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GeoRePORT: Geothermal Research Portfolio Optimization and Reporting Technique

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Katie Contos

Hello, everyone. I'm Katie Contos and welcome to today's webinar which is hosted by the Clean Energy Solutions Center in partnership with the National Renewable Energy Laboratory. Today's webinar is focused on the GeoRePORT: Geothermal Research Portfolio Optimization and Reporting Technique. Before we begin, I'll quickly go over some of the webinar features. For audio, you have two options. You may either listen through your computer or over the telephone. If you choose to listen through your computer, please select the "mic and speakers" option in the audio pane. Doing so will eliminate the possibility of feedback and echo. If you choose to dial in by phone, please select the telephone option, and a box on the right side will display the telephone number and an audio pin you should use to dial in. If anyone is having any technical difficulties with the webinar you may contact the GoToWebinar's helpdesk at 888-259-3826 for assistance. If you'd like to ask a question, we ask that you use the questions pane where you may type it in. The audio recording and presentations will be posted to the Solutions Center training page within a few days of the broadcast and will be added to the Solutions Center YouTube channel where you'll find other informative webinars, as well as video interviews with top leaders on clean energy policies. Finally, one important note to mention before we begin our presentation is that the Clean Energy Solutions Center does not endorse or recommend specific products or services. Information provided in this webinar is featured in the Solutions Center resource library as one of many best practice resources reviewed and selected by technical experts. Today's webinar agenda is centered around the presentation from our guest speaker Katherine Young, who has joined us to give us an overview of the GeoRePORT system, describing how the system can be used to both evaluate resource grade and project progress and to look at case histories of individual and country-wide assessments. Before we jump into the presentation, I'll provide a quick overview of the Clean Energy Solutions Center. And then following the presentation, we'll have a question-and-answer session where the speaker will address questions submitted by the audience. At the end of the webinar, you will automatically be prompted to fill out a brief survey as well. So, thank you in advance for taking a moment to respond. The Solutions Center was launched in 2011 under the Clean Energy Ministerial. The Clean Energy Ministerial is a high-level global forum to promote policies and programs that advance clean energy technology, to share lessons learned and best practices, and to encourage the transition to a global clean energy economy. Twenty-four countries in the European Commission are members,

contributing 90 percent of the clean energy investment and responsible for 75 percent of the global greenhouse gas emissions. This webinar is provided by the Clean Energy Solutions Center which focuses on helping the government policymakers design and adopt policies and programs that support the deployment of clean energy technologies. This is accomplished through support, and crafting and implementing policies related to energy access, no-cost expert policy assistance, and peer-to-peer learning and training tools such as this webinar. The Clean Energy Solutions Center is co-sponsored by the governments of Australia, Sweden, and United States, with in-kind support from the government of Chile. The Solutions Center provides several clean energy policy programs and services including a team of over 60 global experts that provide remote and in-person technical assistance to governments and government-supported institutions. No-cost virtual webinar trainings on a variety of clean energy topics, and partnership building in development agencies and regional global, and organizations to develop support. An online library containing over 5,500 clean energy policy-related publications, tools, videos, and other resources. Our primary audience is made up of energy policy makers and analysts from governments and technical organizations in all countries, but we also strive to engage with private sector NGOs and civil society. The Solutions Center an international initiative that works with more than 35 international partners across its suite of different programs. Several of the partners are listed above and include research organizations like IRENA and IAEA and programs like SEforALL. Regional focus entities such as equal ECOWAS, the Center for Renewable Energy and Energy Efficiency. A marquee feature the Solutions Center provides is the no-cost expert policy assistance known as Ask an Expert. The Ask an Expert service matches policymakers with more than 60 global experts selected as authoritative leaders on specific clean energy finance and policy topics. For example, in the area of energy efficiency and mining industry we are very pleased to have Alejandro Silva, coordinator of mining and industry sector at the Ministry of Energy of Chile, serving as one of our experts. If you have a need for policy assistance and energy efficiency in mining and industry and any other clean energy sector, we encourage you to use this valuable system. Again, assistance is provided free of charge. If you have a question for our experts, please submit it through our simple online form at cleanenergysolutions.org/expert. And we also invite you to spread the word about the service to those in your networks and organizations. Our expert speaker today is Katherine Young, who's the geothermal program manager at the National Renewable Energy Laboratory. She has been with NREL since 2008, working as a senior energy analyst, focusing her research on geothermal exploration, improving drilling through innovative use of data and new tools, regulatory and permitting analysis, and geothermal resource reporting methodologies. And with those brief introductions, I'd like to welcome Katherine to the webinar.

