California Energy Commission
August 13, 2025 Business Meeting
Backup Materials for Renewell Energy Inc.

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

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

[PROPOSED]

RESOLUTION NO: 25-0813-11c

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: Renewell Energy Inc.

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

RESOLVED, that the CEC approves agreement EPC-25-009 with Renewell Energy Inc. for a $5,004,537 grant. The project will install, conduct grid service validation, lifetime testing, and UL certification of networked gravitational energy storage in five idle oil wells located in Kern County; and

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

CERTIFICATION

The undersigned Secretariat to the CEC does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the CEC held on August 13, 2025.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

_____
Kim Todd
Secretariat

STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

CEC-270 (Revised 01/2024)

GRANT REQUEST FORM (GRF)

A. New Agreement Number

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

New Agreement Number: EPC-25-009

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Zoe Marshall
3. MS-43
4. Phone Number: 916-931-5128

C. Recipient's Information

1. Recipient's Legal Name: Renewell Energy Inc
2. Federal ID Number: 85-1110527

D. Title of Project

Title of project: Rigs to Renewables: Demonstrated Application of Networked, Gravity-based Multi-Duration Energy Storage in Idle Oil and Gas Wells

E. Term and Amount

1. Start Date: 9/1/2025
2. End Date: 12/31/2029
3. Amount: $5,004,537.00

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 8/13/2025 .
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Elyse Kedzie
5. Time Needed for Business Meeting: 5 minutes.
6. The email subscription topic is: Enter the email subscription topic name.

Agenda Item Subject and Description:

Renewell Energy Inc
Proposed resolution approving agreement EPC-25-009 with Renewell Energy Inc. for a $5,004,537 grant, and adopting staff's recommendation that this action is exempt from CEQA. The project will install, conduct grid service validation, lifetime testing, and UL certification of networked gravitational energy storage in five idle oil wells located in Kern County. (EPIC funding) Contact: Elyse Kedzie

G. California Environmental Quality Act (CEQA) Compliance

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

   If yes, skip to question 2.

   If no, complete the following (PRC 21065 and 14 CCR 15378) and explain why Agreement is not considered a "Project":

Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because:

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

a) Agreement **IS** exempt?

Yes

Statutory Exemption?
No

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

PRC section number: None

CCR section number: None

Categorical Exemption?
Yes

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

CCR section number: Cal. Code Regs., tit. 14, § 15301 ; Cal. Code Regs., tit. 14, § 15303; Cal. Code Regs., tit. 14, § 15306; Cal. Code Regs., tit. 14, § 15311

Common Sense Exemption? 14 CCR 15061 (b) (3)
No

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

Cal. Code Regs., tit. 14, §15301, provides that projects which consist of the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public and private structures, facilities, mechanical equipment, or topographical features, and which involve negligible or no expansion of use beyond that at the time of the lead agency's determination, are categorically exempt from CEQA. The physical aspects of this work will involve reuse of existing oil wells and oil field sites that are already disturbed and do not constitute an alteration to, or significant change in use of, the immediate environment. For these reasons, the proposed work will not have any significant effect on the environment and is exempt from CEQA under Cal. Code Regs., tit. 14, §15301.

California Code of Regulations, tit. 14, §15303, provides that projects which consist of the 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 CEQA. The project will extend the existing electric field and update electrical connections, without increasing the overall facility footprint. For this reason, the project will not have a significant effect on the environment and is categorically exempt from CEQA under California Code of Regulations, tit. 14, §15303.

Cal. Code Regs., tit. 14, §15306, provides that projects which consist of data collection, research, experimental management, and resource evaluation activities, and which do not result in a serious or major disturbance to an environmental resource are categorically exempt from CEQA. In this project, data and information will be collected on the performance of gravitational energy storage in idle oil wells. For this reason, the proposed work will not have any significant impact on the environment and is exempt from CEQA under Cal. Code Regs., tit. 14, §15306.

California Code of Regulations, title 14, §15311, Accessory Structures, provides that projects which consist of the construction, or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities are categorically exempt from CEQA. The project will install five Gravity Well energy storage systems to existing decommissioned oil wells. The systems will be integrated off-site, will utilize existing concrete pads to anchor when installed on-site, and are easily removeable. For this reason, the project will consist of a minor structure accessory to an existing industrial facility and is categorically exempt from CEQA through California Code of Regulations, tit. 14, §15311.

The project will not impact an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies; does not involve any cumulative impacts of successive projects of the same type in the same place that might be considered significant; does not involve unusual circumstances that might have a significant effect on the environment; will not result in damage to scenic resources within a highway officially designated as a state scenic highway; the project site is not included on any list compiled pursuant to Government Code §65962.5; and the project will not cause a substantial adverse change in the significance of a historical resource. Therefore, none of the exceptions to categorical exemptions listed in CEQA Guidelines §15300.2 apply to this project, and this project will not have a significant effect on the environment.

b) Agreement **IS NOT** exempt.
IMPORTANT: consult with the legal office to determine next steps.

No

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

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

H. Is this project considered “Infrastructure”?

No

I. Subcontractors

List all Subcontractors listed in the Budget (s) (major and minor). Insert additional rows if needed. If no subcontractors to report, enter "No subcontractors to report" and "0" to funds. **Delete** any unused rows from the table.

