VENKAT SRINIVASAN: Good morning, everybody, and welcome again to day two of the second annual Energy Storage Grand Challenge Summit. So, just to remind everybody, especially ones online who might be coming in fresh today and were not attending yesterday, so this is sort of the second session of a two-day workshop that we’ve been conducting at Argonne and virtually. It’s a hybrid session where we’re going through these aspects, and I’ll quickly summarize what happened yesterday in a second. Just to tell you, this meeting has been a wonderful one (unintelligible), right. Yesterday we heard from the beginning Carla Walker Miller with a call to action thinking deeply about DEI, how do we bring everybody along in this transition that we’re going through, going from a fossil fuel world to one which is carbon free. 00:02:37

 We then had some pretty inspirational I would say sort of exciting things coming out of the Department of Energy, the Energy Earthshots, especially the one on long duration that I think many of us are looking at very carefully, the one on hydrogen, but also other parts, right, including the ones that are coming out in (unintelligible) and all that that look like they could be game changers if we achieve the targets we’re looking for. And certainly as a community, it gives us kind of the rallying cry for going and doing something remarkable.

 And then we also heard the Department of Energy has this whole (unintelligible) approach to these problems but also the all of government approach that they’ve been taking, especially sort of looking at these Earthshots and all the other aspects of a clean energy economy.

 We then transitioned in the afternoon to look very carefully at these breakout sessions. First, we looked at workforce. Before the breakout, we had a sort of setting the stage where we spoke a little bit about the needs in kind of the workforce, and then we spoke a little bit about the manufacturing and the supply chain aspects, especially as we move to new technologies. And then we finished off with this interesting I guess hybrid with another meeting that was happening in Albuquerque where we were able to pull off sort of this virtual session where there were two different meetings merged together, and we were joking afterwards that if we can from now on have – we’ve already gone through the world where nobody travels, we were all stuck in our bedrooms, that’s the easy world, so now we can have the world where we have kind of in-person in different parts of the country and I guess people are together.

 Now that everybody’s (unintelligible), I’ll introduce myself and say my name is Venkat Srinivasan. I’m a scientist at Argonne, one of the coordinators in the national lab site of Energy Storage Grand Challenge. And to repeat what I said yesterday for those of you who weren’t here, (unintelligible) who was sort of the main contact from the national lab site, looking at this meeting very carefully, interfacing with DOE, coming up with many of these sessions, he was unable to travel this week for last-minute reasons so I’m a pinch hitter basically.

 What I’ll try to do in the next maybe couple of minutes is just sort of tell you a little bit about what happened in the breakout sessions, sort of, you know, just give you some perspectives. Obviously, lots of conversation. It was an hour and a half, right. So, and I know the various people are still digesting (unintelligible) information. We don’t have, you know, a full picture of all the things that were said, but that’s the task at hand. What we’re going to do in the next few weeks is look very carefully at all of the comments that came out of that, think about what we could do, how do we go from the sort of interesting feedback that we’ve gotten to making them actionable, and we’d be working closely with DOE to do that.

 I was in a couple of sessions, and it’s kind of interesting watching the conversations. The workforce section really reinforced I thought the notion that came out during the main session where they were talking about the need for a governmental network. The conversation was turning to the fact that we have various people in the ecosystem, you know, community colleges, universities, and companies, and there are these needs that companies have, and there are these, you know, information gaps that the community colleges and universities have. And if you can bridge that, then it provides an opportunity for them to create the courses that we need in order to get that part of the workforce going, whether it’s to get new people coming onboard or to retrain the existing workforce so that we can adapt them towards this new economy.

 There was a lot of talk yesterday in the breakout session about the fact that, you know, we tend to sort of think about all these different technologies that could be, for example, the winning technology for long duration, and frankly, (unintelligible) technology for long duration just because long duration is sort of a lost topic. But then for different technologies, you might need very different kinds of workforce, right. So, you know, somebody who is focused on hydro may have a very different set of workforce needs than somebody looking at a (unintelligible) device where membrane casting may be an important thing.

 So, we were talking about the fact that there has to be sort of this metering (phonetic) of what’s happening in technology development, along with what’s happening in the workforce. There are going to be some common things that we absolutely think we will need. So, that will help us create kind of the workforce network, but you have to be adaptive in recognizing that there could be things that could be different. And as the technology evolves, some of these interesting new ways of storing energy are going to become more promising. So increasing TRL and MRL. We know it’s going to become something that we have to anticipate, but others may fall off so we have to be adaptive in kind of thinking about that reality.

 And the last thing that also came up I think is that there has to be sort of a network, which has kind of come up before. You know, there needs to be a roadmap, right. So, let’s say there is somebody who is in a particular field today who says I want to get into energy storage, I want to try to get into this topic, and this came up even in the Q&As in the afternoon, you know, if there is a way for them to go somewhere and there is a roadmap that says you take this set of courses and that will help you evolve from where you are to where you need to be, it becomes very I guess easier for people to kind of get into the (unintelligible) how could we enable that. So, again interesting conversations that focused on that topic.

 Let me quickly sort of talk about the manufacturing one. I happened to be in that session for some time. One of the things that struck me, and it was actually Eric (unintelligible) that said this yesterday in a different breakout session, I think there is a lot of talk today about the lithium-ion workforce challenges, and that’s because there is a significant amount of challenges in lithium-ion. But certainly as we look beyond lithium-ion into long duration and to things like flow batteries or, you know, some of these things that, you know, Billy Woodford was talking yesterday, you know, the CSP conversation that was going on, along with sort of the hydrogen conversations, there could be different needs that might come out of that where the whole supply chain challenges might change pretty dramatically. We know that. We know that that’s going to be a pretty significant aspect of how we have to think about the future of this technology.

 And very similar to the workforce, right, every technology that you can store energy is going to have a different set of supply chain challenges, maybe a different set of workforce challenges. And maybe what is important there to think about, those common ones that we know are going to be useful for many different technologies, how could we enable that, how can we ensure that we (unintelligible) those topics. And then there will be some that will be very specific for those topics where we have to kind of focus on and do something more.

 So, to the conversation that happened yesterday when the DOE folks were here, you may be super worried about nickel or cobalt because you’re worried about lithium‑ion batteries, but you’re not worried about that when you start thinking about a long duration sort of flow battery or something to that extent, right, where your decisions may be based on the fact that, you know, are you able to get the membranes, do you have that locally, do you have to get it from somewhere else, can you create the industry. So, just having those sort of I think sort of a more nuanced way of thinking and a more holistic approach seemed like an important part of what is coming out of the manufacturing, the workforce and supply chain challenges. Sorry.

 The last one in terms of policy and valuation, which was the third topic, again, there was a lot of discussions there both online in the online sessions and in the room, kind of thinking deeply about the fact that that conversation I think turned mostly to LDS, kind of the long-duration part. And, you know, frankly, the reality with long duration is that we still (unintelligible) to find the use cases, right, and what services that LDS can provide. Obviously, we heard yesterday there’s a lot of debate as to exactly which way we will go. So, part of the recommendation that is coming out is that we need to have these very uniform product definitions and requirements so that people understand how to kind of think about the LDS market.

 And we don’t have real market rules and the regulations and the mechanisms right now for LDS. It’s not (unintelligible). So, thinking deeply about, you know, how are we going to get that to become reality is important so that it (unintelligible) end of the day.

 And then the third thing that came out is that, you know, there is quite a bit of work that needs to be done when you start moving into a new market like LDS for economic studies, cost and performance data, you have to have the validation of the technologies that they’re putting (unintelligible). So, all of that still a big need that needs to happen.

 And the last thing that came out is that, you know, when you do things like long duration, the prototype size starts to go up, right, I mean in the sense that you’re talking about big things, often in some cases, you’re thinking chemical storage. And if you’re doing it in a very small scale, you may not be able to prove to yourself that this is going to work on the larger scale. The scale of the prototypes means there’s a lot of funding that is needed, but you may need that kind of funding and that kind of scale for you to prove to the market that this is something that can be an adequate resource. So, certainly a challenge that you have to think about very deeply.

 That’s a quick and dirty summary of what happened yesterday in the breakout sessions. And again, we will be continuing these conversations, looking at the notes very carefully, and the people that were in leadership in these particular sessions will be making sure that they write down the recommendations in talking to DOE to ensure that we’re able to write something actionable.

 We’ve got a pretty busy day today so I think we want to keep moving, and I’m looking at Whitney, she probably wants me to stop in a couple of minutes. Very quickly to tell you that, you know, we’re going to look at multiple aspects like globally and what’s going on in energy storage. Then we’ll go local to really asking what’s happening in regional areas. You’re going to think a lot about what’s the technology, where is it going, how do we move technology towards the market, and you’re going to have some breakout sessions, right, talk a little bit about how are we going to sort of think about these different aspects.

 And remember the pitch sessions yesterday afternoon, right. Just to remind you there were 90 people that submitted. Actually, it’s 91. I heard from somebody today that someone had something this morning. So, people that want to pitch for ideas on what could be a possible technology for long duration. We just don’t have the time for so many, right. So, we’ll have some for the afternoon. It will be a great discussion I think. And then we’ll also in October, like I said yesterday, have a session for the rest of those people that want to make pitches so that they can move forward.

 So, with that, I think we should go into the first session for the day today. Very quickly to tell you I’m going to bring out – I’m losing track on where I am. So, we’re going to start about looking at what is happening on the rest of the globe. That’s going to be the first session. Meredith Braselman, who was here yesterday from ICF, will be moderating this session. So, let me ask Meredith to come out. Meredith? I hear a door opening so I assume that means somebody’s coming. There you are.

MEREDITH BRASELMAN: Good morning. Thank you, Venkat. We are excited to moderate this next discussion today. So, please know that we are going to be taking questions at the end from both our folks here with us today, as well as our virtual attendees. I want to introduce our first speaker, Simon Bretschneider, research and business analyst at SPRIND, the federal German agency for disruptive innovation. At SPRIND he is the technical lead of the long-duration energy storage challenge. So welcome, Simon.

SIMON BRETSCHNEIDER: Thank you, Meredith, for the introduction. It’s really an honor to be here today and to share like our approach how to tackle really the big challenge of long-duration energy storage. And because I’m sure you know the American system, but before I talk about like the details, I would quickly talk about what disruptive innovation to us is because it’s such an important point.

 In the energy storage, there would be like getting the next generation of lithium-ion batteries, and that is like a small step. But disruptive innovation would be yeah, you’re just finding new cell chemistry, which like doubles or triples the energy density, like a really big, big step, which would allow (unintelligible). And there’s a lot of people here from a technical background, and you know that there may be these ideas out there, but they need to push to get from a lab to a demo and then later to full scale.

 So, with that, on the next slide I would quickly start to share the vision what we share here. What if energy would be too cheap to meter? Energy is the base of everything from like food, like driving your car to work, running your cellphone, having meetings like this here. And right now in Europe, we’re seeing the opposite, like gas prices, natural gas prices quintupled due to the conflicts in Eastern Europe. And so, just to give you an idea, imagine a gallon of gasoline costing 20 dollars. And that’s what customers are really looking as a reality.

