

**Exhibit A
SCOPE OF WORK**

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Examine the life-cycle water requirement of future California transportation fuels
3	X	Develop scenario analyses to project the spatial lifecycle water footprint and estimates the local, regional and global water use impacts of California transportation fuel needs
4		Identify the potential scenarios, technology options and management strategies to reduce lifecycle water footprint and water impacts of future California transportation fuels

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	Sonia Yeh (PI)	N/A	N/A
2	Sonia Yeh (PI)	N/A	N/A
3	Sonia Yeh (PI)	N/A	N/A
4	Sonia Yeh (PI)	N/A	N/A

GLOSSARY

Acronym	Definition
CCM	Commission Contract Manager
CPR	Critical Project Review
Energy Commission	California Energy Commission
MS	Microsoft
PAC	Project Advisory Committee
PIER	Public Interest Energy Research
UCC.1	Uniform Commercial Code (Financing Statement)

Problem Statement

California is leading the nation in efforts to adopt alternative transportation fuels to help meet the state's greenhouse gas emission reduction goals. Biofuels, hydrogen, electricity, and petroleum products from unconventional sources, such as oil sands, may all play a role in the State's future. There is concern, however, over the potential environmental effects associated with large scale adaptation of alternative transportation fuels. One specific concern is that future transportation fuel production

and use will likely consume substantial quantities of water. Water demand for alternative transportation fuels will vary greatly depending on the fuel type, the feedstock, cultivation practices, processing, source of energy inputs and refining. Biofuels, especially those with feedstocks produced on irrigated agricultural lands, as well as part of the refining process, may be an especially intense source of water use. The actual amount of water needed for biofuels, such as ethanol, will depend on a number of factors and will vary greatly on a regional basis. For example, ethanol produced from non-irrigated corn feedstock from Iowa will use less than 10 gallons of water per mile driven, while the use of California corn, which is irrigated, as a feedstock will mean over 80 gallons of water will be used per mile driven. However, more research is needed to understand the degree to which these alternative fuels might impact California's already stressed water system, and the water impacts elsewhere. While some recent studies have looked at the water demands associated with certain alternative fuel production and use, none have attempted to quantify the aggregated impacts that a substantial shift to future transportation fuels might have on water demand and water impacts within the state of California and elsewhere.

Therefore, this research will help to understand the degree to which the large scale adoption of alternative fuels might impact California's already stressed water system, as well as the associated water impacts from elsewhere.

Goals of the Agreement

The results of this study will give a better picture of the spatial water impacts of future California transportation fuels at the local, regional and global scale; while at the same time identify technology and policy options to mitigate potential water impacts.

Objectives of the Agreement

This project will examine spatially explicit lifecycle water use and associated water impacts of California's future transportation fuels, focusing on potential technology solutions and best management practices to reduce the water impacts.

This research will (1) examine the life-cycle water requirement of future California transportation fuels, including conventional and unconventional fossil fuels, biofuels, electricity, and hydrogen; and (2) develop scenario analysis to project the sources of transportation fuels demand by 2030, and overlay the spatial lifecycle water footprint with local/regional environmental factors to estimate the local, regional and global water use impacts of California transportation fuel needs. (3) Identify the potential technology options and management strategies to reduce lifecycle water footprint and water impacts of future California transportation fuels.

TASK 1.0 ADMINISTRATION

MEETINGS

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 Contractor shall:

- Attend a “kick-off” meeting with the Commission Contract Manager, the Contracts Officer, and a representative of the Accounting Office. The Contractor shall bring their Project Manager, Contracts Administrator, Accounting Officer, and others designated by the Commission Contract 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 Contract 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:

- Terms and conditions of the Agreement
- CPRs (Task 1.2)
- Match fund documentation (Task 1.7)
- Permit documentation (Task 1.8)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Commission Contract Manager’s expectations for accomplishing tasks described in the Scope of Work;
- An updated Schedule of Deliverables
- Progress Reports (Task 1.4)
- Technical Deliverables (Task 1.5)
- Final Report (Task 1.6)
- Establish the PAC (Task 1.10)
- PAC Meetings (Task 1.11)

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

Contractor Deliverables:

- An Updated Schedule of Deliverables
- An Updated Gantt Chart (if included)
- An Updated List of Match Funds
- An Updated List of Permits
- Schedule for Recruiting PAC Members

Commission Contract Manager Deliverables:

- Final Report Instructions

Task 1.2 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 if it should, are there any modifications that need to be made to the tasks, deliverables, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Contractor. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Contract Manager and as shown in the Technical Task List above and in the Schedule of Deliverables. However, the Commission Contract Manager may schedule additional CPRs as necessary, and, if necessary, the budget will be reallocated to cover the additional costs borne by the Contractor, but the overall contract amount will not increase.