Subcontractor Legal Company Name	CEC Funds	Match Funds
Electric Power Research Institute, Inc.	$ 156,724	$0
Nor-Cal Controls ES, Inc.	$ 95,000	$0
TDN Industries, Inc.	$ 680,805	$0

J. Vendors and Sellers for Equipment and Materials/Miscellaneous

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

Vendor/Seller Legal Company Name	CEC Funds	Match Funds
TIGER OIL WELL WIRE LINE SERVICES, INC.	$0	$33,000
General Production Services, Inc.	$70,000	$36,000
GEO DRILLING FLUIDS, INC.	$14,000	$20,000
CERTEX USA, LLC	$21,325	$6,910
Evergreen Wire Rope Testing	$0	$204,570

K. Key Partners

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

Key Partner Legal Company Name
No key partners to report

L. Budget Information

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

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	23-24	301.001K	$ 1,623,549
EPIC	24-25	301.001L	$ 3,380,988

TOTAL Amount: $ 5,004,537

R&D Program Area: ESTB: ETSI

Explanation for “Other” selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: 101

M. Recipient’s Contact Information

1. Recipient’s Administrator/Officer

Name: Stefan Streckfus

Address: 226 Beech St

City, State, Zip: Bakersfield, CA 93304-2447

Phone:

E-Mail: stefan@renewellenergy.com

2. Recipient’s Project Manager

Name: Sarah Douglas

Address: 226 Beech St

City, State, Zip: Bakersfield, CA 93304-2447

Phone:

E-Mail: sarah@renewellenergy.com

N. Selection Process Used

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

Selection Process	Additional Information
Competitive Solicitation #	GFO-23-317
First Come First Served Solicitation #	Not applicable
Other	Not applicable

O. Attached Items

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

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

Approved By

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

Agreement Manager: Zoe Marshall

Approval Date: 7/1/2025

Branch Manager: Reynaldo Gonzalez

Approval Date: 7/2/2025

Director: Johan Steinback delegated to Branch Manager

Approval Date: 7/2/2025

Exhibit A
Scope of Work
Renewell Energy Inc.

I. TASK AND ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		System Containerization
3	X	Planning, Procurement, and Permitting
4		High-Tension Spooling Process Development and Testing
5		Lubricant Delivery System Development and Testing
6		Development of a GrW SCADA and Telemetry System
7		GrW Field Installation
8		Measured Field Validation of Safety, Component Lifetime, and Well Characteristics
9	X	Demonstration of Networked Storage Applications
10		UL Certification
11		Evaluation of Project Benefits
12		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
AHJ	Authority Having Jurisdiction
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CAISO	California Independent System Operator
CalGEM	California Geologic Energy Management Division
CL	Caliper Log (a wellbore test to determine the inner casing profile)
CPR	Critical Project Review
DER	Distributed Energy Resource
EMS	Energy Management System
EPRI	Electric Power Research Institute
GrW	Gravity Well (a gravitational energy storage system within an idle well)
HMI	Human Machine Interface
LCOS	Levelized Cost of Storage
MIT	Magnetic Image Testing (a wellbore test to determine casing thickness)
NDT	Non-Destructive Test

[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.

Acronym/Term	Meaning
P&A	Plug and Abandonment
PCC	Point-of-Common-Coupling
RTE	Round Trip Efficiency
SDADA	Supervisory Control and Data Acquisition
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

The purpose of this agreement is to fund the installation, grid service validation, lifetime testing, and UL certification of a multi-well demonstration of networked gravitational energy storage in idle oil wells. The purpose of the project is to demonstrate the feasibility of the use of otherwise curtailed renewable energy and accelerate the commercial adoption of Gravity Well (GrW) energy storage technology.

B. Problem/ Solution Statement

Problem

The amount of renewable electricity generation curtailed by California Independent System Operator (CAISO) has increased 29 percent from 2023 to 2024 alone[2]. As such, there is a need to deploy environmentally friendly, low-cost, flexible energy storage that can store electricity generated in times of oversupply for use during times of increased demand to support California in reaching its goal of 100 percent renewable, zero-carbon retail sales of electricity by 2045.

Concurrently, California is home to 38,000[3] idle oil and gas wells, 40 percent of which are actively leaking methane[4]. The estimated clean-up cost of California's idle wells is $13B, while the total expected future revenue from oil and gas production within the state will amount to only $6B, leaving a potential $7B gap for taxpayers to cover[5]. Americans, especially Californians, will benefit from symbiotic, cost-effective solutions that simultaneously advance clean energy goals while mitigating emissions and environmental impacts from legacy energy infrastructure.

Solution

The Recipient has developed a novel technology and process that addresses California's need for increased energy storage while managing idle oil wells by retrofitting already grid-connected idle wells with a proprietary gravitational energy storage device, GrW. The installation of a GrW isolates the well reservoir from the atmosphere, eliminating ongoing methane emissions at a fraction of the cost of traditional Plug and Abandonment. These systems, on average, are carbon negative. The "Activation Fee" paid by oil and gas companies upon installation in exchange for Plug and Abandonment (P&A) deferment subsidizes the initial cost of the system,

[2] "Managing the evolving grid" *California Independent System Operator*, 2025, https://www.caiso.com/about/our-business/managing-the-evolving-grid

[3] "State Oil and Gas Well Plug and Abandonments." *California Department of Conservation: CalGEM*, 2024, www.conservation.ca.gov/calgem/Pages/State-Abandonments.aspx.

