

March 2, 2010

To: Ms. Andrea Holl Pfennig

From: Dr. Igathinathane Cannayen and Dr. Cole Gustafson

Re: Clarification to Reviewers of R008-G, "Biomass Testing Laboratory for Physical and Thermal Characteristics of ND Feedstock"

Thank you for organizing the review of our grant proposal and returning the comments provided. We appreciate the reviewers' effort and time in reviewing the project proposal. The comments display excellent insight and were very helpful.

We would like to respond to the concerns raised by the reviewers. You will find our responses in *Green* following each comment of concern.

Greatly appreciate your coordination effort.

Thanks,

Igathinathane Cannayen

TECHNICAL REVIEWERS' RATING SUMMARY

R008-G

Biomass Testing Laboratory for Physical and Thermal Characteristics of ND Feedstock

North Dakota State University
Principal Investigators: Gustafson, Cannayen
Request for \$283,511; Total Project Costs \$567,022

| <u>Rating Category</u> | <u>Weighting Factor</u> | <u>Technical Reviewer</u> | | | <u>Average Weighted Score</u> |
|-------------------------------|-------------------------|---------------------------|-----------|-----------|-------------------------------|
| | | <u>5A</u> | <u>5B</u> | <u>5C</u> | |
| 1. Objectives | 9 | 4 | 4 | 4 | 36.00 |
| 2. Achievability | 9 | 4 | 3 | 5 | 36.00 |
| 3. Methodology | 7 | 4 | 3 | 4 | 25.67 |
| 4. Contribution | 7 | 5 | 4 | 4 | 30.33 |
| 5. Awareness | 5 | 4 | 2 | 2 | 13.33 |
| 6. Background | 5 | 4 | 4 | 5 | 21.67 |
| 7. Project Management | 2 | 3 | 4 | 3 | 6.67 |
| 8. Equipment Purchase | 2 | 4 | 5 | 4 | 8.67 |
| 9. Facilities | 2 | 4 | 5 | 5 | 9.33 |
| 10. Budget | 2 | 5 | 5 | 4 | 9.33 |
| Average Weighted Score | | 207 | 180 | 204 | 197.00 |
| Maximum Weighted Score | | | | | 250.00 |

OVERALL RECOMMENDATION

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

R008-G
Biomass Testing Laboratory for Physical and Thermal
Characteristics of ND Feedstock
Submitted by North Dakota State University
Principal Investigators: Gustafson, Cannayen
Request for \$283,511; Total Project Costs \$567,022

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 5A (Rating: 4)

It is important in the development of biomass-based industries that we must understand feedstock characteristics, chemical and physical. These characteristics determine the performance of the biomass in various bioenergy uses. In these new technologies, the margins between success and failure are very small and the critical understanding of the feedstock characteristics can determine those margins.

The understanding that the equipment purchased in this proposal creates will help the ND Industrial Commission's Renewable Energy Council meet its goals, specifically goals 1, 4, and 6.

The insight of the reviewer is appreciated.

Reviewer 5B (Rating: 4)

The goals of developing a service lab to test physical, thermal, and mechanical properties of biomass are clear and would provide a valuable service to ND and the region.

Comments appreciated.

A missing element is a comparable chemical analysis of the biomass. I assume that NDSU has a biochemistry or feed analysis lab that performs this service for the state. Although the applicants aren't proposing to actually conduct this work, it would be desirable for them to have described who does this work in ND, and then suggest how their proposed analysis lab could be linked to the pre-existing chemical analysis lab. Biomass suppliers and users will want information from all these areas, and so describing how these efforts could be coordinated would have strengthened the proposal.

The chemical analysis component, as indicated by the reviewer, is important as well to understand the characteristics of feedstock. At the same time, to complete the analytical spectrum, the "biological analysis" that addresses the "feedstock health" in terms microbial growth is also another important characteristic. Determination of these numerous characteristics uses highly involved procedures. Many times, private laboratories are used for their expertise and equipment, even by university researchers.

Therefore, determination of complete chemical (biological as well) characteristics is a massive undertaking and it is a project in itself. Understanding the effort and costs involved, we restricted our scope to physical and thermal characteristics of biomass feedstock at this time based on our expertise. These additional aspects are potential projects for future expansion of our presently proposed project.