Hello, and thank you for joining us today. I'm Kate Young, the geothermal program manager at the National Renewable Energy Lab in Golden, Colorado. I have been working in partnership with others on the development of the Geothermal Resource Portfolio Optimization and Reporting Technique, also known as GeoRePORT for short. The project was sponsored by Eric

Hass at the Department of Energy's Geothermal Technology Office to help with program strategy. Several analysts, geologists, and engineers have been working together over the past five years to put this tool together including Alex Badgett, [INAUDIBLE], [INAUDIBLE], Anna Wall, and Aaron Levine at NREL, Brittany Segneri at the U.S. Department of Energy's Geothermal Technology Office, and Pat Dodson at Lawrence Berkeley National Lab. Many others in industry have contributed significantly to this effort over the past several years through interviews, detailed feedback at workshops, reviews of papers, and review and testing of protocols. Today I'm going to provide a brief overview of the methodology and walk you through some examples of how GeoRePORT can be used. Let me start by asking you a question. How do we as an industry grade geothermal resources?

One way we could do this is by looking at resource temperature. Many temperature scales have been developed by the USGS, by Nickelsen, by Ben Ritter and Chromy. Here's an example temperature grading scale developed by Subir Sanyal in 2005 showing five temperature grades, from extremely low temperature to high temperature. We can take these grades and evaluate a country's geothermal resource. The assessment might look something like this. This is Australia's geothermal temperature at depth map. Now, the colors on this map do not correspond to Sanyal's temperature grade, but the concept is there. This map from IRENA shows higher temperature resources in red and cooler resources in yellow. This may not seem novel to any of you in the audience. Many of you may have seen a map like this before. But most of you also know that temperature isn't the only attribute important to geothermal development. What if instead of looking at one grade, temperature, we instead looked at several? For a single point on the map, say here in New South Wales, we could actually look at several grades, other geological parameters like permeability and reservoir volume, or how about the ability to permit the project and to actually transmit and sell the power, which are vital to the business model? This is the basic concept behind GeoRePORT. So why did we develop GeoRePORT? Well, back in 2008, the DOE geothermal Technologies Office or GTO for short, received a large amount of funding to spend on research. At the time, the U.S. Geological Survey Geothermal Resource Assessment had just been released showing an estimated 30 gigawatts of undiscovered resource and 9 gigawatts of identified resource. So, GTO developed a program to accelerate development of the 30 gigawatts of undiscovered hydrothermal resource. But how could something like this be measured? DOE would have to track the capacity presented by each project prior to funding and what the funding was expected to change. This would have needed to be collected as part of the application process. DOE would have to track the potential capacity moved by the funding from undiscovered to identified, but this would have to have been collected as part of the close-out report. And, finally we would need to require consistency in reporting across projects to be able to aggregate results for reporting to Congress. This would require a standard methodology for reporting consistency, and this drove the start of this project, the Geothermal Resource Portfolio Optimization and Reporting Techniques or GeoRePORT. As the project got underway in 2012, the project team identified other related challenges faced by the geothermal industry. How does the geothermal industry grade a

