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TECHNICAL TASK LIST

Task #	CPR	Task Name
1		Administration
2		Assess Impact of Biomass Electricity Generation on Air Quality and Greenhouse (GHG) Emissions
3		Assess Impact of Biogas Electricity and Heat Generation and Biogas Derived Transportation Fuels on Air Quality and GHG Emissions
4		Data Analysis and Reporting

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1.0	Scott Samuelsen – UCI (UCI)		
2.0	D.Dabdub – UCI J. Brouwer – UCI M. Carreras-Sospedra – UCI B. Jenkins – UC Davis (UCD) R. Williams – UCD N. Parker – UCD		
3.1, 3.2, 3.4	Scott Samuelsen – UCI T.M. Brown – UCI		
3.3	Scott Samuelsen – UCI T.M. Brown – UCI	Empowered Energy	
4.0	Scott Samuelsen – UCI D.Dabdub – UCI B. Jenkins – UCD J. Brouwer – UCI T.M. Brown – UCI M. Carreras-Sospedra – UCI R. Williams – UCD N. Parker – UCD		

GLOSSARY

Term/ Acronym	Definition
APEP	Advanced Power and Energy Program
ARB	Air Resources Board
BIGCC	Biomass Integrated Gasifier Combined Cycle
CAWMB	California Integrated Waste Management Board
CBC	California Biomass Collaborative
Energy Commission	California Energy Commission

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CHP	Combined Heating and Power
CMAQ	Community Multiscale Air Quality model
CNG	Compressed Natural Gas
GBSM	Geospatial Bioenergy System Model
GHG	Greenhouse Gases
GIS	Geographical Information Systems
GWh	Gigawatt-hour (units of energy)
LandGEM	EPA Landfill Gas Emissions Model
LFG	Landfill Gas
LNG	Liquefied Natural Gas
MILP	Mixed Integer-Linear Program
MSW	Municipal Solid Waste
MW	Megawatt (units of power)
NG	Natural Gas
NOX	Nitrogen oxides
PJ	Petajoules (units of energy)
PM	Particulate Matter
PM ₁₀	Particulate Matter with average diameter smaller than 10 micrometers
PM _{2.5}	Particulate Matter with average diameter smaller than 2.5 micrometers
RPM	Regional Particulate Model
RSNG	Renewable Synthetic Natural Gas
SAPRC99	Statewide Air Pollution Research Center Chemical Mechanism, version 99
SJV	San Joaquin Valley
SMR	Steam Methane Reformation
SoCAB	South Coast Air Basin of California
STREET	Spatially and Temporally Resolved Energy and Emissions Tool
TWh	Terawatt-hour (units of energy)
UCD	University of California, Davis
UCI	University of California, Irvine
VOC	Volatile Organic Compound

Problem Statement:

Biomass contributes more than 5,700 Gigawatt-hours (GWh) to California's in-state renewable power (about 19% of in-state renewable power and 2% of full California power mix). Current operating biopower capacity is about 900 Megawatts (MW) (including approximately 550 MW of woody biomass solid fuel combustion, 280 MW of landfill gas-to-energy and 75 MW from wastewater treatment biogas. It is estimated that there is sufficient in-state 'technically'¹ recoverable biomass to support another 2,800

¹ Technical biomass resource is that which can be sustainably recovered with minimal impacts to erosion, riparian zones, soil organic matter and other agronomic factors. There is no economic filter applied to the technical resource estimate.

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MW of capacity or 21 Terawatt-hour (TWh) of electricity (Williams et al., 2008). While most biomass energy is derived from woody material (including urban wood waste, forest product residue and agricultural residues), there is a growing interest in using municipal solid waste (MSW), food processing waste, increased use of animal manures and applying co-digestion techniques at wastewater treatment facilities to generate electricity and renewable fuels. Increasing production of bioenergy contributes to energy sustainability while reducing greenhouse gas emissions and could help reduce criteria pollutant emissions.

