VENKAT SRINIVASAN: I think we heard very, very clearly what the next session is going to be sort of articulating in Dr. Richmond’s comments. She spoke about the need for the whole RDD and the spectrum to work together and how they’ve been pushing the Department of Energy to do that. This is going to be the next session. They’re going to talk about how the DOE folks are coming together in this really wonderful fashion across the department to have these conversations about how are we going to move technology from the early stage R&D to late-stage R&D and ultimately towards manufacturing and deployment in large scale, the scales that we need, right. Remember, energy is (unintelligible) problem. It's not something that you do in small scales. So, that’s going to be basis of the conversation we’re gong to have.

 I’m going to ask Meredith Braselman, the strategic communications marketing partner at ICF to take the stage so that she can moderate the next session for us. Meredith.

MEREDITH BRASELMAN: Thank you so much, Venkat. Welcome to Unifying DOE to Achieve Long-Duration Energy Storage session. I’m excited to moderate this session today. We will be taking questions at the end, both from our in‑person and from our virtual attendees. So, let me introduce some folks here.

 First, I want to introduce Linda Horton, associate director of science for Basic Energy and Sciences at the Office of Science within the Department of Energy. Linda, are you online? There you are.

LINDA HORTON: Yes. Thank you very much for the introduction.

MEREDITH BRASELMAN: Welcome. And we also have some other representatives from the Department of Energy here: Michael Pesin, deputy assistant secretary for the Advanced Grid and Research Development at the Office of Electricity, and Michael Berube, who is the deputy assistant secretary of Sustainable Transportation and Fuels in the Office of Energy Efficiency and Renewable Energy. So first, we’re going to hear from Linda. So Linda, I’m going to let you start.

LINDA HORTON: Thank you very much. I really appreciate the opportunity to be here with my colleagues to talk about this important coordination that we have been doing in energy storage. I am enthusiastic about the important role that the Office of Science plays in this field and trying to bridge the gaps between the science innovations and the technology implementation that are required to attain the clean energy goals that were so clearly articulated by our previous speakers.

 The challenges of long-duration storage will really require the all-hands-on-deck approach that was mentioned by Geri Richmond with a continuing partnership across the department to enable the innovations to move to resolution of technology challenges.

 BS has been engaged with Michael and Michael – Michael and Michael’s staff for many, many years in coordination in the energy storage area. The engagement extends from our leadership interactions, all the way through to the interactions of our PIs at the annual merit reviews that are held by the technology offices.

 Recently, the headquarters coordination has evolved to the Energy Storage Grand Challenge that was discussed by Paul, as well as for a battery and hydrogen joint strategy teams, both of which are integral I believe to reach the goals for long-duration storage.

 One of the aspects that was mentioned by Ms. Walker‑Miller and others is the importance of workforce within the Energy Storage Grand Challenge. John Vetrano from Basic Energy Sciences has been leading the efforts to understand the workforce needs of industry, as well as how we can span from having people engaged in energy storage research from the very early stages of their careers, all the way through to getting the right people that are needed for industrial needs. These interactions and activities are really of increasing importance as DOE works to expand the engagement of individuals from underrepresented groups. To that end, I really appreciated Ms. Walker-Miller’s comments. This is a program that we have been pushing in the Office of Science. We have two initiatives. One is called Renew that’s intended to engage underrepresented students and faculty from minority-serving institutions to work as interns and to be engaged in doing research with the National Laboratories, and a new program that is planned for FY2023 that we call Fair, that will actually provide research funding focused on underrepresented groups and underrepresented institutions.

 We work together in strategic planning. We can’t get there without planning, whether it be for roadmaps or in planning the workshops and reports that provide the directions for the underpinning science, making sure that our science programs and our research priorities actually reflect the technology challenges for today’s industry groups, but also for the future growth and new innovations for the overall field. So, these issues are very important to us. We engage the technology offices in planning for our own workshops and are participating in theirs.

 All of this effort to strategic plan results in funding opportunity announcements, again, mentioned by previous speakers. In Basic Energy Sciences, we’ve had two recent calls for proposals for our Energy Frontier Research Centers and a program looking at clean energy in manufacturing. I am really pleased that we have awards to 15 teams that are working in the energy storage priority areas. We go on and plan for the future, as was mentioned by Dr. Richmond.

