STATE OF CALIFORNIA
GRANT REQUEST FORM (GRF)
CEC-270 (Revised 12/2019) CALIFORNIA ENERGY COMMISSION

A) New Agreement # EPC-22-001 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
ERDD	Mithra Moezzi		916-891-8619

C) Recipient's Legal Name	Federal ID Number
Lumen Energy Strategy, LLC	85-3092783

D) Title of Project
Advancing California's Electricity Resource Planning Tools to Assess and Improve Climate Resilience

E) Term and Amount

Start Date	End Date	Amount
7/14/2022	3/31/2026	$ 1,950,000

F) Business Meeting Information

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

Proposed Business Meeting Date 7/13/2022 ☐ Consent ☒ Discussion

Business Meeting Presenter Susan Wilhelm Time Needed: 5 minutes

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

Agenda Item Subject and Description:
Lumen Energy Strategy, LLC
Proposed resolution approving agreement EPC-22-001 with Lumen Energy Strategy, LLC for a $1,950,000 grant to develop new inputs, assumptions, and tools to capture the impacts of climate change on electricity supply and demand as California transitions to a zero-carbon electricity system. This effort includes re-parameterizing inputs to California electricity system planning models to reflect a changing climate, creating a loss-of-load resilience evaluation model, evaluating the resilience of state resource planning output portfolios, and adopting staff's determination that this action is exempt from CEQA. This effort will advance the state's electricity resource planning model framework to reflect the impact of projected climate patterns and environmental extremes on electricity supply, demand, and the resulting resilience of electricity service to ratepayers. (EPIC funding) Contact: Susan Wilhelm.

G) 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":

2. If Agreement is considered a "Project" under CEQA:
   a) ☒ Agreement **IS** exempt.
      ☐ Statutory Exemption. List PRC and/or CCR section number:
      ☒ Categorical Exemption. List CCR section number: 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. 15306 provides that projects consisting of basic data collections, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. This project involves research and modeling to assess and improve resilience of California's electricity system in climate change. Research and model work will result in paper studies that will not result in a serious or major disturbance to an environmental resource.

This project does not involve impacts on any particularly sensitive environment; 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 section 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 section 15300.2 apply to this project and this project will not have a significant effect on the environment.

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

Therefore, this project is exempt from CEQA for all the reasons discussed above.

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

Check all that apply

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

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

Legal Company Name:	**Budget**
	$

Legal Company Name:	Budget
	$
	$
	$
	$
	$
	$
	$
	$
	$

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

Legal Company Name:

J) Budget Information

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	21-22	301.001I	$1,950,000
			$
			$
			$
			$
			$

R&D Program Area: EGRO: EA TOTAL: $ 1,950,000

Explanation for "Other" selection

Reimbursement Contract #: Federal Agreement #:

K) Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Mariko Geronimo

Address: 6114 La Salle Ave # 251

City, State, Zip: Oakland, CA 94611-2802

Phone: 415.916.7709

E-Mail: mariko@lumenenergystrategy.com

2. Recipient's Project Manager

Name: Mariko Geronimo

Address: 6114 La Salle Ave # 251

City, State, Zip: Oakland, CA 94611-2802

Phone: 415.916.7709

E-Mail: mariko@lumenenergystrategy.com

L) Selection Process Used

☒ Competitive Solicitation Solicitation #: GFO-21-302

☐ First Come First Served Solicitation Solicitation #:

☐ Non-Competitive Bid Follow-on Funding (SB 115)

M) The following items should be attached to this GRF

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

Agreement Manager **Date**

Office Manager **Date**

Deputy Director **Date**

Exhibit A
Scope of Work

I. TASK ACRONYM/TERM LISTS

a. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2	X	Resilience Framework
3	X	Re-Parameterization of Planning Model Inputs and Assumptions
4	X	Development of Resilience Evaluation Model
5	X	Evaluation of Resilience of Planning Model Resource Portfolios
6		Coordination with Related Grants
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities

b. Acronym/Term List

Acronym/Term	Meaning
CAISO	California ISO
California Joint Agencies	California Energy Commission, California Public Utilities Commission, California Air Resources Board
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
CPUC	California Public Utilities Commission
Group 2	Group 2 Recipient of GFO-21-302
Group 3	Group 3 Recipient of GFO-21-302
Resource Planning Models	PLEXOS and RESOLVE, unless re-specified under Subtask 3.2
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 innovations in California's electricity sector long-term resource planning models. Specifically, funds will advance modeling parameters and portfolio evaluation metrics to better capture: (a) climate change impacts on supply and demand, and (b) the ability of the rapidly evolving electric grid to provide resilient service to ratepayers.

b. Problem/ Solution Statement

Problem

Traditional resource planning models are fundamentally designed to evaluate fossil-fired bulk grid-scale resources under "normal"—or expected—supply and demand conditions. California

[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.

has adapted and refined these models to address modern policy questions but is now met with significant barriers to continued innovation. The models have not kept pace with the state's rapid policy and technology advancements towards deep renewables penetration, scalable storage, and more distribution- and customer-sited resources. The models have also not kept pace with the realities of extreme grid stressors due to climate change and how that impacts electricity supply ratepayers. They do not define resilience as an objective or measure resilience as a part of electricity service. As a consequence, the state's planning models inherently cannot evaluate climate resilience and they are losing their ability to reasonably reflect the operability and affordability of the electricity grid to customers.

