Eli Levine: Hello, everyone. Thank you for joining. My name is Eli Levine. We're just going to give it another minute or two to let people get into the webinar and then we'll get started. Thank you all so much for joining us today. All right, so welcome everyone and thank you for coming to this webinar that's part of the better buildings webinar series. This webinar is entitled Lab Partners: How to Leverage DOE National Laboratories. My name is Eli Levine. As I mentioned, I run the Better Plants Program, which is part of the broader Better Buildings Initiative here. We're thrilled to have you here.

Better Buildings is a community of partners from all over, coming together to drive leadership and energy innovation in our nation's homes, in our commercial and public buildings, and our manufacturing plants. And really when we talk innovation, there's really no comparison to the United States Department of Energy national lab. Our new secretary, every day, calls them the crown jewels for research and development. These labs are truly extraordinary and since we know our partners are committed to ambition goals, we wanted to use this webinar to pique your interest and to let you start to think about how you might work with the National Labs to solve some of your most challenging problems.

As I mentioned, I run Better Plants, which is the manufacturing side, and last year, we hosted a technology day, inviting our partners to travel to Oak Ridge, Tennessee for an opportunity to meet with leading scientists and research there, tour the facilities, and hear from lab leadership and private sector partners about their experience forming successful lab industry partnerships. I'll say just stay tuned for more to come in this regard. Across the Better Building sector about trying to help our partners access the technology and expertise that come at our – through our National Labs. But today, we've got three leading experts, two from National Labs, one from the Department of Energy, who are hopefully going to pique your interest about what the labs have to offer. With the labs having nearly 20,000 scientists and engineers from across – taking over about nearly 5,000 buildings, we won't be able to cover everything, but hopefully this can start a conversation. So without further ado, next slide.

It's my pleasure to introduce Rochelle Blaustein, Bill Livingood, and George Hernandez. Rochelle is the Acting Director of the Department of Energy's Office of Technology Transitions. A scientist turned patent lawyer, she's dedicated to developing policies that foster innovation and commercialization. Before

joining the Office of Tech Transition, she served as a senior advisor at DOE and as the director of technology development for the National Institute of Diabetes and Digestive and Kidney Diseases at the U.S. National Institute of Health.

Next up are the two researchers and technologists from the National Lab. Now I don't watch *Stranger Things*, but they have assured me that they're not part of the bad guys who apparently work at the National Labs. But Bill Livingood is an expert in building energy analysis, computational thermal analysis, and data acquisition, and an inventor on three patents for power generation technologies. As manager of the commercial buildings research team at the National Renewable Energy Lab, he oversees the development of next generation simulation capabilities and guidance documents such as the advanced energy design guides, AEDG, that provide building and U.S. climate zone specific design recommendations. Bill comes to us from GE Global Research before that.

George Hernandez joined the Pacific Northwest National Laboratory in 2009 and works in the electricity, infrastructure, and buildings division. He is a technical advisor and senior demand side management professional. Working under the support of Joe Hagerman, he has authored the High Performance RTU Challenge, the buildings performance database, the low cost wireless metering challenge, energy information handbook, portable sensible suitcase, open source small business control system and transactional network project. Most recently, he has championed development and commercialization of an open sourced software platform called VOLTTRON, that I think you'll hear more about today, used to deploy transactional control strategies for building to grid integration. He has extensive knowledge, skills, and capabilities derived from a substantial career in demand side utility management across a wide variety of commercial and industrial sectors and utilities as both a corporate employee and an independent consultant. George received his Bachelor's of Science in Mechanical Engineering from Cal State University and his Master's in Mechanical Engineering at the University of California at Berkley. He's a licensed professional engineer by the state of California. Without further ado, thank you all for coming and I will turn it over to Rochelle. Next slide.

Rochelle Blaustein: Thank you very much, Eli. It is truly my pleasure to be able to share with you some of the reasons I'm really excited about industry partnering at the DOE and the National Labs. I'm also pleased to be able to share some of the ways in which we are

improving how the labs are able to engage with the private sector. Next slide. There is a long history of DOE developing energy as well as many other technologies. Our work helps people power their equipment with bio-fuels and shale gas. It lights the way with electricity from wind and solar. It improves the driving range and safety of electric vehicles. Next slide.

The work of the National Labs saves lives and improves the quality of life. It keeps us safe from national disasters, from malicious actions, and from environmental problems. It makes products less expensive and helps bring them to us faster. It maintains the grid, improves the grid, modernizes the grid, and helps keep the safety of the grid. It improves energy efficiency, energy production, and warns us of detected dangers. It provides materials for improving medical devices and has launched entire industries that in their own right have saved countless lives and improved the quality of life for so many. It creates jobs. Next slide.

