

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 10/2015)

CALIFORNIA ENERGY COMMISSION

New Agreement FRD-17-002 (To be completed by CGL Office)

ERDD	Pilar Magana	43	916-327-2216
------	--------------	----	--------------

Lawrence Livermore National Security LLC	20-5624386
--	------------

Wood-to-Fuel for California's Transportation Sector using Autothermal Pyrolysis

1/8/2018	1/14/2022	\$ 5,700,000
----------	-----------	--------------

<input type="checkbox"/> ARFVTP agreements under \$75K delegated to Executive Director.			
---	--	--	--

Proposed Business Meeting Date	12/13/2017	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
--------------------------------	------------	----------------------------------	--

Business Meeting Presenter	Pilar Magana	Time Needed:	5 minutes
----------------------------	--------------	--------------	-----------

Please select one list serve. Select

Agenda Item Subject and Description

a.LAWRENCE LIVERMORE NATIONAL SECURITY LLC. Proposed resolution approving Agreement FRD-17-002 with Lawrence Livermore National Security LLC for a \$5,700,000 grant to fund the pre-commercial demonstration of an innovative autothermal pyrolysis technology that converts wood to bio-oil. This system will be capable of processing 50 tons per day of woody biomass on-site at Sierra Pacific Industries' sawmill facility in Camino, CA



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. (Attach draft NOE)
 Statutory Exemption. List PRC and/or CCR section number: _____
 Categorical Exemption. List CCR section number: Cal. Code Regs., tit 14, § 15301 -- Cal. Code Regs., tit 14, § 15303
 Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section:

This project includes (1) developing a complete engineering and design package for a 50 tons-per-day autothermal pyrolysis Modular Energy Production System; and, (2) manufacturing the modules for the system and preparing them for shipment and installation at the site. The system will be designed in a modular fashion, consisting of approximately 4 trailer sized modules. The equipment constructed off-site, and installed temporarily at an existing facility; none of the equipment will remain on site after the conclusion of the operational period, and the site will be returned to its prior use.

The equipment will be operated at an closed sawmill site that, at the current time, is being used for industrial purposes (e.g., truck repair, equipment storage); the project operations will consistent with the historic uses of the site and not require any substantial modifications to the site.

Demonstration readiness activities will include (1) delivering the modules to the demonstration site and integrate them; (2) finalizing Standard Operating Procedure documents and train operators; (3) conducting a readiness review; and, (4) complete shakedown trials and production runs to produce at least 50,000 gallons of bio-oil intermediates.

The project will not have a significant impact on the environment because it will only involve the temporary installation of a few small structures (i.e. trailer sized units) (Cal. Code. 14 § 15303) at an existing industrial facility (Cal. Code. 14 § 15301)., where the project operations will consistent with the historic uses of the site and not require any substantial permanent modifications to the site.

15303: New Construction or Conversion of Small Structures

To fit within this exemption, a project must be one of the following:

- 1) Consist of construction and location of limited numbers of new, small facilities or structures; or
- 2) Consist of installation of small new equipment and facilities in small structures; or
- 3) Consist of the conversion of small structures from one use to another where only minor modifications are made in the exterior of the structure.

Project module delivery, integration and readiness review activities will include:

- Deliver and install the modules at the demonstration site
- Integrate the modules and test individual operations

15301: Existing Facilities

To fit within this exemption, a project must meet all of the following criteria:

- 1) Consist of operation, repair, maintenance, permitting, leasing, licensing, or minor alteration
- 2) of existing structure, facilities, mechanical equipment, or topographical features,
- 3) which involves negligible or no expansion of use beyond that existing at the time of the lead agency's CEQA determination.

Demonstration operation activities will include:

- Complete shakedown trials of the integrated demonstration system
- Complete characterization of products
- Produce at least 50,000 gal. of bio-oil intermediates
- Deliver sugar stream to subcontractor demonstration facility for fermentation
- Deliver phenolic oil to ISU for hydroprocessing trials

EXHIBIT A
SCOPE OF WORK

I. TASK AND ACRONYM/TERM LISTS

A. Task List

Task #	CPR¹	Task Name
1		Project Administration
2		Demonstration Site Contract Execution
3	X	Demonstration Unit Configuration, Engineering and Fabrication
4		Demonstration Site Operations
5	X	Bio-Oil Upgrading
6		Commercialization Strategy
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities
9		Production Readiness Plan

