

GRANTS/CONTINGENT AWARD REQUEST



To: Grants and Loans Office

Date: 9/6/2012

Project Manager: Prab Sethi

Phone Number: 916-327-1302

Office: Energy Generation Research Office Division: Energy Research and Development MS- 43

Project Title: Reducing California Industrial Natural Gas Consumption Through Advanced Biomass Gasification

Type of Request: (check one)

Form for New Agreement with fields for Program, Solicitation Name, Legal Name, Address, Project Officer, and Agreement Dates.

Form for Amendment with checkboxes for Term Extension, Work Statement Revision, Budget Revision, Change of Scope, and Other.

ITEMS TO ATTACH WITH REQUEST:

- List of items to attach: A. Work Statement, B. Budget, C. Recipient Resolution, D. Special Conditions, E. CEQA Compliance Form, F. Other Documents.

California Environmental Quality Act (CEQA)

Form for CEQA compliance with checkboxes for CEC finds, project exempt, environmental document, and CEQA finding.

Funding Information:

Form for funding information with fields for Source #1, #2, #3, Amount, Statute, FY, and Budget List #.

If federally funded, specify federal agreement number:

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

Business Meeting Approval: (refer to Business Meeting Schedule)

Form for business meeting approval with fields for Date, Participant, and Consent/Time Needed.

Agenda Notice Statement: (state purpose in layperson terms)

Possible approval of a Grant / Contingent Award to... Possible approval of amendment 1 to Agreement PNG-07-005 with Diversified Energy Corporation for a 5 month no-cost time extension...

# GRANTS/CONTINGENT AWARD REQUEST



## Work Statement

### Reducing California Industrial Natural Gas Consumption through Advanced Biomass Gasification

**Introduction:** Diversified Energy Corporation (DEC) recipient and ~~the Energy and Environmental Research Center (EERC)~~ Millennium Space Systems (MSS) sub-recipient have teamed with ~~Evergreen Pulp, Inc. (EPI) a pulp and paper mill~~ Wyle Laboratories (Wyle) located in Eureka, in San Bernardino, CA, to propose an integrated biomass gasification demonstration project utilizing ~~HydroMax~~, OmniGas, an advanced gasification process, to convert waste wood fines at ~~EPI~~ into usable syngas for process heating.

**Project Description:** The majority of gasification efforts within the United States are focused on large gasification systems (>250 MWe) using coal to generate clean electrical power. While this is clearly an attractive endeavor given the coal resources within the U.S., it overlooks the potential market for smaller biomass gasifiers for industrial applications. The interest in this emerging market is fueled by current industrial consumers of natural gas who are competitively disadvantaged due to increasing production costs resulting from wildly fluctuating natural gas prices (~~\$2-\$15~~ 4-\$15/therm yearly variation). Many of these industrial applications are using natural gas for industrial process drying or heating, a fuel supply that can easily be replaced by renewable syngas produced from biomass gasification. Use of renewable biomass energy sources for industrial process heating and drying is the principle target market for the ~~HydroMax~~ Diversified Energy Corporation (DEC) gasification process.

Leveraging previous laboratory and bench-scale ~~HydroMax~~ OmniGas tests, as well as existing infrastructure at ~~EPI's Eureka~~ Wyle's site, the project team will fabricate the demonstration reactor, modify the ~~EPI~~ site, integrate the reactor with ~~Evergreen's process heating equipment,~~ Wyle equipment and personnel, and execute a ~~12-1~~ month operational test program aimed at ~~successful and seamless integration with~~ demonstrating OmniGas efficiency as an operating industrial application to convert biomass to syngas.

#### PROJECT GOALS:

##### Description of Targets, Qualified Technical and Economic Goals

Technical Objectives of this Agreement are to:

1. Generate syngas with a volumetric flow rate of  $\geq 5000$  scf/hr and a heating value of  $\geq 175$  Btu/scf as a replacement biogas for industrial process heating and drying applications .
2. Demonstrate that the ~~HydroMax~~ OmniGas process can use a variety of biomass feedstock with heating value between 6,000-10,000 Btu/lb and moisture content between 0 and 50%.
3. ~~Blend the two syngas streams and~~ Realize a syngas composition ratio of Hydrogen to Carbon Monoxide between 2.0 and 4.0 to accommodate back-end processes (i.e.

