TECHNICAL REVIEWERS' RATING SUMMARY

R038-A
Integrated Carbon Capture and Storage for
North Dakota Ethanol Production - Phase III
EERC
Principal Investigator: Kerryanne Leroux
Request for $500,000; Total Project Costs $2,650,000

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Average Weighted Score: 241, 234, 225

Maximun Weighted Score: 250.00

OVERALL RECOMMENDATION

FUND x x x
FUNDING MAY BE CONSIDERED
DO NOT FUND
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 1A (Rating: 5)**
The proposed Phase III study will pave the way for a commercial integrated bioethanol / carbon capture operation in western ND that will position the applicants for low-carbon fuels markets available in the Western USA and perhaps Canada. It will generate employment in the short-term for construction, mid-term for facility employees, and in the long-term for other ND biorefineries that will be motivated to leverage the carbon capture integration technologies being developed by the applicants and the inherent capabilities of western ND geological formations for carbon dioxide capture. Economic development in western ND could be catalyzed. The expertise and workforce being developed for biofuel production/ carbon capture integration technology may be attractive for subcontracting to companies outside of ND. Sustainable biofuels certainly fits within the NDIC/REC goals.

**Reviewer 2A (Rating: 5)**
The proposal clearly states the value of CCS integration to North Dakota ethanol operations, including the strategic advantage that the State holds over midwestern producers not in proximity to geologic sequestration (I would note, however, that the Illinois Basin hold similar potential). The economic opportunities here are vast, as numerous academic and popular press articles have pointed out since the passage of 45Q tax credits.

**Reviewer 3A (Rating: 5)**
I still have many questions about what portion of the carbon impact of ethanol production can be addressed with a successful effort here (production itself accounts for only 50% of the CI, the other half being specific to corn production; also, it’s unclear from this proposal what portion of the production-facility CI will be captured). The PI should be prepared to speak to this point. That said, this project’s objectives are very clear and would have a positive impact on the environmental and industry growth goals of the NDIC/REC.

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 1A (Rating: 4)**
The applicants possess the expertise to complete the proposed six tasks and robust plans to complete the tasks. The applicants will leverage the teamwork already established and
the momentum of successful Phase I and II projects to enable successful completion of Phase III.

**Reviewer 2A (Rating: 4)**
The statement of objectives are clear, will advance the commercial viability of this project, and hold lessons for other potential CCS operations in North Dakota.

One notable omission from this document is a firm statement from EERC & RTE about whether or not they plan to comply with the permanence protocols proposed by the State of California as part of their CCS protocol, which is necessary for financial incentives under California’s Low Carbon Fuel Standard. I understand that the final standards have not yet been adopted (they will be finalized by the end of 2018), but this may have important implications for the financial viability of this project, both in terms of costs and benefits. It is my understanding that North Dakota’s Class VI protocols will not satisfy California’s requirements.

I suggest that the project participants continue to monitor CA’s permanence methodology, its intersection with North Dakota’s Class VI program, and the financial implications it may have for this project.

**Reviewer 3A (Rating: 3)**
Given that most of what is to be produced in this phase are detailed plans and studies, they are likely achievable. That said, it’s unclear what the results of the storage feasibility studies will be – it’s quite possible the reservoir is more porous than hoped. To be considered a success, CCS will have to result in very long-term, stable storage. A high bar.

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 1A (Rating: 5)**
Trimeric possesses the expertise to complete the CO2 capture process design package (Task 1). Monitoring and characterization of groundwater and soil gas and baseline seismic activity near the proposed facility site in western ND and preparation of the permit application for drilling a hole fall within the CO2 capture expertise of EERC (Tasks 2 and 3). RTE will be able to complete the cost-benefit analysis involving relating to incentive programs and outreach activities (Tasks 4 and 5). The knowledge of the applicants in-house relates to expertise in the methodologies needed to complete the tasks.

**Reviewer 2A (Rating: 5)**
The five phases of the proposal address all necessary preparations towards commercial operation by 2021.

In particular, Phase III (design) of this CCS project will advance numerous important tasks in advance of construction and operation. This includes completion of capture process designs & quotes, monitoring and reservoir characterization, outreach activities, draft permits, and continued assessment of CO2 markets.
Reviewer 3A (Rating: 5)
Clearly a very professional effort with strong collaborators engaged.

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 1A (Rating: 5)
Completion of the proposed Phase III tasks will enable the application of novel integrated carbon capture and bioethanol production technology developed by the applicants in previous phases to be extended to a commercial-scale facility. Collection of baseline monitoring for CO2 in subsurface water and gas and seismic data for applying for a carbon capture permit is new for ND and will likely impact other biorefineries.

Reviewer 2A (Rating: 5)
See comments on question 1. Notably, this project will be one of the first ethanol-CCS in the United States. Should the project cost-effectively store CO2 in dedicated storage (rather than utilization for enhanced oil recovery), it could provide a model for the United States and other ethanol producers worldwide.

Reviewer 3A (Rating: 5)
While the results are naturally as yet unclear, advancing the understanding of CCS feasibility in the region could have important long-term consequences, hopefully positive ones.

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 1A (Rating: 5)
The EERC is a leader in carbon capture R&D, evidence by its leadership of a major DOE-funded Regional Carbon Sequestration Partnership that involves over 100 partners engaged in CO2 storage technology.

Reviewer 2A (Rating: 4)
While the background and scientific contributions of the investigators are ideal (see comments on Question 6), the PI has omitted reference to several academic and popular press stories identifying the opportunities in CCS for ethanol that have been released in the past year, e.g.

https://www.triplepundit.com/2018/02/federal-budget-bill-includes-tax-credits-carbon-capture/

However, this likely be attributed to the foresight of the PIs, who have been working on this project for several years.

**Reviewer 3A (Rating: 4)**
Most of the references cited appear to be those of the team’s own prior research. That said, as noted below that’s a good body of work to draw from.

**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 1A (Rating: 5)**
Ms. Leroux, the Principal Investigator, has successfully led the earlier phases of this project as well as other projects, and is therefore very capable of leading this project. Co-investigators at Trimeric and RTE are also well experienced to complete the proposed tasks.

**Reviewer 2A (Rating: 5)**
In short, EERC and Trimeric are the ideal participants for this project. Trimeric’s role in the Decatur ethanol-CCS project, in particular, will greatly contribute to the success of Phase III.

**Reviewer 3A (Rating: 5)**
Strong collection of expertise.

**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 1A (Rating 5)**
The applicants have prepared a believable Gantt chart. They have collaborated on the previous phases of this project, with Ms. Leroux serving as PI. Phases I and II have been successful. It is evident that they form an effective team that is managed well.

**Reviewer 2A (Rating: 4)**
I found the public outreach portion of this proposal to be lacking, if only because so little information was provided. I would encourage the participants to continue to build out their outreach plans.
Reviewer 3A (Rating: 5)
No comment given.

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 1A (Rating: 5)
No equipment is to be purchased

Reviewer 2A (Rating: 5)
I am not aware of any proposed purchase using funds from NDIC (I believe the funds for will come from Red Trail Energy)

Reviewer 3A (Rating: 5)
Did not see mention of any equipment to be purcased

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 1A (Rating: 5)
EERC and RTE are well equipped to conduct the analyses needed for assessing carbon capture, seismic activity, economic analyses, and outreach implementation. Trimeric has the necessary y software to complete the process design package.

Reviewer 2A (Rating: 5)
Both EERE and RTE have ideal facilities and equipment for executing this project.

Reviewer 3A (Rating: 4)
Strong capabilities across the collaborating entities.

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 1A (Rating: 5)
The proposed tasks of this Phase III project are logical next steps in the development of a commercial scale facility in Phase IV+V, per Fig 1. They leverage significant investments by RTE and EERC for cash and in-kind support. The technology developed in the proposed project will be of potential benefit to other companies for preparing applications for carbon capture permits and for developing integrated carbon capture process designs.
Reviewer 2A (Rating: 5)
RTE and DOE cost shares are more than sufficient, while the technical outcomes of this project are very valuable. More broadly, demonstrating large-scale CCS via ethanol hold large potential for the commercialization of CCS technologies.

Reviewer 3A (Rating: 5)
Strong contributions from collaborators.

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.

2 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.

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 1A (Fund)
This proposal is strong. The applicants have carefully laid out a five-stage plan for a pioneering venture, the first commercial scale biofuel production facility that will utilize integrated carbon capture technology in ND (Fig 1). They have successfully completed Phases I and II. The tasks of Phase III are logical next steps in the progression toward commercialization. The applicants are committing significant resources as cost share toward this project. The foundation of the project is novel carbon capture technology developed by the EERC. The overall project, if successful, will position ND to be a leader in production of low-carbon fuels, expected to increase in demand, especially in the western USA and Canada. This project leverages the unique geological landscape of western ND for carbon capture. The only missing item in the proposal was a letter of support from Trimeric.

Reviewer 2A (Fund)
I strongly recommend funding.

Merits: As discussed in answers above, this is an ideal project and team. The management plan appears achievable and could lead to successful commercial deployment, with applicability across North Dakota, the United States, and worldwide.

Flaws: As discussed in question #2, I believe more exploration of compliance with the permanence protocols proposed by the State of California for the Low Carbon Fuel Standard is necessary before proceeding from Phase III to other portions of this project. Notably, compliance with California’s protocols will affect both revenues (low-carbon fuel standard abatement credits) and costs (surveying, post-closure monitoring, etc.).
Reviewer 3A (Fund)
In addition to my concerns about the eventual level of CI mitigation (described above), the cost consideration is also a potential issue. The eventual commercial success of any ethanol-tied-to-CCS effort is going to be driven by costs, and early indications (as noted in the proposal) is that this will be a costly effort.

That said, there’s no way to know for sure without pragmatically advancing the knowledge of how this would actually work and what the costs would be. And if successful, the effects for both the environment and industry growth would be very positive. So it’s worth investing in finding these answers.