

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement EPC-15-017 (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, Inc.	27-0498127

Title of Project
Utilizing Waste Heat to Increase Efficiency of Isothermal Compressed Air Energy Storage in a Smart Microgrid Environment

Term and Amount	Start Date	End Date	Amount
	3/1/2016	3/29/2019	\$ 1,085,125

**Business Meeting Information**

<input type="checkbox"/> ARFVTP agreements under \$75K delegated to Executive Director.			
Proposed Business Meeting Date	1/13/2016	<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, Inc. Proposed resolution approving Agreement EPC-15-017 with LightSail Energy, Inc. for a \$1,085,125 grant to increase the efficiency, load following and ancillary service performance and lower the cost of an isothermal compressed air energy storage (I-CAES) system through the design, development and testing of an I-CAES system in a microgrid environment. The I-CAES will utilize waste heat, solar photovoltaic, and other distributed energy generation in a microgrid environment.

**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: Cal. Code Regs., tit 14, § 15303 -- Cal. Code Regs., tit 14, § 15304 -- Cal. Code Regs., tit 14, § 15306

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

Explain reason why Agreement is exempt under the above section:

Cal. Code Regs., tit. 14, sec. 15301 provides that projects which consist of the minor alteration of existing public or private structures, facilities, or mechanical equipment, involving negligible or no expansion of use beyond that existing are categorically exemption from the provisions of CEQA. This project consists of the minor alteration of an existing microgrid to add an I-CAES unit for energy storage and will involve negligible or no expansion of use of the existing facilities and mechanical equipment.

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 new equipment 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, the equipment, 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, approximately 30-feet long by 3-feet deep trenching for electrical system. 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).

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)

Legal Company Name:	Budget
The Regents of the University of California, Irvine Advanced Power and Energy Program	\$ 265,725

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

Legal Company Name:

**GRANT REQUEST FORM (GRF)**

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CALIFORNIA ENERGY COMMISSION



<b>Budget Information</b>			
Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	14-15	301.001B	\$1,085,125
			\$
R&D Program Area: ESRO: ETSI		TOTAL:	\$1,085,125
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

<b>Recipient's Administrator/ Officer</b>				<b>Recipient's Project Manager</b>			
Name:	M. Travis O'Guin			Name:	M. Travis O'Guin		
Address:	914 Heinz Ave			Address:	914 Heinz Ave		
City, State,	Berkeley, CA 94710-2717			City, State, Zip:	Berkeley, CA 94710-2717		
Phone:	510-981-8088	Fax:	- -	Phone:	510-981-8088	Fax:	- -
E-Mail:	toguin@lightsailenergy.com			E-Mail:	toguin@lightsailenergy.com		

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

<b>The following items should be attached to this GRF</b>			
1. Exhibit A, Scope of Work	<input checked="" type="checkbox"/>	N/A	<input checked="" type="checkbox"/> Attached
2. Exhibit B, Budget Detail	<input checked="" type="checkbox"/>	N/A	<input checked="" type="checkbox"/> Attached
3. CEC 105, Questionnaire for Identifying Conflicts	<input checked="" type="checkbox"/>	N/A	<input checked="" type="checkbox"/> Attached
4. Recipient Resolution	<input checked="" type="checkbox"/>	N/A	<input type="checkbox"/> Attached
5. CEQA Documentation	<input type="checkbox"/>	N/A	<input checked="" 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 #	CPR <sup>1</sup>	Task Name
1		General Project Tasks
2		Design, Development and Testing of Prototype
3	X	Site Design, Construction and Installation
4	X	Pilot Project Testing
5		Dynamic Modelling and Analysis
6		Evaluation of Project Benefits
7		Technology/Knowledge Transfer Activities
8		Production Readiness Plan

### B. Acronym/Term List

Acronym/Term	Meaning
ASME	American Society of Mechanical Engineers
CAES	Compressed air energy storage
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
CPV	Concentrated photovoltaic
I-CAES	Isothermal Compressed Air Energy Storage
GHG	Greenhouse Gas(es)
PV	Photovoltaic
TAC	Technical Advisory Committee
UCI	University of California – Irvine

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

# Exhibit A

## Scope of Work

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

#### A. Purpose of Agreement

The purpose of this Agreement is to design, build, and pilot test an isothermal compressed air energy storage (I-CAES) system in a smart microgrid environment at the University of California – Irvine (UCI), or other site approved in writing by the Commission Agreement Officer (CAM), and increase the round trip efficiency of the I-CAES to over 80% by utilizing waste heat, demonstrating benefits in renewables integration, load following and ancillary services, as well as lowering capital costs.

#### B. Problem/ Solution Statement

##### Problem

The Energy Commission has identified energy storage as having the potential to significantly help integrate renewable energy into the California grid. Additionally, the California Public Utility Commission (CPUC) has set energy storage procurement targets for the three Investor Owned Utilities (IOU), maintaining the utilities must secure 1.3GW of cost-effective energy storage by 2020. However, in order for energy storage to be effective in mitigating the variable and intermittent nature of renewable energy and eligible for utility procurement, it must be efficient and low cost. While there are many different energy storage technologies, they all have trade-offs between cost and performance.