California is not alone in this challenge, but it will likely need to be one of the first movers to address it. While working with regulatory and utility clients across the U.S., the Recipients have observed persistent barriers to this innovation. Barriers to innovation in planning models include established resource planning timelines, significant prior investment in model development and stakeholder buy-in, and an extremely complex coordination process for developing a resource plan with many parties and subject matter experts involved. Although stakeholders may agree innovation is needed, established planning processes may not accommodate significant time and budget needed to overhaul models. New commercially-available models are met with reluctance as these models are not originally developed through public process and typically require significant investment to validate and tailor to address the state's key policy questions. In the meantime, many resource planners, including California's, have invested in advanced scenario analysis. This approach yields valuable insight on the operability or resource portfolios and strategic investment pathways. But scenario analysis does not fundamentally address climate change and resilience issues of California's rapidly transforming grid and environment. A next step in planning model evolution is urgently needed. Without it, the state's resource planners will not have the right tools to identify investments and policy actions that support the state's goals of clean, cost-effective, and reliable service.

Solution

The Recipient will address this problem with four advancements. The first is to define resilience. To the Recipient's knowledge, the California Joint Agencies have not established a formal definition. Without a definition, resilience objectives and evaluation metrics cannot be articulated or coordinated across the state. The Recipient proposes to define resilience as the ability to serve essential and critical loads under a variety of known grid stressors, and in the event of catastrophic failure of the grid regardless of cause. At the start of the study the Recipient will engage the CEC and key stakeholders to reflect on this and brainstorm on a common definition. The Recipient will refine the proposed definition as appropriate and develop resilience evaluation metrics accordingly. The final work products will articulate this definition as a fundamental assumption to our analysis. This advancement will help stakeholders work towards a common goal and thus support efficient use of ratepayer funds throughout the clean electricity system transition.

The Recipient's second advancement will be to re-parameterize inputs and assumptions to the state's existing planning models to capture the impacts of climate change on electricity supply and demand. Within the requirements of GFO-21-302 it is clear—and understandable—that the state's existing planning models cannot be abandoned at this time. They reflect significant ratepayer investment and they are a common language for stakeholders' resource planning efforts. Therefore, the Recipient must improve the inputs and assumptions to these models to the extent that their architectures allow. Here, the innovation will be to bridge the knowledge gap between climate scientists the various resource plan development teams. The Recipient will work with the Group 2 and Group 3 Recipients of GFO-21-302 as well as stakeholders to translate historical and projected climate data into existing resource planning processes and

input tables. The product here will not just be a set of input tables, but tools and knowledge-sharing for the state's resource planners. The Recipient believes this work will help the state meet its cost-effectiveness and reliability objectives (e.g., planning reserve margins) as it moves toward the 2045 clean energy grid.

The Recipient's third advancement will be to build a novel probabilistic loss-of-load resilience evaluation model that:

- Synergizes with the existing Resource Planning Models;
- Integrates climate data and its geography with electric grid topology;
- Dynamically models customer-sited and distribution-sited resources;
- Represents all loads and supply resources at the granularity at or similar to distribution sections or census tracts;
- Reflects climate projections for the year modeled;
- Incorporates weather-driven resilience events and shocks to load and supply (like extreme heat waves, drought, wildfire risk); and
- Distinguishes low-impact (e.g., short duration, limited geography) versus high-impact customer outages (e.g., long duration, extended geography, disadvantaged or low-income communities).

The product will include a model and documentation that is available "off the shelf" to stakeholders publicly, with commercially available refinements for those who require further customization. Deliverables will also include stakeholder training and technical support to ensure the usability of the public model in tandem with the state's resource planning models. This work will help California steer towards climate-resilient investments, which would reduce the currently hidden cost of extended outages and extreme events to ratepayers.

The Recipient's fourth advancement will be to evaluate the resilience of the state's resource planning output portfolios. The evaluation will focus on portfolios selected by the CPUC's Integrated Resource Planning group and portfolios highlighted in the California Joint Agencies' Senate Bill 100 studies. Evaluation results will include resilience impact metrics and identification of policy and investment strategies for enhancing portfolio resilience.

c. Goals and Objectives of the Agreement

Agreement Goals

The goal of this Agreement is to:

- Advance the state's electricity resource planning model framework to reflect the impact of climate projections and environmental extremes on electricity supply, demand, and the resulting resilience of electricity service to ratepayers.

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefits of greater electricity reliability, lower costs, and increased safety.

Re-parameterized inputs and assumptions to the state's existing planning models will more realistically reflect future demands and availability of supply under future environmental conditions. Resource planners will have more information about the performance tradeoffs of different supply technologies. They will have more information about how the geographic (as

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

opposed to electrical) location of supply can worsen or relieve grid stressors. They will also have more information about how, even in a normalized future year, environmental stressors to the grid dynamics might coincide and compound. This information will help resource planners better identify the right amount (MW or MWh) of resources, with the right performance attributes, in the right geographic locations that yield the best and most cost-effective services to meet planning objectives. The resulting benefits will be reduced investment costs to ratepayers of the supply portfolio, and improved reliability of the bulk grid to deliver to load bus pool transmission facilities.