Among the principal barriers and knowledge gaps for increased biopower capacity are the uncertain costs and emission factors for novel bioenergy technologies. In particular, we identify the following barriers:

- Commercial costs for novel bioenergy technologies that are in development are uncertain, and will contribute to the uncertainty of the analysis of those technologies.
- Due to the variety of technologies and variability of feedstocks for bioenergy systems, emission factors for certain technologies are incomplete.
- Updated emissions inventories and spatial distribution of the emissions from biopower are needed to assess potential air quality benefits and impacts of increasing biopower in the state.

Currently, there is no analysis tool that integrates economics, resource availability, emissions and air quality aspects. There is the need to understand the best uses of biomass between electricity production, heat generation or transportation fuels considering air quality, economics and the distribution of biomass. This research will combine these aspects into a systems based approach to better understand the feasibility of increased biopower capacity in the state to help inform policy makers and stakeholders.

This project will provide an evaluation of the potential and constraints of reduced carbon electricity and vehicle fuel supply (such as, hydrogen and/or biogas), based upon the regional renewable biomass resources in California. These areas include diverse sources for potential biomass- and biogas-based energy such as wastewater treatment facilities, landfills, green waste from urban areas, and agricultural and dairy waste. The analyses will include a determination of the impact of implementation of the California Energy Commission's 2011 Bioenergy Action Plan, on criteria pollutant emission and resulting air quality. This research will be conducted using state-of-the-art modeling tools to determine the possible fuel paths for biomass and biogas utilization. Models developed by University California Irvine (UCI) and University California Davis (UCD) are among the first capable of simulating infrastructure deployment in the state of California. This effort will be the first to combine a geocoded model developed by UCD, an emissions and air quality modeling framework developed by UCI, a transportation fueling infrastructure methodology developed by UCI, and an economic perspective to determine biomass and biogas supply chain and utilization scenarios.

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This research is complimentary to a currently funded California Air Resources Board (ARB) contract, 11-307, in which the contractors will analyze air quality and greenhouse gas impacts of biomass and biogas use in the State of California, and consider gross county level spatial resolution to determine upper and lower bounds for bioresource availability. In contrast, the CEC project will complement and further the research scope of the ARB work by (1) capturing the geo-coded capabilities provided by the Geospatial Bioenergy System Model (GBSM), (2) linking the data available from CBC/UCD to the UCI air quality models for both the South Coast Air Basin of California and the San Joaquin Valley of California, and (3) conducting high-resolution and detailed analyses, including economic impacts, from generation to utilization.

Goal of the Agreement

The goal of this project is to quantitatively assess the energy and environmental impacts of increased biomass electricity generation, and the generation and utilization of transportation fuels derived from biogas in California with an emphasis on air quality improvement and economic viability.

Objectives of the Agreement

The objectives of this agreement are to characterize system implications of increased biomass and biogas usage for several electricity generation, heat generation, and transportation fuel strategies. These are:

- Air quality implications.
- Greenhouse gas implications.
- Fossil fuel consumption implications.
- Economic implications.

This study will assess the potential implementation of new bioenergy infrastructure to inform preferred uses and strategies for one set of California renewable resources. The analysis will quantify the emissions of criteria pollutants for several biomass and biogas technology supply chain and utilization scenarios. The resulting emissions will be spatially and temporally resolved for subsequent use in air quality modeling to account for atmospheric chemistry and transport to determine the overall air quality impacts of the new biopower infrastructure. The analysis of criteria pollutants will provide a scientific basis to evaluate the potential co-benefits of biomass and biogas use for air pollution control and climate change mitigation strategies.

Results from this study will complement ongoing research and help inform policy makers and industry with respect to further development and direction of biomass and biogas policy and technology alternatives needed to meet energy and environmental goals in California.

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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)

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

Contractor Deliverables:

- An Updated Schedule of Deliverables
- An Updated List of Match Funds
- Schedule for Recruiting PAC Members

Commission Contract Manager Deliverables:

- Final Report Instructions

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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.
- 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.

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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 Report(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

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- 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 Quarterly 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:

- Quarterly 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>

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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.