Participants include the Commission Contract Manager and the Contractor, and may include the Commission Contracts Officer, the PIER Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Contract Manager to provide support to the Energy Commission.

The Commission Contract Manager shall:

- Determine the location, date and time of each CPR meeting with the Contractor. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Contractor 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 to modify the tasks, schedule, deliverables and budget for the remainder of the Agreement, including not proceeding with one or more tasks. If the Commission Contract Manager concludes that the project needs a formal amendment or that satisfactory progress is not being made and the project needs to be ended, these conclusions will be referred to the Commission's Research, Development and Demonstration Policy Committee for its concurrence.
- Provide the Contractor with a written determination in accordance with the schedule. The written response may include a requirement for the Contractor to revise one or more deliverable(s) that were included in the CPR.

The Contractor 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 deliverables identified in this Scope of Work. Submit these documents to the Commission Contract 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.

Contractor Deliverables:

- CPR update(s)
- CPR deliverables identified in the Scope of Work

Commission Contract Manager Deliverables:

- Agenda and a List of Expected Participants
- Schedule for Written Determination
- Written Determination

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement.

The Contractor shall:

- Meet with the Energy Commission 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 Contractor, the Commission Contracts Officer, and the Commission Contract 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 Contract Manager.

The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Agreement. The Commission Contract Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Contract Manager and the Contracts Officer about the following Agreement closeout items:

- What to do with any state-owned equipment (Options)
- Need to file UCC.1 form re: Energy Commission's interest in patented technology
- Energy Commission's request for specific "generated" data (not already provided in Agreement deliverables)
- Need to document Contractor's disclosure of "subject inventions" developed

- under the Agreement
 - “Surviving” Agreement provisions, such as repayment provisions and confidential deliverables
 - Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement.

Deliverables:

- Written documentation of meeting agreements and all pertinent information
- Schedule for completing closeout activities

REPORTING

See Exhibit D, Reports/Deliverables/Records.

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.

The Contractor shall:

- Prepare progress reports which summarize all Agreement activities conducted by the Contractor 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 Contract Manager within 10 working days after the end of the reporting period. Attachment A-2, Progress Report Format, provides the recommended specifications.

Deliverables:

- Monthly Progress Reports

Task 1.5 Test Plans, Technical Reports and Interim Deliverables

The goal of this task is to set forth the general requirements for submitting test plans, technical reports and other interim deliverables, unless described differently in the Technical Tasks. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

The Contractor shall:

- Unless otherwise directed in this Scope of Work, submit a draft of each deliverable listed in the Technical Tasks to the Commission Contract Manager for review and

comment in accordance with the approved Schedule of Deliverables. The Commission Contract Manager will provide written comments back to the Contractor on the draft deliverable within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 5 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

Task 1.6 Final Report

The goal of this task is to prepare a comprehensive written Final Report that describes the original purpose, approach, results and conclusions of the work done under this Agreement. The Commission Contract Manager will review and approve the Final Report. The Final Report must be completed on or before the termination date of the Agreement. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

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

Task 1.6.1 Final Report Outline

The Contractor shall:

- Prepare a draft outline of the Final Report.
- Submit the draft outline of Final Report to the Commission Contract Manager for review and approval. The Commission Contract Manager will provide written comments back to the Contractor on the draft outline within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final outline to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final outline within 5 working days of receipt.

Deliverables:

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

Task 1.6.2 Final Report

The Contractor shall:

- Prepare the draft Final Report for this Agreement in accordance with the approved outline.
- Submit the draft Final Report to the Commission Contract Manager for review and comment. The Commission Contract Manager will provide written comments within 10 working days of receipt.

Once agreement on the draft Final Report has been reached, the Commission Contract Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Commission Contract Manager shall provide written approval to the Contractor within 5 working days.

- Submit one bound copy of the Final Report with the final invoice.

Deliverables:

- Draft Final Report
- Final Report

MATCH FUNDS, PERMITS, AND ELECTRONIC FILE FORMAT

Task 1.7 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. While the PIER budget for this task will be zero dollars, the Contractor may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds during the term of this Agreement. Match funds must be identified in writing, and the associated commitments obtained before the Contractor can incur any costs for which the Contractor will request reimbursement.

The Contractor shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:
 1. 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.
 2. 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 Contractor shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
- 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.
- Discuss match funds and the implications to the Agreement if they are significantly 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 Contract Manager if during the course of the Agreement additional match funds are received.
- Notify the Commission Contract Manager within 10 working days if during the course of the Agreement existing match funds are reduced. Reduction in match funds may trigger an additional CPR.