As pointed out, several NDSU departments, such as Department of Chemistry, Biochemistry, and Molecular Biology, and the Department of Agricultural and Biosystems Engineering (ABEN) have the capability to determine the chemical properties of biomass feedstocks. However, coordination with these labs needs to be in a continuous manner and needs further negotiations with them. We will explore these possibilities in the future. As a faculty member of ABEN, Dr. Cannayen is well positioned to develop this linkage.

Reviewer 5C (Rating:4)

The objective is very straightforward – the funds will be used develop a laboratory (purchase equipment) and to conduct tests (hire staff) to create a data base for use by both processors and producers.

It is excellent that both PIs have extension appointments – so that not only will the lab be developed and the testing be done – but the results will be shared with the people who can benefit most from it.

Comments appreciated.

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 5A (Rating: 4)

With the lab space and facilities already available to house the equipment to be purchased in the grant, the achievability of the goals of the project is very good. Staffing seems to be in place as well, creating a recipe for success.

Comments appreciated.

The only concern I have for achievability is the unknown number of samples to be processed in the timeline of the grant. The authors indicate all farmer samples will be run during the two years of the grant and thereafter one every two weeks. I understand the limitations of the equipment and expenses related to running samples. I can see issues during the first two years with no limits on samples. NDSU and ARS will need to run samples as well during this time. I can see issues related to scheduling and overloading of the lab staff. This is not something that can't be overcome, but should be something that should be a consideration.

The turnaround time of samples can ideally be only two days. Most of the individual physical, mechanical, and thermal analyses take only an hour or two. However, the standard air oven method of moisture content determination requires 24 h. When samples are lined up in parallel, 2 or 3 samples can be easily completed. Allowing time for analyses and preparing reports, one sample result report can be delivered in 3 days from the start of the experiments. An inventory of the samples received from the farmers/users will be made and samples analyzed per the receipt schedule. During peak demand times, simultaneous analyses can increase the sample handling capability.

Some delay is inevitable during peak demands, and this should not upset the activities as samples will be properly stored until analysis. During slower periods, our continuing research effort on ND biomass physical, mechanical, and thermal properties database development will be preformed.

The long-term costs of running samples should also be considered. I think it may be hard to run samples for farmers for free indefinitely. Again, not something that can't be overcome, but something to consider.

Our aim is not to become a financially self-sustaining analysis unit, but as a service unit to the users of ND. It is contemplated that our capability in analysis will grow during the project period, and we should be able to serve the ND users quickly and efficiently at a reasonable cost. If the project grows beyond our expectations, we will make a formal funding request to the State Board of Agricultural Research and Education.

Reviewer 5B (Rating: 3)

Project is straightforward, uses established equipment and procedures, and is primarily dependent upon purchasing and installing equipment, and getting a technician trained to conduct the work. I am a little concerned that only 1/3 time of the technician is budgeted, and that in the second year this technician is replaced by a research assistant at a lower pay rate. Consistency is important in getting a lab up and running, and if the personnel are switched in mid course, that could be problematic.

The Technician, in fact, will be serving for 50% (1 year) of the project time. By the end of this period, the protocol will be well established and the PI will be able to train the Research Assistant easily to get consistent data. We agree that the transition may not be smooth, but can it be managed, as the PI will be there throughout the project. Ideally we may like to continue with the Technician, but we decided to have the budget for the equipment and reduce it to the available matching funds.

A more significant concern is that the applicants do not describe a plan to have a third party lab verify and validate their results. **They make a cavalier statement under Anticipated Results that “Since measurements are based on standard protocols, the success is automatically guaranteed.”** As one with 30 years of lab experience, I know that even when standard protocols are available, it does take time to debug the procedures and get personnel up to speed before valid, reliable data can be consistently obtained. I would strongly recommend that they include funding to send samples to outside labs to

conduct analysis of replicate samples to validate performance of equipment, procedures, and technicians, instead of just assuming that accurate data will be obtained.

The experience and insights of the reviewer in how experiments can take time during the initial phases of setting up the experiments are much appreciated. As suggested, we will make arrangements to send a few samples to outside labs/universities for results comparison.

Reviewer 5C (Rating: 5)

The objectives are well laid out, the workplan and budget are realistic, and the deliverables are certainly achievable.

The PIs have established credibility in their fields, and certainly have the capability to deliver.

Comments appreciated.

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 5A (Rating: 4)

All methods and plans in the proposal are sound and should lead to successful achievements in the program.