[4] Townsend-Small, Amy, et al. "Emissions of Coalbed and Natural Gas Methane from Abandoned Oil and Gas Wells in the United States." AGU Journals, John Wiley & Sons, Ltd, 11 Mar. 2016

[5] Xilas, Evgenia. "California Taxpayers Could Be Stuck with Paying $6.9 Billion to Close and Clean up Oil and Gas Wells." *Carbon Tracker Initiative*, 17 May 2023, carbontracker.org/california-taxpayers-could-be-stuck-with-paying-6-9-billion-to-close-and-clean-up-oil-and-gas-wells/.

allowing GrWs to achieve a leading near-zero levelized cost of storage (LCOS) at scale. Networked operation of multiple GrWs within a field allows for zero-loss energy storage of flexible duration, as a field of 5 GrWs can be discharged in series, in parallel, or in numerous combinations in between. Finally, GrWs reuse existing legacy energy infrastructure and revitalize legacy energy communities by employing the same workforce, in the same locations, using the same processes as fossil energy.

GrWs can address critical barriers to California's energy transition: increasing low-cost, clean energy storage capacity and responsibly managing legacy infrastructure. The proposed multi-well demonstration is an important step to proving to oil and gas companies and energy storage service users alike that converting idle wells into GrWs at scale is environmentally low-impact, economically advantageous, and technically reliable. Several GrWs in one area will allow the Recipient to prove suitability across a range of wellbore types and demonstrate how the control platform can be used to provide flexibility in output duration.

Additionally, a fleet of 5 GrW systems is capable of delivering 1 hour of continuous power, 5 hours of continuous power, or anything in between, while storing energy with zero self-discharge due to its mechanical nature, all at the same high round-trip efficiency (RTE). This allows a seamless transition between storage markets of any duration. Building five collectively controlled GrW systems will allow the demonstration of whether this technology can offer grid operators a unique flexibility in dispatch.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Demonstrate that GrWs are a viable energy storage option in California to reduce curtailment of renewable energy.
- Provide measured validation of the safety, lifetime, and wear assumptions that inform GrW economics and provide key evidence of long-term viability to regulators, customers, and investors.
- Provide confidence to operators that the technology is a viable alternative to plugging and abandonment of existing wells.
- Demonstrate and quantify the positive economic and environmental impact GrW installations may have on California's legacy energy communities.

Ratepayer Benefits:[6]

This Agreement is intended to provide ratepayer benefits in the form of greater electricity reliability, lower cost, and increased safety. The Recipient intends that the installation of GrWs will allow for an additional 65.7 MWh worth of annual clean energy utilization in Kern County and will increase reliability by reducing demand during peak and part-peak hours through peak shaving and energy shifting. The GrWs should also introduce +/- 84 kVar of relevant grid stabilizing reactive power for maintaining voltage and power factor at the point of common

[6] 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).

coupling. By increasing grid reliability and decreasing peak demand, The Recipient intends that this GrW installation will increase grid safety for the immediate community. The GrW installation should result in direct cost benefits including $18,673 saved annually by Pacific Gas and Electric (PG&E) utility payers through peak shaving ($560,000 total saved over the system lifetime) and a distribution deferred savings of $346,944, which will likely be passed on to local customers. These grid reliability and cost benefits will directly impact the low-income community of Shafter in Kern County.

Technological Advancement and Breakthroughs:[7] The Recipient intends that its performance under this Agreement will lead to technological advancement and breakthroughs that will assist California in overcoming barriers to the achievement of California's statutory energy goals by eliminating idle well-based methane emissions from five wells in a low-income community (SB 32) and increasing use of renewable energy resources (SB 100) through the co-location of the gravitational energy storage project and a solar plant. In addition, this project's multi-well installation of GrWs will be the first of its kind, providing grid services to reduce peak load, saving ratepayers money on their energy bills, and increasing the utilization of clean energy resources.

Agreement Objectives

The objectives of this Agreement are to:

- Convert 5 co-located idle oil wells in Shafter in Kern County into GrWs, corresponding to 180 kWh of storage
- Develop a supervisory control and data acquisition (SCADA) and telemetry system to control GrWs in response to aggregator demand
- Demonstrate the duration and capacity flexibility of a networked field of GrWs and characterize performance of those operations with respect to energy storage system (ESS) market requirements
- Convert the Recipient's current single-well design ("Alpha" design) to a containerized system capable of being transported within a shipping container in anticipation of installation scale-up
- Perform UL 9540 testing for the GrW system
- Increase economic activity and environmental equity in a low-income community in Kern County, using this project as a framework for future community-focused workforce transitions

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V).** All products submitted which will be viewed by the public, must comply with the accessibility requirements of Section 508 of the federal Rehabilitation Act of 1973, as amended (29 U.S.C. Sec. 794d), and regulations implementing that act as set forth in Part 1194 of Title 36 of the Federal Code of Regulations**.** All technical tasks should include product(s). Products that require a draft version are indicated by

[7] 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.

marking **"(draft and final)"** after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, **"days"** means working days.

The Recipient shall:

For products that require a draft version, including the Final Report Outline and Final Report

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Consider incorporating all CAM comments into the final product. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product.
- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

For products that require a final version only

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

For all products

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

Instructions for Submitting Electronic Files and Developing Software:

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

  The following describes the accepted formats for electronic data and documents provided to the CEC as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:
  - Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
  - Text documents will be in MS Word file format, version 2007 or later.
  - Project management documents will be in Microsoft Project file format, version 2007 or later.

- **Software Application Development**
  Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
  - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
  - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.

