

BM006-B
Biomass Processing, A Mobile Demonstration
and Education Program

North Dakota State University
Principal Investigators: Dr. Cole Gustafson
Request for \$580,710; Total Project Costs \$708,910

<u>Rating Category</u>	<u>Weighting Factor</u>	<u>Technical Reviewer</u>			<u>Average Weighted Score</u>
		<u>2A</u>	<u>2B</u>	<u>2C</u>	
1. Objectives	9	2	4	4	30.00
2. Achievability	9	5	3	4	36.00
3. Methodology	7	3	4	3	23.33
4. Contribution	7	1	4	3	18.67
5. Awareness	5	3	3	3	15.00
6. Background	5	3	4	4	18.33
7. Project Management	2	3	4	4	7.33
8. Equipment Purchase	2	2	4	4	6.67
9. Facilities	2	3	4	3	6.67
10. Budget	2	2	4	3	6.00
Average Weighted Score		141	186	177	168.00
Maximum Weighted Score					250.00

OVERALL RECOMMENDATION

FUND	x
FUNDING MAY BE CONSIDERED	x
DO NOT FUND	x

BM006-B
Biomass Processing, A Mobile Demonstration and Education Program
Submitted by North Dakota State University
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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 2A (Rating: 2)

Primary Producers of Biomass, which are farmers and landowners, will obtain little value from observing mobile biomass processing demonstrations. The primary concerns of this group revolve around growing a relevant feedstock crop of the selected species on their lands and how this can be integrated with their current farming practices. Post harvesting processing of biomass will unlikely be carried out on the farm due to inefficiencies of scale.

The actual equipment demonstration is of secondary importance. What is being proposed is an educational program. The equipment is utilized to engage participants in discussion. Most producers have not seen specialized grinding or pelleting equipment. It is possible that post harvest processing could end up off-farm. However, three factors may result in at least some on-farm processing – 1) a sizeable retail market likely exists in ND that individual farmers could supply (such is the case for Show Me Energy where 1/4 of production is sold retail at \$150 ton, 2) Biomass is extremely bulky, thus high transportation costs may limit off-site processes at great distance, and 3) On-farm processing would provide more value-added to individual producers. Regardless, farmers who intend to supply biomass to an off-site processor need to be informed of quality standards, optimal harvest timing, and other procedures that differ from traditional crop processing.

Reviewer 2B (Rating: 4)

Addresses important educational needs of potential biomass producers/suppliers.

Reviewer 2C (Rating:4)

This project will generate valuable information, but more importantly educate producers in the state. It meets 4 of the 8 grant priority guidelines provided to the reviewer. The proposal does focus on the technology development end of things and on technical assistance to landowners. The only concern I have is that over half the funding is requested to outfit a research lab. The equipment selected would certainly provide valuable information for research in this project and others, but I do not know if that aspect fits well with the REC goals.

As with everything, quality is critical. Feedstock (biomass) quality is important to be able to produce high quality end-products at least cost. Little is known about the quality characteristics of biomass and its effect on end-product quality or the processes required to create high quality end-products. Without this equipment, it will be impossible to know about the effects of quality on processes and end-products. This is a critical missing link in biomass utilization.

- 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 2A (Rating: 5)

I believe the NDSU project objectives can be achieved as per the proposal.

Reviewer 2B (Rating: 3)

Concept is good. Not sure that the equipment proposed or available to demonstrate is the most applicable. While being able to see something operate is an important educational approach, I am not sure the equipment available provides the best educational experience. Proposed lab will support education and research efforts.

The equipment proposed is a starting point. The Reaction Panel will have final input to equipment selection. After proposal was submitted, Jim Flaherty Sr., Federal Machine, contacted me to offer his support and interest in collaboration. He was contacted earlier, but didn't reply due to health issues. Our goal would be to demonstrate a variety of technologies.

In addition to demonstrations, a website, brochures, and video will be prepared to widely circulate and leverage information. Last year, Dr. Gustafson delivered 40 biomass presentations/workshops in 10 states. Even though the equipment won't be present for all of them, the information will still be included.

Reviewer 2C (Rating: 4)

I believe the objectives of the proposal are easily achievable in the proposal's timeline. The educational program plan is sound and should provide some good benefit to agricultural producers. The development of a testing lab also is very doable in the timeframe allotted.

- 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 2A (Rating: 3)

The quality of the methodology as it pertains to achieving the goals of the NDSU proposal are sufficient. However, the proposal appears to represent a very narrow view of the Commission's objectives, being heavily weighted toward capital investment in equipment by NDSU.

We take a broader view of the objectives and believe this educational program is the first step to building awareness and development of a biomass industry in ND.

Reviewer 2B (Rating: 4)

Methodology is good if adequate demonstrations can be developed.

Reviewer 2C (Rating: 3)

The methodologies described in this proposal would certainly work. The educational program model being used has been developed over many years with different technologies and crops. The technology to be used in the lab is also proven technology and the use of it is fairly straight forward.

The part of the methodology that concerns me is mobile pelletization. The pellet mill itself is not a significant issue, it is the feedstock coming in. the author is correct in stating moisture content is critical. Pelleting is an art, not a straight process, and will take some development. Going from bale to pellet will be challenging from the standpoint of handling, moisture content, grinding, etc. The author suggests that in year two, a bale will be ground at the trailer for pelleting. The type of grinder purchased will be critical to the success of the pelleting. The particle size on the material must be small enough for pelleting. A large tub grinder will have difficulty getting down that small, in most cases, another step with a hammermill is required. Pellet cooling is also critical and the author should consider that as well. Counter flow type coolers can be built for this scale rather easily.

We concur that pelleting is an art. In addition to reviewer's concerns, sufficient volume must be processed to create enough heat to enable pelleting – which is difficult to develop in a demonstration setting. Yet, this is generally unknown to producers. Overcoming these challenges is part of the development step and educational program. To start, we will likely pellet beforehand and only have products available in tubs until process is perfected.

With respect to grinding, we concur with the concern about tub grinders. That is why our budget includes funding for a specialized grinder, not a tub grinder. Perhaps the reviewer overlooked that piece in our equipment list. The suggestion regarding coolers is welcome.

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 2A (Rating: 1)

Pilot scale Biomass Processing Demonstrations are widely available across the U.S. and globally today. Reinventing the wheel would not expedite or optimize the development of North Dakota's biomass processing industry. The capital expenditure in this proposal or development of a laboratory could be seen as a resource to the state, however, current analytical resources in the state could be employed for the majority of requirements. National laboratory resources could also be drawn upon efficiently.

Extension has a long history of sharing programs with other regions and would welcome the opportunity to partner on a project already established elsewhere. We are not aware of any demonstrations in other states, especially mobile. Cornell does have one fact sheet focused on emerging densification processes for biofuel that involve pelletizing or torrefaction (http://grassbioenergy.org/downloads/Bioenergy_Info_Sheet_7.pdf). Programs in other states

focus either on biomass collection (e.g. Poet and Chippewa Valley Ethanol corn cob collection demonstration days) or various baling demonstrations.

Reviewer 2B (Rating: 4)

Feedstock supply is important to Commission/Council goals and educational efforts for farmers ranchers will contribute to increased feedstock supply.

Reviewer 2C (Rating: 3)

This proposal will help develop a knowledge base amongst producers about uses of biomass for energy and products. Broadening the knowledge base of the clientele is incredibly important. Also, the lab developed through this grant will also provide valuable services to clients around the state.

- 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 2A (Rating: 3)

The competency of the P.I. is not in question here as evidenced by a well written and informed proposal. Applicability of the proposal to commercial reality and the objectives of the Industrial Commission is where the proposal exhibits weakness.

Since this proposal was submitted, national discussion on creation of a carbon cap/trade system has ensued. Adoption of this system will intensify interest in biomass development, especially among energy providers.

Reviewer 2B (Rating: 3)

The awareness appears to be adequate, but the literature cited is limited.

Additional resources can be provided. The proposal was constrained due to page length.

Reviewer 2C (Rating: 3)

It seems the investigator has had experience in this area and done some homework. I would encourage the author to look at a variety of pelleting experiences with grasses both in the US and in Canada. I would not focus on one operation to base all expectations on. There have been many research studies done on switchgrass and other grass pellets that can provide lots of information on what works and what does not.

We are very open to alternative technologies and will rely on guidance from the Reaction Panel. We are aware of the grass/hay pellet industry and will incorporate.

- 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 2A (Rating: 3)

From the information made available to me I have made this rating.

Reviewer 2B (Rating: 4)

Investigators background appears to be better than average, but there is not a lot of information supplied.

Reviewer 2C (Rating: 4)

The investigators background, current position, and current research efforts all represent his qualifications well.

- 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 2A (Rating: 3)

N/A – The relatively narrow focus of this proposal within a small team should offset any communication issues with the team.

Reviewer 2B (Rating: 4)

Plan looks good with important cooperators identified and involved.

Reviewer 2C (Rating: 4)

I was impressed by the overall management plan for the project. The idea for a four-person reaction panel is very good and should make for a good project. It is made up of stakeholders, yet is small enough to be effective. I like the idea. The collection of audience survey information will be valuable as well, though it may not collect much data (field day surveys are notoriously hard to get!).