 The Energy Earthshots Initiative has spawned a new initiative in the Office of Science to specifically fund research that will help us do the science to attain the goals of the Energy Earthshot programs, including long‑duration storage. We have a new modality we’re proposing for FY23 called Energy Earthshot Research Centers, for which the funding opportunity would be developed directly with the technology offices, building on our partnerships, as well as an associated program that’s more crosscutting between the challenges because if you look at, for example, long‑duration storage and hydrogen, there are a lot of common factors in those from a science perspective that need to be eliminated, whether it be the fundamentals of electrochemistry or membranes or any of the multitudes of manufacturing challenges associated with those fields.

 So, we are really looking forward to continuing our collaboration. The other activity for 23 that I would be remiss if I did not mention is the re-competition of the Office of Science’s Battery and Energy Storage Hub Program. This is a science-based program that is focused on innovations required for next-generation energy storage. And again, building on the 10 very successful years of JCESR, the Joint Center for Energy Storage Research at Argonne National Laboratory, this competition will build on their success and take on the new challenges. Thank you very much.

MICHAEL PESIN: Good morning. So, this is fantastic audience, and I don’t know how many people are watching this room on the internet, but thank you for joining us today. So, I want to continue the theme that Linda started. This is collaboration. This is the importance of collaboration in the energy storage space. So, my office is the Office of Electricity, and we are responsible for what we call electricity delivery system, so this transmission and distribution network. And what it does, it delivers electricity from where it's produced to where and when it needs to be consumed. And when, this is where energy storage comes in.

 So, there is a lot of things that we need to do in order to meet all these extremely ambitious goals to (unintelligible). But the grid is evolving, the grid is changing. We can no longer operate the grid the way it was operated for the last 120 plus years. So, with more renewables coming online, most of them are variable renewable energy resources. So, they have this issue or challenge or problem, whatever you want to call it, of intermittency. To address it, we need to have more flexibility in the grid.

 There are a number of ways to accomplish this, but energy storage is the best way to do this. Energy storage needs to be everywhere. But the question is what is energy storage. Before we can start collaborating on this energy storage solution, we need to decide, we need to define (unintelligible). And it’s not as simple as it seems. So, I’ve been in this energy space, well, longer than I’m willing to admit, but this is something that was never clear to everybody. When we say energy storage, what are we talking about? And I talk to many different audiences, and depending on where I spoke before, when I say energy storage, people would imagine completely different things. If I go to battery people or battery associations, they will imagine batteries. When I go to hydro energy forums, people think about hydro. When I speak to hydrogen people, it’s hydrogen storage.

 So, before we could join our forces, what we’ve done in the very early stages when we just conceived Energy Storage Grand Challenge, we developed the definition of what are we talking about, what is energy storage. So, to do that, we divided all technologies into three different categories because we didn’t want to be technology specific. It’s about functions, right, what value, what functionality energy storage can deliver.

 And those three categories are first one is what we call bidirectional electrical energy storage. So, this is the technology that can take electricity from a grid or any other system, store it in any form of energy, and then put it back into the grid or into other system that needs electricity. So, examples of this, batteries, flywheels, (unintelligible), and many other technologies that would fit in this category.

 The second category, we combine thermal and chemical storage. So, those are groups of technologies that can absorb electricity and harness energy, thermal energy or chemical energy to store it and then use it in the form of chemical or another way around. It can use chemicals to be stored and then produce electricity.

 And the last (unintelligible) generated most of the debate. (unintelligible) energy storage historically would never think of it as energy storage. But this is the set of technologies that have same functions, that can deliver the same benefits. It’s flexible generation and controllable loads. What energy storage needs to do, it needs to shift demand for electricity. It needs to move electricity in time. So, if you increase flexibility of generation, if you enable your loads to be controllable, you can accomplish similar functions. So, once we’ve done this, it allows us to create this consortium across entire DOE complex and across multiple stakeholders in the industry to talk about energy storage and develop energy storage.

 And, of course, I talk about energy storage for electric grid because for me it is important. The grid really needs a lot of storage because we’re changing, we’re changing a lot. So, in the past, the way we would operate the grid, we had very good way, good track record forecasting the loads, but we could control generation. With renewables coming online more and more, we need to forecast both sides. We need to forecast both sides of the equation, loads and generation. And when you have equation, you have two variables, as you know, you can’t always have a single solution so we need to add second equation, and this is where energy storage comes in.