- Visual Studio.NET (version 2008 and up). Recommend 2010.
- C# Programming Language with Presentation (UI), Business Object and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

- Attend a "Kick-off" meeting with the CAM, and other CEC staff relevant to the Agreement. The Recipient's Project Manager and any other individuals deemed necessary by the CAM or the Project Manager shall participate in this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., Teams, Zoom), with approval of the CAM.

  The Kick-off meeting will include discussion of the following:
  - The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Terms and conditions of the Agreement;
  - Invoicing and auditing procedures;
  - Travel;
  - Equipment purchases;
  - Administrative and Technical products (subtask 1.1);
  - CPR meetings (subtask 1.3);
  - Monthly Calls (subtask 1.5)
  - Quarterly Progress reports (subtask 1.6)
  - Final Report (subtask 1.7)
  - Match funds (subtask 1.8);
  - Permit documentation (subtask 1.9);
  - Subawards(subtask 1.10);
  - Technical Advisory Committee meetings (subtasks 1.11 and 1.12);
  - Agreement changes;
  - Performance Evaluations; and
  - Any other relevant topics.

- Provide *Kick-off Meeting Presentation* to include but not limited to:
  - Project overview (i.e. project description, goals and objectives, technical tasks, expected benefits, etc.)
  - Project schedule that identifies milestones
  - List of potential risk factors and hurdles, and mitigation strategy

- Provide an *Updated Project Schedule, Match Funds Status Letter,* and *Permit Status Letter*, as needed to reflect any changes in the documents.

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

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

CAM Product:
- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings
The goal of this subtask is to determine if the project should continue to receive CEC funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the CEC and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient and may include the CAO and any other individuals selected by the CAM to provide support to the CEC.

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

The Recipient shall:
- Prepare and submit a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

The CAM shall:
- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* with a list of expected CPR participants in advance of the CPR meeting. If applicable, the agenda may include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a schedule for providing a Progress Determination on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. A determination of unsatisfactory progress This may result in project delays, including a

potential Stop Work Order, while the CEC determines whether the project should continue.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:
- CPR Report(s)

CAM Products:
- CPR Agenda(s)
- Progress Determination

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

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

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM of the following Agreement closeout items:
    - Disposition of any procured equipment.
    - The CEC's request for specific "generated" data (not already provided in Agreement products).
    - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
    - "Surviving" Agreement provisions such as repayment provisions and confidential products.
    - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide copies of *All Final Products* organized by the tasks in the Agreement.

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

MONTHLY CALLS, REPORTS AND INVOICES

Subtask 1.5 Monthly Calls
The goal of this task is to have calls at least monthly between the CAM and Recipient to verify that satisfactory and continued progress is made towards achieving the objectives of this Agreement on time and within budget.

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

The CAM shall:

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

The Recipient shall:

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

Product:

- Email to CAM concurring with call summary notes.

Subtask 1.6 Quarterly Progress Reports and Invoices

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

The Recipient shall:

- Submit a *Quarterly Progress Report* to the CAM. Each progress report must:
  - Summarize progress made on all Agreement activities as specified in the scope of work for the reporting period, including accomplishments, problems, milestones, products, schedule, fiscal status, and an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Progress reports are due to the CAM the 10th day of each January, April, July, and October. The Quarterly Progress Report template can be found on the ECAMS Resources webpage available at: https://www.energy.ca.gov/media/4691
- Submit a monthly or quarterly *Invoice* on the invoice template(s) provided by the CAM.

Recipient Products:

- Quarterly Progress Reports
- Invoices

CAM Product:

- Invoice template

Subtask 1.7 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

Subtask 1.7.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Products:

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

Subtask 1.7.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Energy Commission Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)
    - Appendices (if applicable) (Create a separate volume if very large.)
    - Attachments (if applicable)
- Submit a draft of the Executive Summary to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments on Draft Final Report* received on the Executive Summary. For each comment received, the Recipient will identify in the summary the following:
  - Comments the Recipient proposes to incorporate.
  - Comments the Recipient does propose to incorporate and an explanation for why.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt.
- Incorporate all CAM comments into the *Final Report*. If the Recipient disagrees with any comment, provide a *Written Responses to Comments* explaining why the comments were not incorporated into the final product.
- Submit the revised *Final Report* electronically with any Written Responses to Comments within 10 days of receipt of CAM's Written Comments on the Draft Final Report, unless the CAM specifies a longer time period or approves a request for additional time.

Products:

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

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBAWARDS

Subtask 1.8 Match Funds

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

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

The Recipient shall:

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

  If match funds were a part of the application that led to the CEC awarding this Agreement, then provide in the letter:
  - A list of the match funds that identifies:
    - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
    - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
    - If different from the solicitation application, provide a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

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

Subtask 1.9 Permits

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

The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:
    - A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
    - The schedule the Recipient will follow in applying for and obtaining the permits.

  The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

- Permit Status Letter
- Updated List of Permits *(if applicable)*
- Updated Schedule for Acquiring Permits *(if applicable)*
- Copy of Each Approved Permit *(if applicable)*

Subtask 1.10 Obtain and Execute Subawards and Agreements with Site Hosts

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

The Recipient shall:

- Execute and manage subawards and coordinate subrecipients activities in accordance with the requirements of this Agreement.
- Execute and manage site host agreements, and ensure the right to use the project site throughout the term of the Agreement, as applicable. A site host agreement is not required if the Recipient is the site host.

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

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.11 Technical Advisory Committee (TAC)

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the Agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.
- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate, to the extent the TAC members feel is appropriate, on behalf of the project in its effort to build partnerships, governmental support, and relationships with a national spectrum of influential leaders.