Deliverables:

- A letter regarding Match Funds or stating that no Match Funds are provided
- Letter(s) for New Match Funds
- A copy of each Match Fund commitment letter
- Letter that Match Funds were Reduced (if applicable)

Task 1.8 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 reimbursable under this Agreement. Permits must be identified in writing before the Contractor can incur any costs related to the use of the permit(s) for which the Contractor will request reimbursement.

The Contractor shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:
 1. If there are no permits required at the start of this Agreement, then state such in the letter.
 2. 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
 - Schedule the Contractor will follow in applying for and obtaining these permits.
- The list of permits and the schedule for obtaining them will be discussed at the kick-off meeting, and a timetable for submitting the updated list, schedule and the copies of the permits will be developed. 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, then provide the appropriate information on each permit and an updated schedule to the Commission Contract Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Contract Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Contract Manager within 5 working days. Either of these events may trigger an additional CPR.

Deliverables:

- A letter documenting the Permits or stating that no Permits are required
- Updated list of Permits as they change during the Term of the Agreement
- Updated schedule for acquiring Permits as it changes during the Term of the Agreement
- A copy of each approved Permit

Task 1.9 Electronic File Format

The goal of this task is to unify the formats of electronic data and documents provided to the Energy Commission as contract deliverables. Another goal is to establish the computer platforms, operating systems and software that will be required to review and approve all software deliverables.

The Contractor shall:

- Deliver documents to the Commission Contract Manager in the following formats:
 - Data sets shall be in Microsoft (MS) Access or MS Excel file format.
 - PC-based text documents shall be in MS Word file format.
 - Documents intended for public distribution shall be in PDF file format, with the native file format provided as well.
 - Project management documents shall be in MS Project file format.
- Request exemptions to the electronic file format in writing at least 90 days before the deliverable is submitted.

Deliverables:

- A letter requesting exemption from the Electronic File Format (if applicable)

PAC

Task 1.10 Establish the PAC

The goal of this task is to create an advisory committee for this Agreement.

The PAC should be composed of diverse professionals. The number can vary depending on potential interest and time availability. The exact composition of the PAC may change as the need warrants. PAC members serve at the discretion of the Commission Contract Manager.

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

- Researchers knowledgeable about the project subject matter
- Members of the trades who will apply the results of the project (e.g., engineers, local, regional and national policy makers, and industry representatives such as fuel providers and biofuel producers)
- Public Interest Market Transformation Implementers
- U.S. Department of Energy Research Manager
- Public Interest Environmental Groups
- Utility Representatives
- Members of the relevant technical society committees

The purpose of the PAC is to:

- Provide guidance in research direction. The guidance may include scope of research; research methodologies; timing; coordination with other research. The guidance may be based on:
 - technical area expertise
 - knowledge of real-world applications
 - linkages between the agreement work and other past, present or future research (both public and private sectors) they are aware of in a particular area.
- Review deliverables. Provide specific suggestions and recommendations for needed adjustments, refinements, or enhancement of the deliverables.
- Evaluate tangible benefits to California of this research and provide recommendations, as needed, to enhance tangible benefits.
- Provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

The Contractor shall:

- Prepare a draft list of potential PAC members that includes name, affiliations, physical and electronic address, and phone number and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting. This list will be discussed at the kick-off meeting and a schedule for recruiting members and holding the first PAC meeting will be developed.
- Recruit PAC members and ensure that each individual understands the member obligations described above, as well as the meeting schedule outlined in Task 1.8.
- Prepare the final list of PAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each PAC member.

Deliverables:

- Draft List of PAC Members
- Final List of PAC Members
- Letters of acceptance, or other comparable documentation of commitment for each PAC Member

Task 1.11 Conduct PAC Meetings

The goal of this task is for the PAC to provide strategic guidance to this project by participating in regular meetings or teleconferences.

The Contractor shall:

- Discuss the PAC meeting schedule at the kick-off meeting. The number of face-to-face meetings and teleconferences and the location of PAC meetings shall be determined in consultation with the Commission Contract Manager. This draft

schedule shall be presented to the PAC members during recruiting and finalized at the first PAC meeting.

- Organize and lead PAC meetings in accordance with the schedule. Changes to the schedule must be pre-approved in writing by the Commission Contract Manager.
- Prepare PAC meeting agenda(s) with back-up materials for agenda items.
- Prepare PAC meeting summaries, including recommended resolution of major PAC issues.