resource? Petroleum looks at several attributes, such as density and sulfur content using grades such as heavy and light, sweet and sour. The solar industry looks at insulation and radiation, but how does geothermal grade a resource? We discussed this concept earlier when we looked at a temperature map of Australia. But if industry had other grades, permeability or volume or permethrin or market, what would those maps look like? What data would we need to be able to measure the baseline and get a sense of resource potential in a particular country? And suppose we gather this data and made the maps. Would it show that some of the 30 gigawatts of undiscovered resource in the U.S. was actually inaccessible? Too harsh a fluid to develop? Too difficult to permit? Too far from transmission to make it economically viable? Which of these barriers should GTO focus their research on? Which barrier, if overcome, would have the largest impact on allowing geothermal deployment? How does GTO set goals to be impactful? Specific, measurable, achievable results-focused, and time bound. In other words, smart. How does GTO show the impact of their funding and communicate technical, geological advancements and achievements to a non-technical audience? In fact, communication can be quite a barrier to development. This slide demonstrates just some of the complex data collected when assessing the feasibility of geothermal development at a particular location. These data are collected by a team of experts, scientists, permitting and legal experts, among others. Many times, it can be difficult to describe the nuances of the data interpretations within a project team. These large volumes of data can be even more incomprehensible and overwhelming for decision makers unfamiliar with geothermal development. GeoRePORT allows the many project players, from geologists to geophysicists, drillers to power plant developers, and permitting experts to the sales team, to communicate effectively with each other and to decision makers. In this example, scientists developed GeoRePORTs to describe geothermal development potential at several military bases to base commanders. These commanders can then use these reports to negotiate with potential developers for development on the base who can bring the information back to their scientists for evaluation. In addition to project level details, GeoRePORT can be used to quantitatively identify the greatest barriers to geothermal development, develop measurable program goals that will have the greatest impact to geothermal deployment, objectively evaluate proposals based, in part, on a project's ability to contribute to program goals, monitor project progress, and report on portfolio performance. The GeoRePORT protocol has two main parts: resource grade and project readiness level. Each part is divided into three main topics: geological, technical, and socio-economic assessments, which you can see in both the resource grade and project readiness-level graphics. Resource grade addresses the question how feasible is it to develop this resource. Resource grade is represented using a polar area chart with different colors for each of the three topics. Red for geological attributes, blue for technical attributes, and green for socio-economic attributes. Four major attributes were identified for each of these three topics. For example, technical grade has the attributes of drilling, logistics, reservoir management, and power conversion. Each of these attributes are further broken down into subattributes, as I'll demonstrate later in the presentation. The second part of each assessment addresses project progress. How much do we know about this area? Project progress is

represented using a 3D feasibility grid, using the same three colors and a different axis for each of the three topics.

Each of the three project progress scales has five levels, allowing projects to move independently on each axis as they progress through the development cycle. For example, a project may progress along the technical progress axis by successfully drilling wells and/or conducting successful long-term flow tests of reservoirs. Progress along the socio-economic access demonstrates permits and PPAs have been secured. To evaluate each attribute, for example temperature or volume systematically, we developed three indices: character, activity, and execution. Indices are independently evaluated for each attribute using qualitative grades as A through E, A being the best. Character grade is used to describe the attribute itself; for example, how hot is the resource? Is it really hot, a grade A resource, or a relatively cool, a grade E resource? The activity index is used to indicate how you know the grade. For example, are you pulling the estimated temperature from a regional heat flow map, an activity index of E? Have you conducted thermometry at the site, an activity index of C? Or have you actually drilled into the reservoir and measured the temperature, an activity index of A. The execution index is used to indicate how well you have conducted the activity. For example, if your activity is geochemistry, are all that ANions and CATions in balance? Did you obtain the data from a third party with no knowledge of the methodology used? The first index indicates the grade of the resource. The other two indicate the qualitative certainties with which you know the grade. Let's look at an example. Shown are the 12 attributes of GeoRePORT.

Let's continue with our example of temperature.

Suppose you have a resource that you estimate the temperature to be 250 degrees C. It would be reported as a grade B. Now, how did you estimate the temperature? Let's say in our example you have actually drilled into the reservoir. You would report the activity index to be A. Looking at the execution index for subsurface temperature probe readings you scan through and decide to report an execution index of C. Though you did get a downhole temperature probe reading, unfortunately the wireline company had to move offsite before the well temperature had equilibrated. We can take these indices, B, A, and C, and plot them on our polar area chart.

We start with a polar area chart with five levels. E is represented on the inner circle. A is represented on the outer circle. So, the bigger the pie piece, the better the grade. We represent the temperature attribute in the upper left quadrant and then display the three indices in pie pieces: character, activity, and execution. The 250-degree-C B grade resource would be shown by the first wedge.

