

TECHNICAL REVIEWERS' RATING SUMMARY

R002-C

Development of Economically Sustainable Distributed Power from Biomass Gasification for North Dakota

Submitted by Energy & Environmental Research Center

Principal Investigators: Debra F. Pflughoeft-Hasset

Request for \$50,000; Total Project Costs \$100,000

| <u>Rating Category</u> | Weighting <u>Factor</u> | Technical Reviewer | | | Average Weighted <u>Score</u> |
|-------------------------------|----------------------------|-----------------------|-----------|-----------|-------------------------------------|
| | | <u>2C</u> | <u>2E</u> | <u>2H</u> | |
| Objectives | 9 | 2 | 4 | 3 | 27.00 |
| Achievability | 9 | 1 | 5 | 5 | 33.00 |
| Methodology | 7 | 4 | 4 | 4 | 28.00 |
| Contribution | 7 | 2 | 3 | 4 | 21.00 |
| Awareness | 5 | 4 | 5 | 5 | 23.33 |
| Background | 5 | 4 | 5 | 5 | 23.33 |
| Project Management | 2 | 4 | 5 | 4 | 8.67 |
| Equipment Purchase | 2 | 5 | 5 | 5 | 10.00 |
| Facilities | 2 | 4 | 5 | 5 | 9.33 |
| Budget | 2 | 3 | 5 | 5 | 8.67 |
| Average Weighted Score | | 141 | 220 | 216 | 192.33 |
| Maximum Weighted Score | | | | | 250.00 |

OVERALL RECOMMENDATION

| | | |
|---------------------------|---|---|
| FUND | x | x |
| FUNDING MAY BE CONSIDERED | x | |
| DO NOT FUND | | |

R002-C

Development of Economically Sustainable Distributed
Power from Biomass Gasification for North Dakota
Submitted by Energy & Environmental Research Center
Principal Investigators: Debra F. Pflughoeft-Hasset
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- 1. The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Renewable Energy Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.**

Reviewer 2C (Rating: 2)

Is this a marketing activity for a device of early technology which is obsolete and of questionable efficiency and which questionable is labor intensive at producing gas of questionable quality?

Reviewer 2E (Rating: 4)

The proposed project is an extension of a previous project utilizing an existing 50-kW biomass gasification system. The proposal does not identify what specific biomass materials were used in the previous research. However, the proposed project intends to evaluate up to five (5) different biomass materials with respect to the environmental and economic benefits of gasification.

The project objectives appear to match many of the Renewable Energy Council's goals/objectives and may offer potential benefits on a State-wide basis. The development of post-project educational materials and a site specific, self-assessment workbook is particularly noteworthy.

Reviewer 2H (Rating: 3)

Proposal should have addressed the NDIC/REC's goals more specifically. Overall, the objectives stated in the proposal align with the NDIC/REC's goals, but the proposal should have indicated how the NDIC/REC's goals and purposes would be met point by point. The NDIC/REC's first and third goals can be clearly identified in the proposal's objectives section, but the other goals need to be gleaned out of the remainder of the proposal.

- 2. With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or 5 – certainly achievable.**

Reviewer 2C (Rating: 1)

Too small a budget to produce meaningful results. Appears to be mainly information collecting.

Reviewer 2E (Rating: 5)

Since this project is an extension of a previous biomass gasification project (successful), the objectives certainly appear achievable. The incorporation of up to five different biomass fuel

materials into the gasification process will benefit from the knowledge and experience gained from the previous effort.

Reviewer 2H (Rating: 5)

Considering the little if any equipment must be purchased and installed, the objectives of this proposal should be very achievable with the budget and timeline proposed.

- 3. The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.**

Reviewer 2C (Rating: 3)

This is routine testing that has been conducted by many other organizations.

Reviewer 2E (Rating: 4)

The methodology is assumed to be consistent with the previous biomass gasification project which was proven successful. Therefore, the proposed methodology appears suitable for the other biomass materials to be evaluated.

Reviewer 2H (Rating: 4)

The methodology in the proposal is very appropriate for the project. The existence of in place equipment and research facilities reduces the methodology to basic research and reporting which the EERC is very accustomed to performing.

- 4. The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Renewable Energy Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.**

Reviewer 2C (Rating: 2)

This is an old design of gasifier with some new updates. Industry is not likely to favor procurement of this equipment as newer concepts with much more advanced features are producing a high quality of gas that is producing desirable liquid fuels.

