and longest-lifetime energy storage system on the market. Specifically, the agreement will measure and value the performance and benefits of I-CAES and elucidate means to reduce capital costs. The agreement will also lead to technological advancement of utilizing solar forecasting measures to most effectively implement energy storage connected to PV.

Currently, there is no real-world data available on the operation of I-CAES connected to a PV array. This project seeks to test and analyze the use of I-CAES to absorb intermittent solar energy and provide dispatchable power for load following. The project will study the I-CAES performance with sensors and measurement devices connected throughout the machine. These results will then be used by utilities to correctly value and more efficiently incorporate energy storage into the California electric grid, for use in grid services and supporting renewable energy integration.

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)**. 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.

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.

Exhibit A

Scope of Work

- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

For products that require a final version only

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

For all products

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

Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**

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

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

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

- **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).

Exhibit A

Scope of Work

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

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

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

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

- 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)*

Exhibit A

Scope of Work

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

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

The Recipient shall:

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

Exhibit A

Scope of Work

CAM Products:

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

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

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

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

Exhibit A
Scope of Work

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

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

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

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

Subtask 1.6.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

Exhibit A

Scope of Work

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a Final Report for this Agreement in accordance with the approved Final Report Outline, Style Manual, and Final Report Template provided by the CAM with the following considerations:
 - Ensure that the report includes the following items, in the following order:
 - Cover page (**required**)
 - Credits page on the reverse side of cover with legal disclaimer (**required**)
 - Acknowledgements page (optional)
 - Preface (**required**)
 - Abstract, keywords, and citation page (**required**)
 - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
 - Executive summary (**required**)
 - Body of the report (**required**)
 - References (if applicable)
 - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
 - Bibliography (if applicable)
 - Appendices (if applicable) (Create a separate volume if very large.)
 - Attachments (if applicable)
 - Ensure that the document is written in the third person.
 - Ensure that the Executive Summary is understandable to the lay public.
 - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
 - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
 - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
 - Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
 - Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
 - Include a brief description of the project results in the Abstract.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product

Exhibit A

Scope of Work

- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the Final Report to the CAM along with Written Responses to Comments on the Draft Final Report.

Products:

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

CAM Product:

- Written Comments on the Draft Final Report
- Approval of Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

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.

Exhibit A

Scope of Work

- 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*)

Exhibit A

Scope of Work

- 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

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.

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

Exhibit A

Scope of Work

Products:

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

TECHNICAL TASKS

TASK 2: Design, Development, and Testing of Prototype

The goal of this task is to design, develop and test the prototype I-CAES system.

The heart of the I-CAES system is the Power Unit consisting of a proprietary two-stage compressor/expander which will be used to compress air during the charging cycle, and expand air during the discharging cycle, both of which use a near-isothermal process. The Power Unit also consists of a BOP, which includes motors; inverters; power distribution; control system; air-water separators; instrumentation and control valves. In addition to the Power Unit, the I-CAES also consists of water storage and custom-designed, carbon-composite air storage.

The Recipient shall:

- Prepare an *Intermediate Test Report* that includes, but is not limited to the following:
 - Design, develop and test the high pressure stage of the Power Unit in compression and expansion mode.
 - Design, develop and test the low pressure stage of the Power Unit in compression and expansion mode.
 - Design, develop and test high pressure water pump.
 - Design, manufacture and test air storage vessels in accordance with the American Society of Mechanical Engineers (ASME) code.
- Prepare a *Summary Test Report* that includes, but is not limited to the following:
 - Integrate the low and high pressure stages of the Power Unit and test the system in compression and expansion mode.
 - Specify, procure and test components of the BOP and evaluate performance.

Products:

- Intermediate Test Report
- Summary Test Report

TASK 3: Site Design & Construction and Load Analysis

The goals of this task are to prepare site drawings, install equipment at the University of California – San Diego (UCSD), or other site approved in writing by the Commission Agreement Officer (CAM), and perform site-specific load analysis.

The Recipient shall:

- Perform site design, site construction, shipping equipment to site, site installation and equipment integration, and site decommissioning.
- Create *Preliminary Site Drawings* for electrical, mechanical and civil designs required for the installation of the I-CAES.
- Prepare a *CPR Report for Task 3* per Subtask 1.3. The report will include site drawings for electrical, mechanical, and civil designs and a summary of load analysis.
- Participate in a CPR Meeting per Subtask 1.3.

Exhibit A

Scope of Work

- Prepare and develop host site, including installing civil foundations, electrical interconnects, and tie-in of mechanical utilities.
- Ship, install, integrate, and commission equipment to host site.
- Perform site-specific load analysis to simulate storage system behavior under multiple charging and discharging scenarios, including charging from PV and the grid. Prepare a *Load Analysis and Storage Simulation Report* describing the results.
- Submit final *As-Built Site Drawings* incorporating any as-built conditions into the Preliminary Site Drawings.