Compressed air energy storage (CAES) has the potential to be the lowest cost, longest lifetime energy storage technology in the world. The critical barrier to its adoption is the low round-trip efficiency and limited siting possibilities. LightSail Energy, Inc. is tackling this issue by creating the next generation CAES system, utilizing ground-breaking innovations in heat capture, thermal management, efficiency engineering and gas storage technologies to create I-CAES.

In order for I-CAES to achieve commercial deployment and become a valuable asset on the California grid, it must get the round-trip efficiency to greater than 80%, per the CEC's analysis. A unique feature of I-CAES is its ability to utilize waste heat from combustion or industrial processes and convert the heat into usable electricity. This feature can be employed to effectively increase the efficiency of I-CAES.

##### Solution

This project includes pilot testing an I-CAES system connected to a microgrid at UCI, or other site approved in writing by the CAM, and utilizing waste heat to boost round-trip efficiency. The microgrid at UCI is powered by several renewable energy sources, including a two-panel concentrated photovoltaic (CPV) system supplying up to 113kW, and a rooftop photovoltaic installation of 900kW. UCI is also in the process of adding a 14-panel, 826kW CPV array and high temperature fuel cell integrated with an absorption chiller. The UCI microgrid also utilizes several non-renewable distributed generation resources, including a 13MW gas turbine and a 6MW steam turbine.

The project will study the effect of heat addition (from a source of waste heat) on increasing the power output as well as efficiency of the I-CAES system. The high penetration of renewables and the challenges associated with their integration into the existing UCI Microgrid system

## Exhibit A Scope of Work

provides an excellent test platform for I-CAES. The storage unit will be used to smooth out the swings in net load caused by photovoltaic and other forms of generation and reduce intermittency. The project will provide real-time information on the performance and operational characteristics of the I-CAES in a smart microgrid setting and evaluate the energy storage technology capabilities for load following and the provision of ancillary services (e.g., voltage support, frequency response, real and reactive power).

This information will be used in creating a strategy to lower the cost of I-CAES and enhance performance features that are most valuable. The project will also include a project benefit evaluation in order to determine the costs and benefits of the storage unit to California rate payers as well as the end user.

### C. Goals and Objectives of the Agreement

#### **Agreement Goals**

The goals of this Agreement are to:

- Increase the roundtrip efficiency of I-CAES
- Reduce the capital cost of I-CAES
- Reduce intermittency of renewable energy in microgrids
- Increase microgrid efficiency and reduce overall greenhouse gas (GHG) emissions
- Increase grid reliability
- Reduce costs to California ratepayers

**Ratepayer Benefits:**<sup>2</sup> 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. This data can be used to improve performance and lower costs.

Results from this project can be used to support future implementation of renewable energy plus energy storage into the California grid. This directly furthers the state in its goals to reduce GHG emissions and provide safe, reliable, and low cost energy to ratepayers.

**Technological Advancement and Breakthroughs:**<sup>3</sup> This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by advancing the development of I-CAES. Specifically, the agreement will measure and value the performance and benefits of I-CAES, the impact of waste heat addition on power output and efficiency, and elucidate means to reduce capital costs. These results will then be used by load serving entities to correctly value and more efficiently incorporate energy storage for grid services and supporting renewable energy integration.

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

<sup>3</sup> California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

# Exhibit A

## Scope of Work

### Agreement Objectives

The objectives of this Agreement are to:

- Obtain performance data on I-CAES installed at a UCI site, or other site as approved in writing by the CAM, including the effect of heat addition on system performance.
- Identify opportunities for improving performance and lowering costs of ICAES, both capital costs and installation costs.
- Assess potential of energy storage to smooth ramping requirements caused by distributed photovoltaic(PV).
- Understand how energy storage can be used to increase renewable penetration while also increasing grid efficiency.
- Determine the net benefits to California ratepayers of I-CAES.

### 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.
- 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.

## Exhibit A Scope of Work

### 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).

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.

# Exhibit A

## Scope of Work

### 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)*

#### CAM Product:

- Kick-off Meeting Agenda

## Exhibit A Scope of Work

### **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
- Acceptance 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
    - Credits page on the reverse side of cover with legal disclaimer
    - Acknowledgements page (optional)
    - Preface
    - Abstract, keywords, and citation page
    - Table of Contents (followed by List of Figures and List of Tables, if needed)
    - Executive summary
    - Body of the report
    - 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

## **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.
  - 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.

## Exhibit A Scope of Work

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

## Exhibit A Scope of Work

### 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.

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);

## Exhibit A Scope of Work

- 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.