- methanation).
4. Realize a continuous nominal operating time of  $\geq 168$  hours for at least 1 test run ~~and a cumulative nominal operating time of  $\geq 1000$  hours for a 12-month test period.~~
  5. Realize a dry feedstock feed rate conversion efficiency of  $\geq 75\%$  with a flow rate heat yield of  $\geq 875,000$  Btu/hr.
  6. Operate the ~~HydroMax~~ **OmniGas** system at ~~90% the performance of~~ **to replace** natural gas injection to the thermal oxidizer **flare** to realize reduction in natural gas consumption.
  7. Realize a capital cost of  $\leq \$19.50/\text{kscf}/\text{year}$  (**analyzed** operating continuously).
  8. Realize an operation and maintenance cost of  $\leq \$1.65/\text{kscf}/\text{year}$  (**analyzed** operating continuously).

## GLOSSARY

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

Acronym	Definition
CPR	Critical Project Review
DEC	Diversified Energy Corporation
<del>EERC</del>	<del>Energy and Environmental Research Center</del>
<del>EPI</del>	<del>Evergreen Pulp, Inc.</del>
O&M	Operation and Maintenance
<b>Wyle</b>	<b>Wyle Laboratories</b>
<b>MSS</b>	<b>Millennium Space Systems</b>

## TASK LIST SUMMARY

Task #	CPR	Task Name
1		Administration
2	<b>X</b>	<del>HydroMax</del> <b>OmniGas</b> Reactor System Development and Fabrication
3		<del>HydroMax</del> <b>OmniGas</b> Reactor System Validation and Optimization
4		Site Preparation
5	<b>X</b>	Reactor Integration and Demonstration Test
6		Technology Transfer
7		Production Readiness Plan

### TASK 1.0 ADMINISTRATION

#### Task 1.1 Attend Kick-off Meeting

**Goal:** The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

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

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

- Terms and Conditions of the Agreement
- CPRs (Task 1.2)
- Match Fund Documentation (Task 1.6)
- Permit Documentation (Task 1.7)

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

- The Commission Project Manager’s expectations for accomplishing tasks described in the Scope of Work
- An updated Schedule of Products
- An updated Gantt Chart
- Progress Reports (Task 1.4)
- Technical Products (Special Conditions)
- Final Report (Task 1.5)

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

**Products:**

- Schedule of products
- Gantt chart
- List of match funds
- List of permits, if applicable

**Due Date:** June 30, 2009

**Task 1.2 Critical Project Review (CPR) Meetings**

**Goal:** The goal of this task is to determine if the project should continue to receive Commission funding to complete this Agreement and if it should, are there any modifications that need to be made to the tasks, products, schedule or budget.

CPRs provide the opportunity for frank discussions between the Commission and the Recipient. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Project Manager and as shown in the Technical Task List above and in the Schedule of Products. However, the Commission Project Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Recipient.

Participants include the Commission Project Manager and the Recipient, and may include the Commission Grants Officer, the PIER Program Team Lead, other Commission staff and Management as well as other individuals selected by the Commission Project Manager to provide support to the Commission.

The Commission Project Manager shall:

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

The Recipient shall:

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

**Product:** CPR products identified in the Scope of Work for task 2 and 5

**Due Date:** January 1, 2011-September 30, 2012

### **Task 1.3 Final Meeting**

**Goal:** The goal of this task is to closeout this Agreement.

The Recipient shall meet with the 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 Recipient, the Commission Grants Officer, and the Commission Project Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Project Manager.

The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Agreement. The administrative portion of the meeting shall be a discussion with the Commission Project Manager and the Grants Officer about the following Agreement closeout items:

- What to do with any equipment.
- Commission's request for specific "generated" data.
- Need to document Recipient's disclosure of "subject inventions" developed under the Agreement.
- "Surviving" Agreement provisions, such as repayment provisions and confidential products.
- Prepare a CD or similar electronic media to include all project documents.
- Final invoicing and release of retention.

The Recipient shall prepare a schedule for completing the closeout activities for this Agreement.

