

**Technical Advisor Comments**

- 1 reviewer recommended fund, 2 reviewers recommended funding may be considered.
- The 50% match comes from the applicant.
- Regarding the achievability of the project, 1 reviewer recommended the following modifications be made in order to make the project most likely achievable:
  - Commencing full project upon selection/confirmation of the well site provider. This task is currently allotted 4 months from well identification to selection of site. To meet this timeline would presume current involvement/participation of candidate well operators.
    - The applicant has responded that they are already working to confirm an operator in North Dakota and have built flexibility into the schedule.
  - Extending the demonstration period to a minimum of 9 months (versus the proposed 6 months of June through November) to capture both a full winter and a full summer of operations; temperature extremes key to evaluating ongoing production conditions. The proposed plan calls for 13 months of budgeted activities (Oct '16 – Nov '17) with 18 months total for project duration so could make this modification to the schedule and remain at ~ 18 months.
    - The applicant has stated that they are happy to extend the timeline and that the system is designed to account for all temperature extremes, and it will be particularly valuable to demonstrate the geothermal system performance during cold months, when other types of distributed power systems (such as diesel generators) are difficult to operate.
- A different reviewer commented, "The specifics of the proprietary technology are unclear here, so it's hard for me to judge how much difficulty there will be in applying that technology to this application for these objectives."
- Regarding the methodology, 1 reviewer had the following questions/concerns:
  - As stated previously, need a longer period of operational demonstration for validation.
  - Would like to see more detail for the plan to transition from 10 KW to 50 KW, or beyond. The budget is for a 10 KW, though the project description states 10 to 50 in several places. Does 50 KW presume a larger piece of equipment, or multiple sites? If the former, are there noise considerations? If multiple sites, what are the complexities associated with that?
    - The applicant responded that they allowed for some flexibility in the size of the power system because, if the chosen site has a sufficient geothermal resource, they may put additional private capital towards a 50kW system. Either way only 1 site will be used. A 50kW system will consist of five 10kW turbine generators operated in parallel and would allow them capture five times as many operational hours on turbines.
  - What is the cooling system plan? Air versus water or another approach? May be site specific, which is why important to know before commencement of full project. Could impact budget considerably.
    - Applicant is planning on air cooling. However, if water is available and affordable, they may use water cooling during the hottest period of the year. Air cooling is preferred as it does not vary by site.
  - What is the source of the CO2? Is there a cost associated with it?
    - The proposed system will use only a small amount of CO2 within the closed cycle power system itself and will have a minimal cost. CO2 currently costs approximately \$40 per ton, and the power system will not need a ton.
  - What is the connection to the grid, if any?
    - They prefer not to connect to the grid but rather provide power to an onsite user. If there is no on-site user, a grid connection could be pursued but is not necessary.
  - Is there a blueprint/schematic of the equipment to be installed?
    - That material is confidential. It could be provided under a confidentiality agreement.
      - This program can keep information confidential and does allow for that in the application process.

R027-D: Commercial Demonstration of Geothermal and Hybrid Electricity using Produced Fluids at Existing Wellsite  
Submitted by TerraCOH

Principal Investigator: Jimmy Randolph

Request for \$420,000; Total Project Costs \$840,000

- Need additional detail for plan to enhance education, research, development and marketing of ND's renewable resources. Will require the hydrocarbon well owner/operator's support for press access to their facilities, a limiting factor in other geothermal projects in ND.
  - TerraCOH will present the results of the proposed project at well-known industry and academic conferences such as the Geothermal Resources Council annual conference and the Stanford University annual geothermal conference. Additionally, we will work with the press departments of the University of Minnesota, Lawrence Livermore National Lab, and the University of North Dakota to publicize the proposed project and all successes. We are pursuing small operators who are anticipated to see value in marketing the renewable energy aspects of their projects, unlike the other geothermal project in ND.
- Regarding the knowledge of the project team, the reviewers seemed overall comfortable. However, 1 reviewer was uncertain of the team's abilities to promote the project if successful and another reviewer felt the electrical engineering side of the team could be stronger.
  - Applicant has provided details on employees that they have that meet these needs.
- 2 reviewers felt the project management plan was good. 1 reviewer felt s go/no go decision point after selection of a site.
  - That is acceptable to the applicant.
- Regarding the purchase of equipment, 1 reviewer noted that there is justification provided for the piping consultant, but there is no line item in the budget for the piping itself.
- Overall, 1 reviewer commented "Very impressive effort to make use of an underutilized resource. Seems well thought out by a well-matched team. The potential weak link is the reliance upon proprietary technology from a startup, TerraCOH, and it's hard to assess the risk factor there. But the effort to prove out the potential for that technology in this context seems pragmatic, and if successful could provide compelling opportunities for ND."
- Overall, another reviewer stated "This is a well written and thought out proposal in many ways. The team assembled to complete this project is very well qualified on the mechanical, physical and finance aspects of the projects. Two areas of the project concern me. The first is the "renewable classification" of the project. The second is the fact that the proposal hardly addresses electricity markets or policies."
  - That reviewer expanded on the electricity markets/policies by stating "The market for electricity is very complex. Utilities, electric generators and other players in electricity markets all must operate under a highly developed set of rules and regulations designed to keep the electric grid stable, safe, environmentally friendly and affordable. The proposal indicates a "growing electricity demand" and existing emission-free electricity sources (wind and solar). The electricity demand in the US is below 2007 demand and nuclear and hydro power options are also emission-free. The proposal also indicates this power could be used to meet state renewable electricity standards, without any discussion of how the natural gas used in the process would impact the project's eligibility for meeting this requirement. The project also does not discuss what type of contract this electricity will be sold to the utility company. Would the contract be net metering, PURPA, etc? This aspect of the project is not well developed and has the potential to limit or completely halt the implementation of this type of project. This issue is too important to overlook. This project could be strengthened significantly from an electrical engineer and an electrical utility partner joining the project."
    - It should be noted that ND doesn't have mandated renewable electricity standards, and that net metering applies to renewable energy systems and combined heat and power (CHP) systems up to 100 kilowatts (kW) in capacity. Net metering is available to all customers of investor-owned electric utilities; it is not available to customers of municipal utilities or electric cooperatives.
    - TerraCOH has responded that they do have some team members with electrical engineering and utility experience, including a specialist on electricity markets from Ohio

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State University and a consultant who is a former VP of Generation at a Midwest utility.  
For the proposed project, TerraCOH is partnering with Wenck.

### **Technical Advisor Recommendations**

Funding may be considered. This project provides a nice opportunity to highlight synergies between renewable and traditional forms of energy that are abundant in our state. The applicant is willing to establish a business presence in North Dakota, and that could provide new opportunities for economic development to build on.

However, priority should go to projects with clear ties to North Dakota already in place. There were several questions raised about electricity markets and policies. While ND has well sites, more specific and detailed information about how the electricity generated will be sold would strengthen the proposal and better outline how this project will benefit ND.

The applicant is requesting a significant amount of money, and considering the State's budget concerns, it is difficult to justify giving a currently out of state entity that amount of funds when there are some significant questions about the conceptualization of the commercialization of the project.

### **Suggested Contingencies If Funded**

- Applicant must establish a North Dakota business presence and funds must go through that entity.
- Well site must be through an independent operator, helping to demonstrate that industry sees a need and value for this project.
- Follow one of the reviewer's suggestions and split the project into two phases and fund with a go/no-go decision point for remainder the full funding upon successful completion of Phase 1. Phase 1 would go through and including the milestone 'Determine Demo Site'. Recommend adding another task, also to Phase 1, that would refine the budget to the site specific characteristics. In Phase 2, extend the test period to a minimum of 9 months so as to capture a full winter and a full summer season of use.
- Applicant must acknowledge the Industrial Commission and the Renewable Energy Program in all media communications.