 And so energy too cheap to meter is something what is in the future. For some, it could be nuclear fusion. And I’m a physicist by education, and you always say it’s just going to take another 10 years until it’s reality. And that applies for every day. So, it was 10 years 10 years ago, and it’s 10 years today, and hopefully we get beyond this 10 years (unintelligible). But in order to get to the long-term vision, we need to do some steps in the middle, and that is really what this talk is about today is really do the next steps towards energy storage and using what we have to get to the long-term vision.

 So, on the next slide, just quickly what I’m going to talk about because yesterday we got a good look into what the Department of Energy is doing, and I feel like it’s important to explain a bit what SPRIND does and how it’s different from the system here. The second one talks about (unintelligible) challenges. You may have heard of it from (unintelligible) and last, but not least, our approach to energy storage in the long term, long duration.

 So, on the next slide, the SPRIND was founded just three years ago, and the need for that was really to bridge the gap. And in Germany, we have really good universities researching (unintelligible). You may have heard of Max Planck Institutes (unintelligible), which is really like the backbone of the research in Germany, similar to the national labs here.

 And then there is a gap towards what I call market‑shaping products and services. If you think about German brands, you may know cars obviously, you may know chemistry or pharmaceuticals. And if you think when these were developed, they’re all dating back like at least (unintelligible) more like a century ago. Like these are old ideas. And what here the U.S. do well is like make like research into reality. If you look at the S&P 500, there’s the obvious names from the Silicon Valley, who are like very important players now.

 And so, like based on this need like to bridge the gap, being a federal agency, we want to fund, like breakthrough innovations, then we need to do it careful because (unintelligible) national labs spend taxpayers’ money. So, we need to do it carefully but still somehow enable breakthrough innovations. And how we do this I will explain on the next slide or how we attempt to do this.

 Like SPRIND is I would say independent, and I put an asterisk there because we do get money from the Federal Ministry of Economics and Research. But like how we decide on what we do is really independent. And it’s not like the DARPA or the RPE (phonetic), where you have the focus on energy or in defense, like SPRIND really does everything with one exception, and that’s defense first. So, if you have some dual-use technologies, that could also be interesting (unintelligible) looking into space applications. But really it’s civilian (unintelligible).

 I say here on the right like technology based. Obviously driving society or change would be very nice, but it’s not something what you can do with just like money and some other close support. So, the focus is really on technology, but we do this at the interface of regulation, technology, and also (unintelligible).

 And then, as a central focus, it’s like following the focus from DARPA and RPE is really follow high risk, high reward. So, not looking for the incremental innovations but really look for the big things like everybody has an iPhone today. Those who are a bit more senior, 10, 15 years ago, in order to take a picture, buy stocks, just call your family, there are three devices, and just to see everything united just in your pocket is just great.

 And just one more word how we set up. Like in the middle you see this elderly man who is our president, Rafael Laguna, and he is a former software entrepreneur. He ran a company. He stopped for the agency for opensource software, and this is something that really drives us. Like keep working on the big topics, but like also keep the efficiency drive, which you get from the industry because in this sort of area you need to like be ambitious and but also be fast in order to get there.

 And on the next slide, I want to introduce the challenges. So, we have two funding schemes. One would be bottom up where whoever has a greater year can like fill a form on their website and then we look at this. And so there are quite a few good ideas which came up from this bottom-up approach. For example, a new way to think about Alzheimer curing really and not just like preventing Alzheimer.

 But I want to talk about the challenges. This is sort of the other way around. It’s like a top-down approach where we, like the DARPA, ask a question to address questions of the society, you know, (unintelligible). And this is like finding the best solution for a given task. In this case here today, it would be energy storage.

 And then on the next slide, I want to introduce like how we do this specifically. And if you think bet on the race, not the horse, there’s a really good example, an extremely successful example. A bit more than two years ago the coronavirus struck the earth, and then governments around the globe really poured money into developing vaccines to bring us all back together, to allow us to meet in person, to meet our families again and not like isolate by ourselves. And so, there were huge investments. And a lot of the approaches didn’t work out, but like just to put like two or three names like Pfizer and Moderna in the U.S., they made a really successful vaccine, the same for a German company called BioNTech. And they just by pouring huge investments and without a known outcome, all of these approaches could fail, and some actually did fail.

 There’s another company, CureVac from Germany, which got the same funding, but nothing came out. But only by betting on the race and not the horse, funding multiple approaches, we could succeed in the end. And that’s really one of the center arguments here for the challenges (unintelligible).

 On the next slide, I would like to continue describing this approach. It’s really about a competition in the competition. So, how we run these challenges might be a bit different from approaches like doing in the RPE or the DARPA, it’s like a staged (unintelligible). So, whatever proposals fit to the challenge (unintelligible) preselection by jury and then there’s going to be first stage, for example, and we would select like up to eight (phonetic) teams, and they get a year of funding. And after the first year, we look who progressed the furthest, who got the best progress, who like has the highest ambitions and wants to continue and can continue. And then there’s going to be another selection step. And then a second stage, which would be one and a half years in this case. Only the best teams from the first round would get in there. And so really driving or really focusing on the competition.

 Obviously, funding is important role like for the energy storage challenge. There would be like million euros funding in the first stage would be almost the same amount in dollars, and for the second stage, it’s more because when you go from lab to scaling, the amount of money that you need obviously goes up.

 And the third really integral point to the competitive approach is we not just provide money but also like other resources. And one of them being like the coaching. So, as you may know, like (unintelligible) accelerator, they want to push the teams as good as they can so they provide how do you develop a business, how do you take care of regulatory stuff, how do you develop your technology. And if a team has that, then it's not a problem, but if you have a team from a university that doesn’t know how to take care well of these approaches or these issues, then (unintelligible) coach will be answering questions then.

 And as we do here, not just talking about funding and coaching, but also building ecosystem, like the conversation we had yesterday is so important because you get input from the community, you find people, oh, I have this idea, then there’s another person, or I know how to scale, I know how to like build a supply chain. And like building this ecosystem around the technology is really something important, what is an integral part of the challenge.

 And last, but not least, on the next slide, what you’re trying to do is do it fast and easy. Like for the challenge, for the long-duration energy storage, the call participation is open six weeks, and then there will be four more weeks for the internal selection process. And then after the jury meeting in the evening, the teams who won, they get a call and then they send us an invoice, and as soon as the invoice is there, we’ll send the money.

 And like from what we’ve heard from the community, getting the funding fast and not like after a lot of negotiation is such an important part because it keeps these businesses driving and just make it possible that they continue their work. So, as I said, really try to do this challenge as easy as possible as we can do it as a federal agency.

 Before I talk about the actual challenge on the next slide, we are running another challenge, which is called carbon (unintelligible), where we look to remove carbon dioxide from the atmosphere and make it into usable products, not just make some sand or like, but for example, make concrete, which doesn’t need these high-temperature process steps, which are like an important part of the carbon dioxide (unintelligible). And because in the end it’s like climate change is such an important point, reducing emissions is one point, but also like captivating like what is out there is the other part.

 But today, I just want to talk about the challenge, the long-duration energy storage challenge. And on the next slide I would like to – because I think we talked about, enough about motivation so can you change the slide please? I think there’s no need to motivate really the need of the challenge, but I just want to say one word, energy independence. Like last year in Europe people were like okay, why do you need storage, we get like huge amounts of natural energy or natural gas from Russia. And yeah, as you all know, this has changed quite a bit not, just even like yesterday there was news that there were some leaks in the pipeline. So, now even if the conflict would end, you cannot just restore the supply that you’ve lost.

 So, around these three points like the climate change, energy independence, also promoting growth in Europe. The energy independence is such an important point because, as I said in the beginning, like you want to have house which is warm to live in with your family, but also when you’re a business owner, you want to have affordable energy to sell your products.

 And just to outline what the focus points is on the next slide, I think you would remember criteria like this from challenges like the days or the long-duration energy stored (phonetic) because in the end, there’s no magic in long-duration energy storage. Were you hoping to find some? If somebody has the magic solution, which has not been seen, just talk to us. But just to outline that, 10 hours or more storage duration time, looking at extremely low cost because, as we saw before, low energy cost is something extremely important for people at home and in the industry.

 But also scaling. Just to give a number, like the natural gas, which came via pipeline and from Russia was two terawatt hours per day this year. And I mean you do need to replace all of that by renewable resource, but it’s just a massive, massive scale. And the ideas what we’ve seen so far, they work well, but we really want to bring them to the next level.

 And another point would be critical raw materials. (unintelligible) has a list where there’s materials shown such as lithium or vanadium or platinum, which our supply chain (unintelligible), which have big environmental issues. And so what we’re looking here is for technologies which (unintelligible) and by keeping the other criteria running.

 High round-trip efficiency is something which like there’s a lot of great technology around hydrogen because hydrogen can be stored very well in (unintelligible), but the issue so far would be okay, efficiency is just not high enough, and you just need a low of wind power and solar panels. So, even like if you want to use it like atomic power plants and if your efficiency is low, then you’re just (unintelligible).

 And one thing for the challenge specifically what we’re looking for, and yesterday Julia from the LDS Council said like bring from lab to pilot, like and what we’re looking for is really a technology, which right now has a lab scale (unintelligible) so a technological readiness level up around 324 (phonetic), and over the three fours or two-and-a-half years of the challenge, get it to 67. So, really make the push towards pilot (phonetic) plant.

 For the team, like I would say it’s very important to select a good team because what we saw in the preparation of the challenge, there’s excellent people in academia, and so often they have a great idea, but the approach what they use is okay, I want to perfect my system to 100 percent, and really the focus on the market like a business point is often missing. So, this point, a team that is ready to do whatever it takes is something very important.

 This is a disclaimer here. So, the challenge is open, but because there’s the long-duration energy storage shot from (unintelligible) and also there was today’s program, this challenge will only be possible to participate for European teams who have like companies who have their headquarters in Europe. But I think what we can learn on that from here or what our approach is something which I would like to show on the next slide, really carbon-free reliable energy supply and like our answer to that is we look for high-risk, high-reward (unintelligible) and really follow this approach on bet on the race, not the horse. Fund multiple teams and then select the best one. Do it fast and easy, and last, but not least, do it with a great team because that’s what it takes (unintelligible) to succeed.

 And with that, I would like to say thank you for your attention and looking forward to some questions later.

MEREDITH BRASELMAN: Thank you so much, Simon. Now I want to introduce our next speaker, Mike Gravely, team lead and senior electrical engineer for the Energy Systems Research Branch at the California Energy Commission. Mike, welcome.

MIKE GRAVELY: Good morning, all. Thank you, all. I wish I could be there in person, but I’m glad to be able to share what we’re doing virtually, and she’ll be flipping my slides for me, and we’ll go from there. Next slide or first slide please.

 So, the focus today is on non-lithium-ion energy storage technologies and what we’re doing in that area, and we are doing some pretty substantial work, as you’ll hear in this short presentation. The next chart.

 So, I work at the California Energy Commission. I’ve been there 20 years. Prior to that, I was in private industry in a startup energy storage company, and we worked in energy storage for the federal government. So, I’ve got a long history in energy storage. And the Commission R&D division is about 100 people right now, and we expect with the recent funding we’re getting, that will probably rise to 150 to 200 over the next few years.

 On the EPIC program, we’re in the tenth year. The program, we get $130 million, and we just received a 10‑year reauthorization in 2020 for the program. So, a very stable program, and we work the full spectrum of research from applied research, which is really the first prototype in the lab. The first field (phonetic) demonstration and technology demonstration is where you’re trying to ramp up the technology to be more commercial. And then we also work things like interconnection and permitting and other things to help with the commercialization.

 So, I will mention that our Commission this year, as a result of the state budget, is receiving $10 billion in funding. On an average year the last 40 years, 500 million to a billion was our average budget. Our division alone, the R&D division, is receiving an additional billion dollars this year, of which 380 million of that is for long-duration storage. Next chart.

 So, I’m going to be talking about the division itself. We do the full ecosystem. We do everything from efficiency to electric vehicles to grid resiliency and some storage. We spend about a billion dollars to date under the EPIC program. About 25, 30 percent of that funding has gone to energy storage. Next chart.

 And this is the key for the discussion today as far as I’m concerned. California is in a unique environment. California has very aggressive energy storage goals. Currently, California has 330 – I’m sorry, 3,300 megawatts of energy storage installed. And those of you who dwell on the news, three weeks ago, California hit the highest electrical load in the history of California, and Sacramento hit the highest temperature in the history of California records, and all 3.3 gigawatts were called to bear. And the good deal was we went through a week of a heat storm and did not lose our grid and, therefore, things are working well, but we came very close.

 We’ve been talking in some of the previous sessions about integrated resource planning. I will point one thing out. That 3.3 gigawatts, we’re expected to have over 4 gigawatts by the first of the year. Ninety-nine percent of that is lithium-ion. We do have a goal of 15 gigawatts by 2030, and I believe with the current challenges, the CPUC is going to try and meet that goal by 2030 instead of 2032, of which one gigawatt is identified for long-duration storage.

 The other thing that’s important is when you look at our goal of zero, we have a bill called SB 100, which requires California to be zero carbon electricity by 2045. The Energy Commission is the lead agency for implementing that bill. And there was a joint agency report with all the energy agencies within California, and that report indicates that we need somewhere between 40 and 50 gigawatts of energy storage to meet those needs. If you look at the studies being done by the academic community, the utilities, other people, those are the numbers we’re talking about to make California work. So, after we get to 15,000 megawatts in 2030 or 2032, we need another 30 to 40, another 25 to 30 or 40 gigawatts of storage to meet our needs. So, the storage needs in California is rolling very rapidly. Next chart.

 As I mentioned, I’ve been at the Commission 20 years. We have been working energy storage very actively in the last 10 years, much more active than the previous timeframe. We’ve basically done demonstrations with residential, commercial, industrial, and grid. A lot of our experience is on the customer side of the meter. A lot of our experience with systems that are a few megawatts or less, and we’re changing that now as we go forward, where we’re doing more in front of the meter work, and we’re talking about systems that are 10 or 20 megawatts in size for 8 to 10 hours. So, much bigger systems as we go forward.

 One of the things to point out in the reality, to get 15,000 megawatts and to get 50,000 megawatts, you cannot buy that at one megawatt at a time. So, what happens in these non-lithium-ion technologies, if they’re going to compete in the future, they have to rise to the challenge, and they have to be able to provide not just 5 or 10 megawatts for 8 or 10 hours, but they have to provide 50 or 100 megawatts for 8 to 10 hours, and that is a manufacturing challenge for many of these companies today. Next chart.

 I’ve been working in long-duration storage myself for about five or six years, studying it pretty intensely. And in 2020, the Energy Commission did a very substantial grant process where we awarded eight grants for long-duration storage 10 hours or longer. The largest system in that group was eight megawatt hours. Most of them were around three to four megawatt hours, but a pretty substantial jump in there. We also awarded some early-stage grants, which would be the first of a kind of their first demonstration or first field demonstration. Three different technologies, flow batteries – I’m sorry – thermal storage, zinc air, and iron air that are projecting a hundred hours of storage. One of the unique elements of the hundred‑hour system, if you look at those grants and what they propose to us and what they’re estimating that their cost per kilowatt will be in the future, all three of them are estimating their cost to be one-tenth per kilowatt hour of what we pay today per kilowatt hour for energy storage. Next chart.

 The other thing that’s very important, I haven’t had a chance, I’ve listened to some of the sessions and hope to hear more today, the market is growing very rapidly. The opportunity is not just in California, but all over California is kind of the most aggressive right now. And we’re finding a substantial amount of technologies that can reach that challenge of the 5 to 10 megawatts by 8 to 10 hours and potentially grow in a few years to 50 to 100 megawatts for 8 to 10 hours, and these were just some of those. I had reached out to many of these companies to learn about their technology because they’re not in California. They may be in the U.S., they may be in Europe, they may be somewhere else, but these technologies are actually rapidly growing. They have a lot of benefits that they offer California as we go forward. Next chart.

 So, if you look at the real focus on non-lithium-ion, one of the challenges California has, as I’ve mentioned right now, when we go to 4,000 megawatts, 99 percent of that storage is one technology. We do not want to go to 15,000 megawatts, and we do not want to go to 50,000 megawatts with one technology. Everybody knows that lithium-ion has supply chain challenges. There’s a huge growth in the electrical vehicle market. Fifty percent of the electric vehicles in the country are in California. California is growing at a rapid rate. So, lithium-ion, a lot of the companies, their priority is electric vehicles over stationary storage because they make a better margin on electric vehicles. And so it’s going to be a challenge.

 Safety is always a concern. Thermal runaway, we’ve had some issues just recently that have been in the press. And so that’s something that again, we don’t want to put all of our eggs in one basket so we need these non‑lithium-ion technologies to rise to the challenge and become part of the mix.

 Also, when you look at the future projections, as I mentioned, the cost per kilowatt, whether it’s for four hours, eight hours, or longer, and in California by legislation this year, we defined long-duration storage as eight hours or more. Right now in our group we’re working 8 hours to 100 hours right now, and we’re also looking at seasonal storage and where does that fit in California’s future.

 So, as I mentioned before, the challenge we have is when you look at these large systems, most of them are power purchase agreements. They are not outright purchases by the utility or by a third party. So, we need to get the financial community comfortable with financing these large storage systems and these companies so they will last. And that is a big focus that we’re having right now in California, and the big focus is I’m asking those communities what can I do with the $380 million to convince you to invest in future non-lithium-ion technologies and not just invest in lithium-ion. Next chart.

 As I mentioned, this was a monumental year. I’ve been doing storage for over 30 years. This is the most exciting time in my life here. Our division, our office, me personally, I’m working this. So, we received $140 million in July of this year for non‑lithium-ion technologies. In September of this year we went through the worst heat storm we’ve had in the history of California. So, our initial focus is what can we do with non-lithium-ion batteries that can help us next summer and be able to be part of the solution to California to demonstrate to the world that non‑lithium-ion can perform and can perform equally well or better than lithium-ion.

 So, we are awarding three grants to approach that (unintelligible). The first one is with a Native American tribe, an under‑researched community. It’s a 60-megawatt hour, 6 megawatts by 10-hour system. It’s a combination of flow batteries and zinc hybrids. And we are currently scheduled to approve that grant in two weeks from today on October 12th is our monthly business meeting, and this grant is scheduled to be approved and executed so they can make that schedule and commission their system by June of next year.

 The second project we’re working right now is for the military base, and that is 80-megawatt hours, so 8 megawatts by 10 hours. Again, zinc hybrid technology. Again, we’re hoping to award this contract in the next 30 to 45 days and doing so so we can also have this system up and running next summer by the time that we need it for the summer heat storms of 23.

 And then also on the front of the third system we’re doing is we’re taking the venture into the hundred‑hour systems. Right now iron-air, most people know Form Energy, is leading the fleet of those three that we have existing contracts with. I’m hoping later to be able to award a grant or contract with one or two of the other hundred-hour systems. But right now we’re looking at five megawatts, 100 hours. It will commission that we will award this grant probably in November if not December, and we’re expecting the system to commission the end of 24 or early 25. Next chart.

 As I mentioned, we had $380 million that we were approved for. So, next July we get another $240 million, and now we have done kind of what I call our emergency response with lithium-ion. Now we’re opening the market to good technologies. One the things we did when we requested the money from the legislature and explained what we wanted to do with it, we said we wanted California to have a diversified energy storage mix, and our goal was to advance four to six technologies to the point where they can participate, which means to the point that they can deliver 50 to 100 megawatts of system, not just five megawatts. And so we have three that we’re working with.

 We’re going to have a large competition that will be released in the summer of 23 in line with the money being approved. And we’re hoping to award another five to eight contracts, five to seven, five to eight contracts. If we’re lucky, we will advance another three or four companies to the point that these first three companies are going again. In our case, these grants are a steppingstone. They are not the end of the road. We need companies that can deliver 50 to 100 megawatts and multiple times over the next 10 years. So, we’re trying to get companies up that compete in performance and cost with lithium ion and demonstrate their capability and build confidence in the marketplace.

 The one wrinkle that could change things is everybody knows we’re here for DOE, DOE has a huge amount of money they’re putting out. We could look to take this money, and we’re talking about 150 to 200 million dollars in this first solicitation. We could use that money as cost share and double that money with DOE and then work the system that way. So, we don’t know the answer yet, but it’s very likely we may provide a DOE proposal in the spring of next year to do some of that. And then also if we do not use up all the money in 23, whatever money’s left, we will do a follow-up solicitation in 24. Next chart.

 I know I’ve covered quite a bit fast. I’m happy to answer questions. I’m happy for anybody who has questions to email me direct. I’ve been trying to reach out to as many of these companies who feel like they can deliver 5 to 10 megawatts in the 24/25 timeframe to see how many are out there to help us scope out the solicitation. And with that, I’ll turn it back to the administrator for questions and answers.

MEREDITH BRASELMAN: Thank you, Mike. All right. Let’s start with one question for both of you. How do you consider the ability to scale up manufacturing when you’re identifying technologies?

SIMON BRETSCHNEIDER: For our challenge, the focus is really more on like scaling up the technology. The manufacturing will come after that step. But for us, the focus is really on the technology. And unlike the ideas we got yesterday from the Office of Manufacturing from the DOE, it’s not a part of the challenge yet. But like as a follow-up to the challenge, like we’re trying to get people in contact with like private institutions, venture funds, and like after the challenge from SPRIND, these considerations will come into play.

MEREDITH BRASELMAN: Okay. Thank you. Mike?

MIKE GRAVELY: Well, it’s a key element to our work. If you talk about what a system needs to deliver, if I say I would like a company to deliver 50 megawatts for 8 hours, that’s 400-megawatt hours. If they do 100 megawatts, it’s 800-megawatt hours. That is a substantial change. For most of the lithium-ion companies to do 5 to 10 megawatts, we’re talking 50 to 100 hours, and that’s a big jump. So, getting the investment community to see the future, getting the investment community to understand these companies have the ability to build. There is a market in California, there is resources in California to bear for these. We are hoping that the investment community will come to bear to these rising companies.

 The three companies that we are talking about doing these first three grants, all three have received substantial investment income in the last few years to help them grow their manufacturing companies. A lot of these early stage non-lithium-ion companies couldn’t manufacture 50-megawatt hours in a year, much less 500. So, they need to grow. And what we’re trying to do is go through this process and help the ones that are the most ready and the most competitive to give them the opportunity to grow and to convince the investment community so they can continue to grow and reach the needs, not only for California, but for the rest of the U.S. and the rest of the world. So, manufacturing is a key part of keeping up with this large demand that California has.

MEREDITH BRASELMAN: Thank you. Building on yesterday’s conversation with Eric and Carla, how does inclusivity and access factor into how your design or select demonstrations?

SIMON BRETSCHNEIDER: For us, (unintelligible) technology and we would like to encourage like submissions from all like communities, like a different example not from the challenge but from our other funding scheme is we got two high school students who developed a new kind of flow battery who have like a good idea and who did the prototyping. And also to be open to these sorts of community, which otherwise wouldn’t have a chance to like – like nobody would listen to them because they’re just two people from high school, but if the idea is good, why (unintelligible) cannot listen. So, I think that following also on that approach, also what we heard yesterday like how to get the workforce. If you make like young people interested in this technology and listen to them, it’s such an important part.

MEREDITH BRASELMAN: Thank you. Mike, your thoughts?

MIKE GRAVELY: Well, we’re fortunate in California. As I mentioned, the EPIC program, one of the programs we do have is a small grant program where we look at these types of innovative technologies and the initial ideas and proof of concepts. It’s a competitive process, and people can apply for $150,000, and if they’re successful, they can get a second grant up to around 250 or 300 thousand dollars to advance their technology. So, where I am today, we have been using the companies that have gone through that process, and they’re now able to develop multi-megawatt systems. And so, what we’re trying to do now is to reach out to the companies that don’t have an EPIC past and allow them the opportunity to participate in California.

 So, I think, you know, it is a continuum. I think if you look at the growth market, California alone is 50,000 megawatts, I mean 5 gigawatts of energy storage. And we want diversification. We want new products. What that offers us is lower price, higher safety, higher reliability, and longer life. And so, we want to encourage these creativity projects. And what we’re trying to do right now is take some time and prove to the investment community that this market is just not in California, it’s all over. As I understand it right now, about a third of the states in the United States have a zero-carbon goal for 2040, 2050. And what they’re all going to learn is you can’t get there without a lot of energy storage.

MEREDITH BRASELMAN: Thank you, Mike. All right. We’ve got a question from the audience here.

MALE SPEAKER: Hi. (unintelligible) start-up building flexible energy storage. The question is for Simon. In the U.S. we say bet on the jockey, not on the horse. Yours is better, bet on the race. This happens to be a global race. Climate change is a global problem. Fixing it is a need of the hour. My question to you is are you willing to seek proposals from the U.S. headquarter companies who are promising to start operations in Europe?

SIMON BRETSCHNEIDER: So, thank you for the interesting question. Like how we work with this, like once the funding starts, there would need to be like a subsidy in Europe, but it’s not that you can just submit by yourself when you (unintelligible). Another possibility is when you submit as a consortium, like a team, maybe you and like some partners, which like run another part of the system, as long as like one of the teams is headquartered in Europe, they would also be eligible.

MEREDITY BRASELMAN: Very good. Go ahead.

MALE SPEAKER: Hi. (unintelligible), Argonne. So, the question is to both of you. Do you have any independent assessments of the metrics, of the performance metrics and how they compare with the original goals?

SIMON BRETSCHNEIDER: I think I can start with that. Thanks for the question. And what we’re looking for for the metrics would be we have our base, but we need to find some boundaries (unintelligible) for the cost. And I hope that answers your question. Like we’re going to have a jury, which is like comes from a variety of backgrounds like financing, institutions, research, et cetera, and because of all their backgrounds, they have a good view on like what these metrics actually, like how can they make them into a reality. And I hope that answers your question; otherwise, I’ll follow up with you later.

MEREDITH BRASELMAN: Mike, anything you want to add?

MIKE GRAVELY: Yeah. Again, for this group, I really focus on a narrow area of the market, and that is to get companies to grow and to get companies to get additional financing so they can continue to grow. So, for the first three companies and for the solicitation that we’re doing, we are developing what we call a bankability matrix. And so, we’re trying to provide – we use that to help us select the companies that we are investing in right now. So, those three companies, we’re talking about $100 million of investment in those three grants. So, things like their maturity, I’ve learned over my 30 plus years that companies go through different cycles. And to be able to really ramp up manufacturing, you need to have a stable design, and you can’t change your design. So, if you haven’t gone through that growth phase yet where you redesigned your product, it makes a big difference.

 You know, the engineering capability of the company, their customer performance, their field performance, their financial status, other things. So, one of the things we’re hoping to do for the competitive solicitation is provide in that solicitation the bankability matrix and give the companies that win those awards goals to shoot for so that they can reach that bankability point, and that information will help them in the financial market.

 So again, for our effort, there’s two focuses. One is build a system and it has to work. Two is convince the financial market that your company is worth the long‑term investment.

MEREDITH BRASELMAN: Thank you. Kate, we’re going ’til 9:30, right? All right. So, we’ll take this question over here, and then we’ll do our online question.

MALE SPEAKER: Hi, there. Hi, Mike. (unintelligible) from Defense Innovation Unit. This is a really interesting conversation because we have one side is looking at very sort of low TRL and (unintelligible) and familiar with today’s program. And then Mike has sort of companies that have proven and are really kind looking to sort of investment in the market. So, my question is, and many of the companies in the room here are kind of somewhere in between, how are you guys handling TRL? Like what is your expectation? Like what is the expectation after two-and-a-half years here? And, Mike, how do you then help smaller companies, many of them who are in California or coming from Germany then participate in the California market, which is probably the biggest in the U.S.?

SIMON BRETSCHNEIDER: I think I can start on that one. So, what we set the challenge up is we get from a lab scale, you have a lab (unintelligible) prototype and getting that to not a full scale but like the demo scale. So, if you have a container unit, for example, get during the two-and-a-half years from lab to like a container scale and also like prove the scalability of your approach and not just in TRL but okay, we can build one container, but we can also do 10,000 or we can build a huge (unintelligible), and that’s what we are looking to.

 And then as a follow-up on that one, that is like perfectly suitable for people like Mike in the U.S. that works from the funding point of view because then they can take up these and make them into really good scale storage units.

MEREDITH BRASELMAN: Mike?

MIKE GRAVELY: Yeah. I think for us, we’re fortunate the first three grants we have anywhere from two to five or six years’ experience working with the companies and with their product, and so we have a real comfortable level of what the TR level is. I think for the efforts we’re looking for, we’re looking for companies that are at the higher TR level. That’s why I mentioned under the bankability metric that your product maturity, your product performance has been proven and you’re ready for this kind of growth.

 I mean we’re talking about awarding grants in 2023 for delivery in 24, 25. So, we’re talking about what can you do in the next three years, not what can you do in the next six months. So, we are giving companies the opportunity to rise to the challenge, and we’re hoping we’ll be able to help with that.

 So, I think, you know, it is important. To me, the TR level comes down to that initial question of where are you in the design of your system. Every company I’ve worked with over the years, and I’ve been, like I said, 20 years at the Commission, I mean I have to say here too the reality of the financial market, I’ve been around a long time, the two companies that five years ago we said were the leaders in the industry are both insolvent now and we’re going through all the process of that, and that is a challenge we have to address with the financial market. And so, you know, it gets to the point of just finding ways to find your TR level, to validate your TR level, to understand. And we don’t have the flexibility. I mean it’s funny, you know, (unintelligible) at one of the meetings years ago said oh, we should stop what we’re doing and then just test everything for three or four years and then pick up. Well, that ain’t going to work when California is running out of energy and California needs storage to keep their grid running. So, we have to do it in parallel. So, we have to look at how can we confirm these companies are ready. Companies always improve their product. I’m talking about major changes versus tweaking. And so that they’re at the point where they’re ready to do 100 megawatts of a battery in manufacturing and not one megawatt where they’re going to change it the next year to a different design.

 So, I think the TR level helps us understand, the criteria for the TR level helps us understand where these companies need to be. And again, there is probably 30 to 40 companies I’m reaching out to. I don’t think all of them are ready for this scale, but, you know, this is not the end of the road. This is the beginning of the road so there will be other opportunities, and hopefully, they may be able to catch the next round.

 You know, again like I said, we’re looking to diversify in California. And if I’m as successful as I could ever hope to be, we could have four to six companies able to compete in five years that aren’t even competing right now. That’s what we’re shooting for. That’s what this money is used for.

MEREDITH BRASELMAN: Okay. Very quickly, one last question, Zach.

ZACH: This is a question for both, though principally Mike. How do you address the points made yesterday that a market for long-duration energy storage is really at least a decade away? Mike just said that there is a market in California, but CEC is creating that market.

MEREDITH BRASELMAN: Mike, go ahead. We’ve got about a minute left here.

MIKE GRAVELY: Okay. Yes. So, you are correct. I focus on what California needs, and I showed you that California has a clear market. California needs a lot. California has money to pay for a lot, and that’s not true. However, what we do and what we learn is directly transportable throughout the nation and throughout the world. And so what we’re trying to do is help move the market along, help create the diversification of technologies. And so, I think at the big picture, what California is going to do is raise the bar for everyone. And I think yesterday personally, I would disagree with some of the comments from some of the models. Actually, funding is part of my research. I’m funding my own detailed modeling because I think the numbers have not been representative. One of the things I’m trying to figure out is if we’re got about 50,000 megawatts of storage, how much of that needs to be long duration versus short duration, which is four hours, and what’s our flexibility.

 My belief if I go to 50,000 hours, is probably 25 to 30 percent of that will be long duration. And, you know, right now we’re talking about less than 10 percent of the first 15,000 megawatts, but we don’t have companies that can deliver. Right now if I was to give every company I work with that I think could deliver 20 to 50 megawatts in 2028, 2029, I couldn’t even take half of that 1,000 megawatts and fill it up. I’m hoping to get to the point where we have companies that could actually deliver 500 megawatts in the 2030s of energy storage, non-lithium-ion energy storage, to compete with what we’re doing with the lithium-ion market.

 So, I think what we’re doing is going to raise the bar for everybody, raise the awareness for everybody, and I think there is just a wealth of companies that are waiting for this opportunity.

MEREDITH BRASELMAN: All right. Thank you, Mike. We are out of time here. I want to thank Simon and Mike for joining us today. It was a great discussion, and we’ll welcome Venkat back up to the stage.

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