**Product:** Documentation of meeting agreements and all pertinent information

**Due Date:** ~~November 30, 2011~~ **February 28, 2013**

**Product:** One or more CD or similar electronic media containing project documents sorted by task number

**Due Date:** ~~November 30, 2011~~ **February 28, 2013**

#### **Task 1.4 Monthly Progress Reports**

**Goal:** 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 Recipient shall prepare progress reports, which summarize all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Project Manager within 5 working days after the end of the reporting period. The terms and conditions of this Agreement provide the recommended specifications.

**Product:** Monthly Progress Reports  
**Due Date:** By the 10<sup>th</sup> day of each month during the approved term of this Agreement or until submission of the Final Report. **Progress Reports re-initiated on August 10, 2012.**

### **Task 1.5 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 Project Manager will review and approve the Final Report. The Final Report must be completed on or before the termination date of the Agreement. The terms and conditions of this Agreement provide the recommended specifications.

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

#### **Task 1.5.1 Final Report Outline**

The Recipient shall:

- Prepare a draft outline of the Final report.
- Submit the draft outline of the Final Report to the Commission Project Manager for review and approval. Once agreement has been reached on the draft, the Recipient shall submit the Final Outline to the Commission Project Manager.

**Product:** Draft Outline of the Final Report  
**Due Date:** January 31, ~~2011~~ **2013**

**Product:** Final Outline of the Final Report  
**Due Date:** February 28, ~~2011~~ **2013**

#### **Task 1.5.2 Final Report**

**The Recipient shall:**

- Prepare the draft Final Report for this Agreement in accordance with the approved outline.
- Submit the draft Final Report to the Commission Project Manager for review and comment. The Commission Project Manager will provide written comments within 15

working days of receipt. Once agreement on the draft Final Report has been reached, the Recipient shall forward the final electronic version to the Commission Project Manager.

- Submit two bound copies of the Final Report with the final invoice.

**Product:** Draft Final Report  
**Due Date:** ~~November 30, 2011~~ **March 10, 2013**

**Product:** Final Report bound copies and electronic file  
**Due Date:** ~~December 31, 2011~~ **March 26, 2013**

### **Task 1.6 Identify and Obtain Matching Funds**

**Goal:** 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. The Recipient shall 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, prior to the Energy Commission providing reimbursement for any costs incurred under this Agreement.

The Recipient shall prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Project Manager at least 5 working days prior to the kick-off meeting. The letter shall include a list of the match funds that identifies the:

- Amount of each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied.
- Amount of each in-kind contribution, a description, documented market or book value, and its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.

Recipient shall provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.

**Product:** A letter documenting Match Funds  
**Due Date:** July 30, 2009

**Product:** A copy of each Match Fund commitment letter  
**Due Date:** July 30, 2009

### **Task 1.7 Identify and Obtain Required Permits**

The goal of this task is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track.

Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement. The Recipient shall show match funds for this task. Permits must be identified in writing and obtained before the Recipient can incur any costs related to the use of the permits for which the Recipient will request reimbursement.

The Recipient shall prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Project Manager at least 5 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:
  - Type(s) of permit(s)
  - Name, address and telephone number of the permitting jurisdictions or lead agencies
  - Schedule the Recipient 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 Project Manager. As permits are obtained, send a copy of each approved permit to the Commission Project Manager. If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Project Manager within 5 working days. Either of these events may trigger an additional CPR.

**Product:** Letter documenting the Permits or stating that no Permits are required

**Due Date:** ~~June 30, 2009~~ October 30, 2012

**Product:** A copy of each approved Permit

**Due Date:** ~~December 31, 2010~~ October 30, 2012

## **TECHNICAL TASKS**

### **TASK 2.0 ~~HydroMax~~ OmniGas Reactor System Development and Fabrication**

**Goal:** The goal of this task is to finalize the HydroMax OmniGas reactor design for the specific EPI Wyle application, build the reactor system and predict on-site performance. The HydroMax OmniGas reactor consists of a 0.50 meter internal diameter reactor housed inside of a refractory shell, ~~and a water quench reactor that will cool the HydroMax reactor output syngas to the correct temperature for downstream processing. The downstream processing equipment consists of a heat exchanger, a compressor, and a storage tank that will store the syngas at pressure for use in the EPI thermal oxidizer.~~ The waste wood feed system consists of a wood hopper, ~~that inputs warm air from the downstream heat exchanger to remove moisture from the wet wood to increase the efficiency of the reactor to gasify the wood.~~ The entire HydroMax system will fit on a 20 foot long x 30 foot wide x 20 foot tall footprint at EPI Wyle Labs.