It helps develop and make available tools that allow even more discovery. We are able to do this because we are part of a diverse ecosystem of talents, knowledge, and skill the same ecosystem in which you are all a part. Here in this slide is one single example of R&D from DOE and other federal labs contributing to the development of an everyday device which I think you'll agree has considerable economic importance. Next slide.

Despite all the amazing discoveries and technologies from the DOE labs, the pace of technology development and commercialization continues to quicken at increasingly breakneck speed. To help the labs maintain the world class lead they have, the immediate challenges we face in the 21st century, nearly three years ago, the Department of Energy created the Office of Technology Transitions, my office, or OTT as it's known. There are many DOE programs. Along with 17 national laboratories and 4 facilities engaging in technology transfer and industry engagement, all moving forward with overlapping missions and goals.

It is the role of my office, the OTT, to coordinate across the DOE complex on activities related to private sector engagement and public private partnerships. We certainly recognize that DOE can be a challenge for the private sector to navigate if we are also benefited from coordination within our own department. Therefore, it is also an important and critical role of OTT to facilitate industry engagement with the labs. One way in which we

do this is to streamline processes and engagements with the labs. And as a result, technology transfer overall. Next slide.

With the DOE's Energy Investor Center, we are directly building bridges to the investment and business communities to facilitate those public private partnerships needed to unleash domestic innovation and assert U.S. leadership in the fast developing global technology race. The center assists investors and businesses in connecting with our world leading energy experts, a couple of from you will hear from in a few moments. It helps acquire the latest research studies and reports, identify promising funding opportunities and promising energy technologies at our National Labs. The center works with investors representing family offices, private equity, venture capital, strategic corporates, foundations, institutional investors, and others. I won't go down the whole list.

Through the technology commercialization fund, we directly assist the labs in maturing and de-risking lab technologies to a readiness level suitable to attract private sector collaboration and investment. To ease industry engagement, we engage in a continual improvement loop to reduce barriers and streamline access to the National Labs through ___, which are cooperative research and development agreements, through strategic partnership products we call SPP's. Some of you may know the former name of work for others through access to user facilities and other R&D arrangements. Part of our improvement process includes expanding the DOE scientists' ability to understand and engage using an industry focus. We recognize that bringing people together is only part of the challenge. Making sure they can communicate efficiently and effectively clearly with each other is another important means for streamlining our industry engagement. And at OTT, we are always available to assist in navigating the DOE and the National Labs to facilitate connections between individuals, organizations, and between individuals and information. Next slide, please.

Information can be a difficult thing to find. That is, the right information can be difficult to find. That's the impetus behind the Energy Investor Centers lab partnering service or LPS. This web based portal to be launched in the first quarter of 2018 will facilitate the easy connection between interested collaborators and experts having the needed capabilities available at a lab. This portal is being developed with focus groups from our investor and business communities to ensure it is not only delivering the desired information, but doing so in a user friendly way that has meaning and efficiency to the private sector. Next slide.

An existing tool for searching and browsing technologies available to DOE National Labs is the energy innovations portal. This web based tool will be combined with a lab partnering service to begin to create a one stop shop for discovering what is available at our labs. It is already available to assist the search and to help drill down into the search results, to hone in on a solution to the business's problem. Even if the technology does not already exist in this database, browsing related solutions can help identify the lab and the experts at the lab that have the capabilities to collaborate with a partner to solve a business need. Next slide, please.

We have a technology commercialization fund designed for assisting with some of these collaborations. It requires matching private funds for each award, whether the lab is maturing its technology on its own or in collaboration with a partner. In either case, funds are available on an annual basis to encourage development of early stage applied energy technologies that have been created at the lab. In each of the past two years, 54 awards have been made amongst 12 of our National Labs in collaboration with more than 80 private sector partners. In August of this year, the TCF awards totaled nearly $20 million. The 2018 cycle will begin very shortly as we once again to the labs the opportunity to present proposals, including proposals in collaboration with industry partners, in a way array of applied energy technology areas. Next slide.

As I mentioned earlier, we are regularly seeking ways to reduce barriers and streamline the process of engaging with the National Labs. On the OTT website, you can find a guide to partnering with the DOE National Labs. This brief guide explains the major options for partnering and explains some of the most important characteristics and differences amongst the options. Unfortunately, we don't have time here today to go over some of those. The guide is on the web and available. Also on the OTT website, you'll find a listing for points of contact at each of the National Labs and facilities so that you can reach out directly to a laboratory of interest to you. On each of my slides here today, in the lower left, you'll find the URL for the OTT website. You'll also find the address for specific items on related slides. Next slide, please.

