

EXHIBIT A Scope of Work

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2		Coordination of Fuel, Engine and Vehicle Vendors
3	X	Demonstration and Emissions Test Plans
4		Fuel Composition Sensor Integration and Testing
5		Training and Deployment
6	X	Operations and Surveying
7		Emissions Testing
8		Evaluation of Project Benefits
9		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CNG	Compressed Natural Gas
CPR	Critical Project Review
EV	Electric Vehicle
GHG	Greenhouse Gas
LNG	Liquefied Natural Gas
MTO	Marine Terminal Operator
NOx	Oxides of Nitrogen
OLNS	Optional Low NOx Standard
RNG	Renewable Natural Gas
TAC	Technical Advisory Committee
UCR	University of California Riverside

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the demonstration and laboratory emissions testing of yard trucks powered by an emerging low-Oxides of Nitrogen (NOx) 6.7L natural gas engine, in a typical seaport cargo handling operation. Specific comparisons will be made to yard trucks powered by 1) a larger low-NOx natural gas engine, 2) a diesel control engine, and 3) a battery-electric system. The laboratory portion of the testing will demonstrate and assess the efficacy of a novel on-engine sensor that can measure natural gas fuel quality and enable automatic

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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engine adjustments in real-time.

B. Problem/ Solution Statement

Problem

Yard trucks are a leading source of criteria pollutant, toxic air contaminant, and greenhouse gas (GHG) emissions in port cargo handling operations. Advanced natural gas engines that emit at very low levels are becoming available, but have virtually no real-world operational experience or in-use emissions test data. Natural gas engine options for yard trucks certified to the Optional Low NOx Standard (OLNS) have been limited to a 9 liter-class engine that is larger than diesel engines normally specified for yard truck applications. A new 6.7L natural gas engine certified to the OLNS is now commercially available on a special order basis for yard trucks, but it has not yet been demonstrated in this application. Notably, natural gas fueled off- road engines used in California – especially in high-priority applications like the San Pedro Bay Ports -- must increasingly be operated on renewable natural gas (RNG) to realize important GHG-reduction benefits associated with RNG's very low carbon intensity.

However, RNG can have greater variation in gas composition; this tends to be dictated by the specific biogas feedstock from which it is produced. Increased use of RNG can result in significant concentrations of diluents in the natural gas supply, particularly where RNG is used after minimal clean-up. Gas sensors that can monitor fuel quality in real time can enable engines to adapt engine operating parameters in real time to optimize engine efficiency and assess fuel quality-related engine issues.

Solution

The Recipient will demonstrate two natural gas-fueled yard trucks equipped with 6.7L engines certified to the OLNS in cargo handling operations at the Port of Los Angeles. The intent is to demonstrate and conduct a side-by-side comparison of yard trucks powered by this emerging engine and 1) the Cummins Westport 8.9 liter near-zero-emission natural gas engine, 2) a typical yard truck diesel engine, and 3) a battery-electric system. All available options will be obtained and compared in real-world use at the selected host marine terminal operator (MTO). Emissions / performance testing of the yard trucks will be performed on a chassis dynamometer to provide comparative emissions results in controlled conditions. A natural gas fuel quality sensor will be integrated into the laboratory testing of the natural gas yard trucks to validate sensor response and utility when operated on variable sources of RNG, which will be measured for composition.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Help commercialize clean yard truck technology (transferable to other off-road applications) that utilizes smaller, more-efficient natural gas engines certified to Air Resources Board's OLNS and can operate well on very-low GHG RNG fuel that may vary in composition;
- Better characterize and understand the relative emissions and operational performances of the latest diesel, electric, and natural gas yard trucks;

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- Improve the ability of natural gas engines to make real-time, automatic adaptations to variable fuel quality (especially for RNG), which can improve reliability and increase efficiency.

Ratepayer Benefits: This Agreement will result in the ratepayer benefit of emission reductions (NOx, GHGs, toxic air contaminants) in off-road applications. This is expected to be achieved by enabling transfer of ultra-clean engine technology from on-road to off-road applications that are conducive to using heavy-duty natural gas engines operated on very-low- carbon intensity RNG. It will also benefit rate payers by helping engine manufacturers and end users to maintain good operation and low emissions in real-world use, despite being operated on RNG with composition that varies significantly. Finally, it will help ensure that end users will be able to “right size” their cargo handling equipment deployments by purchasing yard trucks equipped with smaller, higher efficiency natural gas engines that are still able to fully meet end user requirements.

Technological Advancement and Breakthroughs: This Agreement is expected to lead to technological advancement and breakthroughs that can help overcome barriers to the achievement of numerous State energy and environmental goals. In addition to the breakthrough of helping to prove that the smaller 6.7 liter low-NOx natural gas engine can work well in yard truck applications, the novel fuel composition sensor technology that will be demonstrated and tested in the laboratory has potential to significantly improve the emissions and performance of natural gas yard trucks (and eventually other off-road equipment) when they are operated on RNG that has variation in composition and quality.

Agreement Objectives

The objectives of this Agreement are to:

- To characterize the relative emissions and operational performance of yard hostlers powered by Cummins Westport, Inc. (CWI) ISB6.7 G and ISL G NZ engines, while using varying blends of renewable natural gas (RNG). This will include laboratory testing at the University of California, Riverside (UCR) of these engines and UCR's novel natural gas sensor technology, which will measure gas quality and enable automatic engine adjustments that can ultimately help maintain low emissions during in-use operation.
- To help engine manufacturers, fuel providers, end users and regulators better understand the full capabilities of off-road natural gas engines to deliver very low emissions and meet key operational requirements – even when encountering RNG that significantly varies in composition and quality.

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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.
- Submit all products in the formats stipulated in GFO-16-506 (repeated below).

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.

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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.

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

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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.

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

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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.

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:

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- 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.

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**)

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- 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 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

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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:
 - 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.

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Products:

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

Subtask 1.8 Permits

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

The Recipient shall:

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

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

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

Subtask 1.9 Subcontracts

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

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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)

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;

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- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

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

Products:

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

Subtask 1.11 TAC Meetings

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

The Recipient shall:

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

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 COORDINATION OF FUEL, ENGINE AND VEHICLE VENDORS

The goals of this task are to: (1) specify and procure new natural gas-fueled yard trucks, (2) modify yard trucks for emissions testing, and 3) manage the procurement and delivery of required test fuels to the emissions test facility.

The Recipient shall:

- Coordinate with the Port of Los Angeles and an appropriate terminal to specify and procure two natural gas-fueled yard trucks equipped with 6.7L engines (expected to be Liquefied Natural Gas (LNG)) certified to the OLNLS and compliant with the terminal’s typical yard truck equipment specifications.
- Secure a host terminal
- Document procurement of the yard trucks by producing a *Vehicle Invoice and Configuration Summary*
- Develop a fuel procurement and transportation strategy to the UCR test facility for RNG:
 - Procure fuel from the renewable-LNG production facility at the Altamont landfill
 - Procure fuel from the renewable- compressed natural gas (CNG) production facility at the CR&R Perris anaerobic digester facility
 - Procure fuel from a standard “fossil” LNG fueling station
- Identify Electric Vehicle Supply Equipment required to support charging of the electric vehicle (EV) yard truck at the UCR test facility and coordinate procurement of required equipment
- Identify any required modifications to the natural gas yard truck fuel systems to support testing at UCR.
- Coordinate implementation of any required modifications to the LNG (or possibly CNG) fuel systems through a qualified natural gas vehicle fuel systems vendor.
- Document fuel procurement strategies by preparing a *Fuel Supply Summary*

Product:

- Vehicle Invoice and Configuration Summary
- Fuel Supply Summary

TASK 3 DEMONSTRATION AND EMISSIONS TEST PLANS

The goals of this task are to: (1) develop a test plan for in-use demonstration of vehicle performance and user acceptance, and (2) develop a test plan for chassis dynamometer emissions testing and fuel quality sensor validation.

The Recipient shall:

- Meet with terminal staff and review existing operational procedures for yard trucks

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- Identify specific work assignments/services that yard trucks perform on the terminal
- Identify existing data collection systems and develop additional data collection tools to capture fueling and maintenance information
- Develop a *Demonstration Test Plan* that will capture key operational parameters for diesel, natural gas, and EV yard trucks, including:
 - Vehicle Configurations/Specifications
 - Fuel/energy consumption records
 - Operating data
 - Operating hours in use
 - Reported energy delivered (hp-hr or kWh)
 - Average load factor
 - Idle time
 - Battery state of charge
 - GPS location
 - Work assignment
 - Maintenance records
 - Scheduled maintenance
 - Non-scheduled maintenance
 - Infrastructure-related issues
 - Total Availability
 - Fueling records
 - Daily/per-shift fuel consumption
 - Recharging times and rates
- Develop a Fleet Experience Survey Tool that solicits feedback from equipment operators, maintenance personnel, and terminal management about the overall experience of the yard trucks; including performance/power, reliability, operational fit, O&M challenges, safety, comfort, fueling/charging infrastructure challenges, and economic viability.
- Prepare a *Fleet Experience Survey Report* that provides the results from the Fleet Experience Survey Tool
- Develop the *Emissions Test Plan* that will be used to conduct Task 7 emissions testing on the actual test yard hostlers. This test plan shall include detailed descriptions of the vehicle fuel-technologies that will be tested (depending on actual availability); the pollutants to be collected and measured; the dynamometer system and pollutant measurement systems; procedures for testing and data collection, and the types of data analysis to be performed.
- Develop a *Fuel Composition Sensor Test Plan* that shall be the basis for testing under Task 4.
- Prepare a *Task 3 CPR Report* and participate in a CPR meeting, in accordance with subtask 1.3 (CPR Meetings).

Product:

- Demonstration Test Plan
- Fuel Composition Sensor Test Plan

EXHIBIT A

Scope of Work

- Fleet Experience Survey Report
- Emissions Test Plan
- Task 3 CPR Report

TASK 4 FUEL COMPOSITION SENSOR INTEGRATION AND TESTING

The goals of this task are to: (1) integrate a fuel quality sensor into a natural gas test engine in the laboratory environment, (2) validate the sensor's performance, and (3) demonstrate the benefits of incorporating the sensor inputs into the engine control system to reduce emissions and improve efficiency. To meet these goals, UCR's prototype fuel composition sensor will be integrated into one natural gas engine in the laboratory environment. Testing will be conducted on various fuel compositions to evaluate sensor integration and performance. Specific details on test types and location (UCR, Cummins Inc., or both) will be determined as the project proceeds, and incorporated into the Fuel Composition Sensor Test Plan (Task 3) and the Task 4 Summary Report.

The Recipient shall:

- Model performance of the sensor-based control strategy in Aspen/STANJAN, or similar combustion model.
- Integrate a fuel composition sensor into a selected natural gas engine test platform (to be determined in collaboration with the TAC and Cummins Westport).
- Demonstrate the sensor-based control strategy using a hardware-in-the-loop system over a range of fuel compositions and operating load points in the laboratory environment, on an appropriate and available test engine.
- Measure the emissions and evaluate the sensor's performance during an engine test using two fuel compositions to be determined in Task 3.
- Prepare a *Fuel Composition Sensor Summary Report* and integrate fuel quality sensor results into the final project report.

Product:

- Fuel Composition Summary Report

TASK 5 TRAINING AND DEPLOYMENT

The goals of this task are to: (1) train equipment operators and terminal staff in the necessary documentation activities and requirements, and (2) ensure the test yard trucks are shipped and received between the host terminal and UCR.