B. Acronym/Term List

Acronym/Term	Meaning
AT-PI	Autothermal Process Intensified – <i>pyrolysis technology developed by Iowa State University and being demonstrated in this project</i>
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
Carbon Intensity	<i>The mass of lifecycle greenhouse gas emissions per unit of energy contained in transportation fuel</i>
CPR	Critical Project Review
EES	Easy Energy Systems
ISU	Iowa State University
LCA	Lifecycle Assessment
LLNL	Lawrence Livermore National Laboratory
M&V	Measurement and Verification
SPI	Sierra Pacific Industries
TAC	Technical Advisory Committee
TEA	Techno-economic Assessment
tpd	tons-per-day

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

EXHIBIT A
SCOPE OF WORK

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the pre-commercial demonstration of an innovative autothermal pyrolysis technology that converts wood to bio-oil, and development of a commercialization pathway for the technology in California.

B. Problem/ Solution Statement

Problem

Achieving California's energy and climate targets will require a substantial reduction in average fuel carbon intensity, supported by a major expansion in the supply of low-carbon alternative fuels. Thus, increasing the supply of low-carbon, drop-in alternative fuels (i.e., renewable fuels) is a high priority for California. Pyrolysis presents an attractive means to producing these fuels from cellulosic feedstocks, such as forestry residues. Early stage research and development funding has encouraged development of efficient lab- and pilot-scale pyrolysis systems. However, advancement of the technology to demonstration of a full-scale prototype in the field is a high-cost endeavor, requiring cooperation from feedstock suppliers, refiners, and fuel distributors.

Solution

The Recipient will adapt an innovative autothermal process intensified (AT-PI) pyrolysis technology developed by Iowa State University (ISU), used to convert corn stover to bio-oil, to instead use wood residues and scale this technology up to a commercially relevant size using a modular approach. The Recipient will then demonstrate the operation of this technology by producing 50,000 gallons of bio-oil. At the same time, the Recipient will show that the bio-oil can be upgraded to a range of low-carbon renewable fuels, and identify a pathway to commercialization for California's transportation market. By funding these activities, the Agreement will reduce uncertainty around performance of the technology, generate publicly available knowledge, and catalyze cooperation amongst entities in the supply chain.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Advance a technology that has the potential to increase the supply of low-carbon, renewable fuels by hundreds of millions of gallons per year using forestry residues
- Create partnerships amongst California stakeholders who can move the technology towards commercialization, and provide a plan for them to act.

EXHIBIT A SCOPE OF WORK

Agreement Objectives

The objectives of this Agreement are to:

- Scale ISU's AT-PI pyrolysis technology from a one-ton-per-day pilot to a modular, 50 ton-per-day project at the demonstration site.
- Produce at least 50,000 gallons of bio-oil over the duration of the demonstration and establish baseline performance of the technology.
- Characterize the bio-oil generated during the technology demonstration at Sierra Pacific Industries sawmill and demonstrate that it can be upgraded to commercially viable transportation fuels, such as gasoline and diesel, using conventional refinery processes (e.g., hydrotreating).
- Demonstrate that a sugar-rich fraction of the bio-oil can be converted to ethanol (a coproduct) through conventional fermentation.
- Evaluate the market potential in California for AT-PI pyrolysis technology, including the availability of wood-waste feedstock, opportunities to optimize the technology to meet market needs, cost-reduction potential and beneficial uses of coproducts in California.
- Show that the fuel produced from AT-PI pyrolysis bio-oil can meet or exceed the low-carbon fuel standard reference baseline for renewable diesel.
- Build market-adoption partnerships and develop an actionable roadmap to commercialize this technology in California.

III. TASK 1 PROJECT ADMINISTRATION

PRODUCTS

Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V)**. Products that require a draft version are indicated by marking “**(draft and final)**” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, “**days**” means working days.

The Recipient shall:

For products that require a draft version

- 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.