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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:

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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)

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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.

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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.
 - Personal computer (PC)-based text documents shall be in MS Word file format.
 - Documents intended for public distribution shall be in Portable Document File (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., designers, engineers, architects, contractors, and trade representatives)
- Public Interest Market Transformation Implementers
- Product Developers relevant to project subject matter

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- 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 market 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, company, 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 1.11.
- 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

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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

TASK 2: ASSESS IMPACT OF BIOMASS ELECTRICITY GENERATION ON AIR QUALITY AND GREENHOUSE GAS (GHG) EMISSIONS

Task 2.1: Determine Biomass Potential and Develop Biomass Supply Chain and Utilization Scenarios

The goal of this task is to provide a consistent analysis of increased electricity generation from biomass in California. The deployment of additional biopower capacity can come from a number of technologies utilizing a range of resources across different regions in the state. Some of the technologies are currently commercial while others have not yet been implemented commercially. These technologies are significantly different from each other in how the industry will organize spatially, the likely emissions produced and the likely costs (capital and operating) of production. A set of scenarios, each examining increased electricity generation from biomass in California, will be generated using the Geospatial Bioenergy System Model to optimize the spatial layout of the industry subject to constraints that include resources, infrastructure, emissions and cost. The team will work with the Energy Commission to select the most appropriate scenarios.

The Contractor shall:

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- Characterize biomass resources in the state of California that are suitable for electricity generation, and determine current biomass infrastructure using data resources maintained by the CBC.
- Establish five supply chain and eight utilization scenarios that span the options for biomass technologies, feedstocks, and end users.
- Using the results of the supply chain and utilization scenarios, evaluate the impact of the spatial allocation of biomass infrastructure.
- Prepare a list and present supply chain and utilization scenarios to Commission Contract Manager (CCM) and PAC for their review and comment. Incorporate changes as appropriate.
- Coordinate with Task 3.1.
- Prepare Report 1 summarizing the biomass supply chain and utilization scenarios and the resulting spatial distribution of biomass infrastructure in California.

Deliverables:

- Final list of scenarios
- Report 1 (no draft)

Task 2.2 Verify Compatibility of GBSM and CMAQ Models

The goal of this task is to verify and accommodate, as necessary, the capability of the Geospatial Bioenergy System Model (GBSM) to mesh with the Community Mutliscale Air Quality (CMAQ) model.

The Contractor shall:

- Update the GBSM with emission factors associated with biomass supply chains and integrate with the CMAQ, and modify the two models as needed to assure compatibility.

Deliverables:

- Task products will be included in the final report.

Task 2.3 Assess Air Quality and GHG Impacts of Biomass Electricity Generation Scenarios

The goal of this task is to develop a high resolution criteria pollutant and GHG emissions database of California air basins for bioenergy scenarios developed in Task 2.1 and perform air quality simulations for each scenario. This task will predict air quality based on meteorology, geography, chemical kinetics, and photo-oxidant effects in the atmosphere associated with emissions from biomass electricity generation.

The Contractor shall:

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- Characterize emissions and resource consumption for the scenarios.
- Simulate emissions and air quality and GHG impacts for electricity generation from biomass using the five electricity generation supply chains and eight utilization scenarios developed in Task 2.1.
- Coordinate with Task 3.3.
- Prepare Report 2 detailing the air quality and GHG impacts.

Deliverables:

- Report 2 (no draft)

Task 2.4: Provide a Biomass Infrastructure Recommendation

The goal of this task is to synthesize results from Tasks 2.1 through 2.3 to determine the preferred bioenergy scenarios that best meet objectives such as (1) air quality improvement, (2) GHG reduction, (3) fossil fuel reduction, and others as determined by team members and the Commission. This task will also integrate findings with those of Task 3.4.