### **Products:**

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

# Exhibit A

## Scope of Work

### IV. TECHNICAL TASKS

#### **TASK 2: Design, Development and Testing of Prototype**

The goal of this task is to design, develop and perform initial testing of the prototype I-CAES system. The heart of the I-CAES system is the Power Unit consisting of a proprietary 2-stage compressor/expander which will be used to compress air during the charging cycle, and expand air during the discharging cycle using a near-isothermal process. The Power Unit also consists of a balance of plant, which includes motors, inverters, power distribution, control system, air-water separators, instrumentation and control valves. The second major component is the high pressure, lightweight, carbon composite air tanks. The last component is the thermal storage, consisting of large, insulated water tanks.

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

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

#### **Products:**

- Intermediate Test Report
- Summary Test Report

#### **TASK 3: Site Design, Construction and Installation**

The goals of this task are to prepare site drawings, install equipment, and perform site-specific load analysis.

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

- Solicit competitive bids for subcontractor(s) for site design, site construction, shipping equipment to site, site installation of the I-CAES and equipment integration into microgrid, 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.
- Prepare and develop host site, including installing civil foundations, electrical interconnects, and tie-in of mechanical utilities.
- Ship, install, integrate into microgrid, and commission I-CAES equipment to host site.

## Exhibit A Scope of Work

- 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 accomplish pilot testing, data collection and analysis of the I-CAES system.

#### The Recipient shall:

- 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. The report will include the Test Plan, Safety Analysis Report, and Performance Evaluation Report.
- Participate in a CPR Meeting per Subtask 1.3.
- Prepare a *Safety Analysis Report* that includes an evaluation of the fire and safety systems and describes the measures taken to ensure all applicable health and safety code compliance.
- Collect data and conduct analysis and provide *Performance Evaluation Report*.
- Conduct an engineering review and check the design of the energy storage system and determine relevant ASTM code compliance with the goal of ensuring eventual commercial product development.

### Products:

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

### TASK 5: Dynamic Modelling and Analysis

The goal of this task is to model and analyze the control strategies and performance of I-CAES system in conjunction with a host of distributed energy resources in the selected microgrid environment.

#### The Recipient shall:

- Develop a *Dynamic Model of the I-CAES* to include the system's control strategies and performance in the selected microgrid with distributed energy resources.
- Analyze the control strategies and performance in a Microgrid with distributed energy resources.
- Prepare a *Dynamic Model Validation Test Plan* and validate the model with actual testing of the I-CAES.

## Exhibit A Scope of Work

- Create a *Dynamic Modelling and Analysis Report* to include but, is not limited to:
  - Dynamic Modelling of an I-CAES control strategies and performance in the selected microgrid with distributed energy resources
  - Dynamic model validation with actual testing of the I-CAES system
  - Analysis of the control strategies and performance in a Microgrid with distributed energy resources

### Products:

- Dynamic Model of an I-CAES
- Dynamic Model Validation Test Plan
- Dynamic Modelling and Analysis Report

### TASK 6: Evaluation of Project Benefits

The goal of this task is to report the benefits resulting from this project. LightSail Energy, Inc. will monetize the totality of value streams to the end user and model key ratepayer benefits from such a grid connected advanced energy storage system sited in Southern California.

Additional goals of this task are to: (1) Measure and verify performance and benefits of I-CAES and (2) Document and distribute cost-benefit results. LightSail Energy, Inc. will utilize a combination of several in-house modeling tools as well as commercially available energy storage simulation programs to fully assess the benefits to the end-user of the storage system as well as to analyze key ratepayer benefits, such as avoided GHG emissions.

### 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*.
  - Develop a comprehensive strategy for modeling end-user and ratepayer benefits, using a combination of proprietary and commercial modeling software tools.
  - Provide an initial load analysis report with estimated benefits of incorporating I-CAES into a microgrid.
  - Create a final report of end-user and key ratepayer benefits using data collected from the project as well as modeling simulations.
  - Provide all key assumptions used to estimate projected benefits, including targeted market sector, projected market penetration, baseline and projected energy use and cost, CAISO market prices, operating conditions, performance characteristics, and emission reduction calculations.

### Products:

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire
- Initial Load Analysis Report
- Report of End-User and Key Ratepayer Benefits

## Exhibit A Scope of Work

### **TASK 7: 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 8: 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's I-CAES is a combination of off-the-shelf and proprietary components. Off the shelf components include motors, pumps, instrumentation, inverters, control valves and heat exchangers that are mature technologies with a well-defined and established supply chain. It is expected that the proprietary components can be manufactured using existing high-volume production technologies found in the automotive industry, and should not present challenges for commercializing the product.

## Exhibit A Scope of Work

### The Recipient shall:

- Prepare a *Production Readiness Plan*. The degree of detail in the plan will reflect information that is deemed not confidential or proprietary by LightSail Energy, Inc. and does not put LightSail Energy, Inc. at a competitive disadvantage. 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 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)

### V. 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-15-017 from PON-13-302 with LightSail Energy for a \$1,085,125 grant to increase the performance and lower the cost of an isothermal compressed air energy storage (I-CAES) system in a microgrid environment. The I-CAES will utilize waste heat, solar PV, and other distributed energy generation through the University of California, Irvine's microgrid; and

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

**CERTIFICATION**

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on January 13, 2016.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Tiffani Winter,  
Secretariat