The activity index was an A and the execution was a C. We can conduct the same analysis for the other three attributes:

Volume, fluid chemistry, and permeability. This diagram lets you quickly assess the geological attributes of a resource. The dark wedges indicate grade, and the light wedges indicate certainty. Now, we can take these four dark

wedges, the attribute grades, and combine them with the other resource attributes. Using the same concept of a polar area chart, we plot the geological attribute grades on the bottom third of the chart. We can use the other portions to display the socio-economic and technical attribute grades. This allows us to display all 12 attributes grades in one graphic. For example, transmission, drilling, and reservoir management won't be a problem at this site, but land access and logistics may cause problems. Grading from different experts on a wide variety of topics from geological to technical, to permitting and market conditions, are collected and assembled into different sections of the report. Individual reports can be added, removed, or updated as needed throughout the life of the project as more information becomes available. The reports are then combined into a complete GeoRePORT, which helps everyone to speak the same language and allows non-experts to understand the suitability of data for evaluating geothermal potential. At the project level, GeoRePORT allows for different projects to be directly compared in terms of resource quality and project readiness. It can also be used to monitor project progress. In this example, GeoRePORTs are completed at three fictitious locations, A, B, and C, and a company's portfolio using detailed project information, typically activity levels of A through D.

Suppose the estimated potential for each of these three locations is 50 megawatts. We can use the GeoRePORT data to compare detailed project data. As an example, let's plot GeoRePORT geological attribute grades for these three fictitious projects. The first project has a relatively high temperature grade of B, a relatively high permeability grade of B, non-harsh fluid chemistry conditions, a grade of A, but has a relatively small resource, scoring a volume grade of D. The second project is hotter than the first, with a temperature grade of A, and larger than the first, with a volume grade of A. But you'll notice the lower permeability grade of D and slightly more caustic fluid chemistry conditions, a grade of B. The third project has the best permeability of the bunch, grade A. It's a large resource with a volume grade of A, and ideal fluid chemistry grade, grade A. But it's also the lowest temperature of the three, with a grade of C. As a project developer, this gives much more detailed information about your three projects, allowing you to make more informed decisions on how to proceed. Thus far I've described how to use your report to evaluate individual project locations, the Portfolio Optimization part of GeoRePORT. But as I mentioned, GeoRePORT was created to assist the U.S. Department of Energy's Geothermal Technology Office to identify the greatest barriers to deployment, develop measurable program goals, evaluate proposals, monitor project progress, and report on portfolio performance.

So how does GeoRePORT do that? Well, just like that temperature map we saw in the beginning of this presentation, we can create similar grade maps for each of these attributes. At the national level, GeoRePORT allows for the creation of these baseline maps using publicly available data, which is represented by activity level E. We tested this methodology using GeoRePORT's socio-economic attributes with monthly feedback on analysis from a panel of industry, environmental consulting, and federal agency personnel. This expert team was overwhelmingly pleased with the

methodology's ability to quantitatively capture these attributes and map them in a meaningful way that matched their experience developing projects in different locations. These analyses were published last fall in support of GTO's upcoming GeoVision Report. The next few slides provide a few examples of these maps. Just like we saw a polar area chart for the geological attribute that rolled up into this summary resource grade chart, we can similarly look at socio-economic attributes, shown in green, in more depth. The four socio-economic attributes are land access, permitting, transmission, and market. Each of these four attributes is broken down into subattributes that contribute to project feasibility for these attributes. For example, the ability to access land for development can be impacted by the presence or absence of cultural and tribal resources, environmentally sensitive areas, biological resources, and military installations, as well as by land ownership and the length of federal and state lease queues. The example maps I will be showing illustrate the state and federal regulatory frameworks and environmentally sensitive areas.

This map shows the relative ease or difficulty in obtaining state level permits with the descriptive grade definitions shown to the right. In western states, it is easier to obtain permits for geothermal development projects, grade B, than in the east, because geothermal regulations exist, and the state agencies have experienced permitting geothermal projects. Alaska is the only state to receive a grade A because in addition to regulations and experience, the state has an effective coordinating permit office that helps to facilitate permitting across state and federal agencies, which was found to significantly reduce permitting time. In our second example, we create a similar map, this time focusing on the federal regulatory framework. The areas shown in white are non-federal lands and are therefore excluded from grading for this subattribute. The variations in grades for this subattribute reflect federal agencies' experience, agreements with states, and available staff and budgets for processing permits. Federal lands in Nevada on BLM lands have experienced staff permitting projects. I'm just going to highlight- Can we use an arrow? While darker shaded areas, for example in northern Idaho and Montana, up here, suggest that these are U.S. Forest Service lands. Developers have found it particularly challenging to permit projects on U.S. Forest Service land due to lack of dedicated Forest Service staff for permitting geothermal projects- they often have to wear multiple hats such as fighting wildfires- and lack of experienced staff in permitting geothermal projects. In our third example, we are able to look at the geographic distribution of various levels of environmentally sensitive areas, including some areas, grade E, where geothermal development is unlikely to occur. Subattribute maps can be rolled up into a single attribute map. This map represents the summary of all 6 of the Land Access subattributes. The colors in the summary map reflect a range of scores from 12, the green areas where all six subattributes are graded as A, to 60. The red areas where all six subattributes were graded E. Unallowed areas, grade E, are shown in black. Significant-barrier areas, grade D, are shown in red. So, this is interesting, but how does this relate back to GTO and their program goals? Well, combining these attribute maps with other available maps such as the U.S. Geological Survey's resource potential maps, we were able to better quantify the U.S.

geothermal resource potential, showing that some of the available resource would have significant challenges to development. Additionally, we were able to quantify how much potential was impacted by each of the subattributes, providing GTO, other federal agencies, and the U.S. industry baseline data in working to overcome these socio-economic barriers. GTO's forthcoming GeoVision Report includes a roadmap for addressing and overcoming the most critical barriers to geothermal development in the U.S. These data provide a baseline from which improvement can be measured. The examples in this presentation illustrated a few ways geothermal grade can be used in individual project reporting and comparison, as well as in larger federal planning. There are additional ways to use resource attribute grades, as well as to use project progress reporting, in both project reporting and federal program planning. But the webinar time is running short, and I'm happy to have more detailed discussions offline with those interested. Before I close, however, I'd like to highlight a couple of the GeoRePORT tools we've created. So back to our original example: we have uploaded these maps that you've seen into the geothermal prospector so that I can click on a point in Nevada and have the map data pop up for that location. Then, click on the socio-economic section of the chart to get more information.

The detailed data for that location are then displayed and can be interacted with to display the subattributes of each of the four socio-economic attributes. This screenshot is displaying the land access of attribute grades.

Another tool we've developed is the GeoRePORT input spreadsheet. Users enter data about each subattributes. In this screenshot, the subattributes for food chemistry are shown, including pH, corrosive gas content, non-condensable gas content, and bicarbonate content. As data are entered by users, the GeoRePORT graphs are drawn automatically. This screenshot shows the summary tab for geological attributes, showing the detailed grades of each attribute and subattribute, as well as the graphical display of the same grade in a polar area chart. When all the data are entered, the cover page of the GeoRePORT displays the summary polar area chart and a smaller category-specific polar area chart.

This spreadsheet has been tested by external experts at a number of areas in the U.S. to provide feedback and develop case-study examples of GeoRePORT. The final spreadsheet and case studies are expected to be published in the next six months on the GeoRePORT website for use by others. Once the spreadsheet and protocol are published Graeme Beardsmore at the International Geothermal Association has offered to have the resource and reserve committee do additional case studies and provide feedback on the tool as well.

Kate Young

It has been reported that East Africa has tens of gigawatts of geothermal potential. But it is, perhaps, unclear how certain the resource potential is, or how easy it will be to access and develop these resources. GeoRePORT could help to get a better sense of what is there, what gaps exist in the data that need to be filled to attract investors to develop here. Just like in the US, GeoRePORT can be applied to these countries, to any country, to better

understand the resource assets and potential challenges to geothermal development. For example, someone using GeoRePORT to evaluate development potential could evaluate a country's policies and regulations and be able to quantitatively evaluate the ease of developing geothermal in that country. Though GeoRePORT doesn't itself make recommendations, an evaluator could easily identify ways to improve regulations that might improve the potential for geothermal development by identifying criteria in the next successive grade. For example, in an area that has a grade C in the permanence of attribute, a country could look to improve its process by looking at grade B and grade A criteria. And just as there are states in the US that do not have geothermal regulations, there similarly may be areas lacking geothermal regulations in East Africa and other parts of the world. Those developing regulations may look to areas that have grade A regulations and policies in specific areas and model policies after these areas. As with anyone looking to improve on any system, it's always important to establish a baseline. Understand where you are before suggesting changes on where you should be going.

Speaker 2 Wonderful, Kate, thank you so much. I'd just like to remind our attendees to submit questions as we go through. And we've already had some great questions come in. So, as we continue to go through, I'll jump in and ask them, that have already been submitted. Our first question, "Is this work conducted by NREL? Or is it a tool that the government agencies can use to evaluate their geothermal sectors themselves?"

Kate Young GeoRePORT is free for anyone to use. The protocols are all available online, and the methodologies we use to evaluate US resource potential have all been published. So, others can apply the same methodology elsewhere in the world. The geological and technical assessment tools are immediately applicable anywhere in the world. These attributes are universal no matter where you are. The socio-economic assessment tool, however, would be more challenging to apply elsewhere as they were developed with specific US regulations and policies in mind. With expert assistance, however, the socio-economic assessment tool could easily be adapted for application to any country.

Speaker 2 Wonderful. Thank you so much. Our next question is, "Can GeoRePORT be used to evaluate areas without substantial geological data?"

Kate Young That's a great question. GeoRePORT was designed to address this issue specifically. If you recall the character grade, the dark wedges indicate the grade of each attribute. The activity and execution indices, the light wedges, indicate certainty, or how well you understand each attribute. If someone suggests an area can produce 50 megawatts of geothermal, how do we know how certain they are? If there's very little data in that location, the certainty is low. As more information is gathered, the certainty increases. Sorry. So, for an area with little data, the GeoRePORT may look something like this, with grade E reported for both activity and execution indices. So, for areas in East Africa that are lacking data, GeoRePORT could highlight these areas.

Speaker 2 Ok, great. I'm going to jump in again and ask another question. Would this tool be a way to attract investors into a country's geothermal sector?

Kate Young We believe so. Transparency into the quality of the geothermal resource and uncertainty in resource capacity estimates in early stages of development have both been cited as a reason for high perceived financial risk within geothermal project development. By systematically collecting and reporting not only the grade of various attributes, but also the uncertainty in the data, investors may be able to better calibrate their risk premium to the geologic uncertainty.

Speaker 2 OK, thank you. The next question is- before we jump again to the next slide- "Who provides the data for these evaluations? And does the data remain confidential?"

Kate Young Yea, we believe GeoRePORT is best used by the geothermal experts evaluating an area. So those who know the data the best. And not by outside, third-party experts. One of the biggest challenges in geothermal is in communicating the interpretation and value of available data. So, it doesn't make sense for experts to pass their reports to someone else to interpret, or misinterpret, the GeoRePORT grade. But rather GeoRePORT was designed for experts themselves to translate their complex data into GeoRePORT grades for use in communicating their complex information to others, for example to regulators, investors and other decision makers involved in their project. In addition to the GeoRePORT more accurately reflecting the data collected in the area, this method also allows the data to remain confidential.

Speaker 2 Very good, Kate, thank you. To follow on with that, do these experts have to pay to use GeoRePORT?

Kate Young No, as I've previously mentioned, the GeoRePORT protocols are available freely for others to use. The spreadsheet, when completed this fall, will also be available on the website for others to download and help facilitate reporting with GeoRePORT. In addition, case study samples, filled out by experts evaluating various areas, will also be available to assist others in using the GeoRePORT system. The web address is included here at the top of the slide.

Speaker 2 Wonderful. And we have one final question for this section, and then we'll do more of the question and answers at the end. Does the land access assessment evaluate how remote the location is vis-à-vis electricity infrastructure?

Kate Young: No, the land access attribute, shown in the upper left here, focuses on regulatory or legal access, identifying land ownership and resources that may impact development potential. But GeoRePORT does have an attribute dedicated exclusively to access to electricity infrastructure. This transmission attribute evaluates not only distance to the nearest transmission line, but also interconnection costs and transmission or wheeling costs. Additionally, the technical assessment tool includes a logistics attribute that evaluates similar attributes. It evaluates physical access, things like

topography and severe weather events, and other hazards that may limit physical access to the site. So, are there any other questions?

Speaker 2

Wonderful. Thank you so much, Kate, for that outstanding presentation. As we shift to the question and answer, I would like to remind our attendees to please submit questions using the question pane at any time. We'll also point to several links up on the screen throughout for quick reference to where to find more information about up-coming and previously-held webinars and how to take advantage of the "Ask-an-Expert" program. We've had some great questions from the audience that we'll use the remaining time to answer and discuss. The first question is, Kate, "How does the GeoRePORT differ from the United Nations framework classification system for geothermal?"

Kate Young

Yea, so when we started this effort, we received other geothermal reporting frameworks and reviewed them, including the Australian and Canadian codes, and UNFC system. In fact, I was on the international committee that helped to develop the geothermal specifications for UNFC. But none of the existing systems, however, allowed us to set the kind of baseline metrics for early stage projects that the US geothermal technologies office needed to report on its program metrics. Additionally, none of the other systems we investigated addressed detailed resource grade.

Speaker 2

Alright, wonderful, thank you. We have time for a couple more. Our next question is, you've shown a lot about the geothermal grading portion of the GeoRePORT. Can you touch on how the project progress portion might be used by the government?

Kate Young

Sure. The ability of projects to progress through the development phases is important to industry growth. Classifying projects by phase helps to highlight potential bottlenecks in the development process. For example, if many projects are stuck at a single phase, that the GTO and other industries can work to overcome. Additionally, there may be business interests for projects in certain phases. For example, I had an investor call me up looking for projects that had been explored, where a well had been drilled and flow-tested, for example, a high geological readiness, or a G5, but there hadn't been sufficient temperatures , or flow, to make an economic resource. So, a low technical-readiness level, or a T1. Their business model was to purchase these sites for development.

Speaker 2

Very good, thank you. And I think we only have time for one more question. So, for any other questions we didn't get to, we'll connect with those attendees offline after the webinar. Our final question today is, "Can you provide more detail on how the GeoRePORT was vetted?"

Kate Young

Sure. For the socio-economic section, we developed an expert team that vetted development of the protocol, analysis using GeoRePORT and the impact conclusion through monthly phone calls for about one and a half years. For the geological and technical section, we started with detailed research to develop the first draft. Followed by hours and hours of interviews, and then review with individual experts to massage and refine those drafts. Once the details seemed relatively reasonable, we held workshops with tens

of industry personnel, reviewing and providing detailed comments on the documents. The documents then went through additional revisions before being sent out for technical review. Finally, for all three topics, the protocol was tested through case studies by experts of multiple areas in the US.

Speaker 2

Great. Thank you again. On behalf of the Clean Energy Solutions Center, I'd like to extend a thank you to Kate Young, our expert speaker, and all of our attendees for participating in today's webinar. We very much appreciate your time and hope in return there were some valuable insights that you can take back to your ministries, departments or organizations. We also invite you to inform your colleagues and those in your networks about the Solutions Center resources and services, including no-cost policy support through our "Ask-an-Expert" service. I invite you to check the Solutions Center website if you'd like to view the slides and listen to the recording of today's presentation, as well as previously held webinars. Additionally, you'll find information on upcoming webinars and other training events. We are also now posting the webinar recording to the Clean Energy Solutions Center YouTube channel. Please allow about a week for the audio recording to be posted. Finally, I would like to kindly ask you to take a moment to complete just a short survey that will appear when we include the webinar. Please enjoy the rest of your day, and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.