The Contractor shall:

- Develop the list of specific environmental, energy and economic objectives to use in determining the preferred biomass supply chain(s) and utilization scenario(s) (e.g., greatest amount of new biopower, best/least air quality (AQ) improvement and impacts, best GHG improvements, most economical, greatest fossil fuel reduction, etc.).
- Present list of objectives to CCM and PAC for review, incorporate changes as appropriate and obtain CCM approval.
- Determine the biomass supply chain(s) and utilization scenario(s) that best meet the list of objectives.
- Prepare a report for Task 2 detailing the results of Task 2.4.

Deliverables:

- Final list of objectives
- Task 2 Report (no draft)

TASK 3: ASSESS IMPACT OF BIOGAS ELECTRICITY AND HEAT GENERATION AND BIOGAS DERIVED TRANSPORTATION FUELS ON AIR QUALITY AND GHG EMISSIONS

The goal of this task is to conduct an evaluation of the best uses of biomass between electricity production, heat generation and transportation fuels considering air quality, economics and distribution of biomass.

Task 3.1: Determine Biogas Potential and Develop Biogas Supply Chain and Utilization Scenarios

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The goal of this task is to conduct an evaluation of the potential biogas resources in California, including the economic viability of each source, and provide a consistent analysis of increased electricity generation along with generation and utilization of transportation fuels from biogas in California. This task will quantify the available biogas sources and calculate emissions outputs and resource consumptions for each step of the established biogas supply chains and utilization scenarios shown in Table 1 that span the options for biogas technologies, feedstocks, fuel clean up, and end users. The project team will work with the Energy Commission to select the most appropriate supply chains and implementation scenarios.

The Contractor shall:

- Update evaluations of landfill and digester gas in the state based on existing CBC and other databases.
- Characterize emissions and resource consumption for five biogas-based electricity generation supply chains and four utilization scenarios such as those identified in Table 1.
- Characterize emissions and resource consumption for three biogas-based heat generation supply chains and two utilization scenarios (Table 1).
- Characterize emissions and resource consumption for five biogas-based transportation fuel supply chains and five utilization scenarios (Table 1).
- Establish the spatial allocation of biogas infrastructure under a series of utilization scenarios that will account for different strategies, technologies and end uses from biogas.
- Prepare a list and present scenarios to CCM and TAC and incorporate comments as appropriate.
- Obtain CCM approval of scenarios.
- Prepare Report 3 on Biogas Potential, and Emissions and Resource Consumption and Scenarios.

Deliverables:

- Final list of scenarios
- Report 3 (no draft)

Task 3.2: Economically Assess Each Biogas Supply Chain

The goal of this task is to develop a detailed analysis of the economic implications of each supply chain from the standpoint of each stakeholder. For example, one option

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may be more beneficial for biogas producers, but less so for energy consumers, and vice versa. Potential legislative incentives needed to drive the market towards the best air quality options will be explored.

Table 1. Biogas to useful work supply chains

Electricity	<ul style="list-style-type: none"> • Onsite reciprocating combustion • Onsite gas turbine combustion • Onsite fuel cell • Onsite tri-generation • Pipeline injection for central electricity generation
Heat	<ul style="list-style-type: none"> • Onsite direct-fired boiler • Onsite combined heat and power system • Onsite tri-generation
Transportation	<ul style="list-style-type: none"> • Onsite CNG production • Onsite Liquefied Natural Gas (LNG) production • Onsite tri-generation • Onsite steam methane reformation (SMR) • Pipeline injection for central CNG, LNG, or SMR

The Contractor shall:

- Quantify levelized cost of energy and potential economic impacts for each electricity, heat, and transportation supply chain scenarios.
- Investigate policy and incentive alternatives for their potential influence on development of the various supply chains.
- Prepare Report 4 on the Economic Analysis.

Deliverables:

- Report 4 (no draft)

Task 3.3: Assess Air Quality and GHG Impacts of Biogas Electricity Generation and the Biogas Generation and Utilization of Transportation Fuels

The goal of this task is to develop a high resolution criteria pollutant and GHG emissions database of California air basins r biogas supply chains established in Task 3.1 and perform air quality simulations for each biogas utilization scenario developed in Task 3.1. This task will project actual air quality based on meteorology, geography, chemical kinetics, and photo-oxidant effects in the atmosphere associated with biogas electricity generation and the generation and utilization of transportation fuels.