- Ask probing questions that ensure a long-term perspective on decision-making and progress toward the project's strategic goals.

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

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

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.12.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

Subtask 1.12 TAC Meetings

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

The Recipient shall:

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* for each TAC Meeting that include any recommended resolutions of major TAC issues.

The TAC shall:

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

Products:

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

Subtask 1.13 Project Performance Metrics

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

The Recipient shall:

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

Products:

- TAC Performance Metrics Summary
- Project Performance Metrics Results

IV. TASK 2: SYSTEM CONTAINERIZATION

The goal of this task is to redesign the GrW structural subsystems to facilitate containerized transport to, and assembly in, the field, which is crucial for reducing installation cost and consolidating installation timelines for the current project and future installations. By increasing the speed and repeatability of installation and simplifying the transportation supply chain, this task positions the GrW technology to be ready for rapid growth.

The Recipient shall:

- Collaborate with project partners to assess the installation procedure for the previous Alpha pilot and identify design and procedural opportunities to optimize field installation.
- Redesign structural subassemblies such that the assembled GrW surface equipment fits within a standard shipping container, enabling offsite pre-assembly.
- Redesign electrical subsystems and connections such that:
    - As many electrical connections as possible are made during manufacturing, and
    - Electrical connections made in the field are limited and streamlined (i.e., as few wire runs as possible, quick connectors and plugs used whenever possible, etc.).
- Share and receive feedback from project partners on the design of the system during both initial and final engineering design.
- Confirm the mechanical and structural integrity of all new designs and compliance with all relevant codes and standards through comprehensive structural design review process.
- Develop a Design *Review Summary Report with Signoff* that includes a description of the final design, changes made in response to project partner feedback, overview of on-site installation procedures and requirements, and a Professional Engineer's stamp on all updated drawings.
- Based on the final design and installation requirements, create a *Field Installation Timeline* that provides estimates for the permitting, installation, other key milestones, and in-operation dates for all GrWs demonstrated in this project.
- Quantify key metrics, including but not limited to the expected cost and time savings associated with the installation optimization, in an *Installation Optimization Report*.

Products:

- Design Review Summary Report with Signoff
- Field Installation Timeline
- Installation Optimization Report

TASK 3: PLANNING, PROCUREMENT, AND PERMITTING

The goals of this task are to establish a project management framework for the planned installations, procure all GrW system components, and obtain all applicable state and local permits required to break ground and operate (see Subtask 1.9).

The Recipient shall:

- Develop and update a *Project Management Gantt Chart* with a schedule of tasks depicting the expected procurement, permitting, and commissioning timelines of the planned installations (Task 7), in addition to the field installation timeline developed in Task 2.
- Source and procure all GrW system components from California businesses and identify long lead time equipment within the system bill of materials.
- Prepare all design and engineering documentation required for permit application review by the California Geologic Energy Management Division (CalGEM) and the local Authorities Having Jurisdiction (AHJ).

- Obtain all local, state, and federal *CalGEM Permits* for the installation of the GrW systems, including rework permits (CalGEM) for P&A and building *AHJ Permits*. [Same as Subtask 1.9]
- Develop a *Field Testing Plan,* based on existing testing manuals (e.g., EPRI's Energy Storage Integration Council (ESIC) Energy Storage Test Manual)[8] with modifications to accommodate GrW as needed, which includes, but is not limited to, the following:
    - The tests planned to be conducted, such as:
        - Grounding and protection.
        - Measurement accuracy: Power instrumentation validation vs. calibrated test set; power measurement accuracy; energy measurement accuracy; and state of charge measurement accuracy.
        - SCADA and telemetry validation: Record value and time accuracy; latency; storage capacity; archiving; and alerts.
        - Safety and reliability tests: Halt operation conditions; emergency stop conditions; control system failure conditions; loss of GrW unit condition - system stability; and voltage ride-thru conditions.
        - System interoperability (Task 9).
        - Storage characterization tests (Task 9).
    - Critical metrics planned for validation, developed in collaboration with project partners, such as:
        - Capacity factor.
        - Charge and discharge time.
          Energy capacity: net kWh, delivered kWh, and received kWh.
        - Energy accuracy, via comparison of production meter to power analyzer data.
        - Frequency-watt response accuracy.
        - Impedance/Resistance.
        - Harmonic distortion.
        - Parasitic load measurement.
        - Power accuracy, via comparison of production meter to power analyzer data.
        - Ramp rate accuracy.
        - Rated continuous power.
        - Rated power.
        - Response, rise, and settling time.
        - Round-trip efficiency.
        - State of charge.
        - Voltage flicker.
        - Voltage support capability via reactive power, demonstrated as a percentage of rated kVA.
    - Measurement tools for verification, expected to include:
        - Converter data.
        - Power analyzer.
        - Revenue grade meter(s).
        - Sub-component sensor data: Tachometers, proximity sensors, and encoders, etc.
- Prepare and submit *CPR Report # 1.*
- Attend CPR meeting.

[8] Thompson, J., and E. Minear. *Energy Storage Integration Council (ESIC) Energy Storage Test Manual*, Electric Power Research Institute, Nov. 2021.

Products:

- Project Management Gantt Chart
- CalGEM Permits
- AHJ Permits
- Field Testing Plan
- CPR Report #1

TASK 4: HIGH-TENSION SPOOLING PROCESS DEVELOPMENT AND TESTING

The goal of this task is to identify and test a cost-effective, repeatable wire rope spooling method that can 1) be performed in one day and 2) install wire rope onto a winch at sufficient tension such that there is no knifing when lowering the weight through its first descent.

