

EXHIBIT A Scope of Work

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2		Biomass Deconstruction
3	X	Strain Engineering and Optimization
4	X	Process Scale-up and Technology Demonstration
5		Evaluation of Project Benefits
6		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
ALE	Adaptive Lab Evolution
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CO ₂	Carbon Dioxide
CPR	Critical Project Review
CRISPR	Clustered Regularly Interspaced Short Palindromic Repeats
DOE	Department of Energy
GHG	Greenhouse Gas
IL	Ionic Liquid
JBEI	Joint BioEnergy Institute
MS	Microsoft
SQL	Structured Query Language
TAC	Technical Advisory Committee
UCC	Uniform Commercial Code

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

A. Purpose of Agreement

The purpose of this Agreement is to fund a technology demonstration project in a partnership between the Joint BioEnergy Institute (JBEI) and Aemetis, a California -based biofuels company. The goal of the partnership will be to address conversion technology challenges and bacterial strain optimization challenges across volumetric scales of production in order to demonstrate a path forward to achieving the realization of \$2.50/gallon of biofuels within 7-9 years after project initiation.

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.

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B. Problem/ Solution Statement

Problem

One of the most significant challenges in achieving California's energy goals is transitioning promising advanced biofuels technologies from laboratory results to commercial success. This includes demonstrating that these technologies are commercially viable and meet the state's required levels of Greenhouse Gas (GHG) emission reductions in accordance with the Low Carbon Fuels Standard. There are two barriers that will be addressed by this proposal:

- **Feedstock agnostic deconstruction:** Biomass pretreatment of California -relevant bioenergy feedstocks (e.g., no starch, do not compete with food production, and are primarily agricultural and timber waste streams) using ionic liquids (ILs). Pretreated substrates will be hydrolyzed using commercially available enzyme mixtures obtained from Novozymes (Davis, CA). Performance metrics: 90% yields of the fermentable sugars present in the initial bioenergy feedstocks.
- **Biofuel production:** Microbial production of the gasoline replacement, such as isopentenol, ethanol, or bisabolene at sufficient titer, rate and yield in order to achieve \$2.50/gallon. This will require optimization of the biofuel-producing strain to efficiently convert sugars that are liberated from CA non-food bioenergy crops.

Solution

The requested Energy Commission funds will be used to support a specific research effort that is differentiated and synergistic with the proposed Department of Energy (DOE) funding, and will be focused on optimization of the deconstruction and conversion of sugars liberated from California-relevant feedstocks and then converted to isopentenol, a leading candidate for internal combustion engine and low temperature combustion engines, such as Homogeneous Charge Compression Ignition, as well as a drop-in gasoline replacement. The optimization effort will require a mix of fundamental and applied science, and the scale-up work will be carried out at facilities in place at Aemetis. Life-Cycle Assessment and Techno-Economic Analysis of the technical results and performance will be carried out to validate gains in economics and sustainability to ensure the conversion pathway meets all the Energy Commission requirements.

C. Goals and Objectives of the Agreement

Agreement Goals

The goal of this Agreement is to jointly develop and demonstrate a conversion technology, based on work in model systems and plant-agnostic biosystems design tools to engineer sorghum, switchgrass and poplar to be significantly improved bioenergy crops and have better tolerance to pests and drought than wild-type plants. The Recipient will continue the development of genetic tools, including CRISPR/Cas9 technology, to facilitate the engineering of these bioenergy crops. This will be carried out at the DOE's Joint BioEnergy Institute (JBEI, www.jbei.org), using tools and knowledge from previous work described above, to convert California waste feedstocks into advanced biofuels. This project is a joint effort between JBEI and Aemetis.