 So, energy storage is something that can help us to reach these (unintelligible) goals. But, of course, electric grid, even though I am biased, I think is one of the most important things, but it’s not the only place where we need energy storage. With a lot of electrification goals in transportation and building center, we need energy storage everywhere. And we need to develop this energy storage so manufacture domestically, we can create good jobs, and we can produce this energy storage, and we can import it in other countries. But it’s not just about grid; it’s about everything else about transportation. And with that, I will turn my space to Mike, who can talk about other applications for energy storage. Thank you.

MICHAEL BERUBE: Thank you, Michael. As I was listening to you speak, I remember well, I guess three, four years ago, now three-and-a-half years ago that one evening you and I, Steve Chalk (phonetic), and a few others kind of started having this conversation and envisioning this. And Michael doesn’t joke. We must have spent six, eight months, I don’t know, more, saying what is energy storage, what do we mean by this, what do we want it to mean. So, I think you did a great job of kind of laying out where we ended up.

 As the person responsible for transportation on fuels inside of EERE at DOE, let me tell you first just a little bit of what’s happening in that space ’cause that leads to this question of how are we unifying DOE on energy storage, right, the focus of the panel here. Just last week, the week before last week – now time is flying here – four secretaries in the administrative EPA across the U.S. signed a Memorandum of Understanding and basically directed their teams – so, the Secretary of Energy, Secretary of Transportation Pete Buttigieg, Administrator Regan from EPA, the Secretary of HUD, directing their three agencies to develop and then implement a deep decarbonization strategy for all of transportation. Develop a blueprint to get to net zero across all of transportation, cars, trucks, offroad, planes, trains, every aspect of the transportation sector, and to basically do that working collaboratively across the agencies working as one team upfront, not just coordinating after the fact, but literally planning those resources.

 And when you think about the tremendous amount of funds that the Inflation Reduction Act and the Infrastructure Bill have provided, how do we manage all of that and achieve that objective together? This is the first time that we’ve ever approached it that way. And as many of you know, transportation is the number-one source of greenhouse gases across the U.S., and that’s true in many countries as well. So, we’re not going to address our climate crisis, which is really our focus of why we’re here, focusing on clean energy, without addressing transportation.

 So, to that end, I’ve been making some big progress. We’ve just today announced the last of state plans. We now have 52 plans, 50 states, two districts to develop a national EV charging network. It’s $5 billion of funds that are now moving out towards states, another 2.5 billion for community-based charging to develop that national EV charging network.

 Last week, we announced the hydrogen hub, $7 billion for hydrogen hubs across the country, which will play a critical role across a large range of clean energy transportation (unintelligible) energy storage in the grid.

 We announced a sustainable aviation fuel (unintelligible) clear goal with all of industry united to decarbonize all of airflight with practical plans in place by 2030. It’s 2040 to 2050. And, you know, soon we’ll be having announcements on first the $3 billion in battery and energy storage, directly batteries, both vehicle and grid level that will be coming out from the Department. These are just really some of the highlights of the activity. So, there’s a lot of specific deep plans that have been happening.

 So, the question is how does that tie to our discussion today. Well, it’s very clear we are electrifying across the economy. That’s true across transportation, the hydrogen that we’re talking about from electricity. One of the biggest new loads actually for the grid as well is actually biofuels. I mentioned 35 billion gallons we need to make by 2050 through advanced biofuels. They will actually draw a lot of hydrogen from that, which will draw a lot of electricity in turn.

 So, and we look forward to the grid, right, and the challenges that Michael and Linda talked about. EVs, both cars and trucks, will be the largest new load in the grid for decades to come. By far, the largest new load. They also though represent potentially the most flexible, almost manageable load across the grid, right, but we need to bring those pieces together. So, when you think about energy storage and transportation, certainly we’re looking at energy storage at EV charging locations itself. We’re going to need energy storage on the grid to help manage the EV load itself. But we also anticipate that if we are smart about how we do this, that we will be able to actually use EVs both in cars and trucks as a flexible load, as a virtual load essentially, right. So, that’s that third piece that Michael talked about to help manage the grid overall.