The Recipient's definition of resilience provides the basis for measuring benefits of the loss-of-load model. This model will reveal information on the negative and potentially hazardous impacts on customers of extensive grid failures—impacts are not currently captured at all in the state's resource planning models. The implication is the risk that current models point resource planners to preferred resource portfolios that are inherently vulnerable to known extreme situations and will fail to meet essential and critical loads. The model will internalize these impacts on customers and help resource planners to lower costs to customers and improve safety—especially in vulnerable or disadvantaged communities.

Technological Advancement and Breakthroughs: 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:

1. Development of a formal definition of resilience and specification of resilience evaluation metrics. Lack of a formal definition and specified metrics are barriers to assessing and improving the resilience of California's electricity investment and policy strategies.
2. Tools to incorporate climate projections and risks into the input and assumptions to the state's resource planning models. Disconnects between resource planning methods and climate projections create barriers to the cost effectiveness of California's future electricity investments and to the reliability of the future bulk grid supply portfolio.
3. A resilience evaluation model that captures the uncertainties of when and where known grid stressors and failures may occur, and the impacts on essential and critical loads. Overly simplified representations of geography, climate variability, distributed resources, system shocks, and types of loads (e.g., vulnerable communities, essential vs. discretionary loads) in the current resource planning models are barriers to improving the resilience of California's future portfolio of electricity resources.
4. A resilience assessment of alternative future resource portfolios under consideration in the state's resource planning efforts. The assessment will include identification of opportunities to improve climate resilience. It will overcome barriers in the decision-making process for policy and investment actions to improve climate resilience by providing quantified and stakeholder-vetted resilience impacts.

Agreement Objectives

The objectives of this Agreement are to:

- Build stakeholder consensus on a common definition of resilience. Based on that definition of resilience, develop a metric or metrics to measure resilience.
- For each input and assumption to the state's standard Resource Planning Models, explore the relationship with projections of climate changes and extremes. Work with stakeholders using the models to re-parameterize the inputs and assumptions within the models' existing architecture if it would meaningfully impact the models' results.
- Design and build a probabilistic loss-of-load model that assesses the resilience of resource portfolios reflected in the state's standard Resource Planning Models.
- Identify investment and policy strategies to improve the resilience of California's future portfolio of electricity resources

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V).** All products submitted which will be viewed by the public, must comply with the accessibility requirements of Section 508 of the federal Rehabilitation Act of 1973, as amended (29 U.S.C. Sec. 794d), and regulations implementing that act as set forth in Part 1194 of Title 36 of the Federal Code of Regulations**.** All technical tasks should include product(s). Products that require a draft version are indicated by marking **"(draft and final)"** after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, **"days"** means working days.

The Recipient shall:

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

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

For products that require a final version only

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

For all products

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

Instructions for Submitting Electronic Files and Developing Software:

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

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

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

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

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

MEETINGS

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

The Recipient shall:

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

  The administrative portion of the meeting will include discussion of the following:
  - Terms and conditions of the Agreement;
  - Invoicing and auditing procedures;
  - Administrative products (subtask 1.1);
  - CPR meetings (subtask 1.3);
  - Match fund documentation (subtask 1.7);
  - Permit documentation (subtask 1.8);
  - Subcontracts (subtask 1.9); and
  - Any other relevant topics.

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

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

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

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

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

CAM Product:
- Kick-off Meeting Agenda

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

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

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

- CPR Report(s)

CAM Products:

- CPR Agenda(s)
- Progress Determination

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
    - Disposition of any procured equipment.
    - The CEC's request for specific "generated" data (not already provided in Agreement products).
    - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.

  - "Surviving" Agreement provisions such as repayment provisions and confidential products.
  - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide copies of *All Final Products* on a USB memory stick, organized by the tasks in the Agreement.

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

REPORTS AND INVOICES

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

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

Products:
- Progress Reports
- Invoices

Subtask 1.6 Final Report
The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Energy Commission Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)
    - Appendices (if applicable) (Create a separate volume if very large.)
    - Attachments (if applicable)
- Submit a draft of the Executive Summary to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments* 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
- Draft Final Report
- Written Responses to Comments *(if applicable)*
- Final Report

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds
The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

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

The Recipient shall:

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

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

Products:

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

Subtask 1.8 Permits

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

The Recipient shall:

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

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

Products:

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

Subtask 1.9 Subcontracts

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

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of each executed subcontract.

- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

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

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

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

- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

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

Products:

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

Subtask 1.11 TAC Meetings

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

The Recipient shall:

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

The TAC shall:

- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- 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 insure a long-term perspective on decision-making and progress toward the project's strategic goals.

- Review and provide comments to proposed project performance metrics.
- Review and provide comments to proposed project Draft Technology Transfer Plan.