EXHIBIT A

SCOPE OF WORK

- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**

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

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

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

EXHIBIT A

SCOPE OF WORK

○ **Software Application Development**

Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:

- Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
- Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
- Visual Studio.NET (version 2008 and up). Recommend 2010.
- C# Programming Language with Presentation (UI), Business Object and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2. XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

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

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

EXHIBIT A

SCOPE OF WORK

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

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
 - An updated Project Schedule;
 - Technical products (subtask 1.1);
 - Progress reports and invoices (subtask 1.5);
 - Final Report (subtask 1.6);
 - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
 - Any other relevant topics.
- Provide an *Updated Project Schedule, List of Match Funds, and List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

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

Recipient Products:

- Updated Project Schedule (*if applicable*)
- Updated List of Match Funds (*if applicable*)
- Updated List of Permits (*if applicable*)

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

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

EXHIBIT A

SCOPE OF WORK

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

CAM Products:

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

Subtask 1.4 Final Meeting

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

The Recipient shall:

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this

EXHIBIT A

SCOPE OF WORK

Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

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

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
 - The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
 - Disposition of any state-owned equipment.
 - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
 - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
 - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
 - "Surviving" Agreement provisions such as repayment provisions and confidential products.
 - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
 - Prepare a *Schedule for Completing Agreement Closeout Activities*.
 - Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

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

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 research 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:

EXHIBIT A

SCOPE OF WORK

- Summarize all Agreement activities conducted by the Recipient for the preceding month, including 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.
- Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the terms and conditions. In addition, each invoice must document and verify:
 - Energy Commission funds received by California-based entities;
 - Energy Commission funds spent in California (if applicable); and
 - Match fund expenditures.

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

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

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

EXHIBIT A SCOPE OF WORK

Subtask 1.6.2 Final Report

The Recipient shall:

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

EXHIBIT A

SCOPE OF WORK

receipt

- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

Products:

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

CAM Product:

- Written Comments on the Draft Final Report

Products:

- Final Report (draft and final)

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

The Recipient shall:

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

If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:

- A list of the match funds that identifies:

EXHIBIT A

SCOPE OF WORK

- The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
- The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
- A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- 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 reimbursable under this Agreement. 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.

EXHIBIT A

SCOPE OF WORK

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

Products:

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

EXHIBIT A SCOPE OF WORK

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 research direction. The guidance may include research scope and methodologies, timing, and coordination with other research. 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 research (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 project research 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 research products.

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

- Researchers knowledgeable about the project subject matter;
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives);
- 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.

EXHIBIT A

SCOPE OF WORK

- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

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

Subtask 1.11 TAC Meetings

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

The Recipient shall:

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

Products:

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

EXHIBIT A SCOPE OF WORK

IV. TECHNICAL TASKS

*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. **Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.*

TASK 2: EXECUTE A CONTRACT WITH THE SELECTED DEMONSTRATION SITE

The goals of this task are to: (1) confirm the availability of the project demonstration site and a measurement and verification (M&V) contractor; and (2) execute any agreements necessary to secure the demonstration site and M&V contractor.

The Recipient shall:

- Reach agreement with the manager(s) of the selected demonstration site regarding the project timeline, space reserved for the project, equipment installation, permit and insurance requirements, indemnity, and the Recipient’s use of any removal or support staff.
- If the selected demonstration site becomes unavailable during the project term, work with the CAM to select a new site.
- Provide a *Copy of the Executed Contract with the Demonstration Site* that confirms the agreement reached above on the Recipient’s use of the site.

Products:

- Copy of the Executed Contract with the Demonstration Site

TASK 3: DEMONSTRATION UNIT CONFIGURATION, ENGINEERING AND FABRICATION

The goals of this task are to: (1) develop a complete engineering and design package for a 50 tons-per-day (tpd) autothermal pyrolysis Modular Energy Production System; and, (2) manufacture the modules for the system and prepare them for shipment and installation at the site.

Subtask 3.1: Demonstration System Engineering

The Recipient shall:

- Translate laboratory and pilot scale data, identify necessary pilot tests to finalize module engineering and design
- Develop *Pilot Scale Test Plan* necessary to finalize design package
- Develop a *Data Collection Plan*, validated by the M&V contractor
- Complete a *Process Hazard Assessment*
- Complete a full engineering and design package, including a *Summary Non-Proprietary Design Package*

EXHIBIT A

SCOPE OF WORK

Products:

- Pilot Scale Test Plan (draft and final)
- Data Collection Plan (draft and final)
- Process Hazard Assessment
- Summary Non-Proprietary Design Package

Subtask 3.2: Demonstration System Manufacturing

The Recipient shall:

- Manufacture modules to be implemented in the demonstration system
- Prepare the modules for shipment to the selected site and provide *Bill of Lading* to demonstration site owners
- Prepare a *CPR Report* in accordance with subtask 1.3
- Participate in a CPR meeting

Products:

- Bill of Lading
- CPR Report

TASK 4: DEMONSTRATION SITE OPERATIONS

The goals of this task are to: (1) deliver the modules to the demonstration site and integrate them; (2) finalize Standard Operating Procedure documents and train operators; (3) conduct a readiness review; and, (4) complete shakedown trials and production runs to produce at least 50,000 gallons of bio-oil intermediates.

Subtask 4.1: Module Delivery, Integration and Readiness Review

The Recipient shall:

- Deliver the modules to the demonstration site
- Integrate the modules and test individual operations
- Finalize *Standard Operating Procedures Report* and use to train operators
- Conduct readiness review procedures and complete *Readiness Review Documentation*

Products:

- Standard Operating Procedures Report
- Readiness Review Documentation

Subtask 4.2: Demonstration System Operation

The Recipient shall:

- Complete shakedown trials of the integrated demonstration system

EXHIBIT A

SCOPE OF WORK

- Complete characterization of products and produce *Mass Balance and Product Characterization Report*
- Produce at least 50,000 gal. of bio-oil intermediates
- Deliver sugar stream to subcontractor demonstration facility for fermentation
- Deliver phenolic oil to ISU for hydroprocessing trials
- Deliver aqueous phase to ISU for anaerobic digestion trials

Products:

- Mass Balance and Product Characterization Report (draft and final)

TASK 5: BIO-OIL UPGRADING

The goals of this task are to: (1) upgrade the sugar stream to alcohols; (2) upgrade the phenolic oil to drop-in hydrocarbon fuel distillate; (3) upgrade the aqueous phase to bio-methane; and, (4) provide operating conditions, yields and mass balances to LLNL for final techno-economic analysis and life cycle assessment.

The Recipient shall:

- Develop *Bio-Oil Upgrading Test Plan*
- Upgrade sugar stream to alcohols via fermentation
- Upgrade phenolic oil to drop-in hydrocarbon fuels via hydroprocessing
- Upgrade aqueous phase to bio-methane via anaerobic digestion
- Provide *Summary Report of Product Yields, Mass Balances and Operating Conditions* to LLNL for final techno-economic analysis and life cycle assessment
- Prepare a *CPR Report* in accordance with subtask 1.3
- Participate in a CPR meeting

Products:

- Bio-Oil Upgrading Test Plan (draft and final)
- Summary Report of Product Yields, Mass Balances and Operating Conditions
- CPR Report

TASK 6: COMMERCIALIZATION STRATEGY

The goal of this task is to undertake analysis that supports commercialization of ISU's AT-PI pyrolysis technology for low-carbon fuel production from wood residue in California. This analysis will include: (1) assessment of the California market for feedstocks and products; (2) optimization of the system for the California market and identification of opportunities for cost reduction; and, (3) establishment of market adoption partnerships.

Subtask 6.1: CALIFORNIA MARKET ASSESSMENT

The goal of this subtask is to assess feedstock availability and cost, and markets for bio-oil (and other products) of AT-PI technology, and to deliver a *Wood-to-Bio-oil Market Report*.

EXHIBIT A

SCOPE OF WORK

The Recipient shall:

- Assess the:
 - Spatial distribution and costs of wood residues available under current policies;
 - Markets for co-products and strategies for waste recycling;
 - Implications of different feedstocks, co-product uses and waste recycling strategies on the resulting fuel carbon intensity;
 - Suitability of California refineries to process bio-oil; and,
 - Non-market barriers to update of the technology.
- Prepare a draft *Wood-to-Bio-oil Market Report* that summarizes:
 - Feedstock potential and costs;
 - Co-product markets, waste recycling strategies and carbon intensity impacts;
 - Suitability of in-state refineries to process bio-oil; and,
 - Non-market barriers to uptake.
- Revise the draft *Wood-to-Bio-oil Market Report* based on input from market adoption partners (Subtask 6.3) and the TAC.
- Prepare one or more manuscripts for peer-reviewed publication that summarize key results of the *Wood-to-Bio-oil Market Report*.

Products:

- Wood-to-Bio-oil Market Report (draft and final)

Subtask 6.2: System Optimization And Cost Reduction

The goal of this subtask is to identify the optimal configuration(s) for the technology given California markets, opportunities for cost reduction, and deliver a *System Optimization Report*.

The Recipient shall:

- Conduct lifecycle and techno-economic assessments to assess:
 - Estimate the carbon intensity of the resulting fuels for different process configurations;
 - The profit maximizing process configuration for California market; and,
 - Potential for cost reductions stemming from unit and manufacturing scale-up.
- Prepare a *System Optimization Report* that summarizes the optimal system configuration and potential for cost reduction.
- Prepare one or more manuscripts for peer-reviewed publication that summarize key results of the *System Optimization Report*.

Products:

- System Optimization Report (draft and final)

Subtask 6.3: Market Adoption Partnerships

The goal of this subtask is to create market adoption partnerships to accelerate commercialization and deployment of ISU's AT-PI technology and develop a technology roadmap.

EXHIBIT A

SCOPE OF WORK

The Recipient shall:

- Provide a *List of Potential California Market Adoption Partners*
- *Establish California Market Adoption Partnerships and provide a List of Market Adoption Partners* to include the following sectors/industries:
 - in the forestry sector, which may be interested in supplying feedstock (e.g. Collins, Calforests)
 - in the oil and gas industry, which may be interested in purchasing bio-oil as a refinery feedstock (e.g., Chevron, Tesoro)
 - in end use sectors, which may be interested in procuring low-carbon fuels (e.g., trucking companies, airlines, U.S. military)
- Hold a workshop to solicit input from market adoption partnerships on the draft *Wood-to-Bio-oil Market Report*.
- Summarize workshop findings in a *Workshop Report*.
- Hold a workshop to develop a *California Wood-to-Fuel Technology Roadmap*.

Products:

- List of Potential California Market Adoption Partners
- List of Market Adoption Partners
- Workshop Report (draft and final)
- California Wood-to-Fuel Technology Roadmap (draft and final)

TASK 7: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
 - For Product Development Projects and Project Demonstrations:
 - Published documents, including date, title, and periodical name.
 - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
 - Greenhouse gas and criteria emissions reductions.
 - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.

EXHIBIT A
SCOPE OF WORK

- Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
- A discussion of research product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Additional Information for Product Development Projects:
 - Outcome of product development efforts, such copyrights and license agreements.
 - Units sold or projected to be sold in California and outside of California.
 - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
 - Investment dollars/follow-on private funding as a result of Energy Commission funding.
 - Patent numbers and applications, along with dates and brief descriptions.
- Additional Information for Product Demonstrations:
 - Outcome of demonstrations and status of technology.
 - Number of similar installations.
 - Jobs created/retained as a result of the Agreement.
- For Information/Tools and Other Research Studies:
 - Outcome of research.
 - Published documents, including date, title, and periodical name.
 - A discussion of policy development. State if the research has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
 - The number of website downloads.
 - An estimate of how the information and research have affected energy use and cost, or have resulted in other non-energy benefits.
 - An estimate of energy and non-energy benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of research.
 - A discussion of research product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

EXHIBIT A

SCOPE OF WORK

Products:

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

TASK 8: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient shall:

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

Products:

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

TASK 9: PRODUCTION READINESS PLAN

The goal of this task is to determine the steps that will lead to the manufacturing of technologies developed in this project or to the commercialization of the project's results.

EXHIBIT A

SCOPE OF WORK

The Recipient shall:

- Prepare a *Production Readiness Plan*. The degree of detail in the plan should be proportional to the complexity of producing or commercializing the proposed product, and to its state of development. As appropriate, the plan will discuss the following:
 - Critical production processes, equipment, facilities, personnel resources, and support systems needed to produce a commercially viable product.
 - Internal manufacturing facilities, supplier technologies, capacity constraints imposed by the design under consideration, design-critical elements, and the use of hazardous or non-recyclable materials. The product manufacturing effort may include “proof of production processes.”
 - The estimated cost of production.
 - The expected investment threshold needed to launch the commercial product.
 - An implementation plan to ramp up to full production.
 - The outcome of product development efforts, such as copyrights and license agreements.
 - Patent numbers and applications, along with dates and brief descriptions.
 - Other areas as determined by the CAM.

Products:

- Production Readiness Plan (draft and final)

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: LAWRENCE LIVERMORE NATIONAL SECURITY LLC

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

RESOLVED, that the Energy Commission approves Agreement FRD-17-002 from GFO-16-901 with Lawrence Livermore National Security LLC for a \$5,700,000 grant to fund the pre-commercial demonstration of an innovative autothermal pyrolysis technology that converts wood to bio-oil. This system will be capable of processing 50 tons per day of woody biomass on-site at Sierra Pacific Industries' sawmill facility in Camino, CA; and

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

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on December 13, 2017.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat