



Geothermal Manufacturing Prize Draft Rules: Opportunity for Feedback

Purpose

The Geothermal Technologies Office (GTO) and the Advanced Manufacturing Office (AMO), in partnership with the National Renewable Energy Laboratory and Oak Ridge National Laboratory, are releasing the abbreviated draft rules content found below to provide the public with an opportunity to provide feedback on structure, evaluation criteria, and timing for the upcoming Geothermal Manufacturing Prize. GTO and AMO want to ensure that these rules reflect the right pathway to encourage innovation through the integration of additive manufacturing processes with tools, components, and equipment necessary for operating in geothermal environments.

Feedback will be accepted through April 3, 2020. Please submit feedback to GeothermalPrize@nrel.gov. Respondents may answer as many or as few questions as they wish using a Microsoft Word (.docx) attachment to their email. An optional response template is also provided at the end of this document (see Appendix A).

Background

The Geothermal Manufacturing Prize will be a multistage competition designed to catalyze manufacturing innovation in the American geothermal industry by harnessing the rapid advances that additive manufacturing can provide in improving design, fabrication, and functionality. The Prize Program is anticipated to be executed through the following contests:

- 1. Ready! Contest (Concept Development)**—Competitors will identify and take action to develop an impactful idea or solution that will partially or wholly incorporate additive manufacturing into a geothermal tool, component, or equipment. They will also propose a path to design, prototype, and test a proof-of-concept.

It is anticipated that up to 20 winners from Ready! submissions will be selected to advance to the Set! contest.

- 2. Set! Contest (Design)**—Competitors will work to substantially advance their additive manufacturing-focused geothermal tool, component, or equipment concept by undertaking rigorous design processes to demonstrate their design promise in meeting engineering and operational requirements outlined by the team. Additionally, it is expected that competitors make significant progress in teaming and partnerships capable of building and testing a functioning prototype.

It is anticipated that up to 10 winners from Set! submissions will be selected to advance to the Make! contest.

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- 3. Make! Contest (Prototyping)**—Competitors will fabricate additive manufacturing prototypes based on their Set! design at a qualified fabrication facility. Make! competitors will be evaluated by a panel of expert reviewers during a live demo day event using, in part, engineering and technical performance criteria previously submitted by each team.

It is anticipated that up to five winners from Make! submissions will be selected to advance to the Geo! contest.

- 4. Geo! Contest (Testing)**—Competitors will manufacture an advanced functional prototype with all additively manufactured components fully incorporated. Testing will use tool-, component-, or equipment-specific performance criteria relevant for geothermal environments submitted with the Geo! contest application package. Overall contest winners will be chosen by a panel of expert reviewers during a live demo day event.

It is anticipated that up to two Grand Prize Winners will be selected.

Rules Evaluation and Feedback Opportunity

Category 1: Contest Timelines

The first contest—Ready!—is anticipated to launch in April 2020. Below are the anticipated timelines for each respective contest. Given the contest descriptions found in the Background section, please provide feedback on the appropriateness and efficacy of the competitor submission timelines.

Contest	Competitor Application Submission Window	DOE Evaluation and Decision	Total Contest Time
Ready!	3 months	2 months	5 months
Set!	4 months	2 months	6 months
Make!	7 months	2 months	9 months
Geo!	4 months	1 months	5 months

Category 2: Draft Evaluation Criteria for the Ready! Contest

A key consideration for the upcoming Geothermal Manufacturing Prize will be the general categories to evaluate contestant submissions. Following is a draft set of evaluation criteria for a contestant's technical narrative for the Ready! contest, anticipated to be the major scored document submitted by competitors

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seeking to compete in this Prize Program. In general, the technical narrative submitted for the Ready! contest is envisioned at a maximum of 5,000 words, as well as up to 10 supporting images, figures, or graphs. Rules for Set!, Make!, and Geo! contests will be finalized prior to each respective contest.

Please provide feedback on the appropriateness and efficacy of these draft criteria for the Ready! contest.

Question 1: Problem—What is the problem, and why is solving it important?

1. The competitor identifies a critical problem using compelling analysis.
2. There is clear linkage and relevance to geothermal applications.
3. The competitor's assessment shows a strong understanding of current manufacturing approaches for their proposed tool, component, or equipment.

Question 2: Innovation—What is your additive manufacturing solution, and why will it be successful?

1. The competitor shows a strong understanding of how incorporating additive manufacturing can provide a solution pathway.
2. The solution represents an innovative approach incorporating additive manufacturing into a geothermal tool, component, or equipment, and is built on reasonable assumptions, valid technical foundations, and lessons learned from other notable efforts in this space.
3. The competitor is pursuing an innovative and compelling solution that will demonstrate promising new geothermal industry manufacturing approaches.
4. The planned Set! design approach is reasonably ambitious and validates the critical assumptions necessary to advance.
5. Performance goals and metrics are verifiable, and aggressive but attainable.

Question 3: Team—What have you done to date, and what qualities give you a competitive edge?

1. The team's track record demonstrates notable entrepreneurial qualities such as adaptability, creativity, decisiveness, and resourcefulness.
2. The team's drive, knowledge, and complementary skill sets provide a strong competitive edge toward realizing this solution in the near future.
3. Winning the contest will significantly increase the team's chances of creating a viable additive manufacturing-focused prototype.
4. A considerable amount of high-quality effort was put into defining and advancing the proposed concept.

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*Supported by the U.S. Department of Energy, Geothermal Technologies Office;
Directed by the National Renewable Energy Laboratory*

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Question 4: Plan—What is your plan to achieve your goals?

1. The stated goals are ambitious, reduce risks, and show a commitment to an accelerated development cycle.
2. Meeting the stated goals will demonstrate critical progress toward designing, fabricating, testing, and validating the functionality of this innovation.
3. The proposed plan effectively uses resources available in-house or through this Prize Program to advance the innovation.

Category 3: Prototype Fabrication and Testing

A key aspect in this multistage Prize Program will be competitor prototyping and testing of their additive manufacturing-incorporated geothermal tool, component, or equipment. GTO and AMO are planning multiple avenues of resources that will be available to competitors for moving along the concept, design, prototype, and testing pathway. As these are finalized in the coming months, GTO and AMO are seeking feedback on the following categories to inform final directions:

1. Of the four stages of additive manufacturing prototype development—**concept development, design, prototyping, and testing**—please provide feedback on the value of DOE-provided assistance during stages based on the contest descriptions found in the Background Section.
 - a. Is DOE support more important in one of these contests versus others?
 - b. Would you value the opportunity to receive Prize-related design feedback through a workshop with DOE additive manufacturing subject matter experts?
 - c. Do you have access to resources in-house that mean one or more development stages can be handled internally?
2. As the Prize Program will be designed to attract a variety of competitors seeking to provide additive manufacturing solutions for a variety of geothermal-related technologies, competitors will be responsible for identifying performance criteria for their specific innovation as they progress through the Prize Program. GTO and AMO are seeking feedback on the appropriate type and resolution of such performance criteria for this Prize Program:
 - a. Given the nascent stage of standards for additively manufactured components, what other resources provide verifiable benchmarking methods for evaluating prototype quality and performance?
 - b. Expected geothermal-related performance criteria in this Prize Program will reflect the harsh service conditions encountered during geothermal operations, including temperature (e.g.,

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200 °C+), high rock compressive strengths (e.g., 30,000 psi), and high free gas constituents. Are there additional performance requirements that should be considered?

3. Grand Prize winners may be eligible for additional financial incentives to deploy their tool, component, or equipment at a field-testing site. Are the timelines described in Category 1 anticipated to be adequate for bringing field testing partners (e.g., commercial geothermal operators) on as collaborators for a post-competition field test?

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Appendix A: Optional Category 2 Response Template

This template is optional to use. Respondents may answer as many or as few questions as they wish.

Question 1: <i>Problem</i> —What is the problem, and why is solving it important?	
Criteria	Respondent Feedback
The competitor identifies a critical problem using compelling analysis.	
There is clear linkage and relevance to geothermal applications.	
The competitor's assessment shows a strong understanding of current manufacturing approaches for their proposed tool, component, or equipment	

Question 2: <i>Innovation</i> —What is your additive manufacturing solution, and why will it be successful?	
Criteria	Respondent Feedback
The competitor shows a strong understanding of how incorporating additive manufacturing can provide a solution pathway.	
The solution represents an innovative approach incorporating additive	

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<p>manufacturing into a geothermal tool, component, or equipment, and is built on reasonable assumptions, valid technical foundations, and lessons learned from other notable efforts in this space.</p>	
<p>The competitor is pursuing an innovative and compelling solution that will demonstrate promising new geothermal industry manufacturing approaches.</p>	
<p>The planned Set! design approach is reasonably ambitious and validates the critical assumptions necessary to advance.</p>	
<p>Performance goals and metrics are verifiable, and aggressive but attainable.</p>	

<p>Question 3: Team—What have you done to date, and what qualities give you a competitive edge?</p>	
<p>Criteria</p>	<p>Respondent Feedback</p>
<p>The team’s track record demonstrates notable entrepreneurial qualities such as adaptability, creativity, decisiveness, and resourcefulness.</p>	

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The team's drive, knowledge, and complementary skill sets provide a strong competitive edge toward realizing this solution in the near future.	
Winning the contest will significantly increase the team's chances of creating a viable additive manufacturing-focused prototype.	
A considerable amount of high-quality effort was put into defining and advancing the proposed concept.	

Question 4: Plan —What is your plan to achieve your goals?	
Criteria	Respondent Feedback
The stated goals are ambitious, reduce risks, and show a commitment to an accelerated development cycle.	
Meeting the stated goals will demonstrate critical progress toward designing, fabricating, testing, and validating the functionality of this innovation.	

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The proposed plan effectively uses resources available in-house or through this Prize Program to advance the innovation.	