Products:

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

Subtask 1.12 Project Performance Metrics

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

The Recipient shall:

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

Products:

- TAC Performance Metrics Summary
- Project Performance Metrics Results

IV. TECHNICAL TASKS

TASK 2: RESILIENCE FRAMEWORK

The goal of this task is to develop a definition of resilience and corresponding resilience metrics that can be used as a basis for the resilience evaluation model proposed in Task 4. The resilience definition and metrics will be developed considering feedback from the CEC, TAC, and other stakeholders.

The Recipient shall:

- Conduct a literature and California policy review to establish a baseline conceptual framework for developing a formal definition of resilience.
    - Include consideration of recent stakeholder proceedings and working groups, such as the CPUC's Resiliency and Microgrids Working Group (under CPUC Rulemaking 19-09-009).
    - Include exploration of what constitutes a resilience event, what are resilience (as opposed to reliability) failures, how can adaptability in resource plans support resilience, and what are the objectives of resilience.
    - Prepare a draft *Resilience Framework Memo* that documents key findings and reference material. Provide to the CAM who will provide written feedback on the Resilience Framework Memo.
- Develop a definition of resilience for electricity resource planning purposes.
    - Informed by the literature and California policy review.
    - Update the draft *Resilience Framework Memo* to include this definition and a brief explanation of the selected wording and phrases.
- Develop resilience metrics that will be calculated using the resilience evaluation model proposed in Task 4.
    - Include alternative metrics or calculations considering potential challenges with data availability.
    - Update the draft *Resilience Framework Memo* to include documentation of the resilience metrics with example calculations.
- Develop *Demonstratives and Slides on Resilience Framework* and solicit feedback from the CEC, TAC, and other stakeholders on the resilience framework, definition of resilience, and resilience metrics.
    - Update the *Resilience Framework Memo* as necessary.
- Prepare a *CPR Report #1* in accordance with Subtask 1.3 (CPR Meetings).
    - Participate in a CPR meeting.

The TAC shall:

- Provide feedback on the resilience framework developed in this subtask.

Products:

- Resilience Framework Memo (draft and final)
- Demonstratives and Slides on Resilience Framework
- CPR Report #1

TASK 3: RE-PARAMETERIZATION OF PLANNING MODEL INPUTS AND ASSUMPTIONS

The goal of this task is to design meaningful and usable modifications to methodologies for preparing inputs and assumptions for the state's Resource Planning Models. The purpose of the modifications is to incorporate impacts of future climate trends on modeled electricity supply and demand so that the models can more accurately estimate the costs and reliability implications of future supply portfolios.

The Recipient shall:

- Explore climate data and identify weather and environmental patterns that would meaningfully impact electricity supply and demand in Resource Planning Models.
- Set reference points and boundaries on re-parameterization efforts based on the existing architecture of the Resource Planning Models and of key input development models (such as the CEC's energy demand forecast models).
- Based on understanding of climate data and existing planning model constraints, refine work plan for re-parameterizing demand and supply inputs and assumptions.
- Re-parameterize Resource Planning Model electricity demand inputs and assumptions.
- Re-parameterize Resource Planning Model electricity supply inputs and assumptions.

Subtask 3.1 Identify Relevant Weather and Environmental Data and Patterns

The purpose of this subtask is to explore climate data and identify weather and environmental patterns that meaningfully impact electricity supply and demand in resource planning models.

The Recipient shall:

- Identify key historical and projected climate datasets and compile data from the Cal-Adapt platform, Group 3, and other identified data sources.
    - Includes identification of the future climate scenario (e.g., RCP 4.5) to serve as the baseline for this Subtask 3.1 and other Task 3 re-parameterization efforts.
    - Prepare a draft *Re-Parameterization Framework Memo* that documents key datasets and future climate scenario relied upon and rationale for selecting them.
- Create or review tables, maps, and/or other figures summarizing future climate trends and patterns including solar insolation or radiation, wind speeds and volumes, hydrological and drought conditions, expected wildfire areas burned, average temperatures, and minimum and maximum temperatures.
    - Update the draft *Re-Parameterization Framework Memo* to include these demonstratives and discussion of future climate trends and patterns.
- Identify climate trends, patterns, and thresholds most relevant to the characteristics, performance, and/or availability of electricity supply and demand reflected in resource planning models.
    - In coordination with Group 2, conduct research on supply technology performance under various environmental conditions, such as extreme temperatures, and changes in solar, wind, and hydrological patterns.
    - Meet with and advise Group 2 to ensure they understand the importance of analyzing future climate-driven changes in short term (one or two days ahead) solar and wind generation forecast uncertainty—the most important or one of the most important drivers of CAISO's grid reliability events of 2020.
    - In coordination with the CEC Demand Analysis Office and Supply Analysis Office, identify absolute and spatial changes in temperature and other environmental conditions relevant to the behavior of gross electricity demand.
    - Leveraging work under GFO-18-301 (Pyregence), identify changes in wildfire threats that would affect electricity demand (if wildfires are mitigated via Public

Power Safety Shutoffs), performance of solar generation (due to smoke transport if wildfires occur), or overall performance of the grid (due to active fires).