The Contractor shall:

Exhibit A

SCOPE OF WORK

- With input from the CCM and PAC, select the most interesting two biogas supply chain scenarios based on the outcome of the previous tasks.
- Spatially allocate emissions sources and infrastructure using the Spatially and Temporally Resolved Energy and Environment Tool (STREET).
- Aggregate net emissions in geographic cells.
- Utilize the emissions database in the Community Multiscale Air Quality model (CMAQ) to generate air quality predictions for both ground level ozone and particulates.
- Generate visual displays of the numerical results.
- Analyze the air quality predictions and rank the benefits for each supply chain.
- Prepare Report 5 on Aggregated Emissions and Air Quality Simulations.

Deliverables:

- Report 5 (no draft)

Task 3.4: Provide a Biogas Infrastructure Recommendation

The goals of this task are to characterize Tasks 3.1 through 3.3 to determine preferred renewable biogas infrastructure scenarios for (1) air quality improvement, (2) GHG reduction, and (3) fossil fuel reduction, and to integrate the findings with those of Task 2.4.

The Contractor shall:

- Determine the biogas supply chain and utilization scenario that results in the greatest air quality improvements, GHG reduction, and greatest fossil fuel reduction.
- Prepare a report for Task 3.

Deliverables:

- Task 3 Report (no draft)

TASK 4: Data Analysis and Reporting

The goal of this task is to analyze data and synthesize results for the Project Final Report.

The Contractor shall:

- Prepare a Fact Sheet for the project for posting on the Commission website.
- Synthesize and integrate the Tasks 2 and 3 reports
- Coordinate and Integrate with Tasks 2.4 and 3.4, merge and integrate the findings of Tasks 2.4 and 3.4, and incorporate the results for the Final Report.
- Present results to the PAC.

Exhibit A

SCOPE OF WORK

- Present project results in at least two technical conferences (e.g., International Colloquium for Environmentally Preferred Advance Power Generation (ICEPAG), California Biomass Collaborative Annual Forum).
- Prepare a manuscript on project results and submit to an appropriate peer reviewed journal.

Deliverables:

- Project Fact Sheet
- Manuscript on project results

CONTRACT REQUESTS FORM (CRF)

CEC-94 (Revised 5/11)

CALIFORNIA ENERGY COMMISSION


 New Contract _____ Amendment to Existing Contract: _____ Amendment Number: _____

Division	Contract Manager:	MS-	Phone	CM Training Date
Energy Research and Development	Marla Mueller	43	916-327-1716	8/19/2002

Contractor's Legal Name	Federal ID Number
The Regents of the University of California, Advanced Power and Energy Program, UC Irvine	95-2226406

Title of Project
Economically and Environmentally Viable Strategies for Conversion of Bioresources to Power

Term	Start Date	End Date	Amount
New/Original Contract	6/29/2012	3/31/2015	\$ 397,236

Line up the Amendment information as best as possible within the following table.

Amendment #	End Date (mm/dd/yy)	Amount

Business Meeting Information			
Proposed Business Meeting Date	6/13/2012	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Marla Mueller	Time Needed:	5 minutes
Agenda Item Subject and Description [This agenda item should be sent to the Research List Serve (Energy RD&D/PIER program)]			
Possible approval of Contract 500-11-028 in the amount of \$397,236 with the Regents of the University of California, on behalf of the Irvine Campus to model the trade-offs of possible fuel paths for California biomass and biogas utilization and to quantitatively assess the energy and environmental impacts, including greenhouse gas emissions of each fuel path, with emphasis on air quality improvement and economic viability. (PIER electricity funding.) Contact: Joe O'Hagan. (5 minutes)			
Business Meeting approval is not required for the following types of contracts: <i>Executive Director's signature is required in all cases.</i>			
<input type="checkbox"/> Contracts less than \$10k (<i>Policy Committee's signature is also required</i>)			
<input type="checkbox"/> Amendment for a no-cost time extension. Must be first extension, less than one year and original contract less than \$100k.			
<input type="checkbox"/> Contracts less than \$25k for Expert Witness in Energy Facility licensing cases and amendments.			

Purpose of Contract or Purpose of Amendment, if applicable
<p>This project will quantitatively assess the energy and environmental impacts of increased biomass to better understand the best uses of biomass between electricity production, heat generation, or transportation fuels derived from biogas in California with an emphasis on air quality improvement and economic viability. The project will characterize air quality, green-house gas, fossil fuel consumption and economic implications of increased biomass and biogas usage for various uses including electricity generation, heat generation, and transportation fuel strategies. It will also assess the potential implementation of new bioenergy infrastructure to inform preferred uses and strategies for a set of California renewable resources. The analysis of criteria pollutants will provide a scientific basis to evaluate the potential co-benefits of biomass and biogas use for air pollution control and climate change mitigation strategies.</p> <p>Results from this study will complement ongoing research and help inform policy makers and industry with respect to further development and direction of biomass and biogas policy and technology alternatives needed to meet energy and environmental goals in California.</p>

CONTRACT REQUESTS FORM (CRF)



California Environmental Quality Act (CEQA) Compliance

1. Is Contract considered a "Project" under CEQA?
 Yes: skip to question 2 No: complete the following (PRC 21065 and 14 CCR 15378):
 Explain why contract is not considered a "Project":
 Contract will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because this project is a modeling study and the project will not result in any changes to the environment.

2. If contract is considered a "Project" under CEQA:
 a) Contract **IS** exempt. (Draft NOE required)
 Statutory Exemption. List PRC and/or CCR section number: _____
 Categorical Exemption. List CCR section number: _____
 Common Sense Exemption. 14 CCR 15061 (b) (3)
 Explain reason why contract is exempt under the above section:

b) Contract **IS NOT** exempt. The Contract Manager needs to consult with the Energy Commission attorney assigned to their division and the Siting Office regarding a possible Initial Study.

Budgets Information								
Contract Amount Funded		Breakdown by FY			Funding Sources			
Funding Source	Amount	FY	Amount	Approved?	Funding Source	FY	Budget List No.	Amount
ARFVTF	\$	11-12	\$397,236	Yes	PIER-E	11-12	501.027J	\$397,236
ECAA	\$		\$					\$
State- ERPA	\$		\$					\$
Federal	\$		\$					\$
PIER - E	\$397,236		\$					\$
PIER - NG	\$		\$					\$
Reimbursement	\$		\$					\$
Other	\$		\$					\$
TOTAL:	\$397,236	TOTAL:	\$397,236				TOTAL:	\$397,236
Reimbursement Contract #:					Federal Agreement			

Contractor's Administrator/ Officer		Contractor's Project Manager	
Name:	Soheil Jadali	Name:	Scott Samuelsen
Address:	UCI Office Of Research 5171 California Avenue, Ste. 150	Address:	UC, Irvine 221 Engineering Lab Facility
City, State, Zip:	IRVINE, CA 92697-3550	City, State, Zip:	Irvine, CA 92697-3550
Phone/ Fax:	949-824-9015 /	Phone/ Fax:	949-824-5468 / 949-824-7423
E-Mail:	soheil.jadali@research.uci.edu	E-Mail:	gss@uci.edu

Contractor Is

Private Company (including non-profits)
 CA State Agency (including UC and CSU)
 Government Entity (i.e. city, county, federal government, air/water/school district, joint power authorities, university from another state)

Selection Process Used

Solicitation Select Type Solicitation #: _____ # of Bids: _____ Low Bid? No Yes
 Non Competitive Bid (Attach CEC 96)
 Exempt Interagency



