

TECHNICAL REVIEWERS' RATING SUMMARY

R017-B

Distributed Nitrogen Fertilizer Plant - Engineering and Development

Progressive Nutrient Systems, LLC

Principal Investigator: Dan Olson

Request for \$500,000; Total Project Costs \$1,000,000

<u>Rating Category</u>	<u>Weighting Factor</u>	<u>Technical Reviewer</u>			<u>Average Weighted Score</u>
		<u>3A</u>	<u>3B</u>	<u>3C</u>	
1. Objectives	9	5	4	2	33.00
2. Achievability	9	5	5	4	42.00
3. Methodology	7	5	4	3	28.00
4. Contribution	7	5	4	1	23.33
5. Awareness	5	4	2	1	11.67
6. Background	5	5	4	4	21.67
7. Project Management	2	4	3	2	6.00
8. Equipment Purchase	2	5	5	5	10.00
9. Facilities	2	5	4	4	8.67
10. Budget	2	5	4	3	8.00
Average Weighted Score		243	199	135	192.33
Maximum Weighted Score					250.00

OVERALL RECOMMENDATION

FUND	X	X	
FUNDING MAY BE CONSIDERED			X
DO NOT FUND			

R017-B
Distributed Nitrogen Fertilizer Plant – Engineering and Development
Progressive Nutrient Systems, LLC
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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 3A (Rating: 5)

Objective is specifically stated: a “basic engineering design package” (BEDP) will be performed to prepare for a bio-fertilizer (urea) process facility to be constructed adjacent to an existent bioethanol biorefinery within a year of the end date for this proposal (if funded). Sub-objectives, i.e., components of the BEDP, are specified.

Reviewer 3B (Rating: 4)

The project fits well within NDICREC goals. It would utilize waste products from corn ethanol plants (biogas and CO₂) to produce ammonia and urea fertilizers. These renewable fertilizers would be used to replace conventionally produced fertilizers. The ethanol plant itself will consume 40% of the fertilizers to provide yeast nutrients, and subsequently enhance the protein content of the DDGS. The remaining 60% of fertilizer will be used by surrounding farmers. Thus the renewable fertilizers will help reduce the carbon footprint of ethanol production both in the conversion process and in feedstock (corn) production. The energy source to be used in this process is not clear, but a renewable source such as windpower or biomass combustion or pyrolysis would further enhance the carbon balance.

Reviewer 3C (Rating: 2)

This is a proposal of acquiring funding for the development of a business planning (or a process design). The expected outcome of this proposal is an engineering design package, which is proposed to utilize methane from biogas as a feedstock to produce fertilizers. Although the feedstock may come from bio-based resources, the process or the product out of this proposal is not renewable energy related. In other words, this is a project that does not clearly align with the goals set by the North Dakota Industrial Commission/ Renewable Energy Council.

- 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 3A (Rating: 5)

The applicants convincingly have demonstrated that the construction and operation of the fertilizer facility will be economically feasible, with their plans for completing the BEDP being “ready deployable”.

Reviewer 3B (Rating: 5)

The objectives of the project are focused on achieving a “Basic Engineering Design Package” for the first commercial plant, including environmental permitting, property surveying and insurance reviews and other pre-construction, development work. The team has sufficient experience in these areas, and the budget and timeline are appropriate.

Reviewer 3C (Rating: 4)

The project (i.e., the Basic Engineering design Package) is most likely achievable as outlined.

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 3A (Rating: 5)

The methodology outlined for the BEDP appears to be of a high quality. The methodology associated with production of bio-fertilizer has been well established through licensing of a patent generated in North Dakota, ND, (EERC) and urea processing expertise possessed by AGREBON, a partner in this project.

Reviewer 3B (Rating: 4)

Standard protocols are described to achieve the proposed design and permitting objectives, and these look to be sufficient.

Reviewer 3C (Rating: 3)

No technical details as presented in the proposal are available for comment.

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 3A (Rating: 5)

The scientific merit of this proposal is high. The use of a lowcost co-product from an existing ND bioethanol facility to as a feedstock to manufacture urea using a novel technological approach is meritorious. The applicants prepared an economic assessment showing that the proposed facility will generate a significant number of jobs, provide ND with tax revenues, and provide a regular source of fertilizer needed by farmers in the region.

Reviewer 3B (Rating: 4)

If successful, the project could readily be extended to the other ethanol plants in ND, as well as throughout the US. The applicants have put forth a preliminary economic impact analysis using a ND Dept of Commerce template, and this analysis shows a significant benefit of deploying this technology.

Reviewer 3C (Rating: 1)

The contribution from the outcome of this project (i.e., the Basic Engineering design Package) will not significantly address the goals set by the North Dakota Industrial Commission/ Renewable Energy Council. This project itself does not address any of the goals at all.

- 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 3A (Rating: 4)

Fertilizer processing technology is very well established. However, the sustainable processing of urea using patented technology appears to be novel.

Reviewer 3B (Rating: 2)

The proposed process makes use of standard, off the shelf technology for most aspects, along with technologies developed by EERC. They have mentioned eventual incorporation of an electrochemical process for ammonia production, which has been patented by EERC. The literature review is limited, and additional exploration may uncover more recent developments that could be evaluated for future use.

Reviewer 3C (Rating: 1)

No discussions on current research activity and published literature are documented in the proposal to show the awareness.

- 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 3A (Rating: 5)

Applicants and their partners have outstanding expertise in the production of bio-fertilizer and in preparing BEDP studies. Benchmark Design, LLC, the firm who will prepare the BEDP, has experience working with bioethanol facilities.

Reviewer 3B (Rating: 4)

The team has acceptable levels of experience in the technology and business aspects necessary to successfully complete this project.

Reviewer 3C (Rating: 4)

The investigators have all the needed expertise to conduct the activities as illustrated in the proposal, i.e., the engineering process design.

- 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 3A (Rating: 4)

A specific project management plan is not given in great detail. However, the elements in place for the effective management of this project will take place. The applicant, PNS (the owner of the bio-fertilizer facility), AGREBON (the entity to complete the design, construction, and operation of the facility), a venture capital supplier of both of these entities (Leading Edge Angel Fund), and the Theraldson Ethanol biorefinery are well integrated. A project manager from AGREBON will be dedicated to this project, interacting with Benchmark and CEAMAG to oversee the BEDP and ammonia synthesis reactor design, respectively.

Reviewer 3B (Rating: 3)

The management plan for the team is acceptable, with a project schedule (including periodic status reports) that should allow the objectives to be completed in a timely manner.

Reviewer 3C (Rating: 2)

There is a management plan in the proposal. However, the milestones are not clearly set or not obviously measurable.

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 3A (Rating: 5)

No equipment will be purchased.

Reviewer 3B (Rating: 5)

No equipment is requested.

Reviewer 3C (Rating: 5)

No equipment is proposed to purchase.

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 3A (Rating: 5)

“Facilities and equipment available” is interpreted to refer to the tools needed to complete the BEDP, which are perceived to be very good, by the subcontractors Benchmark and CEAMAG.

Reviewer 3B (Rating: 4)

The project is an engineering design project that will only require office equipment and facilities.

Reviewer 3C (Rating: 4)

Once again, no details are provided except general descriptions on resources all participants have, which are assumably very good for conducting this project.

10. The proposed budget “value”¹ 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 3A (Rating: 5)

The budgeted BEDP will lead directly to construction and operation of a bio-fertilizer facility, which will create employment opportunities and revenue for ND.

Reviewer 3B (Rating: 4)

If successfully deployed, the project will have high value to ND compared to the investment of state and private dollars. The project uses primarily off the shelf technologies, and thus the proposed engineering design package, coupled with a thorough economic analysis, should clearly indicate if commercialization is justified.

Reviewer 3C (Rating: 3)

It is difficult to comment on the value out of this project. This is largely due to the nature of this project.

¹ “Value” – The value of the projected work and technical outcome for the budgeted amount of the project, based on your estimate of what the work might cost in research settings with which you are familiar.

10a. 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 3A (Fund)

This is a strong proposal to prepare a basic engineering design package (BEDP) to construct and operate a bio-fertilizer facility in conjunction with a specified and existing bioethanol biorefinery

within one year of completion of this project if funded. The strengths are many. The applicants and their partners have significant expertise in bio-fertilizer manufacture and bioethanol manufacturing facilities. The technology, based on a patent developed in ND, is well suited for demonstration-scale bio-fertilizer production. The application's Appendix II demonstrates the delivery of jobs and tax revenue for ND. The plans for the BEDP are sufficiently detailed. One reading this proposal is convinced that the applicants are strongly dedicated to build the bio-fertilizer facility. The use of a low-cost co-product stream from the ethanol biorefinery as a feedstock to prepare hydrogen gas needed for ammonia synthesis via anaerobic digestion and a patented conversion technology is an excellent real-world example of a sustainable biorefinery operation. There appears to be a demand for a local source of fertilizers by farmers residing near the Tharaldson Ethanol facility. The only concern is regarding the economic feasibility of the fertilizer production. Will the applicants' production of bio-fertilizer be cost-competitive with fertilizer produced by larger manufacturers? Will local farmers be willing to pay a slightly higher price for fertilizer produced by PNS/AGREBON compared to fertilizer prepared by larger manufacturers?

Reviewer 3B (Fund)

Recommendation to fund. Project would have substantial benefits to ND ethanol producers and farmers by creating a more sustainable source of nitrogen based fertilizers, while also reducing the carbon footprint of both ethanol and fertilizer production. The process would take advantage of existing infrastructure, and therefore could be deployed in short order at multiple sites, thereby creating benefits for many parties. The proposal would create an engineering design package and environmental assessments for the technology, which then would serve as the basis for commercial deployment. The participants have assembled a strong and experienced team, and have laid out a logical work order for the project.

Reviewer 3C (Funding May Be Considered)

This proposal is really about conducting an engineering design on a technology that will utilize the methane from biogas, which may come from bio-based resources, to produce agrochemicals or fertilizers.

The proposal attempts to establish this project next to corn ethanol facilities in North Dakota. The fertilizer plant may eventually relate to bioethanol facilities indirectly, but not the project presented in this proposal. Therefore, this project is not addressing the goals set by the North Dakota Industrial Commission/Renewable Energy Council.

The fertilizer plant project does provide jobs and environmental benefits to North Dakota, which are the strength of this proposal. It is the North Dakota Industrial Commission/ Renewable Energy Council who makes the final interpretation on if this proposal aligns with its mission, which is to promote the growth of North Dakota's renewable energy industries through research, development, marketing, and education.