- Conduct research and explore publicly-available CAISO OASIS transmission availability and outages to determine performance of major transmission interfaces between CAISO and the rest of the Western Electricity Coordinating Council under extreme environmental conditions (e.g., extreme heat, wildfire smoke).
- Update the draft *Re-Parameterization Framework Memo* to include demonstratives and discussion of what, how, and why future climate trends, patterns, and thresholds are likely to materially impact electricity supply and demand.
- Develop *Demonstratives and Slides on Weather and Environmental Patterns* of key findings and solicit feedback from the TAC on climate trends, patterns, and thresholds identified in this subtask.
- Refine the analysis as needed in response to feedback from the TAC.

The TAC shall:

- Provide feedback on climate trends, patterns, and thresholds identified in this subtask.

Products:

- Demonstratives and Slides on Weather and Environmental Patterns
- Re-Parameterization Framework Memo (drafts)

Subtask 3.2 Set Reference Points and Boundaries on Re-Parameterization Efforts Based on Existing Planning Model Architecture

The purpose of this subtask is to ensure re-parameterizations of inputs and assumptions are designed to be easily integrated and usable within the existing architecture of the state's Resource Planning Models. The CAM will help facilitate internal CEC communication protocols and facilitate engagement of CEC Demand Analysis Office and Supply Analysis Office staff.

The Recipient shall:

- With the CAM, confirm (and modify if needed) the specific electricity resource planning models upon which to focus re-parameterization efforts. By default, the Scope of Work assumes efforts will be focused on the PLEXOS and RESOLVE models, unless re-defined by the CAM and Lumen under this Subtask 3.2.
- Compile information on Resource Planning Models' input data, input file formats, input development methodologies, and modeling assumptions for one representative model run (each) to be used as a reference point for our re-parameterization efforts.
    - Determine whether the CEC already has access to these models. If not, work with the CAM to obtain the necessary data which may include *Data Requests* to the CPUC Integrated Resource Planning group and/or to the CAISO Transmission Planning Process group (via subpoena) recognizing this data collection may be a multi-month process.
    - Compile and review model input and assumptions methodology documentation; conduct interviews and/or additional data requests for missing information.
    - Identify key input models or modules to consider, including but not limited to the CEC's Energy Demand Forecast models.
    - Identify modeling constraints for each Resource Planning Model input and assumption that would put boundaries on our re-parameterization efforts (e.g., models may not be able to adjust forced outage rates by month or season).

- Review the CEC Demand Analysis Office and Supply Analysis Office documentation and data files for the most recently available California Energy Demand Forecast in order to understand methodological constraints, data availability, and load forecasting granularities.
    - Review data files and documentation publicly available under the CEC's 2021 Integrated Energy Policy Report proceedings.
    - Working with the CAM, write and issue (formal or informal) *Data Requests* to the CEC Demand Analysis Office and Supply Analysis Office on the California Energy Demand 2021 analysis on additional information or data needed.
    - Determine whether *Data Requests* to the utilities will be needed in order to capture the spatial granularity and/or detail on customer characteristics needed for re-parameterization. If so, work with CEC to issue data requests.
    - Review all data and identify demand forecasting modeling constraints for each that would put boundaries on our re-parameterization efforts.
- Create spatial mappings among key climate data identified in Subtask 3.1, each of the relevant Resource Planning Model supply resources, and the most granular electricity demand data available that will assist in identifying specific climate trends and patterns relevant to each Planning Model input and further focus our re-parameterization efforts.
- Develop *Demonstratives and Slides on Model Re-Parameterization Framework* of key findings and solicit feedback from the TAC on the feasibility and potential challenges with re-parameterizing Resource Planning Model inputs and assumptions as envisioned under this Subtask 3.2.
- Solicit written feedback from the CAM on the Re-Parameterization Framework Memo.
- Expand and finalize the *Re-Parameterization Framework Memo* to include a plan for adjusting specific Resource Planning Model input and assumption tables.

Products:

- Data Requests, if needed
- Demonstratives and Slides on Model Re-Parameterization Framework
- Re-Parameterization Framework Memo (final)

Subtask 3.3 Refine Work Plan for Re-Parameterizing Demand and Supply Inputs and Assumptions

The purpose of this subtask is to refine the work plan for Subtask 3.4 and Subtask 3.5 for most effective use of ratepayer grant funds.

The Recipient shall:

- Produce a simple Excel table reflecting the *Re-Parameterization Work Plan* for Subtask 3.4 and Subtask 3.5 reflecting adjustments and provide additional detail on specific activities based on work under Subtask 3.1 and Subtask 3.2.
- Solicit written feedback from the CAM on the Re-Parameterization Work Plan and adjust as necessary.
- Prepare a *CPR Report #2* in accordance with Subtask 1.3 (CPR Meetings).
    - Participate in a CPR meeting.

Products:

- Re-Parameterization Work Plan (draft and final)
- CPR Report #2

Subtask 3.4 Re-Parameterize Electricity Demand Inputs and Assumptions for the Resource Planning Models

The purpose of this subtask is to develop recommended adjustments to (a) the CEC's electricity demand forecast analysis and (b) how demand forecasts are represented in Resource Planning Models. Adjustments will be those needed to capture key impacts of future climate trends that will materially affect Resource Planning Model results. CAM will continue to facilitate engagement of CEC Demand Analysis Office and Supply Analysis Office staff.