The Recipient shall:

- Identify and evaluate spooling system designs through an iterative design ideation and review process.
- Choose at least one promising system design to test.
- Design a *Lab and Field High-Tension Spooling Test Plan* of the chosen system(s), including but not limited to identification of performance metrics, a testing timeline, and list of tests to be performed.
- Perform lab testing outlined in the *Lab and Field High-Tension Spooling Test Plan*.
- Make adjustments based on lab testing, as necessary, to the field testing portion of the *Lab and Field High-Tension Spooling Test Plan*.
- Perform field testing and evaluate the viability of using this spooling method for project installations (Task 7).
- Produce a *Spooling Process Document* that outlines the specific steps for implementing the identified method in project installations (Task 7).

Products:

- Lab and Field High-Tension Spooling Test Plan
- Spooling Process Document

TASK 5: LUBRICANT DELIVERY SYSTEM DEVELOPMENT AND TESTING

The goal of this task is to finalize the development of two contained lubricant delivery systems and test the effectiveness of each system through destructive wire rope testing after a year of operation.

The Recipient shall:

- Build upon preliminary lubricant delivery system penetration testing to identify two preferred design pathways for further development.
- Design both lubricant delivery systems to be self-contained, with no excess dripping on site, and integrate with the system containerization efforts (Task 2).
- Produce *5 Lubricant Delivery Systems Images* of the final products to be used during installation (Task 7).
- Track the number of system cycles for each installed system and periodically perform destructive testing on a section of rope from each of 2 systems with different lubricant delivery systems after an equal duration of operation beginning at least 1 effective year.
- Compare the destructive testing results and develop a *Lubrication Learnings Report*.

Products:

- 5 Lubricant Delivery Systems Images
- Lubrication Learnings Report

TASK 6: DEVELOPMENT OF A GRAVITY WELL SCADA AND TELEMETRY SYSTEM
The goal of this task is to develop the Supervisory Control and Data Acquisition (SCADA) and energy management system (EMS) capability for the remote, aggregate operation of installed GrWs.

The Recipient shall:

- Develop an EMS software instance that converts incoming telemetry from the Utility, CAISO, Distributed Energy Resource (DER) aggregator, and/or economic control signals into outgoing telemetry including but not limited to: enable/disable, dispatch schedules (i.e., charge start/stop time, discharge start/stop time), and provide aggregate power capacity setpoints. Prepare a *EMS Software Summary* that describes the capabilities of the software developed.
- Develop an *Aggregate Energy Storage Control System Summary* for multiple GrWs that has two primary functions: 1) Receives enable/disable commands, dispatch schedules, and aggregate capacity setpoints from the EMS, transforming the aggregate commands into individual GrW controls that sequence their dispatch according to the aggregate schedule(s) and capacity setpoint(s) and 2) Generates grid support setpoints.
    - Control system features may include, but are not limited to, the following:
        - Closed loop controller.
        - Incorporates a load balancing algorithm that adjusts real time outputs based on available capacity. It responds to real-time deviations in system output as measured at the Point-of-Common-Coupling (PCC).
        - Implements power factor correction, voltage, and frequency support that are compliant with Rule 21 Volt-Var, Volt-Watt, and Frequency-Watt algorithms.
        - Capable of aggregate ramp rate control.
        - Incorporates fault protection and ride-thru awareness in compliance with IEEE 1547-2018 and UL1741-SB standards.
- Develop a *Cloud/Edge IoT Infrastructure Summary* that has, but is not limited to, the following capabilities:
    - Edge data acquisition system (DAS) that logs time-stamped individual GrW, aggregate, and control system data. The raw data are stored locally and uploaded periodically (e.g., on a 5-, 10-, or 15-minute basis) to a cloud server.
    - Uploaded data are archived and historized and stored on the cloud in a SQL server relational database.
    - The DAS stores ten days of raw data locally so that data integrity is preserved in the event of a loss of remote connection.
    - A universal power supply backs-up the SCADA system. In the event of a loss of power, the system is able to record the event data surrounding the loss of power and then shutdown gracefully.
    - Processes on the edge of the network, uploads to the cloud periodically, and handles incoming and outgoing real-time telemetry (e.g., EMS and Remote HMI) via a gateway device capable of 2030.5, DNP3, IEC 61850, and/or Modbus Sunspec.
- Develop a *Human Machine Interface (HMI) Summary* that includes description and images of the HMI dashboard developed, which has but is not limited to the following control and observation functionalities:
    - Has locally stored and real-time data accessible via local HMI where:
        - Trends can be created and saved locally to do onsite analytics.
        - Raw data can be downloaded from the DAS by onsite personnel.

        - The HMI can be used to control the fleet schedule/setpoints and modify system alarms.
    - Has archived data accessible via remote HMI where:
        - The data have been scrubbed and historized.
        - Alerts are generated on a per unit and aggregate fleet level.
        - Alerts are categorized by severity: Notification, Warning, and Alarm with automated corrective actions for each severity level.
        - Advanced analytics can be realized through keyword-driven cross filtering allowing any column and timeframe of historical data to be compared with any other across the same time frame.
        - The fleet can be controlled from the remote HMI.

Products:

- EMS Software Summary
- Aggregate Energy Storage Control System Summary
- Cloud/Edge IoT infrastructure Summary
- Human Machine Interface Summary

TASK 7: GRAVITY WELL FIELD INSTALLATION

The goal of this task is to install 5 GrW systems in idle wells and commission them for standard operation.