Civil Service Considerations	
<input type="checkbox"/> Not Applicable (Contract is with a CA State Entity or a membership/co-sponsorship) <input checked="" type="checkbox"/> Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER) <input type="checkbox"/> The Services Contracted: <input type="checkbox"/> are not available within civil service <input type="checkbox"/> cannot be performed satisfactorily by civil service employees <input type="checkbox"/> are of such a highly specialized or technical nature that the expert knowledge, expertise, and ability are not available through the civil service system. <input type="checkbox"/> The Services are of such an: <input type="checkbox"/> urgent <input type="checkbox"/> temporary, or <input type="checkbox"/> occasional nature that the delay to implement under civil service would frustrate their very purpose. Justification: Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)	

Payment Method	
<input checked="" type="checkbox"/> A. Reimbursement in arrears based on: <input type="checkbox"/> Itemized Monthly <input checked="" type="checkbox"/> Itemized Quarterly <input type="checkbox"/> Flat Rate <input type="checkbox"/> One-time <input type="checkbox"/> B. Advanced Payment <input type="checkbox"/> C. Other, explain:	

Retention	
1. Is contract subject to retention? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If Yes, Do you plan to release retention prior to contract termination? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes	

Justification of Rates	
The rates paid are those negotiated between the Energy Commission and the University of California.	

Disabled Veteran Business Enterprise Program (DVBE)	
1. <input checked="" type="checkbox"/> Not Applicable 2. <input type="checkbox"/> Meets DVBE Requirements DVBE Amount:\$ _____ DVBE %: _____ <input type="checkbox"/> Contractor is Certified DVBE <input type="checkbox"/> Contractor is Subcontracting with a DVBE: _____ 3. <input type="checkbox"/> Requesting DVBE Exemption (attach CEC 95)	

Is Contractor a certified Small Business (SB), Micro Business (MB) or DVBE?		<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes
If yes, check appropriate box:		<input type="checkbox"/> SB	<input type="checkbox"/> MB <input type="checkbox"/> DVBE

Is Contractor subcontracting any services?		<input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes
If yes, give company name and identify if they are a Small Business (SB), Micro Business (MB) and/or DVBE:			
UC Davis	<input checked="" type="checkbox"/> No	<input type="checkbox"/> SB	<input type="checkbox"/> MB <input type="checkbox"/> DVBE
Empowered Energy	<input checked="" type="checkbox"/> No	<input type="checkbox"/> SB	<input type="checkbox"/> MB <input type="checkbox"/> DVBE

Miscellaneous Contract Information	
1. Will there be Work Authorizations? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes 2. Is the Contractor providing confidential information? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes 3. Is the contractor going to purchase equipment? <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes 4. Check frequency of progress reports <input type="checkbox"/> Monthly <input checked="" type="checkbox"/> Quarterly <input type="checkbox"/> _____ 5. Will a final report be required? <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes 6. Is the contract, with amendments, longer than a year? If yes, why? <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes The Department of General Services has agreed to give the Commission blanket authority to execute multi-year contracts to support the Commission's RD&D Programs.	

CONTRACT REQUESTS FORM (CRF)



The following items should be attached to this CRF			
1. Scope of Work, Attach as Exhibit A.	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Attached	
2. Budget Detail, Attach as Exhibit B.	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Attached	
3. CEC 96, NCB Request	<input checked="" type="checkbox"/> N/A	<input type="checkbox"/> Attached	
4. CEC 30, Survey of Prior Work	<input checked="" type="checkbox"/> N/A	<input type="checkbox"/> Attached	
5. CEC 95, DVBE Exemption Request	<input checked="" type="checkbox"/> N/A	<input type="checkbox"/> Attached	
6. Draft CEQA Notice of Exemption (NOE)	<input checked="" type="checkbox"/> N/A	<input type="checkbox"/> Attached	
7. Resumes	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Attached	
8. CEC 105, Questionnaire for Identifying Conflicts		<input checked="" type="checkbox"/> Attached	

 Contract Manager Date Office Manager Date Deputy Director Date

The following signatures are only required when contract approval is delegated to the Executive Office and not approved at a Business Meeting.
 See Business Meeting Information Section.

 Presiding Policy Committee Date Associate Policy Committee Date Executive Director Date