Products:

- Preliminary Site Drawings
- CPR Report for Task 3
- Load Analysis and Storage Simulation Report
- As-Built Site Drawings

TASK 4: Pilot Project Testing

The goal of this task is to perform pilot testing, data collection, and analysis of the I-CAES system.

The Recipient shall:

- Ship, install, and commission a complete energy storage system.
- Provide communications, control, data collection, real-time monitoring, and direct observability of the energy storage system with the CAISO.
- Provide a *Test Plan* that will describe all of the testing protocols to be evaluated.
- Prepare a *CPR Report for Task 4* per Subtask 1.3.
- Participate in a CPR Meeting per Subtask 1.3.
- Collect data and conduct analysis and provide *Performance Evaluation Report*.
- Prepare a *Safety Analysis Report* that includes an evaluation of the fire and safety systems and describes the measures taken to ensure safety code compliance.
- Conduct an engineering review, check the design of the energy storage system, with the goal of ensuring eventual commercial product development.
- Provide solar renewable energy and load forecasting for a microgrid as input for control of the energy storage system.

Products:

- Test Plan
- CPR Report for Task 4
- Performance Evaluation Report
- Safety Analysis Report

TASK 5: Energy Storage Market Study

The goal of this task is to evaluate future market potential of I-CAES and investigate how this new energy storage technology would participate in CAISO power markets. The emphasis will be on ancillary services markets, load following, and frequency regulation.

Exhibit A

Scope of Work

The Recipient shall:

- Develop a *Market Model of I-CAES* to accurately model the technology's potential value to CAISO markets, and subsequently the value to the storage owner/operator. The market model will include response to price and dispatch signals.
- Determine operational parameters and requirements.
- Prepare *Report on Identification of Market Barriers* to advanced energy storage, with specific emphasis on I-CAES.

Products:

- Market Model of I-CAES
- Report on Identification of Market Barriers

TASK 6: Solar and Load Forecasting Integration with Energy Storage

The goal of this task is to integrate solar and load forecasting with the control systems of the I-CAES to maximize benefits and performance. These forecasts will enable electrical energy storage to be deployed to smooth solar ramping and reduce peak load and demand charges.

The Recipient shall:

- Interface a solar forecasting system with the I-CAES control system.
- Develop control algorithms to respond to solar forecasting predictions.
- Model energy storage response to solar forecasting.
- Determine operational parameters and requirements.
- Prepare *Report on Solar and Load Forecasting* summarizing the work and results of this task.

Product:

- Report on Solar and Load Forecasting

TASK 7: Evaluation of Project Benefits

The primary goal of this task is to report the benefits resulting from this project. Recipient will analyze the performance of the I-CAES system and monetize the totality of value streams and ratepayer benefits from the grid-connected advanced energy storage system developed in Tasks 2 through 6.

Additional goals of this task are to: (1) Develop and implement a cost-benefit methodology to demonstrate the economic potential for energy storage as preferred resources in CA capacity- and emission-constrained areas, (2) Measure and verify performance and benefits of I-CAES and (3) Document and distribute cost-benefit results to the Energy Commission and public stakeholders. Traditional cost-benefit analysis with a CPUC-adopted Distributed Energy Resources (DER) avoided-cost model shows a "Total Resource Cost" benefit-cost ratio of 1.4. Recipient will incorporate additional, quantifiable benefits to demonstrate an even better benefit/cost ratio for this emission-free, local, and flexible-capacity resource. Recipient will pursue two strategies in this regard: 1) representing higher costs for avoided or deferred resources in emission and local capacity constrained regions and b) incorporating additional values for flexible capacity, including load following, ramp and voltage/VAR support.

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.
 - 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

Exhibit A

Scope of Work

TASK 8: Technology/Knowledge Transfer Activities

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

The Recipient shall:

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
 - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
 - A description of the intended use(s) for and users of the project results.
 - Published documents, including date, title, and periodical name.
 - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
 - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
 - The number of website downloads or public requests for project results.
 - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- 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 9 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 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

Exhibit A

Scope of Work

- hazardous or non-recyclable materials. The product manufacturing effort may include “proof of production processes.”
- 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.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: LIGHTSAIL ENERGY

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

RESOLVED, that the Energy Commission approves Agreement EPC-15-011 with LightSail Energy for a \$1,200,276 grant to accelerate commercialization of Isothermal Compressed Air Energy Storage (I-CAES) technology. LightSail Energy will pilot test an I-CAES system for use in integrating renewable energy and providing grid support; 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 December 9, 2015.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Tiffani Winter,
Secretariat