The Recipient shall:

- Complete the analysis of the HydroMax OmniGas demonstration set-up for the EPI application, including final process flows and predicted performance metrics.
- Prepare design details and procurement data sheets for the materials required to fabricate the HydroMax OmniGas Reactor.
- Procure material required to fabricate HydroMax OmniGas reactor and accompanying equipment.
- Fabricate HydroMax OmniGas reactor demonstration system at ~~the EERC~~ Diversified Energy.
- Prepare final process flow diagram for HydroMax OmniGas system, which will be demonstrated at EPI mill Wyle.
- Compile predicted performance/analyses results including material and energy balances.
- Perform AspenPlus modeling to provide chemical and thermal process performance results.
- Prepare procurement data sheets for equipment/materials required to fabricate the EPI HydroMax Wyle OmniGas demonstration system (initial component bids from vendors already received).
- Fabricate HydroMax OmniGas reactor demonstration system for ~~the EPI mill~~ Wyle.

**Products:**

- Demonstration System Design Package. This package will include the final system design information including HydroMax OmniGas system requirements, design, all applicable analysis (component as well as system performance), parts lists, data sheets, flow diagrams, and material and energy balance.

- Critical Project Review #1 Meeting Minutes.

**Due Date:** ~~February 1, 2010~~ **October 15, 2012**

### **TASK 3.0 ~~HydroMax~~ OmniGas Reactor System Validation and Optimization**

**Goal:** The goal of this task is to perform validation testing on the system design information including completed ~~HydroMax~~ OmniGas reactor system for the ~~EPI~~ **Wyle** demonstration and determine optimal reactor operating conditions, which maximize performance. The ~~HydroMax~~ OmniGas reactor system performs at a temperature range between 1250-1350°C.

The Recipient shall:

- Set-up and instrument the ~~HydroMax~~ OmniGas Reactor System for engineering validation and optimization testing at ~~the Wyle~~ **EERC** including instrumentation for gas composition analysis, temperature and pressure monitoring, and flow rate analysis.
- Prepare ~~Hydro-max~~ OmniGas system test plan.
- Conduct initial ~~HydroMax~~ OmniGas reactor shake-down testing ~~with carbon black feedstock.~~
- Conduct ~~HydroMax~~ OmniGas reactor validation testing with dry wood feedstock.
- Compare validation results with analytical modeling.
- Correlate analytical model with validation test results.
- Predict optimum reactor operating conditions for ~~EPI~~-wood feedstock using correlated analytical model.
- Conduct optimization testing of reactor using predicted optimum operating conditions and ~~EPI~~ wood feedstock.
- Conduct ~~methanation~~ sample testing using syngas ~~slip stream~~ from ~~HydroMax~~ OmniGas reactor.
- Package ~~tested~~ ~~HydroMax~~ OmniGas reactor and transport via truck to ~~EPI~~ **Wyle**.
- Validate and correlate ~~HydroMax~~ OmniGas performance model.
- Prepare summary of test data results regarding performance of ~~HydroMax~~-OmniGas reactor ~~for monthly program progress reports.~~

- Recommend operating parameters for the ~~HydroMax~~ **OmniGas** reactor (feed rates, cycle times, steam and oxygen injection rates, etc).
- Confirm receipt of ~~HydroMax~~ **OmniGas** reactor demonstration system from ~~EERC~~ to **EPI at Wyle**.

**Products:**

- ~~HydroMax~~ **OmniGas** System Test Plan Report (Basic). This test plan report will include the test plan, the equipment list, instrumentation list, and test objectives for the baseline ~~HydroMax~~ **OmniGas** System testing.
- ~~HydroMax~~ **OmniGas** System Test Plan Report (Optimization). This test plan report will include test objectives for any optimization or deviations from the baseline ~~HydroMax~~ **OmniGas** System testing.
- ~~HydroMax~~ **OmniGas** System Test Procedure Report (Basic). This test procedure report will include the step-by-step process for executing all baseline ~~HydroMax~~ **OmniGas** System testing. This procedure will include all test instrumentation (including locations and expected readings).
- ~~HydroMax~~ **OmniGas** System Test Procedure Report (Optimization). This test procedure report will include the step-by-step process for executing all ~~HydroMax~~ **OmniGas** System testing to optimize performance.
- Test plan, test procedure reports and notification for receipt of ~~HydroMax~~ **OmniGas** System will be submitted to Energy Commission Project Manager.

**Due Date:** November 30, ~~2010~~ **2012**

**TASK 4.0 Site Preparation**

**Goal:** The goal of this task is to perform modifications to the ~~EPI mill~~ **Wyle** infrastructure to accommodate the integration and operation of the ~~HydroMax~~ **OmniGas** reactor.

The Recipient shall:

- Finalize the site layout including location of the ~~HydroMax~~ **OmniGas** demo reactor and all “plumbing” to and from the interfacing equipment at ~~the mill~~ **Wyle**.
- Perform the infrastructure modifications required to integrate and operate ~~HydroMax~~ **the OmniGas** reactor.
- Prepare, submit and obtain the environmental permits (or revisions) required to enable operation of the ~~HydroMax~~ **OmniGas** demo reactor for a period of no less than one **year month**.

- Complete ~~mill~~ Wyle modifications and installations to enable integration and operation of the ~~HydroMax~~ OmniGas demo reactor.
- Obtain environmental permits authorizing the operation of the ~~HydroMax~~ OmniGas demo reactor at ~~EPI~~ Wyle located in ~~Eureka~~ San Bernardino, CA.

**Product:** ~~Plant~~ Modification Package: This package will include a description and summary of all required ~~plant~~ infrastructure modifications, installations, and permitting, (if necessary), safety and environmental issues, and will be submitted to the Energy Commission Project Manager for final approval.

**Due Date:** ~~September 30, 2010~~ October 30, 2012

### **TASK 5.0 Reactor Integration and Demonstration Test**

**Goal:** The goal of this task is to demonstrate the ability of the ~~HydroMax~~ OmniGas technology to reduce the natural gas usage in ~~a~~ the thermal oxidizer ~~flare~~ at the ~~EPI mill~~ Wyle by combusting ~~substituting~~ syngas created from waste wood fines.

The Recipient shall:

- Develop a test procedure defining the ~~HydroMax~~ OmniGas reactor test operations at ~~EPI~~ Wyle.
- Re-assemble the ~~HydroMax~~ OmniGas reactor system at ~~EPI~~ Wyle.
- Integrate the ~~HydroMax~~ OmniGas reactor system with the required interfaces at the site.
- Conduct approximately one ~~year~~ month of detailed testing of the ~~HydroMax~~ OmniGas demo reactor system as defined in the list of test cases shown below.
  - Reactor Shakedown: Test consists of initial testing after set-up and integration at site. ~~Produced syngas will be dried and stored in tank for flare testing.~~
  - Dry Wood Performance: Test consists of reactor testing with dry waste wood fines and oxygen. ~~Syngas is initially dried and stored in tank for composition and flow rate measurement.~~
  - Wet Wood Performance: Test consists of reactor testing with wet waste wood fines and oxygen. ~~Syngas is initially dried and stored in tank for composition and flow rate measurement.~~
  - Syngas Flow: Syngas produced from reactor will be fed to oxidizer as a ~~1) blended stream with natural gas, and 2) dedicated stream to spare burner.~~
  - Air Blown Performance: Drive both oxidation and reduction cycles using air instead of pure oxygen and operates with both dry and wet wood conditions.
  - ~~Wet Syngas Performance: Plumb wet syngas to oxidizer as blended stream and~~

dedicated stream.

- ~~Hardwood Feedstock: Operate reactor with dry and as-received wet hardwood and monitor syngas quality and composition.~~
  - ~~Agriculture Feedstock: Operate reactor with California agriculture feedstock during reduction cycle. Monitor syngas composition and volumetric flow rate.~~
  - Throughput Capacity: Increase nominal flow rate of waste wood fines into reactor during reduction cycle.
  - Feedstock Moisture Limit: Conduct reduction cycle operation with dry wood and variable amount of water.
  - Reactor Wear: After operating for a significant amount of time, perform a post-mortem evaluation on corrosion, wear, and material deposition.
- Show low-Btu syngas for ~~integration into the natural gas fuel stream~~ for combustion in the thermal oxidizer **flare**.
  - Provide test execution status reports for the monthly program progress reports.
  - Provide test data files for subsequent reduction, analysis and correlation to predictions.

#### **Products:**

- On-Site ~~HydroMax~~ **OmniGas** Test Plan: This test plan will include the plan, the equipment list, instrumentation list, and test objectives for the on-site ~~HydroMax~~ **OmniGas** System testing at EPI **Wyle**.
- On-Site ~~HydroMax~~ **OmniGas** Test Procedure: This test procedure will include the step-by-step process for executing on-site ~~HydroMax~~ **OmniGas** System testing at EPI **Wyle**. This procedure will include the all test instrumentation (including locations and expected readings).
- Critical Project Review #2 Meeting Minutes.
- Midterm ~~HydroMax~~ **OmniGas** Performance Test Report: This test report will document the findings and performance at the 6 month point in the 12 month testing timeframe.

**Due Date:** ~~December 30, 2011~~ **December 30, 2012**

#### **TASK 6.0 Technology Transfer Activities**

**Goal:** The goal of this task is to develop a plan to make the knowledge gained, experimental results and lessons learned, including fact sheets and project briefs, available to the public and key decision-makers, and included in the Technology Transfer Report.

The Recipient shall:

- Develop an execution plan that ensures the information gathered and knowledge gained during the project is distributed to the public and critical decision-making organizations in the industry.
- Prepare document and presentation material as required to support the dissemination of the information gathered during the project.
- Conduct formal presentations on the project results to the appropriate organizations, committees and personnel.
- Prepare a plan identifying the key decision-making entities for this technology and the proposed methods for distributing the gathered program information.
- Prepare a summary report of the ~~HydroMax~~ **OmniGas** system shakedown and validation testing conducted at ~~EERC~~ **Wyle**.
- Prepare final report documenting the ~~HydroMax~~ **OmniGas** demo test at ~~the EPI mill~~ **Wyle**. This includes all data collected during the tests as well as providing a full assessment of the ~~HydroMax~~ **OmniGas** system performance against the quantifiable technical and economic goals shown in section “Project Goals.”

**Products:**

- Technology Transfer Report: This report will identify key decision making entities for the proposed technology and the methods for distributing the gathered program information.
- ~~HydroMax~~ **OmniGas** System Test Report (Baseline): This test report will document all test findings, results, and conclusions from the ~~HydroMax~~ **OmniGas** System Test (Baseline). The report will show the as-run test setup as well as all material and energy balances.
- ~~HydroMax~~ **OmniGas** System Test Report (Optimization): This test report will document all test findings, results, and conclusions from the ~~HydroMax~~ **OmniGas** System Test (Optimization). The report will show the as-run test setup as well as all material and energy balances.
- On-Site-~~HydroMax~~ **OmniGas** Test Final Report: This test report will document all test findings, results, material and energy balances, and conclusions from the on-site ~~HydroMax~~ **OmniGas** System testing at ~~EPI~~ **Wyle**. The report will show the as-run test setup as well as providing a full assessment of the ~~HydroMax~~ **OmniGas** system performance against the quantifiable technical and economic goals as identified in the Project Goals section of this document.

**Due Date:** ~~December 1, 2011~~ January 30, 2013

### **TASK 7.0 Production Readiness Plan**

**Goal:** The goal of this task is to determine the steps that will lead to the manufacture of the technologies developed in this project and the commercialization of the project's results. This task will be funded solely by DEC matching funds.

The Recipient shall:

- Conduct detail economic analysis for the ~~HydroMax~~ **OmniGas** system to determine accurate capital cost estimates, operating and maintenance costs, expected annual fuel costs and anticipated internal rate of return and payback on investment.
- Perform scalability analyses to identify potential issues and solutions regarding sizing the reactor system for industrial applications.
- Develop a commercialization plan moving forward that identifies potential gaps in the overall strategy and puts plans in place to resolve them.
- Engage with manufacturing companies and equipment vendors to assess initial designs, identify unique issues and determine optimal manufacturing processes.
- Prepare economic proforma for the commercial-scale industrial ~~HydroMax~~ **OmniGas** system.
- Prepare summary of scalability analysis for inclusion in the final report.
- Prepare commercialization plan including strategies to bridge potential gaps.
- Prepare draft of a production unit procurement specification including materials and parts list.

### **Products:**

- ~~HydroMax~~ **OmniGas** Commercialization Plan Report: This plan report will document strategies and approaches for taking the demonstration system to a commercial production capability including how to bridge potential gaps in designing from a demonstration to a production system.
- Production Procurement Specification (Draft): This will include a procurement specification for the entire ~~HydroMax~~ **OmniGas** system including requirements, materials, and a parts list.

**Due Date:** ~~December 1, 2011~~ **February 28, 2013**

## Budget Details

Recipient: Diversified Energy Corporation

Project Title: Reducing California Industrial Natural Gas Consumption Through Advanced Biomass Gasification

### Personnel - Direct Labor, Unloaded Hourly Rates

(Please provide Name and Title OR Job Classification)

Name	Title / Job Classification	Rate Range over term of project*	Number of Hours	Total Cost
Schenk, Steve	VP - Special Projects	80.29	839	67,328
Keeler, Christopher	Senior Engineer	43.27	2,662	115,202
<u>Dr. George Kosanovich, PhD, Chem-E</u>	<u>Director of Programs</u>	<u>80.29</u>	<u>839</u>	<u>67,328</u>
<u>Scott Cheney, BS Chem-E</u>	<u>Senior Engineer</u>	<u>43.27</u>	<u>2,662</u>	<u>115,202</u>
<b>TOTAL PERSONNEL COST</b>				<b>182,530</b>

\* Maximum salary rate is considered to be a cap: PIER will not reimburse at a higher rate over the term of the project.

### Fringe Benefits

Name	Title / Job Classification	FB % Range over term of project*	Direct Labor Cost	Total Cost
Schenk, Steve	VP - Special Projects	0.18	67,328	12,119
Keeler, Christopher	Senior Engineer	0.18	115,202	20,736
<u>Dr. George Kosanovich, PhD, Chem-E</u>	<u>Director of Programs</u>	<u>0.18</u>	<u>67,328</u>	<u>12,119</u>
<u>Scott Cheney, BS Chem-E</u>	<u>Senior Engineer</u>	<u>0.18</u>	<u>115,202</u>	<u>20,736</u>
<b>TOTAL FRINGE COST</b>				<b>32,855</b>

\* Maximum fringe benefit rate is considered to be a cap: PIER will not reimburse at a higher rate over the term of the project.

### Travel, Pre-approved

Location	Purpose	Number of People	Total Cost
Sacramento, CA	Attend Kick-off Meeting, 1 trip	2	900
Sacramento, CA	Critical Project Review Meetings, 2 trips	2	1,800
Sacramento, CA	Final Meeting, 1 trip	2	900
Grand Forks, ND	Procure Components and Assemble HM, 5 trips	2	7,200
Grand Forks, ND	Setup and Test, 3 trips	2	5,250
Eureka, CA	conduct infrastructure mods, 2 trips	1	1,300
Eureka, CA	Reassemble at site, 3 trips	2	2,700
Eureka, CA	Testing, 7 trips	1	12,425
<u>Wyle Laboratories, San Bernadino, CA</u>	<u>Procure Components and Assemble Reactor System, 5 trips</u>	<u>2</u>	<u>7,200</u>
<u>Wyle Laboratories, San Bernadino, CA</u>	<u>Setup and Test, 3 trips</u>	<u>2</u>	<u>5,250</u>
<u>Wyle Laboratories, San Bernadino, CA</u>	<u>Conduct infrastructure mods, 2 trips</u>	<u>1</u>	<u>1,300</u>
<u>Wyle Laboratories, San Bernadino, CA</u>	<u>Reassemble at site, 3 trips</u>	<u>2</u>	<u>2,700</u>
<u>Wyle Laboratories, San Bernadino, CA</u>	<u>Testing, 7 trips</u>	<u>1</u>	<u>12,425</u>
<b>TOTAL TRAVEL COST</b>			<b>32,475</b>

\* PIER Share: Travel is reimbursed at State rates. Higher travel costs can count as Match Share.

