

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: UNIVERSITY OF CALIFORNIA, RIVERSIDE

RESOLVED, that the State Energy Resources Conservation and Development Commission (Energy Commission) approves Contract 500-11-014 for \$1,400,536 with the Regents of the University of California on behalf of the Riverside campus to investigate improved renewable natural gas production by steam hydrogasification with carbon capture. (PIER natural gas funding.)

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 February 8, 2012.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Harriet Kallemeyn,
Secretariat

CONTRACT REQUESTS FORM (CRF)

CEC-94 (Revised 5/11)

CALIFORNIA ENERGY COMMISSION


 New Contract 500-11-014 Amendment to Existing Contract: _____ Amendment Number: _____

Division	Contract Manager:	MS-	Phone	CM Training Date
Energy Research and Development	David Effross	43	916-327-1314	6/26/2008

Contractor's Legal Name	Federal ID Number
The Regents of the University of California on behalf of the Riverside campus	94-3067788

Title of Project
Improved Renewable Natural Gas Production by Steam Hydrogasification with Carbon Capture

Term	Start Date	End Date	Amount
New/Original Contract	5/1/2012	4/30/2014	\$ 1,400,536

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	4/11/2012	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	David Effross	Time Needed:	5 minutes

Agenda Item Subject and Description

Possible approval of Contract 500-11-014 in the amount of \$1,400,536 with the Regents of the University of California on behalf of the Riverside campus to investigate improved renewable natural gas production by steam hydrogasification with carbon capture. (PIER natural gas funding) Contact: David Effross (5 minutes)

Business Meeting approval is not required for the following types of contracts: *Executive Director's signature is required in all cases.*

- Contracts less than \$10k (*Policy Committee's signature is also required*)
- Amendment for a no-cost time extension. Must be first extension, less than one year and original contract less than \$100k.
- Contracts less than \$25k for Expert Witness in Energy Facility licensing cases and amendments.

Purpose of Contract or Purpose of Amendment, if applicable

This contract will fund the laboratory-scale development of a method of renewable natural gas production that captures and recycles carbon dioxide. This process is more efficient than previous processes and releases fewer greenhouse gases into the environment.

California Environmental Quality Act (CEQA) Compliance

- 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":
- 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: 14 CCR 15262
 - Common Sense Exemption. 14 CCR 15061 (b) (3)
 - Explain reason why contract is exempt under the above section:
The project involves modeling, design, and laboratory bench-scale activities that do not have the potential to cause a significant environmental impact.
 - 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.

CONTRACT REQUESTS FORM (CRF)



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	\$1,400,536	Yes	NG Subaccount, PIERDD	10-11	501.001E	\$1,400,536
ECAA	\$		\$					\$
State- ERPA	\$		\$					\$
Federal	\$		\$					\$
PIER - E	\$		\$					\$
PIER - NG	\$1,400,536		\$					\$
Reimbursement	\$		\$					\$
Other	\$		\$					\$
TOTAL:	\$1,400,536	TOTAL:	\$1,400,536				TOTAL:	\$1,400,536
Reimbursement Contract #:					Federal Agreement			

Contractor's Administrator/ Officer		Contractor's Project Manager	
Name:	Gillian Fischer	Name:	Joseph Norbeck
Address:	200 University Office Building University of California	Address:	Ce-Cert/Ur 1084 Columbia Ave.
City, State, Zip:	RIVERSIDE, CA 92521-0001	City, State, Zip:	Riverside, CA 92887
Phone/ Fax:	951-827-4816 / 951-827-4483	Phone/ Fax:	951-781-5778 / 951-781-5790
E-Mail:	gfischer@ucr.edu	E-Mail:	joe.norbeck@ucr.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

Not Applicable (Contract is with a CA State Entity or a membership/co-sponsorship)

Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)

The Services Contracted:

- are not available within civil service
- cannot be performed satisfactorily by civil service employees
- are of such a highly specialized or technical nature that the expert knowledge, expertise, and ability are not available through the civil service system.

The Services are of such an:

- urgent
- temporary, or
- occasional nature

that the delay to implement under civil service would frustrate their very purpose.

Justification:
The contract is with the UC Regents.

CONTRACT REQUESTS FORM (CRF)



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 type="checkbox"/> No	<input type="checkbox"/> Yes

Justification of Rates
The overhead rates charged in this contract are the standard negotiated rates between the Energy Commission and the University of California. All other rates are standard published UC rates.

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 checked="" type="checkbox"/> No	<input type="checkbox"/> Yes
If yes, give company name and identify if they are a Small Business (SB), Micro Business (MB) and/or 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	
9. CEC 106, IT Component Reporting Form		<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

**EXHIBIT A
SCOPE OF WORK**

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Perform a Bench-Scale Demonstration
3		Evaluate Process Economics
4		Develop a Basic Engineering Design for a Pilot Plant

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor	Key Partner(s)
1-3	Chan Seung Park (UC Riverside)		
4	Chan Seung Park (UC Riverside) Joe Norbeck (UC Riverside)		

GLOSSARY:

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

Acronym	Definition
C	Carbon
CCM	Commission Contract Manager
CFB	Circulating Fluidized Bed
CH ₄	Methane
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CPR	Critical Project Review
DOE	United States Department of Energy
Energy Commission	California Energy Commission
GHG	Greenhouse Gases
H ₂	Hydrogen
HHV	Higher Heating Value
m	Meter
M	Million
NH ₃	Ammonia

NG	Natural Gas
PIER	Public Interest Energy Research
ppmv	Parts per Million by Volume
ROI	Return on Investment
SE-SHR	Sorption Enhanced Steam Hydro-Gasification Reaction
SHR	Steam Hydro-Gasification Reaction
SNG	Substituted Natural Gas
TAC	Technical Advisory Committee
UC	University of California
UCC.1	Uniform Commercial Code (Financing Statement)
Vol%	Percent Volume
WGS	Water Gas Shift reaction

Problem Statement

The vast majority of California's Natural Gas (NG) customers are either residential or small commercial customers, who account for approximately 40% of the NG delivered by California utilities. Large customers, such as electric generators and industrial customers, account for the remaining 60% of NG delivered by California utilities. Most of the NG used in California comes from out-of-state sources. California receives 46% of its NG from sources located in the Southwest, 19% from Canada, 22% from the Rocky Mountains, and only 13% from basins located within California. In 2008, total NG consumption in California was 2,405,266 Million Cubic Feet. Based on statistical data provided by the California Public Utilities Commission, 13% of the total NG is estimated to be 312,685 Million Cubic Feet.¹

Thermo-chemical production of Substituted Natural Gas (SNG) from renewable sources offers a viable solution to reductions in fossil fuel-based NG. However, there are technical and economic limitations to using conventional SNG production processes (such as anaerobic-digestion and conventional methanation of gasification product gas) to produce fungible NG from sustainable biomass resources.

Use of the new innovative technology proposed in this Agreement with the renewable biomass resources in California has the potential to replace 30% of the total NG consumed annually in California. This will occur without any increase in greenhouse gases (GHGs) into the atmosphere. An estimated minimum of 50 MM tons of GHGs can be displaced.

Purpose of the Agreement

The purpose of this Agreement is to further develop and demonstrate a highly efficient thermo-chemical process that combines a Carbon Dioxide (CO₂) Sorption Enhanced Steam Hydrogasification Reaction (SE-SHR) with a Water Gas Shift (WGS) reactor to produce high levels of SNG using biomass resources from California.

The University of California, Riverside has been involved for a number of years in the development of a new gasification technology based on the Steam Hydrogasification Reaction (SHR) to produce a "synthesis gas" from biomass (carbonaceous) feedstock. This includes green waste and organic wastes from landfills, biosolids from wastewater treatment facilities, and agricultural residues. The SHR can handle wet feedstocks, does not require expensive oxygen plants, and operates at a lower temperature than any other conventional gasification processes. This technology was intensively reviewed by institutions including the United States Department of Energy's National Energy Technology Laboratory and has been shown to be an efficient and economic process compared to existing technologies.

¹ The source of these statistics is *An Assessment of Biomass Resources in California 2007*, published by the California Energy Commission in March 2008 (<http://biomass.ucdavis.edu/files/reports/2008-cbc-resource-assessment.pdf>).

SNG produced from biomass feedstock can be used as a source of electricity or as an alternative transportation fuel source. Conventional processes for SNG production require additional steps such as methanation of the synthesis gas, which have several limitations in terms of process efficiency. UC Riverside's research team has been developing the new, efficient way of producing SNG not by the methanation of synthesis gas, but simply by combining the WGS process into the SHR process. A recent demonstration of the process with a bench scale reactor shows very promising initial results.

The research team has also found the enhancement of the SHR with the addition of dolime, which is called SE-SHR (Sorption Enhanced-SHR). The dolime can be produced from the WGS process as spent sorbent for CO₂ Capture. The captured CO₂ can be used as a source for algae growth or chemicals.

This Agreement will involve experimental and modeling studies of the SE-SHR process using biomass as the feedstock.

Goals of the Agreement

The goals of the Agreement are to:

- Demonstrate and validate the production of SNG with the SE-SHR process. The demonstration will be performed at the bench-scale SE-SHR Circulating Fluidized Bed (CFB) reactor.
- Evaluate the process economics and energy balances by developing an integrated process flow and economic model with in-house engineering software packages.
- Complete a basic engineering design for a pilot plant using key information developed under this Agreement.

Objectives of the Agreement

The objectives of this Agreement are to:

- Validate the production and quality of SNG from the SE-SHR process under optimum operating conditions.
- Meet target specifications for the producer gas composition with specified biomass feedstock (pine wood).
- Evaluate the process economics with the assistance of the Aspen Economic Analyzer, which can predict the Return on Investment (ROI). Knowing the ROI will help the Contractor evaluate the economic impact of the process and compare the life cycle energy production cost of different technologies.
- Develop the basic engineering design of the pilot plant. The design will allow both technical and economic feasibility analyses of a commercial scale process.

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 1.5)

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

Contractor Deliverables:

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

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.
- 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 Report
- CPR deliverables identified in the Scope of Work

Commission Contract Manager Deliverables:

- Agenda and a List of Expected Participants
- Schedule of 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 Office 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 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>

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. The Contractor shall

incorporate the CCM's comments into the draft. 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. The Final Report Contents and Format, provides the recommended specifications. 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 the 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 matching 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 not 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)

TAC

Task 1.10 Establish the TAC

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

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

The TAC 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
- U.S. Department of Energy Research Manager
- Public Interest Environmental Groups
- Utility Representatives
- Members of the relevant technical society committees

The purpose of the TAC 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 TAC 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 TAC meeting will be developed.
- Recruit TAC 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 TAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each TAC member.

Deliverables:

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

Task 1.11 Conduct TAC Meetings

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

The Contractor shall:

- Discuss the TAC meeting schedule at the kick-off meeting. The number of face-to-face meetings and teleconferences and the location of TAC meetings shall be determined in consultation with the Commission Contract Manager. This draft schedule shall be presented to the TAC members during recruiting and finalized at the first TAC meeting.
- Organize and lead TAC meetings in accordance with the schedule. Changes to the schedule must be pre-approved in writing by the Commission Contract Manager.
- Prepare TAC meeting agenda(s) with back-up materials for agenda items.
- Prepare TAC meeting summaries, including recommended resolution of major TAC issues.

Deliverables:

- Draft TAC Meeting Schedule
- Final TAC Meeting Schedule
- TAC Meeting Agenda(s) with Back-up Materials for Agenda Items
- Written TAC meeting summaries, including recommended resolution of major TAC 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 Perform a Bench-Scale Demonstration

The goal of this task is to:

- Design, fabricate, and operate the laboratory bench scale SE-SHR CFB reactor, which will produce a SNG with the following target specification:

- Producer Gas Yield (Carbon Conversion Efficiency into SNG):

Above 65%

- Producer Gas Composition – dry basis (pre clean-up), Hydrogen (H₂)-free basis:

Carbon Monoxide (CO):	5-20 Percent Volume (Vol%)
Methane (CH ₄):	65-80 Vol%
CO ₂ :	< 25 Vol%
Tars:	< 3 mg/m ³
Sulfur:	< 150 Parts per Million by Volume (ppmv)
Ammonia (NH ₃):	< 0.05 Vol%

The Contractor shall:

- Prepare and submit a “*SE-SHR Demonstration Test Plan*” that includes:
 - A Startup Test Plan with suggested standard operation procedure
 - A Shake-down Test Plan with major variables and time table
 - A Salibration Test Plan from the optimum process condition
 - A Sontinuous Process Operation Plan with operation shift schedule, feedstock switch schedule
- Prepare and submit a “*SE-SHR Detailed Design Flow-sheet*” that includes:
 - A process block flow diagram
 - A process and instrument diagram
 - A process utility flow diagram
- Determine the process mass energy balance.

- Prepare and submit a *“Process Mass and Energy Balance Report”* that includes:
 - A process mass and energy balance diagram
 - A process mass and energy balance analysis
- Operate the SE-SHR CFB reactor using biomass feedstock.
- Perform parametric testing of the SE-SHR process. The testing shall evaluate the influence of operating conditions including:
 - SE-SHR Temperature: Evaluate at 700, 750, and 800 °C
 - Sorbent /carbon ratio of SE-SHR: Experiments will be conducted at three different sorbent/carbon ratios
- Based on the parametric testing results, conduct additional tests under the ideal conditions to evaluate process efficiency.
- Survey the impurities in the producer gas.
- Prepare and submit a *“Process Performance Results Report”* that includes but is not limited to: (1) a discussion of the SE-SHR process technology; (2) Aspen Plus simulation results from the SE-SHR process including mass and energy balance; (3) a design of the SE-SHR reactor; (4) results of the parametric testing of the SE-SHR process; and (5) recommendations for the design of the pilot-scale process.

Deliverables:

- SE-SHR Demonstration Test Plan (no draft)
- SE-SHR Detailed Design Flow-sheet
- Process Mass and Energy Balance Report
- Process Performance Results Report (no draft)

Task 3 Evaluate the Process Economics

This task category consists of: (1) developing the integrated process flow sheet using ASPEN Plus Equilibrium modeling software adjusted by laboratory results; and (2) evaluating the process economics using ASPEN ICARUS with in-house modifications.

The Contractor shall:

- Prepare and submit an *“Integrated Process Flow Sheet”* that shows the process flow.
- Prepare and submit a *“Process Economics Report”* that evaluates the economic impact of the process and predicts the ROI.

Deliverables:

- Integrated Process Flow Sheet
- Process Economics Report

Task 4 Develop a Basic Engineering Design for a Pilot Plant

The goal of this task is to develop the basic engineering design of a pilot plant located in California that can process one to five tons per day of city biomass waste co-mingled

with biosolids. The basic engineering design of the pilot plant will allow both technical and economic feasibility analyses of a commercial scale process. This task includes life cycle comparison with other processes for SNG production.

The Contractor shall:

- Prepare and submit a “*Block Flow Diagram*” showing the finalized mass and energy balance.
- Prepare and submit “*Process and Utility Flow Diagram*” for the pilot plant.
- Prepare and submit a “*Pilot Plant Design Report*” on the project that includes but is not limited to:
 - A detailed discussion of the SE-SHR process.
 - A basic engineering design of the pilot plant.
 - Cost estimates for the pilot plant scale process.
- Prepare and submit a “*Life Cycle Comparison Report*” that compares different technologies for producing SNG from wet organic wastes. The report shall include but not be limited to:
 - A comparison of process HHV efficiency
 - Process flow diagrams of other processes with mass
 - A balance comparison of production cost as \$/million metric british thermal unit (MMBtu)

Deliverables:

- Block Flow Diagram
- Process and Utility Flow Diagrams
- Pilot Plant Design Report
- Life Cycle Comparison Report