Comments appreciated.

Reviewer 5B (Rating: 3)

As noted in item 2, standard protocols will be followed, but the results need to be validated against a third party lab. Many universities would have such equipment and PIs should establish contacts with these groups.

We will establish the contacts and have some samples analyzed at different locations for scientific reporting in journal articles and other reports. But, we expect that routine samples can be handled at our facilities.

We would like to add that the research group of the Project Investigator Dr. Cannayen (at different university locations: UT, TN; MSU, MS; UBC, BC Vancouver) has published and reviewed several peer-reviewed articles on physical, mechanical, hydration, and thermal properties of biomass in the recent years in a US university setting, and this research group was a leading team in the US on these aspects.

Another issue that I was expecting to see was a discussion of how the costs of these analyses would be determined. In the 4th paragraph of page 6, the applicants state that the lab will “continue its mission after the project duration. NDSU and USDA-ARS will provide the necessary aid to cover the cost of maintenance and repairs and manpower

involved in managing the functioning of the laboratory.” I think that it is unrealistic to expect that these organizations will “eat” the cost of these analyses, especially when the precedence of fee based chemical analysis labs already exists. Thus it is critical that this project determine the actual costs of these analyses, so the lab can be financially self sufficient in the future.

This is a valid point. After the project period, we will charge the users reasonably to cover actual costs (non-profit basis) as a service to the ND users.

Small maintenance charges can be absorbed by NDSU. Other agencies (e.g. ND Farmers Union) will as well be contacted to fund biomass analysis activities so that ND users will get the samples analyzed at subsidized rates. We are not thinking of converting the lab into a financially self-sustaining entity as an immediate priority, but we understand this will be necessary in the future.

The applicants also talk about creating and testing densified biomass samples, but provide no details on how the biomass will be densified.

For this project, our intension is to test the densified biomass samples if supplied by the users. Biomass densification and pelleting is one of our research areas of interest and we are pursuing this as internal and externally funded research activities. Once we develop our densification capabilities, we will also test the characteristics of the densified biomass.

Reviewer 5C (Rating: 4)

The methodology is very straightforward (obtain equipment, establish the lab, hire the staff, acquire the materials for testing, do the testing, share the results).

The equipment will remain available for use in North Dakota after the project is over – which is good – you will be building capability in-state to do on-going important analysis. (The answer to the first question in section titled “Response to earlier Council Questions” is confusing to me however. The authors state: “The equipment will remain property of the Biomass Testing Laboratory at USDA_ARS, Mandan, ND. The Department of Agricultural and Biosystems Engineering, NDSU, Fargo, ND will actually own the equipment.” How can the equipment be property of one entity, but owned by another? I would recommend that the North Dakota Industrial Commission ask for further clarification on this issue.

The Assistant Professor position of investigator Dr. Cannayen is actually an NDSU faculty position (fully funded by NDSU), but located at the USDA-ARS Laboratory that extends infrastructure and research facilities as a collaborative research effort with NDSU. Therefore, the Biomass Testing Laboratory establishment will be at the location of the Northern Great Plains Research Laboratory (NGPRL) USDA-ARS, Mandan, ND, but the equipment will be on the inventory of NDSU. In principle the Biomass Testing Laboratory itself is the property of NDSU, even though located at USDA-ARS, Mandan, ND.

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 5A (Rating: 5)

The chemical and physical information provided by this equipment will increase the usability of biomass feedstocks. This laboratory equipment can be used to determine the impacts of all sorts of varietal, production, harvesting, transportation, and storage practices on biomass characteristics. Many industrial users of biomass require this type of information prior to entry into a market.

Ultimately, the scientific information generated through this equipment and program, can lead to new industries, new jobs, new markets for farmers, and new revenue for the state of ND.

Comments appreciated.

Reviewer 5B (Rating: 4)

The information generated will provide a valuable database that producers and processors can use to establish biomass standards and thus prices, both in the near term and on an on-going basis.

Comments appreciated.

Reviewer 5C (Rating: 4)

This project will provide useful data regarding ND biomass feedstocks grown in North Dakota conditions (“all biomass is local”). This is important. The data should allow for the development of biomass “grading” which will benefit processors and producers.

The equipment will also build capability at NDSU and ARS – that will allow the state to be more competitive for federal funds – which is extremely important.