- 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 2A (Rating: 2)

Little value will be obtained from this equipment long term. Here, I am particularly referencing the small scale demonstration biomass processors, tractor, trailer. Stronger support for capital investment in laboratory equipment is plausible but this should be done in the context of improving or adding to additional laboratory resources in the State that could be employed as biomass related research.

The tractor and trailer will be utilized by other NDSU researchers following completion of the project.

Reviewer 2B (Rating: 4)

Equipment list is well justified with the reservation expressed before that some of the equipment listed for use in the educational program may not provide the best educational information.

Reviewer 2C (Rating: 4)

Though expensive, the equipment spec'd out seems sufficient and appropriate. The TGA analyzer, MTI universal testing machine, ENV control chamber, and bomb calorimeter are all directly related to the pelletization demonstration and other biomass studies. The only piece of equipment I would wonder about is the tractor. Do the investigators really need 80 hp or could it be smaller?

Tractor was sized based on recommendation of two different dealers and brands. Paramount is audience and operator safety. Depending on feedstock, biomass bales could be heavier than traditional grass bales. The 80 hp tractor has a loader capacity of 3,000 lbs. which is needed to provide safety cushion when handling bales potentially weighing more than 2,000 lbs. Moreover, if additional equipment/processing alternatives are added to the trailer, we would investigate hydraulic transmission power to avoid downtime hooking/unhooking as well as insuring audience safety (power take-off shafts, chains, etc.)

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 2A (Rating: 3)

Proposed purchases will facilitate completion of the proposal.

Reviewer 2B (Rating: 4)

Cooperation with the USDA-ARS Mandan is an important strength.

Reviewer 2C (Rating: 3)

The university facilities described are all very adequate for the proposed project and should not pose a hindrance to its completion.

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 2A (Rating: 2)

A substantial sum of money is budgeted here to obtain results/objectives currently available elsewhere nationally.

Again, we would welcome receipt of these contacts if the reviewer could provide them.

Reviewer 2B (Rating: 4)

Educational program is important if they can pull it off.

\$580,710 is requested and \$128,200 is listed as external match. This does not meet the 50% of total project cost criteria. While there is contribution from NDSU in the form of the PIs salary and related support, this amount is not quantified and it is not likely to bring the total contribution from other sources to 50% of the total project cost.

We tried to find other match sources, but several potential partners had conflicts of interest. Moreover, this is very early stage development and commercial industry does not exist in the state.

Reviewer 2C (Rating: 3)

This is a difficult point to evaluate on this proposal. How do you put a value on the knowledge transfer or interest building this project can have? I think it provides average value to the knowledge base for the producers. It is not really developing new information, but simply getting the word out (which is very important). The equipment in the lab could prove beneficial to private biomass businesses in the future as they will need help with analytical services and the like. I see the state and the university gaining value from that.

Here again, the project match does not meet the 50% minimum requirement as noted below. If this minimum is to be enforced, then the project would not pass muster.

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 2A (Do Not Fund)

The proposal by NDSU is a well grounded academic project. Its principle value lies in introducing NDSU students and staff to biomass research. This value will be realized as these students graduate and become available to work in the biomass industry which will develop

independently of this proposal being completed or not. I would recommend that NDSU revisit the necessity to integrate this proposal with all stakeholders within the biomass sphere in ND.

On the ability to fulfill the objectives of the ND Industrial Commission this proposal will have limited success. My opinion is that the development of biomass processing needs to be expedited using the currently available knowledge base both nationally and globally as opposed to re-demonstrating such work in ND. I would not recommend funding of this proposal in its current format.

This project is far more than an “on-campus” exercise to educate students. The goal is to have a traveling demonstration that can educate farmers/ranchers, lenders, crop insurance agents, environmental groups and the general public across the state at shows like Big Iron, Valley City Winter Show and other agricultural shows in the state.

Reviewer 2B (Funding May Be Considered)

This is an interesting project and I believe that the educational effort is important. I wonder if there might be a more effective way to provide a visual educational experience in a demonstration mode. I don't have specific suggestions to accomplish this at this point.

We intend to develop video clips and place on NDSU Bio-Energy and Product Innovation Center web site as well as Youtube, etc.

Reviewer 2C (Fund)

I think this proposal is extremely well written and does a good job explaining the project. I think the investigator is entirely capable of making it a success.

The only other comment I would have is that I feel that some additional exploration of pelleting research and experiences would be beneficial to the project. There are many different views, experiences, and tests out there. None are perfect, but we can learn from each of them.

We intend to collaborate widely in this project. Doing so promotes peer education which is also an important aspect. We will be consulting with Kim Koch, program manager of NCI Feed Mill.