RESOLUTION NO: 12-0314-1i

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: Cummins

RESOLVED, that the State Energy Resources Conservation and Development Commission (Energy Commission) approves Amendment 1 for Agreement ARV-10-044 to extend the agreement by six months to accommodate delays caused by budget changes, including additional match funding and a change in the size of the "downsized" engine. Cummins will develop and demonstrate a low-carbon emission powertrain with a specially designed E-85 engine and a dedicated hybrid drive system. There are no changes to the amount of the grant. (ARFVT funding.) Contact: Eric VanWinkle.

FURTHER BE IT RESOLVED, that this document authorizes the Executive Director to 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 March 14, 2012.

AYE: [List of Commissioners]
NAY: [List of Commissioners]
ABSENT: [List of Commissioners]
ABSTAIN: [List of Commissioners]

_____
Harriet Kallemeyn,
Secretariat

STATE OF CALIFORNIA

GRANTS/CONTINGENT AWARD REQUEST

CEC-270 (Revised 03/10)

CALIFORNIA ENERGY COMMISSION

To: Grants and Loans Office

Date: February / 16 / 2012

Project Manager: Eric VanWinkle Phone Number: (916) 651-1235 ext.

Office: Emerging Fuels and Technology Office Division: Fuels and Transportation MS- 27

Project Title: Ultra-Low Carbon Powertrain Program

Type of Request: *(check one)*

☐ **New Agreement:** *(include items A-F from below)* Agreement Number:

Program:

Solicitation Name and/or Number:

Legal Name of Recipient:

Recipient's Full Mailing Address:

Recipient's Project Officer: Phone Number: ( ) - ext.

Agreement Start Date: / / Agreement End Date: / /

☒ **Amendment :** *(Check all that apply)* Agreement Number: ARV-10-044

- ☒ Term Extension – New End Date: 09 / 30 / 2014
- ☒ Work Statement Revision *(include Item A from below)*
- ☒ Budget Revision *(include Item B from below)*
- ☐ Change of Scope *(include Items A – F as applicable from below)*
- ☐ Other: (Specify)

ITEMS TO ATTACH WITH REQUEST:

A. Work Statement
B. Budget
C. Recipient Resolution, if applicable. (Resolution may be requested in Special Conditions if not currently available.)
D. Special Conditions, if applicable.
E. CEQA Compliance Form
F. Other Documents as applicable
- Copy of Score Sheets
- Copy of Pre-Award Correspondence
- Copy of All Other Relevant Documents

California Environmental Quality Act (CEQA)

☒ CEC finds, based on recipient's documentation in compliance with CEQA:

- ☒ Project exempt: Section 15061 (b)(3) NOE filed: / /
- ☐ Environmental Document prepared: Type NOD filed: / /
- ☐ Other: Explain

☐ CEC has made CEQA finding described in CEC-280, attached

Funding Information:

*Source #1: ARFVT	Amount: $ 683,684.00	Statute: 2009	FY: 10/11	Budget List #: 601.118B
*Source #2: ARFVT	Amount: $ 2,028,456.00	Statute: 2010	FY: 10/11	Budget List #: 601.118C
*Source #3:	Amount: $ 0.00	Statute:	FY:	Budget List #:

If federally funded, specify federal agreement number:

* Source Examples include ERPA, PIER-E, PIER-NG, FED, GRDA, ARFVT, OTHER.

Business Meeting Approval: *(refer to Business Meeting Schedule)*

Proposed Business Meeting Date: March / 14 / 2012 ☒ Consent ☐ Discussion

Business Meeting Participant: Eric VanWinkle Time Needed:

Agenda Notice Statement: *(state purpose in layperson terms)*

Possible approval of a ☐ Grant / ☐ Contingent Award to…

Amendment 1 to ARV-10-044 with Cummins, Inc., to extend the agreement by 6 months to accommodate delays caused by budget changes, including additional match funding, and a change in the size of the "downsized" engine. Cummins will develop and demonstrate a low-carbon emission powertrain with a specially designed E-85 engine and a dedicated hybrid drive system. There are no changes to the amount of the grant.