 And then (unintelligible) one other specific use case, the bidirectionality that I think was in the first category. Certainly, as we, you know, place batteries on – just to take one example, we’re spending $5 billion right now as a federal government to electrify school buses across the country to electrify hopefully 40 to 50 in the school bus fleet. That’s a significant number of batteries. One of the things about school buses is they’re pretty predictable on what they do and where they go, and they do end up sitting a lot of the time, and that’s potentially a significant local battery source with bidirectional use. The technology of the bidirectional is not hard to do. The question really is the use case and the patterns and the managing of that. The same thing with a lot of stationary storage.

 So, with that as our challenge, at least I have in front of me on the transportation side with my team, how are we working together across DOE? Both, you know, Michael and Linda mentioned a few of them. I do want to start kind of up at the very top organizationally. We announced two new joint strategy teams. These are teams that cut across DOE, report directly to the deputy secretary, and the secretary herself has line of sight to them as well, one on batteries, and one on hydrogen. And as DOE has grown tremendously in the infrastructure bill, I think $60 billion, right, we recognize the need to make sure we are having strategic coordination across all parts of the Department. So, these teams job is as the people enter into there into that group, to take their organizational hat off and basically be making sure they are shepherding the overall strategy of the department across all aspects of it. So, that will be a significant new effort that we have, and that will certainly impact the work here in the Energy Storage Grand Challenge.

 The second one is Michael and I have asked our teams to develop and launch something called VGI Initiative, Vehicle Grid Integration Initiative, to really pull together what has been a number of good work and interactions across both the Office of Electricity, Office of Technology Transfer, across EERE, but to bring them all together to look at how do we really take the next step on integrating vehicles with the grid and creating that managed load that we talked about that really will be critical.

 There’s a new program on EV Grid Assist, a lot of utilities and especially public utility commissions have expressed they need information, they need data, they need help. So, that program will help serve there.

 Then, of course, on battery R&D, as Linda mentioned, you know, there’s been a great partnership on R&D. We need to have a continuum from the early stage out through the latest stage of battery R&D, you know, and that’s going to be critical as we work jointly to figure out what are the right chemistries. You know, we all know the supply chain challenges we have on batteries, and really the holy grail there is to be developing that next or next-next generation of battery technology that does not use limited (unintelligible), it will use earth-abundant minerals, and that’s really one of the big challenges. And that’s going to take all of DOE working together to accomplish that.

 The hydrogen hubs that I talked about are an excellent collaboration. With the new Office of Clean Energy Demonstrations, OCED, brand-new office set up within DOE to help implement the infrastructure law, they have been working seamlessly with the hydrogen fuel cells office, my team, to help develop those hubs, and they’ll be working together over time as we manage both the R&D of hydrogen out to the deployment of hydrogen.

 And the last example I want to mention, Linda talked about this a little bit, but workforce training. This is going to be a critical area as we move in transportation to electric vehicles. I spent 25 years in Detroit. Think about every plant that makes engines and really the transmissions, all the powertrain and related components, all those suppliers. We are going to move to basically have 100 percent light-duty EVs, and really a large percent, if not all, of our trucks, either battery or hydrogen. It’s a sea change in manufacturing.

 Now, luckily, that’s not going to be happening just overnight. That will be a continual change for the next 20 years. We need to basically help transition that workforce of people who have been building transportation so critically for us into the new technologies, into batteries, into those new power electronic components. So, that’s going to take a lot of work for us, training, activity as well. That’s activity that we are working on collectively with our folks in the manufacturing office and ERE but also with the Office of Science as well.

 So, lots of examples of great collaboration. Look forward to taking your questions, along with Linda and Michael now.

MEREDITH BRASELMAN: Thank you so much. We’re going to bring Linda back. There she is. So, we’ve got some questions that have come in front the audience, and you are welcome to come down to the microphones as well. So, first question, and you guys can take your turns here. How has the Bipartisan Infrastructure Law shaped how your offices think about transitioning early-stage R&D to demonstrations?