The Recipient shall:

- Evaluate the spatial granularity of the CEC's electricity demand forecasting model and its ability to represent key climate trends, patterns, and thresholds identified in Subtask 3.1. As part of this subtask, disaggregate or downscale each component of the load forecast (e.g., non-EV non-battery load, EVs, distributed CHP/solar/other, distributed storage) to a census tract level of spatial granularity, which will also be needed in the resilience evaluation under Task 4 and Task 5.
- Evaluate the internal consistency of key climate trends, patterns, and thresholds identified in Subtask 3.1 flowing through to all components of the CEC's final electricity demand forecast. Key components include distributed solar generation profiles consistent with Group 2's work and Subtask 3.5, distributed battery storage charge/discharge profiles and/or availability of market-responsive capacity, availability of demand response, and application of final hourly load shapes from a future (not historical) climate year.
- Evaluate the representation of climate projections in electricity demand scenarios, what points on the probability distribution of annual weather outcomes are represented, and electricity demand scenarios might be most useful in the downstream scenario analyses of the Resource Planning Models.
- Including but expanding beyond the electricity demand scenarios, develop a simplified parameterization of the relationship between electricity demand and the full spectrum of annual weather outcomes. These parameters may be used in both the Resource Planning Models and in the resilience evaluation under Task 4 to incorporate weather outcomes not represented in the set of electricity demand scenarios.
- Evaluate existing methodologies for incorporation of CEC Energy Demand Forecasts into the Resource Planning Models for preservation of key climate trends, patterns, and thresholds identified in Subtask 3.1, e.g., if existing methodologies aggregate or simplify demand forecasts in a way that could mute key climate information.
- Develop and document recommended methodologies for electricity demand forecast re-parameterization in a draft *Re-Parameterization of Demand Inputs for Electricity Resource Planning Models for Climate Change Memo*.
- Develop *Demonstratives and Slides* of proposed re-parameterizations and solicit feedback from the TAC on methodologies and specific changes identified in this Subtask 3.4 (under the assumption that the TAC includes CEC Demand Analysis Office and Supply Analysis Office staff).
- Refine the analysis as needed in response to feedback from the TAC and CAM.

The TAC shall:

- Provide feedback on electricity demand re-parameterizations identified in this Subtask 3.4.

Products:

- Demonstratives and Slides on Proposed Demand Re-Parameterization (final)
- Re-Parameterization of Demand Inputs for Electricity Resource Planning Models Memo (draft and final)

Subtask 3.5 Re-Parameterize Electricity Supply Inputs and Assumptions for the Resource Planning Models

The purpose of this subtask is to develop recommended adjustments to the electricity supply-related inputs and assumptions to the Resource Planning models. Adjustments will be those needed to capture key impacts of future climate trends that will materially affect Resource Planning Model results.

The Recipient shall:

- Coordinate with and advise Group 2 as needed on solar, wind, and hydro generation characteristics that will materially impact Resource Planning Model results (such as day-ahead market generation forecast uncertainty) and applications of their findings across all grid domains (such as customer-sited solar).
- Leveraging work from the CPUC/Lumen Energy Storage Procurement Study, evaluate the recent historical availability and behavior of energy storage across all grid domains (customer-, distribution-, and transmission-sited) and how that might materially change under future normal and extreme environmental conditions (e.g., heat waves, high wildfire threat). Go through the formal data request process with the CPUC if needed.
- Building off of E3's *The Challenge of Retail Gas in California's Low-Carbon Future*[3] (2020) and using the Environmental Protection Agency's Continuous Emissions Monitoring System (EPA CEMS) datasets and other public sources, evaluate the historical availability and behavior of in-state natural gas-fired capacity and how that might materially change under normal and extreme environmental conditions. Depending on data availability, this analysis may be extended to fossil-fired generation technologies in the rest of the Western Electricity Coordinating Council.
- Develop and document recommended methodologies for electricity supply forecast re-parameterization and update the draft *Re-Parameterization of Supply Inputs* for *Electricity Resource Planning Models Memo*.
- Develop *Demonstratives and Slides* of proposed re-parameterizations and solicit feedback from the TAC on methodologies and specific changes identified in this Subtask 3.5.
- Refine the analysis as needed in response to feedback from the TAC.

The TAC shall:

- Provide feedback on electricity supply re-parameterizations identified in this Subtask 3.5.

[3] Aas, Dan, Amber Mahone, Zack Subin, Michael Mac Kinnon, Blake Lane, and Snuller Price. 2020. *The Challenge of Retail Gas in California's Low-Carbon Future: Technology Options, Customer Costs and Public Health Benefits of Reducing Natural Gas Use*. California Energy Commission. Publication Number: CEC-500-2019-055-F.

Products:

- Demonstratives and Slides on Proposed Supply Re-Parameterization (final)
- Re-Parameterization of Supply Inputs for Electricity Resource Planning Models Memo (draft and final)

Subtask 3.6 Re-Frame Resource Planning Model Scenario Development
The purpose of this subtask is to advance scenario development for Resource Planning Models to include additional information about projected changes in future weather patterns and extremes that are relevant to identifying portfolios that support bulk grid reliability and efficient use of ratepayer investment funds.