### Equipment

Item	Quantity	Unit Cost	Total Cost
Various Reactor Components	Various	Various	200,000
<b>TOTAL EQUIPMENT COST</b>			<b>200,000</b>

### Materials

Item	Quantity	Unit Cost	Total Cost
NONE	NONE	NONE	0
<b>TOTAL MATERIALS COST</b>			<b>0</b>

**Subcontracts**

Subcontractor Name	Purpose	Total Cost
EERC	Initial Unit Assembly, Testing, Transportation, and Re-Assembly On-Site	300,000
Evergreen Pulp	On-Site Project Layout and Gasifier Integration	71,301
<b>Wyle Laboratories, San Bernadino, CA</b>	<b>Unit Assembly and Test Support On-site</b>	<b>300,000</b>
<b>Wyle Laboratories, San Bernadino, CA</b>	<b>On-Site Support for Gasifier Integration and Control Equipment</b>	<b>71,301</b>
<b>TOTAL SUBCONTRACTS COST</b>		<b>371,301</b>

**Miscellaneous**

Item	Purpose	Total Cost
Graphics, Printing, and Reproduction	Reports and Presentations	9,000
<b>TOTAL MISCELLANEOUS COST</b>		<b>9,000</b>

**Indirect Overhead**

Indirect Overhead Base	Indirect Overhead % Range over term of project*	Base Cost	Total Cost
NONE	NONE	NONE	0
<b>TOTAL INDIRECT OVERHEAD COST</b>			<b>0</b>

\* Maximum Indirect Overhead rates are considered to be caps: PIER will not reimburse at higher rates over the term of the project.

**General & Administrative Overhead**

G&A Overhead Base	G&A Overhead % Range over term of project*	Base Cost	Total Cost
Total Direct Labor + Fringes	113%	215,385	243,385
<b>TOTAL G&amp;A COST</b>			<b>243,385</b>

\* Maximum G&A rates are considered to be caps: PIER will not reimburse at higher rates over the term of the project.

**Summary Category Budget**

<b>Summary Category Budget</b>							
<b>Recipient:</b>	Diversified Energy Corporation						
<b>Project Title:</b>	Reducing California Industrial Natural Gas Consumption Through Advanced Biomass Gasification						
<b>Budget Category Item</b>	<b>Amd. 1 PIER Share</b>	<b>Original PIER Share</b>	<b>Amd. 1 Match Share</b>	<b>Original Match Share</b>	<b>Amd. 1 Total Cost</b>	<b>Original Total Cost</b>	
<b>Personnel:</b>							
Personnel Direct Labor	110,253	110,253	72,277	72,277	182,530	182,530	
Fringe Benefits	19,845	19,845	13,010	13,010	32,855	32,855	
<b>Total Personal Services</b>	<b>130,098</b>	<b>130,098</b>	<b>85,287</b>	<b>85,287</b>	<b>215,385</b>	<b>215,385</b>	
<b>Operating Expenses:</b>							
Travel	24,091	24,091	8,384	8,384	32,475	32,475	
Equipment			200,000	200,000	200,000	200,000	
Materials			0	0	0	0	
Subcontracts	191,300	191,300	180,001	180,001	371,301	371,301	
Miscellaneous	7,500	7,500	1,500	1,500	9,000	9,000	
<b>Total Operating Expenses</b>	<b>222,891</b>	<b>222,891</b>	<b>389,885</b>	<b>389,885</b>	<b>612,776</b>	<b>612,776</b>	
<b>Overhead:</b>							
Indirect Overhead	0	0	0	0	0	0	
G&A Overhead	147,011	147,011	96,374	96,374	243,385	243,385	
<b>Total Overhead</b>	<b>147,011</b>	<b>147,011</b>	<b>96,374</b>	<b>96,374</b>	<b>243,385</b>	<b>243,385</b>	
<b>TOTAL COST</b>	<b>\$500,000</b>	<b>\$500,000</b>	<b>\$571,546</b>	<b>\$571,546</b>	<b>\$1,071,546</b>	<b>\$1,071,546</b>	
<b>% of Total Cost</b>	<b>46.7%</b>	<b>46.7%</b>	<b>53.3%</b>	<b>53.3%</b>	<b>146.7%</b>	<b>146.7%</b>	