MICHAEL BERUBE: I’ll take an initial stab here. I think one of the big things, right, as we looked at the Infrastructure Law that was passed, and not just as it was passed, but as we collectively were helping to form it and provide those ideas, one of the things that we all said is urgency. We have to have implementation now. Now DOE is a science and engineering and technology agency at its core, right. So, we’ve always not been quite comfortable with deployment and what that means and how like, you know, that implies picking technologies and choosing them. So, this was really a new way of thinking for us. And I think we set up, you know, of course, this new infrastructure within the Department under the undersecretary for infrastructure. You’ll be hearing I know from Steven Boyd from the manufacturing supply chain piece later. I mentioned OCED, the Clean Energy Demonstration program. So, these are huge dollar amount in terms of billions of dollars, but they need to work seamlessly with the traditional science and applied offices like where Linda and Michael and I come. So, part of it is building these new bridges cross them, but part of it is also I think becoming comfortable with the fact that we have to start making choices collectively as a society. And as the Department and government, we have help guide some of those to get implementation, which is a little different than just kind of throwing the technology out there and saying let’s see what sticks.

MEREDITH BRASELMAN: Very good. Michael, to you.

MICHAEL PESIN: So, as you know, DOE has fantastic laboratory complex, right. We have best expertise in the world. And on the other hand, we have industry that is extremely (unintelligible). So, industry is reluctant to deploy new technologies until somebody has proven it works. Nobody wants to be (unintelligible) number one. So, before we can go and deploy, deploy, deploy because the objective of the Redeployment Office, for example, or Clean Energy Administration Office, we need to make sure that this technology is validated, is proven that it will work long term. And for that, we have a lot of different (unintelligible) that we’re developing.

 So, one is recently – well, not recently anymore. So, we started construction of the energy storage test facility at the Pacific Northwest National Lab, which we call Launchpad. So, this grid energy storage launchpad will allow us to test this technology and eventually scale them up from single cell to hundred kilowatts in size, and then after that, it can be commercialized (unintelligible). The other initiative that we are starting, we call it (unintelligible) grid (unintelligible) solutions. So, this is for early-stage technologies that are almost ready to be commercialized. But before it can be deployed in the industry, they need to be piloted in a controlled environment. So, what we’ll be able to do is to put it in the lab or in the field but in the controlled environment. You (unintelligible) and it runs through multiple scenarios, multiple use cases to validate not only the technical performance but also (unintelligible). And that will help to accelerate adoption in deployment by using this significant funds, $62 billion, the deal we received for infrastructure.

MEREDITH BRASELMAN: Thank you. Linda?

LINDA HORTON: Oh, the Office of Science and BES is viewing these demonstration projects and the deployment as a data opportunity. One of the tings that we’re anticipating with the Energy Earthshots Initiative in the Office of Science is looking for mechanisms to work with the technology offices to leverage the data that will be coming out of these new demonstration projects and deployment activities as input for our science because we can take the data, we can use AIML techniques, we can take the insights from that data in working with these demonstration and deployment projects as a way to accelerate what we can develop, the understanding that is needed to, as I have said, solve current problems, but also looks towards the future and the design of the new chemistries, the new architectures, the new systems that we will need to realize the energy storage goals for the nation. Thank you.

MEREDITH BRASELMAN: Thank you. The next question, Linda, I’m going to start with you because you were bringing up Earthshots there. What kind of partnerships outside of DOE will be most important to achieving Earthshots?

LINDA HORTON: Oh, it all depends on the Earthshot I have to say. I’m on one of the committees within the Department that looks at these from the big-picture perspective. And for many of the Energy Earthshots areas, the collaboration with other agencies is really important. Offshore wind comes to mind as having some close ties with other agencies, as does geothermal.

 But from the science side, we’re looking at also the partnering opportunities for some of the unique programs out of the National Science Foundation, but also the teams of researchers that we expect that we will support to do the science will engage the technology, will go very broad. So, we’re looking at teams of the National Lab performers, the university performers, but also industry in launching our research efforts for the Energy Earthshot areas. Thank you.

MEREDITH BRASELMAN: Very good. Michael Pesin.

MICHAEL PESIN: So, I think the more people, the more organizations get involved with this, the higher chances for success, and we’re looking for everyone. It’s not just National Labs, not just universities, but it’s also businesses that are small startups that they get engaged. But as much as I love talking about technology – well, I’ll get one of the soundtracks for my soapbox – technology without right policy cannot succeed. So, we need to make sure that we work with policymakers as well. So, they need to be engaged in all this conversation to make sure that we have the right policies in place to create a marketplace for all these new technologies. And this is another factor that we’re working on.