Eric VanWinkle	02/16/2012		2/16/12	Pat Perez	2/16/12
Project Manager	Date	Office Manager	Date	Deputy Director	Date

EXHIBIT A

WORK STATEMENT

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Systems Analysis and Definition
3	X	Powerplant Development
4	X	Integrated System Demonstration
5		Vehicle Installation and Demonstration
6		Data Collection and Analysis

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	Tim Frazier		
2	Sam Geckler		
3	Sam Geckler		
4	Sam Geckler		
5	Sam Geckler		
6	Sam Geckler		

GLOSSARY

Specific terms and acronyms used throughout this scope of work are defined as follows:

Term/Acronym	Definition
ARFVT	Alternative and Renewable Fuel and Vehicle Technology
BOM	Bill of Material
CPR	Critical Project Review
E85	85% Ethanol, 15% Gasoline Blend
FTD	Fuels and Transportation Division

Background:

Assembly Bill 118 (Nùñez, Chapter 750, Statutes of 2007), created the Alternative and Renewable Fuel and Vehicle Technology (ARFVT) Program. The statute, subsequently amended by AB 109 (Nùñez, Chapter 313, Statutes of 2008), authorizes the Energy Commission to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. The Energy Commission has an annual program budget of approximately $100 million and provides financial support for projects that:

- Develop and improve alternative and renewable low-carbon fuels;
- Optimize alternative and renewable fuels for existing and developing engine technologies;
- Produce alternative and renewable low-carbon fuels in California;

- Decrease, on a full fuel cycle basis, the overall impact and carbon footprint of alternative and renewable fuels and increase sustainability;
- Expand fuel infrastructure, fueling stations, and equipment;
- Improve light-, medium-, and heavy-duty vehicle technologies;
- Retrofit medium- and heavy-duty on-road and non-road vehicle fleets;
- Expand infrastructure connected with existing fleets, public transit, and transportation corridors; and
- Establish workforce training programs, conduct public education and promotion, and create technology centers.

The California Energy Commission issued solicitation PON-09-004 to provide funding opportunities under the ARFVT Program for projects which commercialize advanced medium- and heavy-duty vehicle technologies. To be eligible for funding under PON-09-004, the projects must also be consistent with the Energy Commission's ARFVT Investment Plan updated annually. In response to PON-09-004, Recipient submitted application #41 which was proposed for funding in the Energy Commission's Notice of Proposed Awards (as revised January 28, 2011), and is incorporated by reference to this Agreement in its entirety.

Problem Statement:
The most prolific alternative fuel used in motor vehicles today is ethanol. While millions of passenger cars are capable of using high blends of ethanol (so called "flex-fuel" vehicles), no full-production medium-duty or heavy-duty vehicles have this capability. Recipient believes an optimized E85 engine can be highly competitive on a total cost of ownership basis.

Goal of the Agreement:
The goal of this agreement is to design and demonstrate an E85 powertrain concept for medium-duty truck operation. The integrated system will be capable of meeting California criteria emission levels within the time frame of the agreement.

Objectives of the Agreement:
The objectives of this agreement are to:

- Design, build, and demonstrate, using test cell operation, a technology package (E85 optimized engine and electronic hybrid technology) that meets California's criteria emission levels.
- Establish a technology development path for scalability for medium- heavy-duty vehicles.

TASK 1 ADMINISTRATION

Task 1.1 Attend Kick-off Meeting
The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

- Attend a “Kick-Off” meeting with the Commission Project Manager, the Grants Officer, and a representative of the Accounting Office. The Recipient shall bring its Project Manager, Agreement Administrator, Accounting Officer, and others designated by the Commission Project Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Project Manager will provide an agenda to all potential meeting participants.