The Recipient shall:

- Train host terminal staff on documentation procedures of fueling and maintenance records
- Provide host terminal staff with a 1-hour, on-site LNG handling and training safety demonstration and conduct a *Training/LNG Handling Demonstration Event Survey* with participants to gather information on the overall satisfaction of the demonstration
- Coordinate delivery of the 6.7L-equipped natural gas (expected to be LNG) yard trucks to the host terminal for in-use demonstration

EXHIBIT A

Scope of Work

- Coordinate delivery of all yard trucks to UC Riverside for emissions testing and subsequent return to the host terminal
- Provide documentation of the delivery of vehicles to the host terminal and UC Riverside in a *Yard Truck Delivery Report*

Product:

- Training / LNG Handling Demonstration Event Survey
- Yard Truck Delivery Report

TASK 6 OPERATIONS AND SURVEYING

The goals of this task are to: (1) install data loggers and collect operational data from diesel, electric and natural gas-fueled yard trucks, (2) collect fueling and maintenance records, and (3) collect end user perspectives through a survey. The period of field testing and data gathering will be six months.

The Recipient shall:

- Install and verify the operation of data loggers on all yard trucks
- Periodically download data from the data loggers
- Review data logger records to ensure information is being successfully recorded consistent with the demonstration test plan
- Periodically collect and review fueling/charging records and maintenance records to confirm recordkeeping is consistent with the demonstration test plan
- Summarize operational data in an *Operation Data Summary Report*
- Administer the Fleet Experience survey to equipment operators, maintenance staff, and end-user management
- Prepare a *Fleet Experience Survey Report* providing details and results from the fleets experience using the demonstration vehicles including benefits and issues.
- Provide on-going support to address technical or operational issues attributable to the demonstration test plan procedures or data logging equipment
- Prepare a *Task 6 CPR Report* and participate in a CPR meeting, in accordance with subtask 1.3 (CPR Meetings).

Product:

- Operational Data Summary Report
- Fleet Experience Survey Report
- Task 6 CPR Report

TASK 7 EMISSIONS TESTING

The goal of this task is to implement the previously prepared Emissions Test Plan(Task 3) to conduct comparative chassis dynamometer emissions testing on the natural gas yard hostlers, and fueled by natural gas of variable gas composition. Note: under Task 8, test results from Task 7 (natural gas hostler testing) will be combined with results from Task 4 (fuel composition sensor effectiveness) to assess the potential benefits of the fuel composition sensor in helping heavy-duty off-road natural gas engine technology compensate for variable gas composition.

The Recipient shall:

- Perform chassis dynamometer testing of diesel, electric, and natural gas-fueled yard trucks

EXHIBIT A Scope of Work

- Collect regulated and non-regulated pollutant emissions and greenhouse gas emissions over representative test cycles for yard trucks
- Test at least one yard truck of each of the following, depending on availability from the selected MTO host site (e.g., Everport) or another nearby MTO / drayage company:
 - 2010-2016 diesel
 - 2016 8.9L ISL G NZ (certified to 0.02g NOx OLNS)
 - 2017 6.7L ISB NZ (certified to 0.1g NOx OLNS)
 - Battery-electric
- Test the natural gas-fueled vehicles using fuel from the following sources:
 - LNG from pipeline natural gas
 - LNG from renewable natural gas
 - CNG from renewable natural gas
- Integrate test results into final report
- Summarize test results in an Emissions Test Summary

Product:

- Emissions Test Summary

TASK 8 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.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the 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.
- 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.
 - 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.

EXHIBIT A Scope of Work

Products:

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

TASK 9 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 annual EPIC symposium(s) sponsored by the California Energy Commission.
- 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.
- 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)

EXHIBIT A

Scope of Work

- 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: GLADSTEIN, NEANDROSS & ASSOCIATES, 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 PIR-16-016 from GFO-16-506 with Gladstein, Neandross & Associates, LLC for a \$1,399,681 grant to develop and demonstrate two natural gas off-road port yard hostlers in the Port of Los Angeles. The yard hostlers will operate on low carbon renewable natural gas and integrate an innovative fuel gas sensor to optimize emission performance; 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 April 12, 2017.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat