

4.3.5 Life-cycle Analysis of Geothermal Technologies

Presentation Number: 005

Investigator: Wang, Michael (Argonne National Laboratory)

Objectives: To develop greenhouse gas (GHG) emissions profiles of geothermal technologies; to develop water resource impacts of geothermal technologies; and to address GHG and water issues of other power generation technologies for comparison purposes.

Average Overall Score: 2.7/4.0

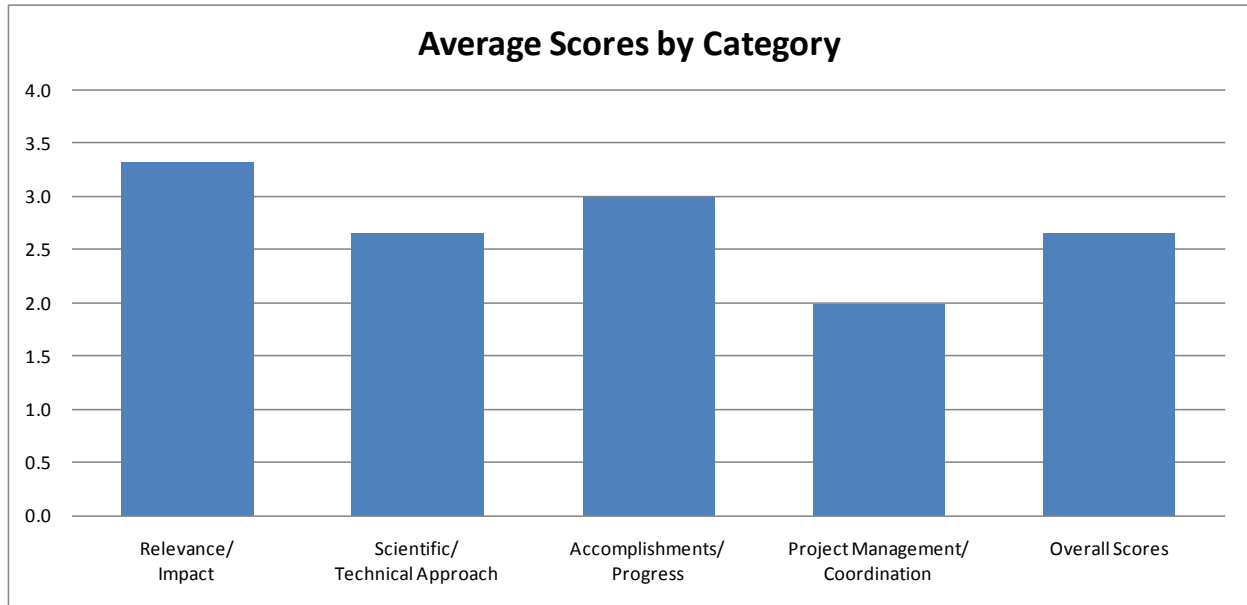


Figure 20: Life-cycle Analysis of Geothermal Technologies

4.3.5.1 Relevance/Impact of the Research

Ratings of Three-member Peer Review Panel: Good (3), Good (3), Outstanding (4)

Supporting comments:

- Well-founded modeling of comparative GHG contributions by various energy sources is critical, and this project is making good progress in developing a rigorous basis to estimate these.
- This project is relevant to barriers W,X, and Y. The questions of net life-cycle energy benefits and GHG mitigation benefit accruing to GT need better answers and this project should provide those quantifications. The question of fracturing water, water losses for EGS system operation and cooling water requirements and availability for power plants are of crucial importance to viability of GT expansions, especially EGS.
- The project addresses EGS as well as other types of geothermal generation and the goals are sound. If successful, this project would produce some much needed information.

4.3.5.2 Scientific/Technical Approach

Ratings of Three-member Peer Review Panel: Good (3), Fair (2), Good (3)

Supporting comments:

- The technical approach seems relatively well founded, but I am concerned that data from previous DOE programs are not being included. I am also concerned that documentation of meta-data about assumptions included in parameters and sources of data are not being fully documented. For example, there is extensive DOE-funded and other literature about their work to "evaluate correlations between key reservoir properties and chemical constituent concentrations." The presentation did not express to me exactly what new material this project is bringing to the table. The meta-data question is critical. This analysis is based on compilation of data from many sources (literature, industry experts, ICARUS, etc.), and documentation of these sources will help end users, especially as the data are integrated into GREET.
- Well defined technical approach using accepted techniques. PI needs to ensure equal bases for comparison, i.e. ICARUS was used to estimate GT materials requirements whereas literature values were used for conventional (coal, nuclear and gas) power plants. Use of ICARUS needs to be validated. However, the overall scope of the project is ill-defined. A logical end-point needs to be defined for basic model development, along with the extent of the effort for annual updates and model maintenance.
- The technical approach seems to be sound.

4.3.5.3 Accomplishments, Expected Outcomes and Progress

Ratings of Three-member Peer Review Panel: Good (3), Good (3), Good (3)

Supporting comments:

- The productivity of the team seems to be good. They have compiled mammoth amounts of data (e.g. 53,000 chemical analyses), and seem to be making good progress about analyzing these and incorporating them into their models. They do not, however, seem to be sharing the results of their compilations.
- The graphics (at least in the presentation) are not well done, e.g. perhaps the parametric benefit should be (energy out)/(energy in) rather than the inverse. This would better imply a benefit and would be more readily grasped by the reader. Scenarios need to be standardized to ensure there are no scale benefits, i.e. a 1000 MW coal plant versus fifty 20 MW EGS plants. Overall, good progress.
- Progress on this project seems to be satisfactory, but percentage completion and project end dates were deemed to be "Not Applicable" – this should be explained. The project team seems to be fully capable of carrying out this project. Although they have limited geothermal

experience, they appear to be interacting well with others having more experience, and this type of communication should be continued and strengthened.

4.3.5.4 Project Management/Coordination

Ratings of Three-member Peer Review Panel: Poor (1), Fair (2), Good (3)

Supporting comments:

- The project overview slide states that the project end date and percent complete are not applicable. The investigators therefore seem to feel that ending or redirecting this project is not appropriate. Thus the DOE guideline above that decision points be appropriately placed in the research plan is not met. Critical management checks and controls are missing. Is this project really intended to last forever?
- Would be rated as a "good" if the project scope and extent were better defined. This reviewer was somewhat irritated by an implied attitude exemplified by "Project End Date: Not applicable" and "Percent Complete: Not applicable". While this valuable project (especially GHG mitigation extent) may be on-going, there is a phase to develop and apply the model, and a phase to provide annual updates. The PI and the GTP must define the scope, detail and the potential costs of this project. It should not be open-ended.

Absolutely no question that the project team is highly competent and are good managers.

- There is no mention of decision points in the project, but the project appears to be carried out well.

4.3.5.5 Overall

Ratings of Three-member Peer Review Panel: Fair (2), Good (3), Good (3)

Supporting comments:

- While this project has shown some good results so far, it seems to be working in relative isolation from data and efforts outside the national labs. For example, the compiled geochemical data are exceptionally valuable, but there is no plan to share these data with other DOE programs, such as the efforts by Drs. Snyder and Allison, which were featured at the meeting.

I would like to see very close coordination among model developers. Is there any chance that all the models funded by DOE could be based on one front end, so users will not have to learn separate models and programs to answer questions, but instead could learn one program and have multiple options in how they run it?

The investigators must, however, be thanked greatly for their many presentations to the

geothermal community. It is critical to get their efforts out and reviewed, and they are doing this well.

- There must be a better definition of the project plan. This is a needed effort by a strong performer.
- This is an important project that will help decision makers and others at the state and federal levels compare costs and environmental consequences of our electrical power generation infrastructure. It should show geothermal energy in a favorable light compared with some of the other energy technologies.

4.3.5.6 PI Response

No response.