The Recipient shall:

- Review existing methodologies for scenario development; range of climate, weather, and/or environmental factors considered; and identified relationships between those scenario drivers and others such as macroeconomic, market, and policy drivers.
- Evaluate the existing methodologies' ability to capture the key future climate trends, patterns, and thresholds identified in Task 3 and potential compounding effects with other scenario drivers; build recommendations for enhanced scenario development.
- Evaluate the existing methodologies' ability to distinguish a given climate scenario's normal and extreme weather outcomes from alternate climate scenarios to inform real options analysis. Build recommendations for enhanced scenario analysis that will also tie to the resilience evaluation model in Task 4 and Task 5.
- Develop and document recommended methodologies for advancing Resource Planning Model scenario analysis and provide to CAM for feedback. Update the draft *Re-Parameterization of Electricity Resource Planning Models for Climate Change Memo* and submit to CAM for feedback.
- Develop *Demonstratives and Slides* of proposed scenario development enhancements and solicit feedback from the TAC on methodologies and specific changes identified in this Subtask 3.6.
- Refine the analysis as needed in response to feedback from the TAC and CAM.
- Prepare a *CPR Report #3* in accordance with Subtask 1.3 (CPR Meetings).
    - Participate in a CPR meeting.

The TAC shall:

- Provide feedback on Resource Planning Model scenario design identified in this Subtask 3.6.

Products:

- Demonstratives and Slides of Proposed Scenario Development Enhancement (final)
- Final Re-Parameterization of Electricity Resource Planning Models for Climate Change Memo
- CPR Report #3

TASK 4: DEVELOPMENT OF RESILIENCE EVALUATION MODEL

The goal of this task is to construct a model that can be used in tandem with the existing Resource Planning Models to evaluate the climate resilience of their projected future resource portfolios.

The Recipient shall:

- Define and summarize the model inputs, outputs, and analytical architecture in a *Resilience Evaluation Model Framework Flowchart*.
- Seek and obtain CAM approval for proposed file formats and software applications (e.g., Python).
- Define and develop spatial, temporal, and resource granularity of each demand and supply input to the model.
- Develop model output metrics using the resilience framework defined in Task 2 and add output summaries to the model's user interface.
- Define and develop stochastic inputs for each demand and supply input to the model, and create probability distribution summary graphics as part of the model's user interface. Work with CAM to obtain data through data request as needed.
    - Note that this task may include additional data collection from the CEC's electricity demand forecasting model, the Resource Planning Models, and/or from public data sources.
- Validate stochastic inputs by comparing actual historical variabilities and probability distributions with projected future variabilities, assessing their consistency with climate observations from Subtask 3.1, vetting them with the TAC, and comparing to available industry studies such as the Western Electricity Coordinating Council's probabilistic analysis of demand and supply variability in its 2021 Western Assessment of Resource Adequacy. (But note that validation against industry studies will be limited as the resilience evaluation model will be first of its kind.)
- Construct the *Resilience Evaluation Model*; iteratively examine and de-bug as needed.
- Calibrate and benchmark the model's bulk grid reliability results (i.e., traditional loss of load expectation metric) to a historical year and evaluate the actual supply and demand conditions in that year against a historically-defined "normalized" year. Our preference is to evaluate 2020 and build off the CAISO's *Root Cause Analysis: Mid-August 2020 Extreme Heat Wave* (2021).
- Develop *Demonstratives and Slides on Model Validation and Benchmarking* and solicit feedback from the TAC on model results for the benchmark year.
- Refine the model as needed in response to feedback from the TAC and CAM.
- Prepare a *CPR Report #4* in accordance with Subtask 1.3 (CPR Meetings).
    - Participate in a CPR meeting.

The TAC shall:

- Provide feedback on model results for the benchmark year.

Products:

- Resilience Evaluation Model Framework Flowchart
- Resilience Evaluation Model (draft)
- Demonstratives and Slides on Model Validation and Benchmarking

- CPR Report #4

TASK 5: EVALUATION OF RESILIENCE OF PLANNING MODEL RESOURCE PORTFOLIOS
The goal of this task is to evaluate the resilience of future electricity resource portfolios and service to ratepayers under projected climate trends and extremes as the grid transitions to meet the state's clean energy goals.

The Recipient shall:

- With the CAM, identify the future resource portfolios to evaluate.
    - Portfolio selection will consider potential roles of emerging technologies such as offshore wind, green hydrogen, long-duration energy storage, and enhanced load flexibility.
    - All resource portfolios will incorporate latest plans to replace Diablo Canyon nuclear plant.
- Run the model for each portfolio and future study year (2025, 2035, 2045, unless otherwise agreed to in Task 4) under the baseline climate scenario's trends, variabilities, and extremes defined in Subtask 3.1.
    - Evaluate changes in resilience metrics and drivers of those changes.
    - Evaluate impacts on vulnerable communities.
    - Evaluate customer cost and safety implications of outages under normal and extreme conditions, and how that might change the relative cost-effectiveness of portfolios as they are measured in the Resource Planning Models.
- For the transition year 2035 (unless otherwise agreed to in Task 4), conduct a real options analysis to evaluate the cost and resilience consequences of the state realizing it is on a worse climate trajectory than it assumed in 2025.
    - Evaluate which resource portfolios and their development paths provide adaptability to the state in this situation.
- Consider and identify resource development strategies that can enhance future climate resilience, including but not limited to resource locations (geographic and grid domain), technology characteristics, development timelines, and market or policy incentives that support resilient electricity service.
- Develop *Demonstratives and Slides on Resource Portfolio Resilience Evaluation* and solicit feedback from the TAC on key observations and recommendations.
- Refine the *Resilience Evaluation Model* as needed in response to feedback from the TAC and CAM.
- Prepare a *CPR Report #5* in accordance with Subtask 1.3 (CPR Meetings).
    - Prior to assembly and preparation of a final report, as described in Task 1.6, that incorporates content from the memos and demonstratives prepared under Task 2, Task 3, Task 4, and Task 5.
    - Participate in a CPR meeting.

Products:

- Resilience Evaluation Model (final)
- Demonstratives and Slides on Resource Portfolio Resilience Evaluation
- CPR Report #5

TASK 6: COORDINATION WITH RELATED GRANTS

The goal of this task is to ensure timely and clear communication as well as shared understandings regarding products and activities that are shared between or impact grants (e.g., data products and/or activities of one grant that serve as inputs or impact another).

The Recipient shall:

- Coordinate with Recipients of other CEC-funded grants for which there are shared data products and/or activities to identify and name inter-grant dependencies
- Describe the nature and timing of products and/or activities that are shared between grants
- Deliver to CAM an *Initial List of Inter-Grant Dependencies and Contingency Plan* that*:*
    - Includes the names, describes, and indicates expected timing of products and/or activities that are shared between grants, and;
    - Describes risk to the grant in the event that shared products and/or activities are not delivered as expected
- Communicate with Recipients of related grants (insert grant numbers) at least quarterly throughout the grant period to ensure continued communication regarding inter-grant dependencies.
- Deliver a *Mid-term List of Inter-Grant Dependencies and Contingency Plan* to CAM, highlighting any changes from the initial versions of these products and/or activities
- Respond to CAM feedback regarding mid-term products and/or activities
- Deliver a *Final List of Inter-Grant Dependencies and Contingency Plan* to CAM

Products:

- Initial List of Inter-Grant Dependencies and Contingency Plan
- Mid-term List of Inter-Grant Dependencies and Contingency Plan
- Final List of Integrant Dependencies and Contingency Plan

TASK 7: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete *the Initial Project Benefits Questionnaire*. The Initial Project Benefits Questionnaire shall be initially completed by the Recipient with 'Kick-off' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Complete the *Annual Survey* by December 15th 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 8: Technology/Knowledge Transfer Activities

The goal of this task is to ensure the scientific and techno-economic analysis and tools developed under this agreement are utilized in the energy policy, and/or planning decisions at the state and/or local levels, academic community and/or commercial sector.

The Recipient Shall:

- Develop and submit a *Knowledge Transfer Plan (Draft/Final)* that identifies the proposed activities the recipient will conduct to meet the goal of the task. The *Knowledge Transfer Plan* should include at a minimum:
  - Specific policy and planning efforts this project is expected to inform.
  - Specific stakeholder groups and energy policy and planning practitioners who will utilize the results of this project.
  - Proposed activities the recipient will conduct to ensure the tools and results from this project be utilized and adopted by the groups identified above.
- Present the *Draft Knowledge Transfer Plan* to the TAC for feedback and comments.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the *Draft Knowledge Transfer Plan*. This document will identify:
  - TAC comments the recipient proposes to incorporate into the *Final Knowledge Transfer Plan*.
  - TAC comments the recipient does not propose to incorporate with and explanation why.
- Submit the *Final Knowledge Transfer Plan* to the CAM for approval.
- Implement the activities as described in the *Final Knowledge Transfer Plan.*
- Develop a *Knowledge Transfer Summary Report (Draft/Final)* that includes high level summaries of the activities, results, and lessons learned of tasks performed relating to implementing the *Final Technology Transfer Plan*. This report should not include any proprietary information.
- When directed by the CAM, develop presentation materials for an 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:

- Knowledge Transfer Plan (Draft/Final)
- Summary of TAC Comments
- Technology Transfer Summary Report (Draft/Final)
- High Quality Digital Photographs

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

RESOLUTION NO: 22-0713-09

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: Lumen Energy Strategy, LLC.

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

RESOLVED, that the CEC approves Agreement EPC-22-001 with Lumen Energy Strategy, LLC for a $1,950,000 grant to develop new inputs, assumptions, and tools to capture the impacts of climate change on electricity supply and demand as California transitions to a zero-carbon electricity system. This effort will advance the state's electricity resource planning model framework to reflect the impact of projected climate patterns and environmental extremes on electricity supply, demand, and the resulting resilience of electricity service to ratepayers; 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 July 13, 2022.

AYE:

NAY:

ABSENT:

ABSTAIN:

_____

Liza Lopez

Secretariat