  The administrative portion of the meeting shall include, but not be limited to, the following:
  - Discussion of the terms and conditions of the Agreement
  - Discussion of Critical Project Review (Task 1.2)
  - Match fund documentation (Task 1.6) No work may be done until this documentation is in place.
  - Permit documentation (Task 1.7)
  - Discussion of subcontracts needed to carry out project (Task 1.8)

  The technical portion of the meeting shall include, but not be limited to, the following:
  - The Commission Project Manager’s expectations for accomplishing tasks described in the Scope of Work
  - An updated Schedule of Products
  - Discussion of Progress Reports (Task 1.4)
  - Discussion of Technical Products (Product Guidelines located in Section 5 of the Terms and Conditions)
  - Discussion of the Final Report (Task 1.5)

  The Commission Project Manager shall designate the date and location of this meeting.

Recipient Products:

- Updated Schedule of Products
- Updated List of Match Funds
- Updated List of Permits

Commission Project Manager Product:

- Kick-Off Meeting Agenda

Task 1.2 Critical Project Review (CPR) Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and to identify any needed modifications to the tasks, products, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Recipient. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Project Manager and as shown in the

Technical Task List above. However, the Commission Project Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Recipient.

Participants include the Commission Project Manager and the Recipient and may include the Commission Grants Officer, the Fuels and Transportation Division (FTD) team lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Project Manager to provide support to the Energy Commission.

The Commission Project Manager shall:

- Determine the location, date, and time of each CPR meeting with the Recipient. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Recipient the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not modifications are needed to the tasks, schedule, products, and/or budget for the remainder of the Agreement. Modifications to the Agreement may require a formal amendment (please see the Terms and Conditions). If the Commission Project Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Transportation Committee for its concurrence.
- Provide the Recipient with a written determination in accordance with the schedule. The written response may include a requirement for the Recipient to revise one or more product(s) that were included in the CPR.

The Recipient shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other products identified in this scope of work. The Recipient shall submit these documents to the Commission Project Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Commission Project Manager Products:

- Agenda and a list of expected participants
- Schedule for written determination
- Written determination

Recipient Product:

- CPR Report(s)

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement.

The Recipient shall:

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

  This meeting will be attended by, at a minimum, the Recipient, the Commission Grants Office Officer, and the Commission Project Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Project Manager.

  The technical portion of the meeting shall present an assessment of the degree to which project and task goals and objectives were achieved, findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The Commission Project Manager will determine the appropriate meeting participants.

  The administrative portion of the meeting shall be a discussion with the Commission Project Manager and the Grants Officer about the following Agreement closeout items:
  - What to do with any equipment purchased with Energy Commission funds (Options)
  - Energy Commission's request for specific "generated" data (not already provided in Agreement products)
  - Need to document Recipient's disclosure of "subject inventions" developed under the Agreement
  - "Surviving" Agreement provisions
  - Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement.

Products:

- Written documentation of meeting agreements
- Schedule for completing closeout activities

Task 1.4 Monthly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement on time and within budget.

The objectives of this task are to summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, and to form the basis for determining whether invoices are consistent with work performed.

The Recipient shall:

- Prepare a Monthly Progress Report which summarizes all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Project Manager within 10 days of the end of the reporting period. The recommended specifications for each progress report are contained in section 6 of the terms and conditions of this Agreement.

Products:

- Monthly Progress Reports

Task 1.5 Final Report

The goal of the Final Report is to assess the project's success in achieving its goals and objectives, advancing science and technology, and providing energy-related and other benefits to California.

The objectives of the Final Report are to clearly and completely describe the project's purpose, approach, activities performed, results, and advancements in science and technology; to present a public assessment of the success of the project as measured by the degree to which goals and objectives were achieved; to make insightful observations based on results obtained; to draw conclusions; and to make recommendations for further projects and improvements to the FTD project management processes.

The Final Report shall be a public document. If the Recipient has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Recipient shall perform the following activities for both the public and confidential versions of the Final Report.

The Recipient shall:

- Prepare an Outline of the Final Report.
- Prepare a Final Report following the approved outline and the latest version of the Final Report guidelines which will be provided by the Commission Project Manager. The Commission Project Manager shall provide written comments on the Draft Final Report within fifteen (15) working days of receipt. The Final Report must be completed at least 60 days before the end of the Agreement Term.
- Submit one bound copy of the Final Report with the final invoice.

Products:

- Draft Outline of the Final Report
- Final Outline of the Final Report
- Draft Final Report
- Final Report

Task 1.6 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. Although the Energy Commission budget for this task will be zero dollars, the Recipient may utilize match funds for this task. Match funds shall be spent concurrently or in advance of Energy Commission funds for each task during the term of this Agreement. Match funds must be identified in writing and the associated commitments obtained before the Recipient can incur any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. 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 such 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 each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied.
    - Amount of each in-kind contribution, a description, documented market or book value, and its 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 shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
- Provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured. For match funds provided by a grant a copy of the executed grant shall be submitted in place of a letter of commitment.
- Discuss match funds and the implications to the Agreement if they are reduced or not obtained as committed, at the kick-off meeting. If

applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.

- Provide the appropriate information to the Commission Project Manager if during the course of the Agreement additional match funds are received.
- Notify the Commission Project Manager within 10 days if during the course of the Agreement existing match funds are reduced. Reduction in match funds must be approved through a formal amendment to the Agreement and may trigger an additional CPR
.

Products:

- A letter regarding match funds or stating that no match funds are provided
- Copy(ies) of each match fund commitment letter(s) (if applicable)
- Letter(s) for new match funds (if applicable)
- Letter that match funds were reduced (if applicable)

Task 1.7 Identify and Obtain Required Permits

The goal of this task 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. Although the Energy Commission budget for this task will be zero dollars, the Recipient shall budget match funds for any expected expenditures associated with obtaining permits. Permits must be identified in writing and obtained before the Recipient can make expenditures for which a permit is required.

The Recipient shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If there are no permits required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
  - A list of the permits that identifies the:
    - Type of permit
    - Name, address and telephone number of the permitting jurisdictions or lead agencies
  - The schedule the Recipient will follow in applying for and obtaining these permits.
- Discuss the list of permits and the schedule for obtaining them at the kick-off meeting and develop a timetable for submitting the updated list, schedule and the copies of the permits. The implications to the Agreement 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 the Progress Reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, provide the appropriate information on each permit and an updated schedule to the Commission Project Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Project Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Project Manager within 5 working days. Either of these events may trigger an additional CPR.

Products:

- Letter documenting the permits or stating that no permits are required
- A copy of each approved permit (if applicable)
- Updated list of permits as they change during the term of the Agreement (if applicable)
- Updated schedule for acquiring permits as changes occur during the term of the Agreement (if applicable)

Task 1.8 Obtain and Execute Subcontracts

The goal of this task is for Recipients to identify any subcontracts required to carry out the tasks under this Agreement, and to procure them consistent with the terms and conditions of this Agreement and the Recipient's own procurement policies and procedures. It will also provide the Energy Commission an opportunity to review the subcontracts to ensure that the tasks are consistent with this Agreement, that the budgeted expenditures are reasonable and consistent with applicable cost principles.

The Recipient shall:

- Prepare a letter documenting the subcontracts required to conduct this Agreement, and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If there are no subcontracts required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that subcontracts will be required during the course of the Agreement, provide in the letter:
  - A list of the subcontracts that describes the anticipated maximum budget and general scope of work for each,
  - A description of the procurement process to be used, and
  - The schedule the Recipient will follow in applying for and obtaining these subcontracts
- Submit a draft of the subcontract to the Commission Project Manager for review and approval, and incorporate any changes recommended by the Commission Project Manager.
- Submit a final copy of the executed subcontract.

Products:

- Letter describing the subcontracts needed, or stating that no subcontracts are required
- Draft subcontracts

- Final subcontracts

TASK 2 SYSTEMS ANALYSIS AND DEFINITION

The goal of this task is to complete the systems level engineering analysis required to identify the detailed technical requirements of both the engine and “Start/Stop” systems. This will first be done through a complete system simulation and then subsequently through modeling of the individual subsystems (engine and “Start/Stop” system).

Task 2.1 Integrated System Simulation

The goal of this task is complete vehicle level engineering analysis of the system performance to identify the technical requirements of the overall integrated powertrain.