Deliverables:

- Draft PAC Meeting Schedule
- Final PAC Meeting Schedule
- PAC Meeting Agenda(s) with Back-up Materials for Agenda Items
- Written PAC meeting summaries, including recommended resolution of major PAC issues

TECHNICAL TASKS

The Contractor shall prepare all deliverables in accordance with the requirements in Task 1.5 Deliverables not requiring a draft version are indicated by marking “(no draft)” after the deliverable name.

Task 2 Examine the life-cycle water requirement of future California transportation fuels

The goal of this task is to evaluate the total water requirements from all stages of the fuel life cycle from cultivation or extraction, storage and transport, fuel production at the refinery, to fuel distribution, and the embodied water of energy inputs at all stages of lifecycle.

The Contractor shall:

- Propose a comprehensive and meaningful measurement of water intensity, taking into account the services provided (e.g. megajoules of fuel), spatial scale of analysis (farm level vs. field level, or hydrological basin level), types of water (green water vs. blue water, surface water vs. ground water), and “indirect” water use (i.e. indirect effects of biomass production and consequences on water use).
- Evaluate the total water requirements from all stages of the fuel life cycle from cultivation or extraction, storage and transport, fuel production at the refinery, to fuel distribution, and the embodied water of energy inputs at all stages of the lifecycle. This will include both the direct (fuel level) water use such as process, refining, steam reforming, synthetic gas production process, enhanced oil recovery and oil extraction; and the indirect (where the embodied water of energy inputs at all stages of the lifecycle are included). For example, this may include, but not be limited to, diesel used for corn harvesting and biomass transportation, and electricity and natural gas consumed at the bio-refinery. The corresponding water requirements of

these fuels are included to calculate total requirements. Electricity use for water transport, water treatment, water heating, waste water treatment and disposal can also be included.

- Develop, and provide to the Commission Contract Manager (CCM), the criteria for a comprehensive and meaningful measurement of the lifecycle water footprint of fuels.
- Provide to the CCM estimates of lifecycle water footprint for future transportation fuels, which may include, but not be limited to, biofuels, hydrogen, electricity, and new conventional and unconventional gasoline/diesel.

Deliverables:

- Report of lifecycle measurement criteria
- Report of estimated lifecycle water footprint(s)

Task 3 Develop scenario analyses to project the spatial lifecycle water footprint and estimate the local, regional and global water use impacts of California transportation fuel needs.

The goal of this task is to develop a better understanding of the impacts of the total California transportation fuel demand at the local, regional, national or even global level. This will require a better understanding of the spatial and temporal impacts of water requirements, as well as possible measurement of the impacts to watershed/natural flow of the affected region.

The Contractor shall:

- Develop, and provide to the CCM, scenario analyses to project the future changes in California transportation fuel uses, and to identify the sources of these fuels. These scenario analyses will represent a range of possible fuel pathways, and the potential sources of fuel stock productions and technology options. The scenarios can be developed based on work from various sources, including the California Air Resources Board for the California Global Warming Solutions Act (AB32 2006), or other projections.
- Combine the scenario analysis with Geographic Information Systems to project the spatial water footprint of future California transportation fuels by year. The spatial water footprint of California fuel use will be weighted by future transportation fuel pathway scenarios such as those estimated in the mitigation scenarios for the low carbon fuel standards (Yeh, Lutsey et al. 2009). Provide report of projections to the CCM.
- Propose appropriate matrix to measure water use impacts. Provide matrix to the CCM.
- Identify the source of water, the necessary water quality and the location of the water use for alternative fuels. The relative impacts of water intensity on regional water resources will be estimated.
- Participate in the CPR and prepare a CPR Report in accordance with Task 1.2.

Deliverables:

- Transportation fuel use scenarios
- Report of water lifecycle footprint projections by year.
- Water use impacts matrix
- CPR Report

Task 4 Identify the potential scenarios, technology options and management strategies to reduce lifecycle water footprint and water impacts of future California transportation fuels.

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

While the state is a leader in energy and water conservation, increased efforts will be needed to reduce future water use and water impacts within the state and elsewhere.

The Contractor shall:

- Identify and provide a report of technology and management options to increase water efficiency and reduce water impacts from alternative fuels to the CCM. Such options may include water recycling and reuse, technology substitution, water management and crop management.
- Evaluate the environmental tradeoffs (increase in water efficiency, increase in energy use, reduction in water pollution, etc) of these technology and management options. Provide a report of that evaluation to the CCM.
- Conduct workshop to explain research results and take comments from stakeholders. Provide stakeholder comments to CCM.
- Revise report based on stakeholder comments as appropriate.

Deliverables:

- Report of technology and management options
- Report of environmental tradeoff evaluation
- Stakeholder workshop comments