The Recipient shall:

- Complete a partial P&A within each well being converted to a GrW. As outlined by CalGEM, this includes the pouring and tagging of a 100 ft cement plug above the top perforation, an inspection, and a pressure test.
- Prepare each well for GrW installation, including:
    - Clearing accumulated residue and scaling from the inner well casing.
    - Performing Magnetic Image Testing (MIT) and Caliper Log (CL) runs of the wellbore to measure the current casing thickness profile and gather pre-operation baseline data of the precise shape and diameter of the casing inner surface through the full depth of the wellbore.
    - Filling the wellbore with water, biocide, corrosion-inhibitor, and friction-reducing additives.
- Install each GrW system, including:
    - Weight installation, filling, and hangoff.
    - Wellhead modifications, methane sensing, and secondary containment systems.
    - Structure anchoring in compliance with the AHJ permit.
    - Mechanical connection of any non-shop-assembled subassemblies.
    - Electrical connection to site power equipment.
    - High tension, precise wire rope spooling onto the drum, and weight-to-wire rope connections.
    - All required permit-related field inspections.
- Complete a *5 Fully Commissioned Systems Summary* that describes the commissioning process and functioning of the installed systems based on 5 successful charge-discharge cycles totaling 5 hrs of operation at 30kW or greater per well.

Products:

- 5 Fully Commissioned Systems Summary

TASK 8: MEASURED FIELD VALIDATION OF SAFETY, COMPONENT LIFETIME, AND WELL CHARACTERISTICS

The goal of this task is to provide measured validation of the safety, lifetime, and wear assumptions that inform GrW economics and provide key evidence of long-term viability to regulators, customers, and investors.

The Recipient shall:

- Charge and discharge three of the GrW systems at a rate of 3 times per day (compared to a normal operation of once per day), for a duration of at least ten months, to achieve the equivalent of approximately 3 years of normal use wear. (Cycles per day may be adjusted as long as 3 years of wear is achieved by the agreed upon completion date.)
- Characterize wellbore wear over time by:
    - Temporarily uninstalling each weight after the equivalent of 3 years of normal use wear and running a CL within each wellbore to characterize the wellbore casing's internal dimensions and surface profile.
    - Reinstalling each weight.
    - Comparing the baseline MIT and CL runs obtained during GrW installation (Task 7) to the 3 year wear CL runs to determine a material loss profile for each wellbore casing.
    - Extrapolating the 3 year material loss to estimate the expected material loss range over a 30 year GrW lifetime.
    - Utilizing the existing well drilling surveys and the calculated material loss of each wellbore to determine the relationship between downhole wellbore geometry (e.g., angle of inclination, dogleg severity, etc.) and casing material loss.
    - Using industry casing standards to create a reliable estimation methodology of the maximum number of years of allowable GrW operation for a given wellbore geometry (e.g., angle of inclination, dogleg severity, etc.) shown in well drilling surveys and casing thickness.
- Characterize the field wear profile and expected lifetime of wire rope on all five GrW system by:
    - Obtaining non-destructive test (NDT) magnetic imaging measurements of the wire rope on each GrW after every 3 months of operation. (Testing takes less than an hour and should not materially impact the operating schedule.)
    - Using the number of lifetime cycles at each measured NDT interval to chart the material area and strength loss profiles of each rope over time.
    - Comparing the measured strength loss profiles of the wire used in each well, and the wellbore characteristics likely to influence downhole friction (angle of inclination, dogleg severity, etc.) to draw a relationship between wellbore geometry and wire rope wear profiles. The team will further assess the strength loss profile, differentiating sources of loss (e.g., internal abrasion, external abrasion, crushing, etc.), to identify wire rope design modifications to enable longer service lifetimes.
    - Comparing wire rope wear profiles in GrW operation to the wire rope manufacturer's charted strength loss and lifecycle charts to determine the safe, usable lifetime of wire rope in the context of this unique application.
    - Performing destructive testing on 2 of the wire ropes at the end of the 3 effective years of cycle testing to validate prediction of remaining strength.
- Use the grid side power meter readings to determine the RTE profile (RTE vs. depth) in each wellbore, and characterize the impact of wellbore geometry (shape, angle, dogleg severity, etc.) on RTE.
- Produce a *Measured Field Validation Report* that summarizes findings related to:
    - Well casing wear over time and its impact on GrW operational lifetime.

- Measured wire rope wear profiles and the impact of wellbore geometry on these profiles.
- Impact of wellbore characteristics on RTE and other performance metrics
- Boundary conditions for wellbore characteristics that allow for economic GrW installations and any corresponding increase or decrease in market size.

Products:

- Measured Field Validation Report

TASK 9: DEMONSTRATION OF NETWORKED STORAGE APPLICATIONS

The goal of this task is to demonstrate the duration and capacity flexibility of a networked field of GrWs and to characterize performance of those operations relative to energy storage market requirements. The system will be operated in multiple storage modes, primarily but not limited to: peak shaving, load shaping, and demand response.