Ratepayer Benefits: Lignocellulosic biomass can be converted into economically viable, carbon-neutral, specialty biofuels, all of the organic chemicals currently derived from petroleum, and many other useful bioproducts that cannot be efficiently produced from petroleum. Cutting edge science and developing new technologies under this agreement will provide California with

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dedicated, resource-efficient, energy crops and efficient processes to convert nearly all of the carbon in those crops into specialty biofuels and bioproducts at prices that are competitive with petroleum-derived fuels and chemicals with a 90% reduction in green-house gas emissions relative to petroleum-derived products. Development of technologies for producing advanced biofuels as drop-in replacements for current petroleum-derived transportation fuels will benefit California in a variety of ways including, but not limited to: reducing carbon dioxide emissions into the atmosphere, providing technologies to support nascent company formation, and educating the next generation of the biotechnology workforce. This research will provide technologies that will significantly reduce greenhouse gas emissions to the target of 40% below 1990 levels by 2030 as detailed by Governor Brown (Executive Order B-30-15). Achieving this goal will reduce the likelihood of major climate events such as droughts and rising sea levels, as well as improve air quality across the state. Successful implementation of these technologies will also overcome important economic factors that currently prevent widespread adoption of cellulosic biomass-derived biofuels, thus enabling small start-up companies to build competitive businesses without significant investment capital and catalyze partnerships between public and private entities. The proposed effort will have the following quantitative benefits to CA:

- Demonstration of an advanced biofuel pathway with the potential to reduce GHG emissions by $\geq 70\%$ relative to petroleum;
- Demonstration of an advanced deconstruction technology with the potential to generate sugar yields of 90% from a wide range of CA-relevant, non-food feedstocks;
- Demonstration that advanced biofuels are commercially relevant in meeting the goals of the Low Carbon Fuel Standard;
- Enabling the CA bioeconomy through the production of advanced biofuels and bioproducts

Technological Advancement and Breakthroughs: This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by developing our technical approach to efficiently convert California Agriculture and Hardwood waste to fuels and chemicals of immediate value which will leverage three critical technical approaches and will be demonstrated at scale in collaboration with Aemetis Inc. Specifically we will focus on the following research efforts:

- **Biomass Deconstruction:** Intensify the JBEI pioneered Ionic liquid based deconstruction of the CA woody biomass feedstocks.
- **Strain Engineering and Optimization:** Develop a microbial strain that can convert the carbon (specifically C6/C5 sugar streams) to the gasoline/diesel replacement and a platform chemical, such as ethanol, isopentenol, or bisabolene.
- **Process Scale-up and Technology Demonstration:** Collaborate with Aemetis Inc. to evaluate both the IL deconstruction process and the microbial biofuel production at a commercially relevant scale.

Agreement Objectives

The objective of this Agreement is to develop, and demonstrate, at a commercially relevant scale (defined as at least 300L volume pretreatment reactor and 600L volume fermenter) a biomass conversion technology that can efficiently and cost-effectively transform CA waste feedstocks into advanced biofuels. The technology demonstration will be carried out by Aemetis.

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III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

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

The Recipient shall:

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

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

For products that require a final version only

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

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.

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

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
 - Text documents will be in MS Word file format, version 2007 or later.
 - Documents intended for public distribution will be in PDF file format.
 - The Recipient must also provide the native Microsoft file format.
 - Project management documents will be in Microsoft Project file format, version 2007 or later.
- **Software Application Development**
- Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
- Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
 - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
 - Visual Studio.NET (version 2008 and up). Recommend 2010.
 - C# Programming Language with Presentation (UI), Business Object and Data Layers.
 - SQL (Structured Query Language).
 - Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
 - Microsoft SQL Reporting Services. Recommend 2008 R2.
 - XML (external interfaces).

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

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.

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

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

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

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

The CAM shall:

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

Recipient Products:

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

CAM Product:

- Kick-off Meeting Agenda

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

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place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

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

CAM Products:

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

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

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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 project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

The Recipient shall:

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

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Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

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

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM. (See *Task 1.1* for requirements for draft and final products.)

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

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.

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- Ensure that the Executive Summary is understandable to the lay public.
 - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
 - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
 - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
- Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
- Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- Include a brief description of the project results in the Abstract.

- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

Products:

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

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

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The Recipient shall:

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

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

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

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- 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 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*)

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TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
 - Technical area expertise;
 - Knowledge of market applications; or
 - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

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

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

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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

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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 BIOMASS DECONSTRUCTION

The goal of this task is to develop an ionic liquid (IL)-based deconstruction process that can efficiently liberate sugars from California waste biomass feedstocks. Further, to overcome the economic and sustainability challenges associated with conventional ILs used for biomass pretreatment, the recipient will use a new generation of ILs containing ions derived from naturally occurring bases, acids and aldehydes from lignin and hemicellulose which has recently been developed at JBEI.

The Recipient shall:

- Use the ability of certain ILs capable of capturing high volumes of CO₂ under ambient or low-pressure conditions that generate a decrease in pH by forming the corresponding carbonate salts. In addition, this process will be reversible at elevated temperatures or by sparging nitrogen gas. The recipient will expand this concept to other industrially relevant microbes and demonstrate that this approach is effective against a wide range of biomass feedstocks that are native to the state of California and relevant for Aemetis.
- Develop an IL-based deconstruction process that is effective at processing California feedstocks, amenable to enzymes and microbes used downstream in the conversion process, and are acceptable to Aemetis in terms of processing conditions and materials compatibility with existing infrastructure. From this process, develop a *Biomass Deconstruction Report* that captures the following:
 - Complete initial screening of ionic liquids on CA waste biomass feedstocks
 - Complete second round of screening ionic liquids effective at breaking down CA waste biomass feedstocks for biocompatibility
 - Identify optimized processing conditions (biomass loading, temperature, time, enzyme loading) that achieve at least 90% sugar yields
 - Examine IL-fermentation host interactions under pretreatment processing conditions, phase partitioning and boiling points of fuel molecules.
 - Examine the tolerance of hosts to biocompatible ILs using high-throughput screens of growth and adapt sensitive hosts to high concentrations using Adaptive Lab Evolution technologies, an approach that has been successful with *E. coli* in collaboration with broader JBEI team.
- Develop *Technology Transfer Package* that includes intellectual property and knowledge behind the pretreatment and microbial technologies, including work from previously completed research, to be scaled up at the Aemetis Facility. The Technology Transfer Package is a starting point for scale-up with Aemetis to be able to take the technology to market and includes the following:
 - Protocols for biomass pretreatment
 - Protocols for enzymatic saccharification
 - Protocols for microbial fermentation
 - Protocols for product separation and recovery
- Assist optimization and scale-up activities.

EXHIBIT A

Scope of Work

Products:

- Biomass Deconstruction Report (draft and final)
- Technology Transfer Package

TASK 3 STRAIN ENGINEERING AND OPTIMIZATION

The goal of this task is to engineer a strain of yeast that is capable of transforming the sugars liberated by the IL-based process into a gasoline/diesel replacement and a platform chemical, such as ethanol, isopentenol, or bisabolene.

The Recipient shall:

- Develop a stable scalable microbial platform that has maximal conversion of biomass-derived sugars into biofuel candidates such as ethanol, isopentenol, or bisabolene using genome-engineering tools such as Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)/Cas9 to integrate variations of the synthetic pathways into the chromosome.
- Develop a *Strain Engineering Report* that assesses and captures results on the following:
 - Generate a library of yeast strains with various promoter or ribosome binding site strengths for integrated genes and to screen the strain that shows improved production. A more systematic genome engineering approach will be also performed for strain optimization using CRISPR/Cas9 and CRISPRi to regulate genes in the chromosome simultaneously and at different growth phases.
 - Develop an organism that is capable of generating high yields of isopentenol from the sugars liberated from California waste biomass feedstocks, and is acceptable to Aemetis in terms of processing conditions and materials compatibility with existing infrastructure.
 - Establish performance baseline of yeast and isopentenol in terms of specific growth, titer, rate and yield
 - Complete first round of metabolic engineering
 - Complete second round of metabolic engineering to increase titer, rate and yield
- Develop a *Demonstration and Optimization Report* that captures results from the following:
 - Demonstrate growth and isopentenol production in "one-pot" configuration on hydrolysates generated from California woody biomass feedstocks
 - Optimize yeast bioconversion process (e.g., batch, fed batch) and demonstrate titer, rate and yield using mock configuration based on Aemetis work flows
- Assist optimization and scale-up activities
- Prepare a *CPR Report* in accordance with subtask 1.3
- Participate in a CPR meeting

Products:

- Strain Engineering Report (draft and final)
- Demonstration and Optimization Report (draft and Final)
- CPR

EXHIBIT A

Scope of Work

TASK 4 PROCESS SCALE-UP AND TECHNOLOGY DEMONSTRATION

The goal of this task is to engineer an organism that is capable of transforming the sugars liberated by the IL-based process into a gasoline and diesel replacement and a chemical component, such as ethanol, isopentanol, or bisabolene.

The Recipient shall:

- Collaborate with the subcontractor to conduct a scale-up of the best IL-based deconstruction of the lignocellulose and couple the resulting sugar stream with the most optimized bacterial strain for advanced biofuel production.
- Demonstrate that an IL-based deconstruction and conversion technology is capable of efficiently converting California woody biomass feedstocks into advanced biofuels at a commercially relevant scale of operations and develop a *Process Scale-Up and Demonstration Report* that captures results on the following:
 - Compare the performance of the deconstruction and production process relative to the known values in the laboratory, and use samples from the scaled-up cultures to obtain omics data.
 - Complete initial scaling of IL-based conversion technology
 - Downselect to one strain, biofuel target (such as ethanol or isopentanol) and process configuration for scale-up
 - Complete first round of scale-up and optimization of IL-based process of at least 10L pretreatment volume reactor and 20L volume fermenter.
 - Complete second round of scale-up and optimization of IL-based process of at least 50L volume pretreatment reactor and 100L volume fermenter.
 - Conduct the next round of process and conversion optimization. In the period of performance, 3 rounds of scale-up testing allowing will be completed to approach the final goal of establishing a viable and scalable commercial process. In addition, based on performance of the engineered organism and the titers, rates and yields of biofuel candidates, there will be a down-select process to either the engineered strain that produces isopentanol, bisabolene or an ethanol-producing strain that Aemetis already possesses as a risk mitigation strategy. This activity will be at a minimum scale of 300L volume pretreatment reactor and 600L volume fermentation.
- Prepare a *CPR Report* in accordance with subtask 1.3
- Participate in a CPR meeting to update CAM on the progress of the scale-up process

Products:

- Process Scale-Up and Demonstration Report (Draft and Final)
- CPR Report

TASK 5 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*.

EXHIBIT A

Scope of Work

- 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.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
 - A discussion of project 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 project.
 - Published documents, including date, title, and periodical name.
 - A discussion of policy development. State if the project 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 project information has 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 project.

EXHIBIT A

Scope of Work

- A discussion of project 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.

Products:

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

TASK 6 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient shall:

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

EXHIBIT A

Scope of Work

- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- High Quality Digital Photographs
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: DOE-LAWRENCE BERKELEY NATIONAL LABORATORY

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-17-004 with the U.S. Department of Energy's (DOE) Lawrence Berkeley National Laboratory for a \$3,000,000 grant to develop and demonstrate a biomass conversion technology with commercial scale production potential that can efficiently and cost-effectively transform California waste feedstocks into an advanced biofuel and reduce GHG emissions in transportation fuels. The proposed project leverages \$120,000,000 from the DOE; 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 February 21, 2018.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat