STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 12/2019) CALIFORNIA ENERGY COMMISSION

A) New Agreement # EPC-21-035 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
ERDD	Molly Mahoney		916-776-0790

C) Recipient's Legal Name	Federal ID Number
LookIn, Inc.	83-3301948

D) Title of Project
In-Line Quality Control of Lithium-Ion Battery Electrodes through Terahertz Scanning

E) Term and Amount

Start Date	End Date	Amount
6/29/2022	3/31/2025	$ 999,947

F) Business Meeting Information

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

Proposed Business Meeting Date 6/8/2022 ☐ Consent ☒ Discussion

Business Meeting Presenter Molly Mahoney Time Needed: 5 minutes

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

Agenda Item Subject and Description:
Lookin, Inc. Proposed resolution approving Agreement EPC-21-035 with Lookin, Inc. for a $999,947 grant to produce a high-throughput terahertz scanner for in-line quality control of battery electrodes, which improves manufacturing capability to deliver high power batteries with better shelf life, increased safety, lower cost, and decreased production lead-time, and adopting staff's determination that this action is exempt from CEQA. Lookin's breakthrough terahertz scanner technology addresses the limitations of existing terahertz scanners by providing 1000-times higher sensitivity and scanning speed through a patented terahertz transceiver technology.

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, § 15301

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

Explain reason why Agreement is exempt under the above section: 14 CCR 15301 "Existing Facilities"

Projects that consist of the operation, repair, maintenance, and minor alteration of existing public or private structures, facilities and mechanical equipment, involving negligible or no expansion of existing or former use are categorically exempt from CEQA under CCR section 15301. The project involves the development of a field prototype of an in-line quality control instrument that detects defects and non-uniformities in lithium-ion battery electrodes during manufacturing will occur at an existing laboratory. The prototype will be installed in two existing manufacturing facilities for validation studies and testing. There are no planned modifications to the facilities and the project involves no expansion of existing or former use at the sites. There will be no excessive generation of noise or odors anticipated and no hazardous waste involved.

This project 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 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.

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**
The Regents of the University of California, on behalf of the Los Angeles Campus	$ 202,536
The Regents of the University of California, on behalf of the Irvine Campus	$ 250,000
	$

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	$999,947
			$
			$
			$
			$
			$

R&D Program Area: EDMFO: EDMF TOTAL: $ 999,947

Explanation for “Other” selection

Reimbursement Contract #: Federal Agreement #:

K) Recipient’s Contact Information

1. Recipient’s Administrator/Officer

Name: Nezih Yardimci

Address: 12016 Washington Pl Apt 112

Apt 112

City, State, Zip: Los Angeles, CA 90066-5347

Phone: 734-546 1878

E-Mail: info@lookininc.com

2. Recipient’s Project Manager

Name: Nezih Yardimci

Address: 12016 Washington Pl Apt 112

Apt 112

City, State, Zip: Los Angeles, CA 90066-5347

Phone: 734-546 1878

E-Mail: info@lookininc.com

L) Selection Process Used

☒ Competitive Solicitation Solicitation #: GFO-20-301

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☐ 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		Build The Terahertz Scanning Unit
3	X	Assessment of the Scanning Unit Before Installation in Battery Manufacturing Facilities
4		Install the Scanning Unit In LG Energy Solutions R2R Battery Manufacturing Facilities And Conduct Experiments On Battery Electrodes During Manufacturing
5		Evaluation of Project Benefits
6		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
TAC	Technical Advisory Committee
FOV	Field of View
UCLA	University of California – Los Angeles
UCI	University of California - Irvine
LGES	LG Energy Solutions
QC	Quality Control
LIB	Lithium-Ion Battery
NDE	Non-Destructive Evaluation
EV	Electric vehicle
R2R	Roll-to-Roll
SNR	Signal-to-noise ratio
THz-FPA	Terahertz Failure Prevention Analysis

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the applied research and development of an in-line Quality Control (QC) instrument to detect defects and non-uniformities in Lithium-Ion Battery (LIB) electrodes during early stages of LIB manufacturing, which reduce the scrap rate of LIB manufacturing significantly and the cost and price of LIBs, while improving the safety of LIBs. The agreement will support the development of a field prototype which will be installed in two LIB

[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.

manufacturing facilities for field validation studies to determine the optimum performance parameters and technical specifications of the QC instrument.

B. Problem/ Solution Statement

Problem

LIBs are still expensive for most of their applications. Substantial effort to reduce the cost of LIBs has been made over the last few decades to make them widely available. Improvements in QC of LIB production would offer a major cost reduction by decreasing the scrap rate, which is currently about 5-10% during manufacturing. Unfortunately, inadequate flaw detection increases the average cost of LIBs. Currently, the world's LIB production capacity exceeds 320 GW-h/year. Considering the $156 kW-1-h-1 production cost of LIBs in 2019, reducing the scrap rate to zero would save more than $250M dollars for LIB manufacturers every year. The defects in flawed electrodes that are unknowingly assembled into battery cells can cause premature capacity fading, which results in a lower battery lifetime. They can also cause thermal runaway, which can result in an explosion. Therefore, QC is especially needed for LIBs, as they rely on flammable electrolytes, which can be the source of a hazard.

Currently, the only way to determine if a LIB is defective or not is through electrical testing at very late stages of manufacturing, after the battery cell formation, which cannot identify all types of defects. Therefore, early identification of these defects through an efficient in-line quality control tool is crucial for battery manufacturers to save money, time, and material and ensure safety. Existing methods of non-contact QC have serious drawbacks for battery QC application, especially in terms of their measurement speed. The most applicable one among these techniques, infrared thermography, has a limited throughput and cannot support rolling speeds of more than 1 meters/min while nowadays, battery manufacturers use rolling speeds as fast as 100 meters/min for LIB manufacturing. For this reason, LIB manufacturers, such as Tesla, Panasonic and LG-Chem, are in an urgent need to have effective solutions for QC at early stages of production to detect the defective parts and re-use the material before completing the entire production cycle.

Solution

The Recipient has developed a unique scanning technology employing terahertz radiation as the enabler of the battery QC application. Terahertz waves have enormous potential for various Non-Destructive Evaluation (NDE) applications. Using non-ionizing terahertz waves for scanning, the NDE instrument does not pose any safety hazard. It can offer A-, B-, and C-scans in a single measurement, which can be used to spot defects and measure coating thickness. Despite these great promises, the use of terahertz scanning for in-line NDE applications was not possible before due to the low sensitivity of conventional terahertz scanners, which suffer from a trade-off between the signal-to-noise ratio (SNR) and the measurement time. The Recipient's proposed terahertz scanner addresses these limitations through two patented innovations:

(1) The use of our plasmonic terahertz source and detector technology significantly enhances source/detector efficiency, leading to improvements in the SNR of the terahertz scanning system by three orders of magnitude compared to available terahertz systems. This SNR enhancement allows us to achieve high accuracy data with a short scanning time. The scalable design of the plasmonic terahertz detectors also allows the development of multi-pixel terahertz focal-plane arrays, which offer large field-of-view and reduced scanning times offered by the proposed scanner. (2) The use of advanced image reconstruction and machine learning algorithms that are capable of direct identification of defects with sub-wavelength resolution and measurement of

coating thicknesses with micrometer accuracy, which is required to detect the defects that impact battery performance.

Combining all these innovations allows the Recipient to develop a high-speed and high-sensitivity terahertz scanner. By enabling QC of battery electrodes at the early stages of manufacturing, the proposed instrument would be an indispensable tool for LIB manufacturers by reducing the excessive scrap rates of battery electrodes, while providing the highest level of performance, safety, and product availability. The proposed instrument would also reduce the fabrication cost of LIBs by reducing the excessive scrap rates, which will reduce the price of LIBs and, eventually, products utilizing LIBs, such as electric vehicles. This cost reduction would be a significant milestone to move toward the cost target of the Vehicle Technologies Office, $80/kWh, for automotive batteries

C. Goals and Objectives of the Agreement

Agreement Goals

The goal of this Agreement is to develop a high-throughput and high-sensitivity terahertz scanner for in-line QC of LIB electrodes to automatically detect defective LIB electrodes. The field of view FOV of the scanner will be as large as 1.5 meters and could be adjustable according to the roll-to-roll R2R manufacturing facility where the instrument will be installed. The instrument will use artificial intelligence to identify the type/size of the defects and will make the decision on the severity of defect by using its trained pass/fail criterion.

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefits of lower costs and increased safety by reducing the cost of LIBs through decreasing the scrap rate of LIB electrodes. The final product of the agreement will have the capability of detecting defective battery electrodes at early stages of manufacturing, which will significantly reduce the number of defective LIBs that can cause unexpected fire and explosion. The final product also reduces the scrap rate of LIB manufacturing; thus, the production cost of LIBs. Cost reduction in LIB technology decreases the price of EVs. There are many initiatives and programs to spread the utilization of EVs in the state of California. The product can eventually result in a remarkable cost reduction in EV price.

Technological Advancement and Breakthroughs:[3] This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by developing an in-line QC unit for LIB manufacturing, which is currently an unmet need. Improvements in QC of LIB manufacturing would offer a major cost reduction by significantly decreasing the scrap rate, which is currently as high as 10% during manufacturing. Previous studies have investigated the very strong correlation between agglomerates, blisters, pinholes, divots, metal particle contaminants, and non-uniform coatings introduced during the LIB electrode manufacturing with the LIB electrochemical performance. Different conventional techniques based on X-rays and infrared imaging have been evaluated to be used for QC of LIB electrodes; however, none of them offered the desired performance by LIB manufacturers. This agreement will provide the opportunity to develop a unique terahertz technology that can offer a real solution to this problem, for the first time, and provide a high-throughput and high-resolution platform for QC of LIB electrodes

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

Exhibit A
Scope of Work

Agreement Objectives

The objectives of this Agreement are:

- Developing a terahertz scanner that can be installed in real-world R2R LIB manufacturing facilities. The Recipient will optimize the terahertz scanner hardware and packaging to make it compatible with R2R LIB electrode manufacturing facilities. To have a robust scanner system that can offer consistent performance in different manufacturing environments, The Recipient will evaluate new packaging options and will manufacture specifically designed holders and enclosures.
- Investigating the capabilities of the developed terahertz scanner for battery inspection. An extensive terahertz scanning campaign in collaboration with UCI and LG Energy Solutions will be conducted on LIB electrode samples and the results of these tests will be used to optimize the sensitivity, scanning speed, FOV, and resolution of the terahertz scanner. Various trade-offs between the FOV, resolution, SNR, and scanning speed will be evaluated.
- Investigating advanced data analysis techniques. Models based on machine learning techniques will be used for post-processing the terahertz scanner data to further improve the sensitivity and resolution of the terahertz scanner. To acquire a sufficiently large dataset to successfully train our data analysis models, many LIB electrode samples with different types of defects and defect size will be tested.
- Defining a pass/fail criterion for LIB battery electrodes. The combination of the terahertz scanner data and the battery performance (e.g., cycle efficiency, discharge capacity, and life span) will be used by The Recipient to optimize the data analysis algorithm to identify pass/fail criteria for the in-line quality control scanner.

Exhibit A
Scope of Work

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
- 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 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 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 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:

Exhibit A
Scope of Work

- TAC Performance Metrics Summary
- Project Performance Metrics Results

Exhibit A
Scope of Work

IV. TECHNICAL TASKS

TASK 2 BUILD THE TERAHERTZ SCANNING UNIT

The main goal of this task is to develop a field prototype of the terahertz scanner that will be used in the battery manufacturing facilities of project partners. The Recipient will work with project partners to fabricate terahertz sources and optics. The Recipient will also fabricate Terahertz Failure Prevention Analysis (THz-FPAs) that will be used in the prototype to take terahertz images with high throughput. The Recipient will assemble the terahertz scanning unit according to the dimensions required by the manufacturing facilities for the easy integration of the unit.

The Recipient shall:

- Fabricate, package, and characterize terahertz sources.
- Fabricate, package, and characterize a THz-FPA.
- Print 3D terahertz lenses that will be used to guide terahertz radiation.
- Order the parts, such as laser, optical delay line, optical components, etc., that are necessary for the terahertz scanner prototype**.**
- Assemble the terahertz scanner.
- Validate the prototype operation at the laboratory.
- Create a *Terahertz prototype technical memo* that will include, but is not limited to, identifying all the key components as well as videos, photos, and technical documentation for the Terahertz scanner prototype.

Products:

- Terahertz prototype technical memo

TASK 3 ASSESSMENT OF THE SCANNING UNIT BEFORE INSTALLATION IN BATTERY MANUFACTURING FACILITIES

The goal of this task is to determine the performance parameters of the terahertz scanning unit. Before the installation of the terahertz scanner prototype in industrial R2R manufacturing facilities, the Recipient will conduct a measurement campaign on LIB electrode samples fabricated at the project partner's facilities. The team will characterize the effect of different parameters of terahertz scanner on data accuracy and resolution to understand the trade-off between throughput and sensitivity. The terahertz scan results will be compared with other techniques to validate the performance of the terahertz scanner. In addition, battery cells will be produced from the electrodes identified as defective by the terahertz scanner. The electrical performance of these samples will be measured to understand the effect of defect as a function of type and size more clearly. By doing so a pass/fail criterion will be developed. As more samples are measured, a more advanced data analysis algorithm based on machine learning will be developed. Performance parameters of the developed scanner will be experimentally determined.

The Recipient shall:

- Take measurements on battery electrodes in a R2R manufacturing plant at a project partner facility.
- Evaluate the results and create terahertz images.
- Compare the results with the measurements taken by other QC instruments at a project partner facility.
- Prepare an *Electrode Evaluation Report* that summarizes and compares the battery electrode measurements taken by the terahertz scanning unit with the other QC instruments.

- Prepare battery cells from defective electrode samples.
- Evaluate the electrical performance of these samples to understand the effect of type and size of defects on the battery performance.
- Develop a *Battery Cell Performance Report* that summarizes electrode defects and associated impact on the electrical performance of the battery cells. The report should also discuss the ability and/or accuracy of the terahertz scanning unit to predict battery cell performance based on identified electrode defects.
- Develop more advanced data analysis algorithm based on machine learning as the number of measurements increase.
- Prepare a *CPR Report* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Electrode Evaluation Report
- Battery Cell Performance Report
- CPR Report

TASK 4 INSTALL THE SCANNING UNIT IN LG ENERGY SOLUTIONS R2R BATTERY MANUFACTURING FACILITIES AND CONDUCT EXPERIMENTS ON BATTERY ELECTRODES DURING MANUFACTURING

The goal of this task is to evaluate the performance of the optimized terahertz scanner prototype that will be used in battery manufacturing facilities by installing the prototype in the R2R LIB manufacturing facilities of project partners. After the installation, different types of defects will be intentionally created for feasibility tests. The defective parts on LIB electrodes will be detected with the scanner unit in real-time during the manufacturing process. The detected electrodes will be assembled to understand the effect of the type and size of the defects on the LIB performance. The team will further test data evaluation methods based on statistical analysis and machine learning. With the help of big data that will be obtained in these measurements, more complicated data analysis methods based on neural networks will be also used for analyzing LIB electrodes. With the help of this plan, the team will finalize the faultless realization of the real-time automated operation of the defect detection algorithm.

The Recipient shall:

- Install the optimized scanner prototype at the battery manufacturing facilities of project partners.
- Evaluate the in-line QC performance of the prototype with different types of LIB electrodes.
- Create a *Test Plan & Review* to document the methodology in feasibility tests and evaluation methods.
- Finalize the software for real-time automated defect detection.
- Develop a *Verification Report* that summarizes the results of feasibility tests including, but not limited to:
    - The ability and accuracy of the terahertz scanning unit to detect electrode defects in a R2R manufacturing setting
    - The ability and accuracy of predicting how those defects impact battery cell performance

Products:

- Test Plan & Review
- Verification Report (draft and final)

TASK 5 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 6 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES
The goal of this task is to conduct activities that will accelerate the commercial adoption of the technology being supported under this agreement. Eligible activities include, but are not limited to, the following:

- Scale-up analysis including manufacturing analysis, independent design verification, and process improvement efforts.
- Technology verification testing, or application to a test bed program located in California.
- Legal services or licensing to secure necessary intellectual property to further develop the technology

- Market research, business plan development, and cost-performance modeling.
- Entry into an incubator or accelerator program located in California.

The Recipient Shall:

- Develop and submit a *Technology Transfer Plan (Draft/Final)* that identifies the proposed activities the recipient will conduct to accelerate the successful commercial adoption of the technology.
- Present the *Draft Technology 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 Technology Transfer 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 Technology Transfer Plan* to the CAM for approval.
- Implement activities identified in *Final Technology Transfer Plan.*
- Develop and submit a *Technology 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 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:

- Technology 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: 22-0608-8c

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: LOOKIN, 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-21-035 with Lookin, Inc. for a $999,947 grant to produce a high-throughput terahertz scanner for in-line quality control of battery electrodes, which improves manufacturing capability to deliver high power batteries with better shelf life, increased safety, lower cost, and decreased production lead-time. Lookin's breakthrough terahertz scanner technology addresses the limitations of existing terahertz scanners by providing 1000-times higher sensitivity and scanning speed through a patented terahertz transceiver technology; 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 June 8, 2022.
AYE:
NAY:
ABSENT:
ABSTAIN:

_____
Liza Lopez
Secretariat