MICHAEL BERUBE: I’ll just add Michael, Linda, and I all sit in a small team that have been reviewing and talking about the Earthshots. We spend a lot, a lot of time talking about what makes an Earthshot, what’s needed, is it the right thing ’cause these are, you know, a finite number of things where we are saying these are critical problems.

 One thing that is almost a constant across all of them when we start talking about what would we need to achieve it is scale. At some point, a lot of these, it’s scale in different ways. There’s certainly some more science breakthroughs needed and a number of them, but ultimately, to get to these really aggressive goals, you need to scale up, and that will take a lot of cooperation with industry with people who are the initial entrepreneurs, the people making those early scale investments so we don’t hit that valley of, you know, we’re kind of making great science breakthroughs and we’ve proven something out at lab scale and then we can’t quite get it into the market. So, I think that will be one of the critical aspects as well.

MEREDITH BRASELMAN: Very good. Thank you. No other questions from the audience? Do you want to come on down? Yeah.

MALE SPEAKER: Hi. This is (unintelligible). I’m a startup from Phoenix working on short and long-duration energy storage. We had a booth in (unintelligible) last week in (unintelligible), which is the largest gathering of renewable energy in U.S., and what I heard from the customers was different forms and shapes and demands of energy storage. So yes, we need to produce something for the greater scale. While we are working on it, the CNIs are asking for all, you know, from (unintelligible) to megawatt and from one hour to all the way 24 hours of energy storage. My question to you is, is DOE going to help startups like us prove solutions that are catering to the CNIs, the commercial and (unintelligible) market today? Because most likely our (unintelligible) is going to come from them and that’s a way to survive while we, you know, produce the greater scale technologies in the future.

MICHAEL PESIN: Let me take a shot at this. So, many technologies can be scalable, right, and it sounds like what you’re looking at, what you’re working on is scalable technology. So, depending on where you are in your development stage. And I just speak generally, not specifically of your company. So, if you develop new technology with single cell, then Energy Storage Launchpad would be fantastic way to scale it up to the larger size. If you already have something that is working on a bigger scale, but you want to get it all the way up to grid scale, then the other program that I was talking about (unintelligible) grid demonstration solutions, we can put it in the controlled environment so you can demonstrate the ability of your technology to perform under the use cases that is your target, but you cannot sell it, which is completely understandable. I’ve been in the (unintelligible) industry for 30 years. Nobody’s going to buy your (unintelligible) number one, but if it goes in the lab and it gets validated, that gives you credibility to be able to go to the customer and tell them that it will work.

ESTHER: Good morning. My name is Esther (unintelligible). I’m from Brookhaven National Lab and Stony Brook University. It’s such a delight to hear from all three of you this morning. I guess my question is a little bit granular. I absolutely understand the importance of linking pieces together and having this maybe I’ll call it translational opportunity, right, to start from really fundamental research and then progress all the way to a deployed product. Do you envision this evolving as specific calls or should existing programs be trying to implement aspects of that in work that they do? In other words, how do you in a more granular way see the different offices of DOE contributing to make this vision a reality?

MICHAEL BERUBE: Excellent question. I think there’s going to be a little bit of everything there to be honest. One of the things, and we have many people in National Labs here and listening, I would suggest is to make sure every single person at the National Labs, every PI, every manager and executive in the lab makes you drive down to your teams that we are very much focused on integrated approach across all the work we do. And the reality of, if you’re a university or National Lab, of a funding organization to funders, right, PIs look to who they’re getting funding from, you’ll want to address that need. Oftentimes, I believe the national labs, they see first maybe, you know, before DOE does, what’s that direction, what’s that need, they see across multiple programs at DOE. And I would say not only do they have permission, but they have direction to make sure that they are challenging back to us of how do we bring these things together, bringing forward the integrating ideas, the crosscutting ideas. And we will be trying to do that, but I also want to make sure people hear that directly, that that is our focus, that is the type of work and research we want to do, that so many of the solutions we have just can’t live within a single office anymore. They have to live across offices and working collaboratively, whether that be within the, you know, EERE offices or across ERE and other applied offices and Office of Science.

 So, I would encourage the lab to be bringing those crosscutting things and also be thinking that as you’re thinking about the work and the research you do and how it evolves, that there is this sese of urgency, there is this sense of how do we make sure that these technologies ultimately address our end goal of that climate crisis. So, make sure that people are well aligned. When I talk about we’re going to be issuing a transportation decarbonization blueprint, we’ll be aligning 100 percent of all funding across these four agencies in that space to address those issues. So, be aware of that and be on point to that blueprint as well. That will help guide some of the work.

MICHAEL PESIN: And I just want to reinforce Michael’s point. So, you have a lot of knowledge in National Labs. There’s this fantastic brain trust. So, you can help us to collaborate as well. But on the other hand, we have the responsibility to do it as well, and we are doing this, we’ve been doing this. So, one example, in (unintelligible) GMI, Grid (unintelligible) Initiative and we have Grid (unintelligible) Lab (unintelligible). So, we are working to evolve it so it’s better, even better, and this is what we are trying to do. And eventually, we want to get to the point where we coordinate (unintelligible) process on all the initiatives so we can coordinate them.

MEREDITH BRASELMAN: Linda, anything you want to add?

LINDA HORTON: Yes, absolutely. In FY23, we have a new initiative that I believe Esther is well aware of. It’s called Accelerate, and Accelerate is exactly addressing some of the points that Esther raised. The goal of Accelerate is to fund the science side, building the bridge towards the technology offices to make sure we can bridge that infamous valley of death between the science programs and the technology programs. I expect that that initiative will be granular in that it will be focusing on specific technologies and how we can build the science that’s needed for scaleup, for translation for the kinds of activities that will make a difference on the technology side.

 I already had mentioned the Energy Earthshots research centers, which are envisioned as these teams of researchers that would leverage the data and the experiences being held taking place under the bipartisan infrastructure bill activities, but also would have that continuing close coordination with the technology office consortium and all those kinds of teams of researchers that are already being funded on the technology offices to provide that science bridging to those groups to address the stretch goals of the Energy Earthshots program. Thank you.

ESTHER: Thank you very much. This is such an exciting time, opportunity to bring together National Labs, the academics industry and policy. So, thank you again.

MEREDITH BRASELMAN: Thank you. Another question?

MALE SPEAKER: Good morning. My name is (unintelligible) with the NRECA, National Rural Electric Corporate Association in Arlington, Virginia. My question (unintelligible) to Mike. You talk about the challenge in solving the supply chain issue is the intent of using less limited elements like you said. So, can you talk a little bit more about what kind of elements you’re looking at? I kind of saw maybe a short documentary a few months ago in Finland while using sand, you know, to store energy and deploy it back into the grid. So, can you talk a little bit more about the elements that you guys are working on?

MICHAEL BERUBE: (inaudible) the sound is really bad coming back. I can’t hear. So, kind of what are some non‑critical mineral-type technologies?

MALE SPEAKER: Exactly.

MICHAEL BERUBE: Yeah. Yeah. So, I think, of course, this might vary a little bit, right, if we’re talking, you know, what type of storage we’re talking about, but looking at, you know, battery within the DOE complex, so the vehicle technologies office, our site, tends to really focus on the lithium ion-based element. Michael’s team and, you know, Eric really are looking at a lot of other long-duration storage technologies. But I think on the vehicle side, right, on the lithium battery technology, you’ll probably hear from Steven Boyd later, who’s more of our battery expert, he can share more, but I think we’re looking at silicon based, looking at even sulfur based, sulfur metals for type of, you know, technologies that really can move us fundamentally away from the current (unintelligible) type technology. We have been working on that for a while. And when you look even at today’s batteries, right, we produce the amount of cobalt, quite a bit, probably on the order of 60, 70, 80 percent now getting in there, you know, and the manufacturers are already starting to mix in a little bit of silicon in there, but can you get to a full type of silicon battery system, that would be kind of the next big step that we could go to. I think those are some of the types of technologies, but I don’t know, Michael, on the grid side –

MICHAEL PESIN: Yeah. I think I have to admit we have it a little bit easier on the grid side in this respect because we don’t have the same challenges. We have different challenges, but we don’t have same challenges as transportation sector. So, we’re not as concerned about energy density, for example. So, we can take more real estate in our energy storage. That allows us to explore technology that don’t necessarily require these very expensive commodity materials like cobalt or lithium. So, one of the technologies that we developed is flow batteries. So, it’s (unintelligible) flow batteries, and right now, the chemical that is used is (unintelligible). So, (unintelligible) again is a commodity material so we’re working on developing same technology or similar technology but using earth‑abandoned material. So, we can go into (unintelligible). So, this is just one example.

 But ultimately, if you want to have batteries very cheap, there is a saying that if you want batteries to be dirt cheap, they have to be made from dirt and prefer the local dirt, right. So, you can mine it here or you can develop it here, you cannot manufacture it here. Also, it’s not just about batteries. There is a lot of other, as I was mentioning, different categories. There’s other technologies of energy storage. So, they don’t need (unintelligible) materials. They can be earth-abandoned materials. They don’t need to use any chemicals that can be harmful to the environment. So, this is where (unintelligible).

MICHAEL BERUBE: One other piece I should have mentioned as well is recycling, right. So, if we can develop a really advanced recycling system for consumer electronics first, then ultimately vehicle batteries as they grow, you know, a lot of research says that for some of those critical minerals, up to 40 percent can ultimately come from that recycled supply chain. It will take a while to get, you know, vehicle batteries will swamp consumer electronics when they start growing by 2030, but in the meantime, recycling the consumer electronics can give us a decent supply chain, especially with things like cobalt.

MALE SPEAKER: Thanks. And about solving the supply chain issue, how much effort has also been put into reducing the flammability of these elements? I think (unintelligible) issues it kind of catches fire like it did I think a week ago in California in this Tesla battery. So, how much effort has also been put into reducing the flammability of these new elements that you are developing?

LINDA HORTON: I would say that that’s the flammability issue, and moving to solid electrolytes, for example, is something that is indeed a subject of the basic research program. Along with looking at totally alternate chemistries and architectures for next‑generation batteries or flow systems, the JCESR program there at Argonne is, of course, one of the leading efforts in looking at next-generation energy storage approaches, and there is a lot of data out there available. If you look at the materials project, which is at Lawrence Berkeley National Laboratory, they have a lot of information about alternate chemistries, alternate electrolytes, alternate electrodes that might be useful in the efforts that people’s companies are looking at in terms of alternate chemistries for their systems. So, yes, those are indeed topics of basic research, along with, as Michael said, looking at chemistries that don’t involve as much lithium, that don’t involve as much cobalt, that don’t involve as many rare earth elements, non-platinum group catalysts are important as well as improving the membranes in the system. So, a lot of science is working on these challenges, and hopefully we’ll see opportunities to translate those efforts moving forward.

MICHAEL BERUBE: Solid-state batteries would be kind of the holy grail, right, because less of the electrolytes, thus the flammability issues, but there’s significant manufacturing challenges I think we still see. Even though every week there seems to be someone saying they’ve got the solid-state battery, they’re going to be commercial in another year or two or build a plant, so far we still see challenges, but I think we’re hopeful that those will be able to be solved.

MICHAEL PESIN: Yeah. And while we’re developing this nonflammable (unintelligible) batteries, we have very robust safety (unintelligible) program in (unintelligible) so we’re working (unintelligible) and want others to make sure that people are trained and they can safely operate these batteries. And then if fire happens, also working with firefighters how to put out the fires because it’s very different from your house, typical housefire.

MALE SPEAKER: Thank you.

MEREDITH BRASELMAN: All right. Not seeing any other questions. All right. Well, thank you so much, Linda, for joining us virtually. Michael and Michael, thank you so much. I will turn it over to Venkat.

VENKAT SRINIVASAN: Thank you, Meredith, Linda, Michael, and Michael. Remember, for most of you who are working in the DOE system, we interface a lot with the Department of Energy. So, the National Labs, that’s our sort of obviously a place where we go to, and over the last decade, I think all of us have seen the dramatic interactions that have happened across the offices. It used to be when I first joined the National Lab System, people would say well, the idea is interesting, but nobody in DOE will want it because it belongs in this office and not in that office. There were all these sort of kind of silos. We don’t have that today. And you can see the exciting stuff that these people spoke about. I was really intrigued by the fact that we now have these giant efforts going on, whether it’s EERCs (phonetic), the BGI that came up today. The idea that we don’t, even going back five years ago, have a common definition for energy storage, but we have that today, and we can think about different ways of storing energy, either chemical versus demand response and, you know, chemical, and sort of put them in the common framework. All that is I think what makes it exciting. So, great session. Hopefully all of you enjoyed it. We don’t have a break.

**[End of File]**