Recipient will utilize existing system simulation tools (combined engine and “Start/Stop” system tools) to develop high-level technical profiles for both the E85 engine and the “Start/Stop” system to be simulated in Tasks 2.2 and 2.3.

The Recipient shall:

- Develop target vehicle configuration and representative vehicle duty cycle.
- Simulate the combined engine and “Start/Stop” system using the target vehicle configuration and representative vehicle duty cycle, thereby establishing high level technical profile elements including electric motor capacity, battery capacity, and engine torque and power requirements.
- Prepare and submit Integrated System Simulation Report including integrated powertrain system technical profile, E85 engine technical profile, and “Start/Stop” technical profile.

Products:

- Integrated System Simulation Report

Task 2.2 Engine System Modeling and Analysis

The goal of this task is to use the previously established complete system level performance specification, which includes high level characteristics for the engine, and conduct simulation assessments to establish the detailed technical profile for the engine.

Recipient will utilize existing modeling capability to determine the optimum engine configuration to be designed within Task 3 of the scope of work. The high-level engine technical profile resulting from Task 2.1 will be used as the input to the modeling effort under this task. The output of this simulation effort is a specific engine architecture and detailed engine technical profile to guide the design effort in Task 3.

The Recipient shall:

- Simulate the engine to be designed by using the high-level technical profile output from Task 2.1 and thereby establish an engine architecture (physical design of engine) and detailed engine technical profile

- Establish sizing requirements for flow control valves/actuators and ranges for sensors
- Prepare and submit an Engine System Modeling and Analysis Report including E85 Engine detailed technical profile (with electric motor capacity, battery capacity, and engine torque and power requirements).

Products:

- Engine System Modeling and Analysis Report

Task 2.3 "Start/Stop" System Modeling and Analysis

The goal of this task is to use the previously established complete system level performance specification, which includes high level characteristics for the "Start/Stop" system, and conduct simulation assessments to establish the detailed technical profile for the "Start/Stop" system.

Recipient will utilize existing modeling capability to determine the "Start/Stop" system component requirements which will drive the design within Task 3 of the scope of work. The high-level "Start/Stop" system profile resulting from Task 2.1 will be used as the input to the modeling effort under this task.

The Recipient shall:

- Simulate the components (electric machine, clutch, battery, power electronics and accessories) to be designed by using the high level technical profile output from Task 2.1.
- Prepare and submit a detailed "Start/Stop" System Technical Profile Report including:
  - Electric motor specification
  - Power electronics ratings and cooling requirements
  - Battery rating and cooling requirements
  - Attributes of accessories to be electrified, if any, in order to maintain all powertrain services during the idle shutdown periods.

Products:

- Detailed "Start/Stop" System Technical Profile Report

TASK 3 POWER TRAIN DEVELOPMENT

The goals of this task are to design the engine and "Start/Stop" system according to the technical profiles development under Task 2, to construct prototypes of the engine and "Start/Stop" system hardware, and to conduct development testing on the engine to bring it to a performance level necessary to begin integration of the "Start/Stop" system under Task 4.

Task 3.1 Engine and "Start/Stop" System Design

The goal of this task is to complete the concept layout, detailed design and drafting for each of the components of the E85 engine.

It is anticipated that an existing Recipient engine development platform will be used as the basis for E85 operation. A 4.5L engine displacement will be the targeted platform although substantial top-end, bottom-end, and subsystem redesign will be required. It is anticipated that a diesel-like “short block” will be used to carry the cylinder pressure necessary for optimized performance on E85.

The Recipient shall:

- Design each component necessary for the E85 engine and integrated “Start/Stop” system culminating with the E85 Engine Bill of Material (BOM) and the “Start/Stop” System BOM. Components include cylinder head, combustion system, valvetrain, fuel injection system, air handling system, cooling system, engine side of the “Start/Stop” System interface, and all necessary exhaust system components.
- Submit a copy of the E85 Engine and “Start/Stop” System BOM.

Products:

- Copy of E85 Engine and “Start/Stop” System BOM

Task 3.2 Engine Control Development

The goal of this task is to define and develop the necessary hardware and software to control the engine and “Start/Stop” system when integrated together.

The Recipient shall:

- Specify the control system architecture including sensors, actuators, and associated algorithms to simultaneously manage the air, fuel, spark, and exhaust gas recirculation dilution levels, if required, to deliver the desired torque, fuel economy, and emissions levels for representative drive cycles.
- Validate (in simulation) the transient performance of the control system including torque response and control of emissions-critical parameters.
- Prepare and submit Engine Control Development Summary Report including control system architecture diagram and transient simulation performance.

Products:

- Engine Control Development Summary Report

Task 3.3 Engine Procurement

The goal of this task is to procure, test, and machine all components of the prototype E85 engine.

The Recipient shall:

- Procure all necessary parts for testing the prototype E85 engine.
- Work with internal and external suppliers to ensure complex subcomponents have been tested and verified.
- Work with machine shops to ensure all parts have been completely machined.

- Prepare and submit Engine Procurement Summary Report verifying all engine components are ready for assembly.

Products:

- Engine Procurement Summary Report

Task 3.4 “Start/Stop” System Procurement

The goal of this task is to procure and test the components for the “Start/Stop” system.

The Recipient shall:

- Procure all necessary components of the integrated “Start/Stop” system
- Work with internal and external suppliers to ensure the system is tested and verified prior to engine integration
- Prepare and submit “Start/Stop” System Procurement Report verifying the “Start/Stop” system is ready for integration.

Products:

- ”Start/Stop” System Procurement Report

Task 3.5 Engine Testing

The goals of this task are to assemble the E85 demonstration engine and start performance testing in an engine dynamometer test facility. The controls calibration will be optimized to deliver the required torque, fuel economy, and emissions specified in Task 2. Refinement of the engine and/or controls may occur during this task.

The Recipient shall:

- Assemble the prototype E85 demonstration engine
- Install and commission E85 engine in an engine dynamometer test facility
- Develop and calibrate the E85 engine and electronic controls relative to the technical profile determined during Task 2
- Prepare and submit an Engine Testing Summary Report providing engine test results for power, performance and emissions.

Products:

- Engine Testing Summary Report

Task 3.6 Engine Performance Documentation

The goal of this task is to document the optimized performance of the engine prior to integration with the ”Start/Stop” system. The engine fuel economy, efficiency, and criteria emissions will be measured using appropriate legislated or otherwise documentable test cycles.

The Recipient shall:

- Measure engine efficiency and fuel consumption on representative test cycles

- Measure criteria emissions under, or consistent with, Federal test procedures
- Prepare and submit Engine Performance Documentation Summary Report documenting the fuel economy and emissions of the E85 engine.

[CPR WILL OCCUR DURING THIS TASK. See Task 1.2 for details]

Products:

- Engine Performance Documentation Summary Report

TASK 4 INTEGRATED SYSTEM DEMONSTRATION

The goals of this task are to demonstrate, in a test cell environment, operation of the engine and integrated "Start/Stop" system over representative simulated transient vehicle cycles, to quantify the reduction in fuel consumption, and to assess emissions capability.

Task 4.1 "Start/Stop" System Upfit and Integrated System Development

The goals of this task are to integrate the E85 engine and the "Start/Stop" system as a single system in a test cell and continue the development of the system in combination. Refinement to both the engine and "Start/Stop" system components and electronic calibration may occur during this task to ensure that the overall powertrain system performance meets the desired requirements specified in Task 2.1.

The Recipient shall:

- Install E85 engine and "Start/Stop" system together as an integrated powertrain system into a test cell
- Execute system level performance tests
- Refine the integrated control system software and calibration if necessary
- Prepare and submit a Task 4.1 Summary Report, summarizing system level performance test results.

Products:

- Task 4.1 Summary Report

Task 4.2 Integrated System Fuel Economy and Emission Demonstration

The goal of this task is operate the integrated powertrain system over a representative simulated transient vehicle drive cycle(s) in order to collect the fuel consumption and emissions information so that a comparison to a competitive diesel system can be made for carbon dioxide reduction.