Reviewer’s insight is appreciated.

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 5A (Rating: 4)

The authors obviously have good experience in this field, are aware of scientific applications related to the equipment. Major citations were not necessary for this proposal.

Comments appreciated.

Reviewer 5B (Rating: 2)

Equipment and protocols are standard accepted practices.

The big gap is that there was no documentation of the physical, thermal, and mechanical properties of similar types of biomass from other parts of the country. It would have been valuable to see some tables that show the range of values that would be expected, based on prior data.

This is a good suggestion. We will work on this, collect the information from the published literature, and supply the data on “what is available” so far. Data may not be available for most of the ND crops, but crops from other locations of the nation can be compiled. We will report this in the first-interim report (after 1st 6 months).

Reviewer 5C (Rating: 2)

Although the proposal text clearly indicates sound knowledge of the investigators’ awareness of current research and published literature, there were no citations included with the proposal.

Since the procedures use the appropriate “Standards” (ISO, ANSI, and ASABE), they can be easily cited. Citations of several “Standards” to be used and other research protocols will be given in the first interim report (after 1st 6 months). By then, we will have finalized the necessary procedures. If the reviewer can be more specific with respect to desired citations, we would be more than happy to comply as a condition for funding.

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 5A (Rating: 4)

The investigators are known in the scientific area and have published many papers related to the work to be performed via this equipment and the feedstocks in question. They have adequate experience as evidenced by these publications and their participation in professional activities.

Comments appreciated.

Reviewer 5B (Rating: 4)

Sufficient capabilities of both investigators. However with one being an economist, I was disheartened to see that there was no effort to establish the costs for these tests, so that the ultimate facility users would pay for the service.

At the end of page 12 the applicants describe that farmers will be served free of charge, but that only one extra sample per two weeks could be handled. This will not be sufficient if the biomass industry takes off. Customers will expect rapid turn-around times or will take their business elsewhere.

We understand the concern of the reviewer. The major appeal of the project is the service orientation and extension component. We haven't intended to make it a financially self-sustaining venture. However, we will work out the economics and make it a service-oriented and non-profit establishment – in concert with the mission of NDSU.

As pointed out by the reviewer, when peak demand and rapid turnaround times are expected, we will seek additional operating grants to meet the need. If such grants are not made available, the activities will go ahead at the regular pace. If more research assistants (RAs) become available, the capabilities will increase proportionally, but cannot yet be predicted .

Another option is the simplified results structure with a limited number of properties evaluated. For example, properties such as moisture content, dimensional properties, bulk density, and calorific value will adequately characterize the biomass for the industrial applications. When such simplified results are desired, the turnaround time will be substantially reduced and peak demands can be addressed.

Reviewer 5C (Rating: 5)

Both PIs are well qualified to do this work. They are well know for their applied research and extension activities. It is especially good that they both have extension appointments and clearly state their intent to share the results of their research so that this project will be *science with practice*.

Comments appreciated.

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 5A (Rating: 3)

The project management plan seems adequate for this type of work. The timeline is reasonable for all work to be performed. Care needs to be taken to address demand in excess of analysis capabilities of the lab. A clear priority determination procedure needs to be outlined for assigning priority to samples from farmers, industry, and researchers. In many cases I have seen labs like this overwhelmed with requests and to avoid unhappy clients, a clear procedure for prioritization is needed.

As indicated earlier 1) additional operating grants, 2) additional RA's, and 3) limited analysis can address the peak demand issue. Thanks to the reviewer's comment. We may prioritize (or limit the number of properties analyzed) our analysis based on the demand, without compromising the scientific quality of the measurements. As the matching funds are limited, we cannot propose for more man-power at this time.

Reviewer 5B (Rating: 4)

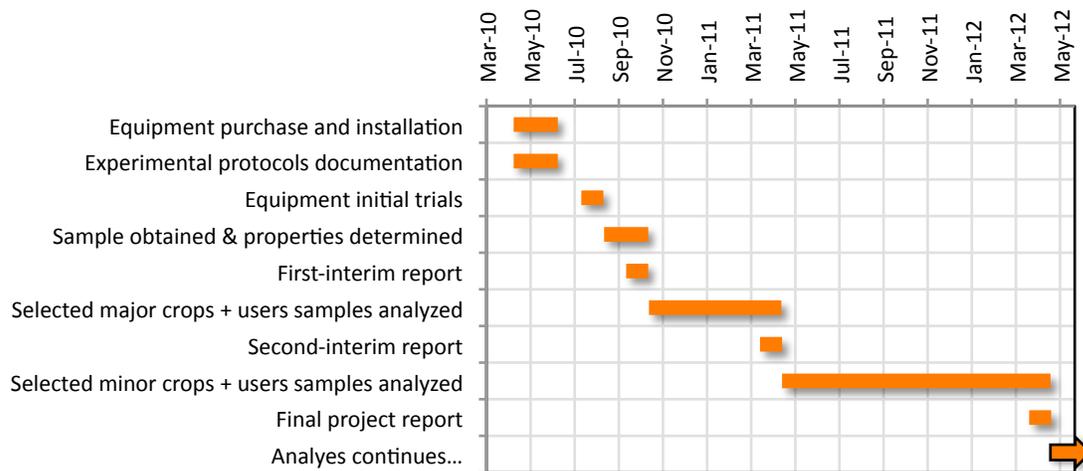
Okay, except that again, testing costs should be established.

Cost will be established after the project, to make the laboratory a non-profit testing facility.

Reviewer 5C (Rating: 3)

It would have been good to have a Gantt chart to clearly show the timeline and deliverables in one chart – but the plan they have outlined in text form gives a pretty solid picture of what they will be doing when, and when to expect deliverables.

Done. Gantt chart of the timeline shown below:



Timeline of the Biomass Testing Laboratory Project

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 5A (Rating: 4)

The justification provided by the investigators is good for the equipment. The equipment can be fully utilized for the tasks described and the costs provided are reasonable. By incorporating this equipment into an existing lab, it should provide a complete facility through which biomass can be analyzed for any use.

Comments appreciated.

Reviewer 5B (Rating: 5)

Needs are clearly identified. However the complementary equipment at the USDA/ARS lab (middle page 4) is not listed.

We had a list of equipment already available to us for this project in the earlier version of the proposal, but during revisions we have deleted it.

The equipment from USDA-ARS lab that can be used for the project include:

*Biomass grinding Wiley mills (3 numbers)
Biomass grinding hammer mill
Full-fledged machine shop for miscellaneous fabrication and repair*

The wet lab space provided by USDA-ARS for the Biomass Testing Laboratory is 30 feet by 18 feet. This space is adequate for all the equipment and housing an office for the Technician/RA. All the facilities and technical manpower of the USDA-ARS are also accessible to this project's in-station investigator.

In addition, we received the following list of other equipment that are being purchased from NDSU funds (several were received already):

*Air oven (moisture content; 2 numbers)
Band saw (cutting)
Blower (drying)
Deep freezer (storage of fresh samples)
Digital calipers (dimensions)
Digital humidity/Temp meter (relative humidity)
Digital multi-meter (testing and repair)
Digital stopwatch (timing the operation; 1/100 s)
Digital tachometer (rpm)
Hot wire anemometer (air velocity)
Infrared temperature gun (temperature)
Kitchen/coffee grinder (sample grinding)
Laboratory glassware and supplies
Measuring tape handy (dimension; hand)
Measuring tape reel (dimensions; reel)
Muffle furnace (ash content)
Platform scale (sample mass; 100 kg capacity)
Portable air heater (quick drying)
Refrigerator (sample and chemical storage)
Vacuum pump (vacuum application)*

Reviewer 5C (Rating: 4)

The equipment purchases for this project fit the scope of the project outlined. The PIs certainly have the capability to use the equipment and train the staff to operate it.

Comments appreciated.

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 5A (Rating: 4)

The equipment proposed is specific to the tasks to be accomplished and should work well for the project. The lab facility at the ARS should be adequate to house the equipment. It would have been good, though, to have had a description of other equipment that would be available through the ARS lab for biomass analysis. Other equipment, specifically more for chemical or spectral analysis, would also be good for a lab like this.

Comments appreciated.

Reviewer 5B (Rating: 5)

Okay

Comments appreciated.

Reviewer 5C (Rating: 5)

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 5A (Rating: 5)

The dollar for dollar match provided through ARS, though it is not a “private industry,” is very valuable. Building the cooperative relationship between the university and ARS is extremely important too. I think that this grant leverages the two institutions’ resources very well. Biomass analysis costs are typically rather high in commercial lab settings, so the service this facility could provide would be extremely valuable. If farmers and industry were to pay for these types of tests, the costs could become prohibitive. Funding this grant would allow ND to remove a barrier to commercialization of biomass in the state.

