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Launch of the Resilient Energy Platform and an In-depth Look at Power Sector Resilience Planning in Lao PDR

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Speaker

Vickie Hello, everyone. I'm Vickie Healey and I would like to welcome you to today's webinar, which is hosted by the Clean Energy Solutions Center in partnership with USAID and NREL. Today's topic will focus on the Resilient Energy Platform and power sector resilience training in Lao PDR.

Before we begin, I just quickly want to go over some of the webinar features. For audio, you have two options. You may either listen from your computer or over your telephone. And if you choose to listen through your computer, please select the "mic and speakers" option on the radio button on the right-hand side of your screen. 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 audio PIN you should use to dial in. And if anyone is having technical difficulties with the webinar, you may contact the GoToWebinar's Help Desk at (888) 259-3826 for assistance.

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informative webinars as well as video interviews with our leading responsive energy topics.

One final note of mention before we begin the presentations 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's resource library as one of many best practice resources reviewed and selected by technical experts. And so, with that, we will begin our presentations. Our first presenter is Ms. Sherry Stout from US Department of Energy's National Renewable Energy Laboratory. And with that, I will switch over to Sherry and yeah, Sherry. Over to you.

Sherry

Thanks, Vickie. Welcome to today's webinar on the launch of the Resilient Energy Platform and we will also be taking an in-depth look at power-sector resilience planning in the Lao PDR. My name is Sherry Stout and I'm an energy and resilience subject matter expert at the US Department of Energy's National Renewable Energy Laboratory. And my co-presenter today is Yevang Nhiavue from the Ministry of Energy and Mind of the Lao PDR.

This project is a product of the USAID-NREL Partnership. SUAID and NREL partner to deliver affordable power to the developing world. The USAID-NREL Partnership addresses critical aspects of deploying advanced energy systems in deploying advanced energy systems in developing countries through policy planning and deployment support as well as global technical toolkits.

Some of these technical platforms include the renewable energy explorer, which provides renewable energy data and geostational analysis tool. Greening the Grid, which is a platform to support countries and power system transformation and grid modernization. I-JEDI or the International Jobs and Economic Development Impacts model, which is a free online tool for analyzing the potential economic impacts and job benefits of renewable energy projects around the world. And the Resilient Energy Platform, and that's what we'll be talking about today.

The Resilient Energy Platform was recently released as a collaborative under the initiatives of the USAID-NREL Partnership and the platform provides expertly curated trainings, data, tools and direct technical assistance in planning resilient and sustainable secure power systems. The platform enables decision makers to assess power sector vulnerabilities, identify resilient solutions and make informed decisions to enhance power resilience at off scale.

Within the Resilient Energy Platform is an interactive power sector planning guidebook. This details a holistic process to engage stakeholders, identify vulnerabilities and implement critical actions to enhance power sector resilience. What sets the Resilient Energy Platform apart is the breadth of resources that are included. These include training materials, guides, case studies and data and tools. These resources assess decision makers in assessing power sector vulnerabilities, identifying resilient solutions and making informed decisions. Also included within the platform are brief fact

sheets on resilience projects, some resources such as webinars and a curated newsfeed with up-to-date stories about disaster management and resilience in the power sector.

Another unique feature of the resilient energy platform is the ability to interact directly with experts in the fields of resilience. The "Ask an Expert" service in the Resilient Energy Platform connects power system stakeholders across the globe to experts from our network to provide remote consultation and advice. Now, we will take a look at how this process was applied to the power sectors in Lao PDR. To start, I want to introduce a few key points of resilience planning. First, the provision of safe, reliable and secure power is essential for economic development. Second, the power sector has vulnerabilities that depend on context and may change over time. Third, it is crucial that vulnerabilities be characterized and address to increase resilience and ensure reliability and availability of power. And by following this process, other countries can assess their power sector vulnerabilities and create resilient solutions.

Another key point I want to make is we need to define "resilience." At its most basic level, resilience refers to the ability to recover from the application of stress. NREL defines resilience as "the ability to anticipate, prepare for and adapt to changing conditions and withstand, respond to and recover rapidly from disruptions through adaptable and holistic planning and technical solutions." It's important to note that resilience is much broader than just reliability, as it also looks at things like economic sustainability and operational flexibility.

There are numerous ways to assess vulnerability but most have the same basic components. This is a process we followed in assessing power sector resilience in the Lao PDR. First, we identified threats. This was done by reviewing both quantitative data such as climate projections and qualitative data such as utility operator understanding of grid trouble spots. Second, we engage stakeholders to talk through the impacts in the power system when those threats are present. The goal of this exercise was to use system impacts to uncover vulnerabilities within the system. Next, we assess vulnerability by working with stakeholders to assess severity scores, a process I'll explain momentarily. Then, we calculated risk as the likelihood of the threat times the severity of the impact when vulnerability was exposed. Finally, the stakeholder group worked with the resilience team to develop solutions and resilience action plan.

Threats, sometimes referred to as hazards, are conditions that cannot be changed by the power system operator. Natural threats include climate-related threat such as flooding severe storms and drought and non-climate-related threat, such as natural disasters like earthquakes or volcanoes. Technological threats include equipment failure or poor workmanship and human concepts can include things like sabotage by bad actors or accidents.

Once threats are identified, we need to understand how likely it's that these threats will occur. Some threats can be easily scored by using historic or statistical data. For example, volcanic eruptions. Other scores, such as the

likelihood a bad actor will disrupt the system, can change rapidly based on a variety of human factors. This chart shoes one way to score threats. Here, we use a scale where nine almost certain to occur and one has a very low probability of occurrence.

One of the questions we often get asked is, "Where do you find that threat data?" And there's a lot of places where data may be found. Some of those would include your power system operator, your national weather center, any kind of river hydrology authorities, particularly for countries that have high hydropower resources but also national planning units, the power sectors integrated recess plan or national emergency response organizations.

Stakeholder engagement is one tool to define the impacts of past events or predicted future events. The goal of the exercise to define impacts is to begin to identify vulnerabilities in the system that could be exposed by different threats. This exercise is best completed with a broad stakeholder group as it will capture a more holistic picture of impacts than working with the power system operator alone.

Vulnerabilities are weaknesses within infrastructure systems or processes which can be modified and mitigated to either prevent a disruption from occurring or lessen the impact. These are usually identified by stakeholders with knowledge of the power system and to review the past disruptive events. This table shows the types of vulnerabilities. For example, physical vulnerabilities could include single points of failure in the system. Human-related vulnerabilities include having a poorly trained or under-resourced workforce. Similar to threats, vulnerabilities are then scored on severity and impact. Severity can be measured as the percent of system impacted, population impacted, loss of life, lost revenue or other factors as defined by the power system operators and stakeholders. Again, for this study, we used a scale of one to nine. Nine represented the highest-magnitude impact. For example, the entire power system being inoperable whereas one represented minimal system damage.

Risk is the potential for loss, damage or destruction of power system assets or other key resources resulting from the exposure to a threat. Risk is evaluated as a product of the threat likelihood score and the vulnerability severity score. Note that not all threats directly influence each vulnerability. As such, the first step involves determining which threats and vulnerabilities are associated. In this chart, you will see that some of the vulnerabilities are not related to some of the threats. In our assessment, we therefore remove this combination of threat and vulnerability from consideration. These show up as white or blank boxes in the risk matrix. There are many different methodologies for scoring risk. The methodologies highlighted here is based on the one developed at NREL and uses risk matrices to score and prioritize risk. Risk matrices show the relationships between threat and vulnerability. The severity score of each vulnerability is multiplied by the threat likelihood score to create a risk score for each specific threat-vulnerability combination.

Risk scores are scales from one to 100 with higher scores corresponding to higher risk. In this example, higher scores show up as red where lower scores

are color coded as either yellow or green. Developing a risk matrix provides a structure for combining scores in a meaningful way. That enables analysis and ranking of the risk-prioritized mitigation action. The final risk score is shown in the matrix and used to prioritize the vulnerabilities that need to be addressed through resilience measures.

There are numerous ways to increase resilience in the power sector. Some solutions include adding energy storage, diversifying the energy mix or creating a redundant supply chain. Let's talk through a few of these in a little more depth.

The first strategy is spatial or generation diversification. In the modular nature of renewable energy technologies such as wind turbines or PV allows greater spatial diversification of energy supplies compared to conventional power generation systems. Modular renewable energy technology also allows for increased diversification of energy cmix compared to single fuel conventional power plants. This increased diversification reduces the vulnerability of the energy supply to damage form a single event or at a single critical location, which increases overall energy system resilience.

Micro-grids that are capable of islanding or separating intentionally from the grid may ensure that customers have access to power during long-term power outages that impact central grid systems occurring after major events. Micro-grids can also be used in demand-response programs to reduce peak loads and overall stress on the system.

Redundancy, which means including additional resources that are beyond those required for daily operations, increases a power system's resilience because these resources can be relied on during other infrastructure failures or fuel shortages. Also, it's really important to remember the role of policy in enhancing resilience and enabling policy landscape may help to accelerate resilience, adoption in the power system whereas restrictive policies can stifle resilience efforts.

Resilience options can be evaluated on a variety of criteria based on the goals of the implementing agency. Solutions are also prioritized on the extent of potential to reduce impact, either by number of systems or by severity of the vulnerability. Other common evaluation criteria include the cost or finance ability of solutions and the complexity of implementation. Here are two of the prioritization charts used in our work at Lao PDR. The chart on the left paused the complexity of implementation against cost. In this case, the most favorable outcomes would be found in the lower left quadrant. The graph on the right lists the severity of the vulnerability addressed versus the number of systems impacted by the solution. In this case, the most favorable outcomes will be found in the upper right corner. The results of the prioritization process then need to be combined into a cohesive plan for coordinated implementation. This is the process we followed in the Lao PDR assessment. Possible solutions were identified then prioritized. The non-prioritized actions were then removed from consideration. The prioritized solutions were then grouped into action categories, given timelines and assigned responsible parties to create a final action plan.

This action plan is too detailed to read on this webinar but I'm presenting it here as an example plan. Each color corresponds to an action category. In this case, policies, system flexibility, hydropower operations and watershed management. There are also timelines for expected start and completion dates with each task. I will now hand this over to my colleague, Yevang, to further discuss this process.

Yevang Hello? Could you please go back to the –

Sherry We can hear you, Yevang.

Yevang The first slide, please? Return to that. Can you go back to the first slide, please? Good evening, everyone. Good evening from Laos. First, I would like to thank the USAID and NREL for this opportunity to present on enhancing power sector resilience in the Lao PDR. Today, I am presenting for the first obvious time power sector resilience learning in the Lao PDR. This project is led by the Lao government and the Ministry of Energy and Mines, which is pollenated and supported by the USAID and in both a resilient planning team from both the NREL and USAID public energy. My name is Yevang Nhiavue, I'm a technical fixer from the Department of Energy Policies and Planning under the Ministry of Energy and Mines. I'm in charge of energy matters and the utility pricing. Next, please.

The Lao PDR system gives access to reliable, secure and affordable electricity is essential to powering the economy growth and development and to becoming a major regional power provider. Currently, the Lao public sector is at risk from an era of natural, technological and human caused hazards which may interrupt the provision of electricity or lead to a chronic undersupply of power and we recognize that a resilient power system could try under changing conditions would stand and respond and recover rapidly if found in passive hazards. To address this risk, the Lao PDR conducted a stakeholder-driven power sector vulnerability assessment and resilience action planning process to safeguard the power system. Now, the Lao PDR can deal out complete system policies and implement actions that increase its power sector resilience incrementally over time. Today, I am presenting the process and outcomes of this stakeholder-driven power sector resilience action planning process, complete ability, power sector planning in the region.

First, it's important to emphasize that this was a stakeholder-driven process. This would include the vulnerability assessment advisory group which composed of high-level power sector decision makers and vulnerability assessment and resilience stakeholder group, which is a broader and more diverse stakeholders from various Department of the Ministry of Energy and Mines, Ministry of Natural Resource and Environment, Ministry of Finance, Ministry of Labor and Social Welfare, the Central Bank of La Pierre and the Laos-Vietnam Unions and the Electricity drivers on the others.

The process consisted of two main activities. The first one was vulnerability assessment, which is a comprehensive assessment of the Lao public sector's vulnerability to climate and non-climate hazards and to human and

technological hazards. And the second verse and the resilience action planning process, which consists of developing and prioritizing strategies that address the high-risk vulnerabilities of the Lao power sector. Today, I wanted to present these next steps in conference.

Next slide, please. The process started with vulnerability assessment. The first step was to identify and score the others that the Lao power system faces. This includes natural hazards, technological hazards and human-caused hazards. And the top four most likely hazards identified in the power sector were extreme precipitation, extreme tornados, planning and landslides makes the team-assessed power system vulnerabilities that these hazards may expose. For example, the power system rules regulations and training standards do not meet current and changing environment for conditions and construction does not follow design specifications. Transmission-line infrastructure—look at it in live wire areas. And finally, the risk score was calculated for hazards that may expose vulnerabilities to identify the high-risk vulnerabilities. An example is showing what's showing on the right-hand side which scores with high and medium-high with the vulnerabilities indicated in the table. This score of vulnerabilities would be the focal point or the pinpoint for the development of the power sector that's in planning, which is the same process.

The next activity was the development of a power sector resilience action planning. The resilience action planning provides strategies to address the high-risk vulnerabilities identified in the vulnerability assessment. The approach included both technical and operational solutions. The team developed a set of four top priority actions to support implementation. The first one was to develop and implement resilient power system policies. The second, improve power system flexibility The third one, improve coordination across hydropower dam operations and the last one was to facilitate better sedimentation management in hydropower watersheds. And as an example for action two is to improve power system flexibility, this includes activities to increase the diversity of the energy needs to support resilience. This includes jabberwocky, geographic diversity, fuel supply diversity and water use diversity as the figures are showing here is the first solar power plant located in, outside the Vientiane capitol is an example of diversification of renewables in the Lao PDR. Next, please.

The resilience action plan identified activities that we helped the Lao PDR increase sector resilience intentionally over time. This shows the related timeline or implementation of the resilience action plan. Don't worry about trying to read this. I'm just putting it out to show some of the outcomes of planning that result from the process and to show that each of the four actions even were broken down into different activities and that implementation plans over the next two years, more, more years. The immediate, medium-term and long-term activities for each of these actions were identified and incorporated into a concurrent integrated resource and resilient planning process for the Lao PDR or the core IRRP. This also the first IRRP process to be taken for the Lao power sector and the informant from this power sector resilience action planning.

Through this process, the Lao PDR Ministry of Energy and Mines identified vulnerabilities in its power system and took priority actions to reduce them. It is important to note that power sector resilience is a dynamic concept and it cannot be achieved through at obtaining commissions. As we work in many actions from the process, we will also explore comprehensive policies and strategies that would improve institutional or organizational capacity or implementing and managing our resilience solutions.

Also, this resilience action plan is not the final step to improve Lao public sector resilience. The many steps following completion of this action plan are to incorporate these actions as appropriate in our action ongoing implemented process, as I had mentioned, and to share these actions with our wide stakeholder group. The ongoing IRRP activity is a great opportunity for the Lao PDR to ensure that resilience strategies from these resistance action plans are incorporated into the conference for the sake of planning framework and containment of the activities. In addition, immediate, medium-term and long-term space in this action plan, real people and decision makers to address high-risk vulnerabilities and improve our cycle resilience over long-term. It is crucial for the Lao PDR to continually operate its vulnerabilities and incorporate noble resilience strategies on the continued power sector planning framework. This resilience action plan and vulnerability assessment should provide a working foundation for power sector planning for many years. However, as climate pollutions and the power sector able, it may be necessary to review and update over of this.

Key takeaway for the Lao PR followed the power sector resilience approach that consists of two main activities that other countries in the region would explore. The first one is the A or vulnerability assessment and the second one is the resilience action planning. The Lao PDR also identified a set of prioritized resilience actions and detailed implementation solutions to be implemented over the next two years. And the key components include comprehensive resilience policies, capacity building to the staff of the Ministry, operational and technical solutions. All this work, we will support in ongoing and future power sector planning such as the IRRP process. And so, the feature show on your right hand is the Resilient Energy Platform, which should be local and highly available. Sherry already mentioned in detail already.

This all my presentation. If you have any questions, you can ask. Thank you, thank you very much.

Sherry Thank you, Yevang. And as Yevang just mentioned, if there are questions on either presentation, we will be taking those now.

Yevang Yes?

Vickie Hi, this is Vickie Healey again and I'll moderate the question and answer session. And as Sherry just mentioned, if you have questions, please type this into the questions pane on the right side of your screen and we'll be happy to address those. But in the meantime, I do have a few questions related to the Resilient Energy Platform which thank you very much for that summary,

Sherry. It's clearly a very valuable resource and it's great to know more about that.

Just to kick off the questions, Sherry, this is over to you I believe. [Clears Throat] Excuse me. You mentioned in your presentation that a broad group of stakeholders should be involved in the planning process. I was wondering if you could give some examples of what agencies might be involved in that process.

Sherry Thank you. Great question. In general, it's best to involve the most diverse group as practical. Some groups, that are typically involved obviously include the power system operator, the Ministry of Energy, local utilities but it's also good to look beyond just the energy sector. For example, your national disaster emergency response agencies give really good data on threats or even location or operability of backup power systems like generators. Some other groups, maybe the agricultural sector, transportation department which would be heavily affected after major events, education divisions looking at the impact on students and local industrial manufacturing customers, they would all bring a really unique perspective to power sector resilience and should be included. Mostly, they would bring just a different perspective on what the impacts of outages would be. Some countries may also participate in cross-border trade of electricity. For example, Laos does. In that case, it also is worth coordinating to at least some degree with those partner countries of which you trade power. Yevang, do you have any additional comments on stakeholders you think are important to include?

Yevang Can you repeat question, please?

Sherry Sure. Planning the vulnerability, what stakeholders, so what different agencies—did you guys choose? I know you listed a group of them. Were there any agencies that you thought were particular important to include in the process?

Yevang Yes, as I mentioned in the, in my second, the, that's like, that's this vulnerabilities assessment is a large task. It includes the Ministry of Natural Resource and Environment, Ministry of Industry and Commerce and also the Labor and Social Welfare.

Sherry Yeah, some of those groups just bring a different perspective, view the impacts of power system outages and disruption. Thanks for the question.

Vickie Thanks to both of you for addressing this next question, Yevang, this next question comes over to you related to your presentation. The person asking the question is interested to know more on action three, improving coordination across hydro-powered dam operations and the question is, is it included in all existing projects in Lao PDR or only EDL generation projects and which organization will lead on this particular activity? Yevang, did you hear that question?

Yevang Yes, yes. Actually, EDL is involved. It is the state enterprise and the Division of Energy and Monies and the Ministry of Energy and Monies. And also,

related to the environmental aid, ASUS, which is correlated to the Ministry of Environmental and Natural Resource.

Vickie Right, thank you. Next question. Sherry, you mentioned in your presentation the importance of policies. What sorts of policies in enhanced power sector resilience would create an enabling environment?

Sherry Another great question. There are a lot of policies that can enhance resilience, depending on the need and the context. For example, policy that requires a certain level of generation and diversification may enhance resilience. The fuel supplies disruptions or hydro-powered water shortages is something, for example, the Lao PDR is working on right now. Developing cogent standards for interconnection of variable generation can help increase power sector resilience, as it allows interconnection of the different technologies in a safe and efficient way. Sort of on that same vein, setting coaching standards around the reliability of service is a useful code of—one of the ones we've learned here, in the United States, is setting provisions to allow for the islanding or separating from the grid intentionally of renewable resources, particularly solar PV, solar home systems 'cause that sort of solar-plus-battery micro grid can enhance resilience and reliability. And also, developing standard operating procedures. And continuity of operation plans for its sheen of it can help the power sector recover more quickly from a disruption.

Vickie Thanks, Sherry. Yevang, did you have anything to add to that?

Yevang Yes, I want to add one more thing. For our dams in Laos, the Ministry of Energy and Mines, we are working together. We have EDL leading the actions of these efforts.

Vickie Thanks for that additional information on that. And again, Yevang, next question to you. You mentioned that one of the outcomes to improve power system flexibility is to introduce possibilities, solutions into power system operations. Can you mentioned some of the examples you had in mind?

Yevang Yes. Could you repeat your question again?

Vickie Yes, absolutely. You mentioned that one of the outcomes to improve power system flexibility is to introduce flexibility solutions into power system operations. Can you mention some of the examples you had in mind?

Yevang I already mentioned in my presentation that an example is to use that which also includes the solar power plant because in Laos, the power generation is mainly from hydro because we have lots of potential of hydro. The dedication of renewable, like solar, is also important for us and that's the example.

Vickie Thanks again. Thanks for repeating that. Let's see. Next question, I believe, Sherry would be back over to you. Let's see. How the loss estimates could be obtained if all - I'm sorry, that question isn't clear to me so I'm going to skip to the next one. The illustrative framework seems to consider exclusively the power system assets vulnerability. Would you equally consider community vulnerability aspects in your overall resilience analysis? Meaning that

interesting skills or capabilities that communities can develop to face the weather events and prevent or recover from the power system interruption?

Sherry That's a really great question. This particular tool is—at least at the moment—purely focused on the power sector. That doesn't mean all-resilient planning needs to be focused exclusively on the power center. Looking at things like community capacity to recover what opportunities for local communities to have onsite energy sources or to build and do construction in what we would call passive survivability mode which means, even without power, that the communities can survive under certain temperature and humidity conditions for several days. Those are things to consider but also building just that broader resilience into the communities in general. One of the things that I look at, I work in a lot of communities where cost of power is quite high. And so, that makes the economic resilience of communities really low.

And so, one of the things you look at is how can we boost economic resilience of communities so they can be more resilient overall to things such as power outages? There are some technology solutions. Obviously, with the cost of solar and batteries reducing rapidly plus you've got small-scale hydro, small-scale wind. There are a lot of opportunities to really look at the community specifically and look at impacts. And how do you plan specifically with communities? This particular tool is looking more broadly at the power sector, largely on the country scale. Within the resources tab on the resilient energy platform, there's something called the resilience road map and that looks more detailed at smaller scale. Looking more at local government planning within the United States or looking at it through state-level planning. Just brings it down to a smaller scale. We definitely have those resources available and they're available within the platform itself.

Vickie Excellent. Thanks, Sherry. Next question. Does the process to identify an calculate risk impact in any way on the choice of electricity sources of the country and your thoughts on that.

Sherry Can you repeat that real quick, Vickie?

Vickie Oh yes, sure. Does the process to identify and calculate risk impact in any way on the choice of the electricity source of the country?

Sherry I think in general, yes. Particularly, for example, countries—and Yevang mentioned this—the Lao PDR has quite high reliance on hydropower and so if they start looking at electricity choice and EDL generation choice, one of the things they're looking at is diversifying that. Lao PDR has incredible hydro potential which is great but that also means that any sort of major climate event that affects the availability of water can affect the availability of power. And so, in countries that have maybe a single source of generation or heavy reliance on a single source of generation really could fall on the steps of the Lao PDR in diversifying that mix and making energy choices that perhaps mitigate some of those risks. Equally, if you're in a location really prone to, say, hurricanes or typhoons, you want to look at where and how you would cite, for example, wind resources as wind turbines tend to have some

pretty significant impacts from hurricanes. It also affects how you cite things. If you're looking at solar and you're in a storm zone or a zone with high winds, that affects what kind of racking you use, how you install those systems. The risk, most definitely, inform electricity choice.

Vickie Great. Thanks so much. Here's a question related to other regions. In addition to Lao PDR, how is the Smithsonian Energy Platform process of analysis applied by the Partnership used to assess and assist vulnerable power risks in other developing countries, such as on the content of Africa.

Sherry Great question. We actually haven't rolled this out with any partner nations in Africa. It doesn't mean it's not doable. It just means we haven't got there. It's a pretty new platform. It is being used at the moment within our Latin American and Caribbean partnership countries. If there is an African nation that is specifically interested in using this platform, please get in touch with us. Our contact information is on the slides and we can discuss how that might be possible.

Vickie Great, thanks so much, Sherry. Let's see, next question. In one of—I believe this was in your presentation, Sherry—in one of your slides, you mentioned costs and complexity in terms of evaluative factors for solutions implementation but you did not mention quality of technical solutions as a factor. To what degree should quality be a predecessor that directly contributes to liability and lifecycle costing of investments?

Sherry Heavily, is the short answer. Quality should definitely be a piece of this and I should have mentioned this, a sort of pre-screen to those two charts that I saw was looking for solutions that specifically did significantly address the different lists that were noted. And so, when we say "costs," we don't necessarily just mean pure number value. What we're also looking at is these systems, can these be financed? And so, if we're looking at sort of the finance ability and solutions that definitely includes a component of quality. And so, we use a variety of tools to look at that depending on what kind of solutions is being developed. It's not a pure just number basis on the cost. It really can use systems being financed. and with that finance ability, it definitely includes a piece of quality. And that was one of those things we looked at within the Lao PDR and within some of our other partner nations.

Vickie Thanks so much. Let's see. Next question would be you addressed this a little bit already but can power sector advancement planning be expanded to cover additional sectors such as food and water?

Sherry Yes is the short answer. The power sector basically exists to serve the needs of other sectors. If you think about it, the power sector is usually there to serve loads and empower other activity. And so, including industry, agriculture, other water needs besides the hydro power but drinking water or agricultural water. That enables you to develop a more holistic plan. It looks more broadly at sort of natural resilience or community resilience rather than surely the power sector. It's also, I think, maybe important to include energy is broader than electricity so it's important to consider that transportation of energy in the process, particularly when it comes to moving around supplies.

Transportation is a significant issue, particularly for some of our island nations who might have to barge in or fly in supplies. And for those who might be in colder climates or that have countries with industries who are highly reliant on process heat, you may also want to include analysis of thermal energy in resilience plans, as well.

Vickie Excellent. And then, building on that a little bit more, would you equally consider community vulnerability aspects in overall resilience analysis, meaning the capabilities that communities can develop to face extreme weather events or things of that nature and prevent and recover from the power system interruption?

Sherry Yeah, and I think we've kind of hit that in a couple of ways. But other ways of looking through the resilience also includes stuff like transportation availability, particularly after a major disruption. Also looking at housing and constriction design. Do your building codes match your local conditions and local context, particularly wind loading or flooding. For some of the things we look at for communities are really what specific events should they prepare for? And then, realistically, what can they prepare for? Because ultimately, communities—particularly the local-levels—tend to be more resource constrained.

And so, you definitely want to look at that risk matrix and say, "What are the most impactful and most likely events to happen?" And really try and tackle those first. Looking across the building sector, looking at transportation, looking at access to food, particularly after a major event, access to clean water and sanitation. Those are major events or major things that can really affect most communities after major events.

And so, looking at how do we maintain these communities during or after a power outage? It can be fairly significant. As I mentioned, I think in one of the slides, the modular nature of renewables make renewable energy sources, particularly solar tanks or PV, easy to cite in local communities. In some ways, those local systems can really offset the impacts of those power outages, particularly if you can separate them intentionally from the grid which is called making a micro grid or islanding a micro grid. And when you do that, you can serve some of those local loads—even if the power system itself has been disrupted.

Vickie Excellent. That's a great answer to that question. Yevang, did I hear you? Did you want to add something?

Yevang No. Sherry already mentioned –

Vickie Sorry, I thought I heard you chiming in there. Let's see, so I'll mention the next question. You mentioned electrical islanding capability. Is that considered a major resiliency factor?

Sherry I'm going to say it can be. It's not a one-size-fits-all everything solution but one of the things that we have seen—and we've seen this sort of in major events that's happened with people in the United States is when the power

sector goes down, it really doesn't matter how much rooftop solar you have or distributed generation you have if those systems can't run without the grid connections, meaning that if the power sector goes down, all of those rooftop PV systems also go down and are inoperable.

And so, one of the things we've really started focusing on is when the grid goes down, how can we make those safely island? And so, there's a couple of things people talk about when they talk about islanding. There's unintentional islanding which could cause damage or even a safety issue on distribution lines. But if we're talking about intentional islanding, we mean purposefully separating from the grid and running those generation assets in the stand-alone mode.

And so, when that happens, you may not have the same level of service. In fact, you most likely will not have the same level of service as being supplied by the grid in terms of the amount of electricity that is available but at the same time can run really critical loads. And so, we see that type of system going on in mostly critical facilities. Hospitals, for example, do critical loads in island mode. In a lot of ways, these systems are replacing sort of the traditional backup generator that you would think of or even being added to the traditional backup generator doing sort of a solar plus battery but generator mix to have that redundancy but also being able to island and run these really critical facilities during a major grid outage. It's not the only solution to resilience but it is one that allows for the provision of power if the grid goes down.

Vickie Great. Thanks, Sherry. Thanks so much. Here's a question I think related to developing the Resilient Energy Platform and the question is did you review the construction standards as part of your review or update or revise them?

Sherry If that's specific to the Lao PDR, we did review. If you notice, I think that first risk that Yevang mentioned or first vulnerability that Yevang mentioned was that current standards don't necessarily meet current and changing conditions. And so, yes. In general, we would recommend review. What are the current practices? What are the current standards? And then, how would you revise those? Yevang might have a little more up to date information on how they're advising those, as his group at NEM is working with EDL to do that.

Yevang, do you have anything to add on looking at whether or not looking at the codes and standards on construction in the Lao PDR meet the current conditions?

Yevang Yes. According to the climate change and financial issues, it depends on the conditions. If we can keep the existing standard so if we can grid, if it's not part of the response, we can review and make modification to a compliance with the actual conditions.

Vickie Addressing the questions, I believe I just was going through them all and I believe we addressed everything that was asked by our attendees. With that,

I think I just would like to ask first of all, extend a very hardy thank you to both Sherry and Yevang for their excellent presentations today. And depending on both the Resilient Energy Platform as well as the resilience action planning that Lao PDR has undergone. And with that, I'd just like to offer both Sherry and Yevang to provide any additional thoughts or concluding remarks you'd lie to make.

Sherry Thanks, Vickie. Thanks everyone for listening in on the webinar today. Resilience is one of those things we are really passionate about at NREL and are working in a variety of ways to help nations really become more resilient. If there's any question you have in addition to what was discussed on the webinar, please feel free to reach out. If I don't know the answer, I probably work with people who do and we can work to answer those questions for you.

Vickie Excellent. Thanks, Sherry. Yevang?

Yevang Yes. Of course, I would like to thank the announcer, Victoria, for organizing this webinar and the USAID for supporting us. And plus, this resilience action planning is the new process for us, for the Ministry of Energy and Mines. It is still under consideration of our high-level people. We be looking for what to have more support from the USAID in Croatia and NREL for supporting us in implementing and how to implement all these actions. Thank you very much.

Vickie Great. Thank you. Thanks so much. With that, I would just like to say on behalf of the Clean Energy Solutions Center, USAID and NREL, I once again want to extend a very hardy thank you to both of our panelists and to, of course, our attendees for participating in today's webinar. We really very much appreciate your time and hope you return with some very valuable insights that you'll be able to take back to your colleagues ministries, departments or organizations wherever you may work. And we also advise you to visit the Clean Energy Solutions Center website to review. Again, this presentation and webinar as well as others that might be of interest to you. And with that, I would like to wish everyone a good day. And this concludes our webinar.