Although the transient test cell will not have certification level constant volume sampling emission capability, Recipient can document the raw emissions performance to demonstrate the feasibility of the system over the applicable Federal Heavy-Duty Transient cycle.

The Recipient shall:

- Develop test plans for the fuel economy demonstration based on an advanced vehicle simulation test cell environment and “hardware-in-the-loop” simulation test cycles (where real components are used in the simulation tests)
- Develop test plans for the emissions demonstration
- Measure integrated fuel economy
- Measure integrated system emissions
- Prepare and submit an Integrated System Fuel Economy Summary Report, including information on test plan developments and measurements.

[CPR WILL OCCUR DURING THIS TASK. See Task 1.2 for details]

Products:

- Integrated System Fuel Economy Summary Report

TASK 5 VEHICLE INSTALLATION AND DEMONSTRATION

The goal of this task is to complete the installation of the E85 engine with integrated “Start/Stop” capability into a medium- heavy-duty vehicle. During this task the vehicle will also be instrumented to collect basic performance information in California.

Task 5.1 Vehicle Packaging Layout and Design

The goal of this task is to design a plan for integrating and installing the powertrain into the vehicle. The design of any new parts or the modification of production components will be completed as necessary within this task.

The Recipient shall:

- Determine the vehicle platform to be used for powertrain integration
- Develop powertrain layout in vehicle
- Design any new parts for powertrain integration with the vehicle
- Design modification of vehicle components for integration with powertrain
- Develop and submit a Powertrain Integration Plan including the powertrain layout and any modifications required to integrate the powertrain into the vehicle.

Products:

- Powertrain Integration Plan

Task 5.2 Installation, Integration, and Integrated System Development

The goals of this task are to procure any new components necessary for the integration of the E85 engine and ”Start/Stop” system, to modify the vehicle, to install the powertrain, and to prepare the demonstration vehicle for instrumentation. The integrated vehicle system will be developed to ensure that the applied powertrain can at a minimum meet the vehicle performance of the currently available diesel engine. The

integrated powertrain system technical profile, developed in Task 2, will be used as the reference to determine that the vehicle performance is satisfactory.

The Recipient shall:

- Procure necessary parts for vehicle installation
- Modify vehicle as necessary for powertrain installation
- Install powertrain
- Develop and submit instrumentation list
- Install instrumentation on vehicle
- Verify instrumentation data retrieval
- Calibrate vehicle-specific controls
- Modify engine and “Start/Stop” system calibration, if necessary.

Products:

- Instrumentation List

Task 5.3 Integrated Vehicle System Demonstration

The goal of this task is to demonstrate the powertrain performance in the vehicle. The demonstration process will include the operation of the vehicle in California for approximately one month on representative duty cycles to evaluate performance and fuel economy.

The Recipient shall:

- Demonstrate final vehicle performance in California for approximately one month
- Document the fit for service of this vehicle in the Final Report

Products:

- None. Information will be included in Final Report.

TASK 6 DATA COLLECTION AND ANALYSIS

The goal of this task is to perform the final analysis of all project data and to prepare final reports for the Energy Commission.

The Recipient Shall:

- Compare petroleum baseline vehicle and proposed vehicle performance data, including the following.
  - Quantified benefits in fuel reduction
  - Quantified emission reductions
  - Vehicle duty cycles
- Provide market penetration scenarios and the assumptions for the scenarios, including the achievement of operational goals and objectives.
- Using the market penetration scenarios
  - Estimate gasoline and/or diesel fuel displaced annually.
  - Explain how the proposed project will reduce applicable criteria air pollutants and air toxics (using the Energy Commission data

collection templates) and lead to a decrease, on a life cycle basis, in emissions of water pollutants or any other substances known to damage human health or the environment project incorporated and achieved the sustainability goals.

- o Provide a quantified estimate of the project's carbon intensity values for life-cycle scale greenhouse gas emissions.
- o Provide data on job creation, economic development, and increased state revenue
- o Describe any energy efficiency measures used in the project or in the manufacturing process

- Provide additional data that may be requested by the Energy Commission during the term of this Agreement, as is reasonably available.

Products:

- None. Data from this task will be included in the Final Report