The Recipient shall:

- Complete the tasks outlined in the Field Testing Plan established in Task 6, logging and recording all relevant data and measurements. All derived data and analyses will be extracted from the available data in the measured data section found at the end of Attachment 10, Performance Metrics. Expected use cases include, but are not limited to:
  - Remote control verification, as measured by the system's production meter at the point of common coupling.
  - Characterization of system start up time in two cases:
    Case 1: The system is de-energized; the AC supply is connected but the grid coupled inverter is not enabled and the DC bus is not energized.
    Case 2: The grid coupled inverter is synchronized and the DC bus is energized.
  - Characterization of charge and discharge cycles:
    - Charge the system at 100%, 75%, 50%, and 25% of rated capacity to demonstrate the variability of charge rate and duration
    - Discharge the system at 100%, 75%, 50%, and 25% of rated capacity to demonstrate the flexibility of discharge rate and duration. Demonstrate bumpless transition when operating GrW units in time-series operation.
  - Dispatch latency when dispatched via the EMS system built in Task 6, utilizing the economic and remote dispatch commands issued from a qualified aggregator or utility.
  - Autonomous energy shifting, demonstrating automatic peak shaving with control response relative to instantaneous demand and solar production. The re-captured energy is then discharged according to the EMS schedule and capacity setpoints.
  - Demand response demonstration by responding to simulated or real utility demand response grid events.
  - Interoperability demonstration in response to supply voltage and frequency deviations (i.e., Volt-Var, Volt-Watt, Frequency-Watt, Constant Var and Constant Power Factor).
  - Anti-islanding capability in response to loss of supply.
- Validate grid services through data analysis of time-stamped meter, converter, and sensor data, and create a *Grid Service Optimization Report* addressing:
  - Aggregate grid support operation.

    - Demonstration of properly interleaved economic, EMS, and Utility references resulting in expected plant behavior (i.e., economic and timely dispatching of the fleet at the expected aggregate capacity for the expected duration).
    - Demonstration of peak shaving.
    - Demonstration of load shaping through validated demand charge reduction and utilization of recaptured energy.
    - Demonstration of CEC's Demand Side Grid Support response, Option 1.
- Generate a *Utility Bill Optimization Report* demonstrating site utility bill savings based on revenue and utility meter data.
- Produce a *Networked Operation Characterization Report* addressing key measured characteristics, including:
    - Response time.
    - Aggregate ramp rate.
    - Static and dynamic load balancing.
    - Grid support: Voltage and frequency response.
    - GrW fleet ride-thru and fault response.
    - Energy shifting and demand response performance.
- Partner with subrecipients to complete onsite system performance testing and remote data monitoring to validate data accuracy and system performance, and summarize the findings in *Subrecipient Quarterly Reports*. One of the goals of this longer-term review is to calculate availability. These reviews will calculate the same performance indicators as those for the onsite testing.
- Prepare and submit *CPR Report#2.*
- Attend CPR meeting.

Products:

- ∉ Grid Service Optimization Report
- Utility Bill Optimization Report
- Networked Operation Characterization Report
- Subrecipient Quarterly Reports
- CPR Report #2

TASK 10: UL CERTIFICATION

The goal of this task is to submit for UL 9540 certification for the GrW system.

The Recipient shall:

- Review the technical and safety requirements for UL 9540 – Standard for Energy Storage Systems and Equipment.
- Consult with UL or a UL-certified testing laboratory to confirm testing methodology modifications needed for UL 9540 certification of the GrW energy storage device and develop a *Gravity Well UL Certification Test Plan**.***
- Conduct a safety analysis, including risk assessments for fire hazards, electric shock, and other potential dangers. Document the safety features and design mitigations in a *Risk Assessment and Safety Analysis Review.*
- Conduct tests according to the *Gravity Well UL Certification Test Plan*, including:
    - Electrical safety and performance tests.
    - Mechanical durability tests (e.g., shock, vibration).
    - Thermal tests to assess fire propagation risk .
    - Environmental impact and chemical testing.
- Prepare *UL Certification Submission Package*, including:
    - Detailed technical specifications of the device.

    - Design schematics and component lists.
    - Test results from internal safety and performance validation.
    - Component datasheets (e.g., battery, inverter, and controller certifications).
    - User manual and installation instructions.
    - Risk assessment and safety analysis reports.
- Submit the *UL Certification Submission Package* to UL for formal evaluation.
- Address any issues identified during testing, make necessary design or manufacturing adjustments, and submit the updated design for retesting, where applicable.

Products:
- Gravity Well UL Certification Test Plan
- Risk Assessment and Safety Analysis Review
- UL Certification Submission Package

TASK 11: EVALUATION OF PROJECT BENEFITS
The goal of this task is to report the benefits resulting from this project.

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

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

TASK 12: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient Shall:

- Develop and submit a *Project Case Study Plan* that outlines how the Recipient will document the planning, construction, commissioning, and operation of the technology or system being demonstrated. The Project Case Study Plan should include:
    - An outline of the objectives, goals, and activities of the case study.
    - The organization that will be conducting the case study and the plan for conducting it.
    - A list of professions and practitioners involved in the technology's deployment.
    - Specific activities the recipient will take to ensure the learning that results from the project is disseminated to those professions and practitioners.
    - Presentations/webinars/training events to disseminate the results of the case study.
- Present the draft *Project Case Study Plan* to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the draft *Project Case Study Plan*. This document will identify:
    - TAC comments the Recipient proposes to incorporate into the final *Technology Transfer Plan*.
    - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Submit the final *Project Case Study Plan* to the CAM for approval.
- Execute the final Project Case Study Plan and develop and submit a Project Case Study.
- When directed by the CAM, develop presentation materials for a CEC sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California CEC.
- Provide at least (6) six High Quality Digital Photographs (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

Products:

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

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.