Reviewer 2E (Rating: 3)

Gasification technology isn't new technology from a scientific perspective. However, the further development of gasification technology with respect to biomass resources prevalent in North Dakota is supported by this reviewer.

Reviewer 2H (Rating: 4)

The contribution of this proposal to the NDIC/REC's goals will be very significant. With the rising cost of fossil fuel prices, many small businesses, communities, schools and agricultural industries will be searching for alternative methods to heat and power their facilities. The results of this proposal will be used to educate and prove that biomass is an economic and environmentally sound alternative to fossil fuels.

- 5. The principal investigator's awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.**

Reviewer 2C (Rating: 4)

Good work has been done in preparing the references. Further effort of this level needs to be done in investigating the accomplished activity of competitors.

Reviewer 2E (Rating: 5)

The co-principal investigators knowledge and experience in the area of biomass gasification appears excellent. The proposed project is an extension of a previous project conducted by the EERC.

Reviewer 2H (Rating: 5)

The co-investigator's indicated in the proposal have many years of experience with not only biomass as an alternative fuel source, but also with gasification of biomass.

- 6. The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.**

Reviewer 2C (Rating: 4)

The background that was submitted on Ms. Pflughoeft-Hasset is rather impressive. Her Academic Achievements would enhance her accomplished work.

Reviewer 2E (Rating: 5)

The co-principal investigators have a combined 40+ years of experience researching biomass utilization and energy production.

Reviewer 2H (Rating: 5)

See comment in number 5 above.

- 7. The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.**

Reviewer 2C (Rating: 4)

The EERC is very well experienced at managing millions of dollars of contracts.

Reviewer 2E (Rating: 5)

The project management plan, financial plan and communications plan are well defined. The proposed project cost share is 50% REC grant (\$50,000) and 50% ERDC-CERL funds (\$50,000).

Reviewer 2H (Rating: 4)

Again, with the minimal need to purchase equipment, the milestone chart, schedule, financial plan and plan for communication is very adequate for this proposal.

- 8. The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)**

Reviewer 2C (Rating: 5)

Reviewer 2E (Rating: 5)

The proposed project does not indicate a need for capital expenditures for equipment acquisition.

Reviewer 2H (Rating: 5)

No need to purchase equipment as it is already installed and in operation.

- 9. The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.**

Reviewer 2C (Rating: 4)

The EERC has well developed facilities.

Reviewer 2E (Rating: 5)

The proposed project is an extension of a previous project and thus, the facilities and equipment should be ideal due to prior successful utilization.

Reviewer 2H (Rating: 5)

As indicated in the proposal, the EERC has been conducting research of this type and magnitude since 1951 and is known worldwide for its research.

- 10. The proposed budget “value” relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value. (See below)**

Reviewer 2C (Rating: 3)

This is nonexceptional funding to promote a nonexceptional gasifier.

Reviewer 2E (Rating: 5)

The request for \$50,000 in REC grant funding appears to be a good investment based on the potential State-wide benefit to North Dakota.

Reviewer 2H (Rating: 5)

If this proposal can provide the technical and educational information needed by different public and private entities across North Dakota to implement biomass gasification systems to provide both heat and power there will be a very high value to this proposal. There would need to be very few entities that would need to install and utilize this technology for this proposal to have made a significant impact in reduced need for fossil fuels across North Dakota.

Financial commitment from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Higher priority is to be given if the application has private industry investment equal to or at least 50% or more of total cost.

The minimum 50% cash match is demonstrated.

Section C. Overall Comments and Recommendations:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 2C (Funding May Be Considered)

The overall objective of this funding request appears to be to demonstrate the ability of a small scale gasifier to convert local materials of low value and abundant volume into energy products such as electricity or heat.

The choice of a small scale gasifier to process abundant raw material for a useful purpose is an excellent idea. The problem is the choice of candidate gasifier and the use that the resultant gas is employed in.

In this case the candidate gasifier is an early generation device that had its origin as a village gasifier in a developing nation. The quality standard of gas output as well as the amount of labor needed to sustain operation and maintenance were not of great importance. In its birth environment and time of development it did quite well.

Other engineering organizations reviewed the suggested gasifier in its foreign home site and established a list of design and operational criteria that would be necessary to successfully operate a small scale gasifier on the American scene.

The foresightedness of these engineers has resulted in a very successful program that over the past six years yielded sales of well over fifty units to The U.S. Forest Service, grade and high schools, and universities in Alabama and Montana. The state of Minnesota's National Resource Lab in Culeraine, Minnesota also has an operating gasifier. A unit has been installed on a farm in California that is operating daily consuming walnut shells and meeting California's strongest emission standards.

In documents issued by the EERC in 2006, the ash and char emitted from their gasifier with a 1274 lbs/hr fuel input would be 64 lbs/hr with 382 lbs/hr of effluent water. Interesting calculations can be made if it is assumed that perhaps 4% of the wood fuel is silica. This would result in the ash having at least 51 lbs of noncombustible material or about 80% of the total and the balance 20% (13lb) of char.

To their credit, it appears that the EERC group has devised bolt on equipment that provides for burning the surplus char and filter materials. This would appear to be a labor intense activity.

The 382 lbs/day of effluent water appears also to have been replaced with a requirement of 25 gallons per day of makeup water. If true, this is a very reasonable amount of water, if any is required.

Competing gasifiers have been known to produce an ash of only 2% char and 98% noncombustible mineral. Additionally no make up water is required and no efficient water is discharged. There are no filters to be serviced and ash is removed on a weekly basis. All operational events are microprocessor controlled. The quality of the gas produced has been exceptional, in fact requiring the establishment of new standards to better describe the level of achievement.

As described in our opening paragraph, the EERC request is for efforts to produce syngas from their small scale unit as well as to demonstrate the employment of this gas. Using a gasifier to convert cellulosic fuel to a product to be used for heating would be much more efficient than merely burning the cellulose for its sensible heat.

Except for a few special applications, the use of a small scale gasifier to make electricity here in the state of North Dakota is not only economically marginal, but is not of much help in the current energy market.

There is an urgent need for rural North Dakota communities to be able to generate their own liquid fuel from local resources. A small scale gasifier can be an important component to solving this problem. Processes that convert syngas to liquid fuel require exceptionally clean gas in order not to poison catalysts, or in some cases bacteria, employed in the chemical conversion process.

The Universities of Arkansas and Oklahoma are marketing small scale gasifier ethanol plants that utilize bacteria to convert the syngas to ethanol. General Motors Corporation has contracted with the Oklahoma group and Westinghouse Plasma to produce a small pilot plant.

A Colorado based engineering group has been operating a small syngas to diesel fuel plant for over a year and is in a semi production status for the equipment package.

Recommendations:

Given the rather admirable credentials of Ms. Pflughoeft-Hasset in her many years of pursuing documents, it is suggested that she be funded to investigate the work that has already been done

in by other small scale gasifier organizations and collate this data in a manner suitable to the manufacture of liquid fuels in the local rural level in North Dakota.

The much admired EERC has a world wide reputation for originality and vision as well as having a staff of high intellectual achievement. It is suggested that the EERC should revisit their current position with regard to the small scale gasifier and the type of liquid fuel it can successfully generate.

The market for small scale gasifiers has been growing and offering advanced technology such as plasma and microwave. It does not seem justifiable to promote the sale of an early generation device.

Reviewer 2E (Fund)

The proposed project is an extension of a previous project which developed a biomass system utilizing gasification for thermal and electrical power purposes. It was not clear what specific biomass materials were evaluated under the original project(s). However, the proposed project would evaluate the gasification potential of up to five (5) different biomass materials (prevalent in North Dakota) including the handling issues associated with process bi-products such as emissions, ash residual and wastewater.

The proposed project may be of great benefit to small industrial and agricultural operations on a State-wide basis. Also, the proposed development of post-project educational materials and a site specific, self-assessment workbook seems particularly beneficial.

It is “not clear” that an investment in this project will:

- Generate information and knowledge that will have the highest probability of bringing new renewable energy companies and industry investment to North Dakota.
- Have the highest potential for creating new renewable energy jobs, wealth, and tax revenues for North Dakota.
- Maximize the market potential for renewable energy resources and the associated byproducts produced therewith.

It is “certainly” clear that an investment in this project will:

- Most effectively educate the general public about the benefits and opportunities provided by the North Dakota renewable energy industry.
- Preserve existing jobs and production levels.
- Identify and develop renewable energy technologies presently not used in North Dakota.
- Develop baseline information that will lead to other projects, processes, ideas and activities.

Reviewer 2H (Fund)

In general the proposal is very well written and of significant merit to the NDIC/REC. Gasification of biomass is in need of more research in North Dakota as an alternative fuel source. There are very few people in the general public who knowledgably understand what gasification is and how it can be used and what fuel sources are available in North Dakota for gasification.

This proposal should be able to prove the viability of biomass gasification in North Dakota. I recommend funding of this proposed project.