The reviewer demonstrates great understanding of the NDSU & USDA-ARS cooperation, importance of the project, and the project’s role in commercialization of biomass in the state. The comments highly appreciated.

Reviewer 5B (Rating: 5)

Good value and matching support.

Comments appreciated.

Reviewer 5C (Rating: 4)

This equipment will also provide on-going testing capability after the completion of the project – and will position the state well to compete for federal funds.

The match provided by ARS and NDSU is significant.

Comments appreciated.

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 5A (Fund)

This proposal for the establishment of biomass analysis capabilities in a joint ARS/NDSU project was well-written and justified. Equipment such as this is necessary for the development of biomass based industries. The investigators are well qualified and should succeed in these endeavors.

Comments appreciated.

Care should be taken in making the equipment available for any and all samples. As noted, a prioritization procedure should be established for samples. It is easy to get overwhelmed.

We have noted this concern and proposed some measures (Item 7, Page 10) of addressing this.

Another note involves intellectual property. Since NDSU and ARS already have a standing relationship, I would assume the two have come to agreement on IP as it relates to the joint laboratory. The proposal notes that NDSU retains all rights to IP developed (and there will be some developed) but care should be taken to make sure there is an appropriate written agreement between the two parties.

USDA-ARS has not expressed any interest of owning the intellectual property (IP) that might come from the research. USDA-ARS is supporting the cooperative venture of hosting the NDSU faculty and is involved in other combined research activities through Specific Cooperative Agreements. We will make sure an appropriate agreement will be

written between these two organizations when IP's are developed. We greatly appreciate the reviewer for pointing this out.

In conclusion, I would recommend that the ND Industrial Commission fund this project.

Recommendation greatly appreciated.

Reviewer 5B (Funding May Be Considered)

In general I think a lab such as proposed could provide a valuable contribution to ND as well as the region. However there were some gaps in the proposal as noted previously. From a more practical standpoint, some other concerns/issues are listed below.

1. Are there other fee-based labs already doing this work? What are their costs? I know that several other universities and federal labs have capability to do similar testing. Could they be competitors in the future? What is the potential market in ND, as well as in the surrounding region?

To our knowledge, chemical labs exist, but not an exclusive lab addressing the physical, mechanical, and thermal properties characterization activities (as proposed in this project (Fig. 1)). It is also very much possible for several laboratories and universities to have the relevant equipment to carry out these experiments; but not as single commercial unit. The physical and mechanical properties will usually be performed by individual research units of the university as a part of characterizing biomass before utilizing it for several downstream processes.

We contemplate that the market will develop after our research activities and results reach the users. Our Biomass Testing Laboratory will serve as a model for other universities and commercial labs, as the biomass economy picks up. As such labs do not exist, it is not possible to estimate the charges. However, from an economic standpoint, we are able to work out, the equipment, man power, and other relevant fixed and operating costs for such a lab to be financially self-sustaining based on relevant assumptions (following general economics calculations).

2. The scientific component of this proposal is minimal. It is really more of a business plan to justify development of this service lab. However it fails to mention how costs will be determined so prices can be established. It also fails to discuss how the lab will be self sufficient. It is naïve to assume that NDSU and USDA ARS will cover all these costs over the long term. Users need to pay for the service.

The point was well taken. We will work out the non-profit cost of sample analysis (considered after the project). Other measures (Item 7, Page 10) of subsidizing the cost to the users will also be sought.

3. It is important to describe comparable labs that determine the chemical composition of biomass, and how the efforts proposed herein would/could be coordinated with that. Producers and processors would want the full spectrum of information, and a plan that

describes how this would be provided would have been much stronger.

We agree that a full spectrum, including chemical composition analysis, will be desirable. As we described (Item 1, Page 3), the chemical and biological aspect deserve a separate research proposal involving a chemical/biochemical faculty. With the available matching funds, this will be beyond the scope of our project and capabilities. But, we strive to establish coordination or provide at least direction towards this end.

Reviewer 5C (Fund)

This is a strong proposal. The project will definitely provide information that will benefit North Dakota's biomass industry. I recommend the project be funded.

Recommendation greatly appreciated.