Although we are vigilant about assuring flexibility for the labs in negotiating with industry, there are some requirements that are wired into law or policy as implemented in the traditional tech transfer agreements created as an STP, as I mentioned a few

moments ago. After listening and seriously considering the concerns of industry about these inflexible terms, in 2011, the DOE launched a six year pilot known as Agreements for Commercializing Technology, after ACT. This arrangement leverages the contractor operated nature of all but one of our DOE National Labs. And just last month, Secretary Perry announced that we will be making this pilot, ACT, permanent following the success of the pilot.

Under ACT, should the contractor opt to use it instead of one of the traditional agreements, more industry standard terms can be available as it is an agreement with the contractor operating the laboratory rather than with the federal government. During this early pilot, arrangements could not be made using ACT for work that was federally funded such as you may have under an SDIR. Just last month, however, Secretary Perry also announced that a new pilot will begin in 2018 to extend ACT to work that is federally funded.

One example of the work conducted under ACT during the pilot is the Wells Fargo Innovation Incubator, or IN2. ACT enables an arrangement between the National Renewable Energy Lab and Wells Fargo Foundation to support small businesses in developing energy efficient building technologies for adoption by Wells Fargo. ___ was able to administer the program and provide technical assistance to the program participant companies. The initial funding from Wells Fargo was $10 million in 2014. IN2 was so successful that in April of this year, Wells Fargo extended the program by an additional $20 million. Next slide.

In order for the labs to work as seamlessly as possible with the private sector, understanding the industry focus is essential. Professional developments of the scientists, such as we provide an energy I-Corps that DOE adaptation of the NSF I-Corps program geared for the energy sector. We provide two month intensive training for DOE lab scientists to immerse them in the private sector commercialization process with one of their own technologies. Lab teams come together with industry mentors and instructors to learn how to pitch their ideas and plans and to engage in customer discovery, often leading to a pivot on plans for the technology once an understanding of the market is realized.

Energy I-Corps has been a great success in just a couple of years, particularly as measured by the scientists' greater understanding of industry and how to engage. At this time, OTT is exploring options for expanding the professional development opportunities to reach

a larger number of researchers and to provide more advanced programming such as follow on courses with a manufacturing focus. I have no doubt that this will extend the ability of our scientists and other researchers to work easily with industry. Next slide.

Understanding is an enormously useful tool and it goes both ways of course. Many potential industry partners lack in depth understanding of lab expertise and resources or how to work with the National Labs. Resources such as OTT, the technology commercialization fund, the energy investors center, the lab partnering service, the energy innovation portal, and the guide to partnering with the National Labs go a long way in bridging some of that understanding. While lab researchers may not understand the most pressing industry problems, it is likewise difficult for industry to have a clear understanding of the DOE and its labs. When industry and labs do engage, it has traditionally been mostly on a project by project basis and lacks long term strategic value for both sides.

One program conducted by the EERE Office of Advanced Manufacturing seeks to overcome this gap. The technologist in residence program pairs senior technical staff from national laboratories with technologists from manufacturing companies to work toward impactful manufacturing solutions. An important outcome from the technologist in residence program is improved transparency into the DOE and its laboratories. It raises awareness of, for both the labs an industry partners, of high impact industrial relevant technology challenges. Similar to the energy I-Corps, it additionally provides a heightened industry focus for the lab scientists involved. Next slide.

Improved transparency, raised awareness, heightened industry focus, streamlined processes and legal mechanisms, technology maturation funding, we're making a great deal of progress. Just as we teach our scientists that customer discovery is a vital tool, assuring life into a life, or in a case a program, we too need to keep our finger on the pulse of industry. I know we've come a long way, but with your help, I know we can do even better. I hope I've started to pique your interest in the Department of Energy and our labs. I know my colleagues who will be speaking in just a few moments will do a great job doing that and more. Thank you.

Eli Levine: Thanks so much, Rochelle. That's fantastic, very informative. I'm now going to turn it over to Bill Livingood. The one thing I'll mention for all of our attendees, should you have any questions,

please feel free to use the chat function through the webinar thing. You type questions there and then we can take questions for all three panelists at the end of the presentation. With that said, over to you, Bill. Excited to hear your presentation.

Bill Livingood: Thank you. We can go to the next slide and thank you for this opportunity to speak with all of you. Next slide, please. A bit of history before talking about the partnership opportunities. NREL started in 1977 as the Solar Energy Research Institute or SERI. It was spurred by the national concern with – during the 1973 oil embargo. In 1991, President George H. Bush elevated SERI to a U.S. DOE National Lab status and renamed it to the National Renewable Energy Laboratory. NREL's clean energy research and development spans from foundational science to research and development to components and to energy delivery systems. Next slide, please.

NREL is the national lab with a sole focus on renewable energy and energy efficiency in the areas of solar, wind, and water, bio-energy, transportation, and hydrogen production, energy efficient systems and energy systems integration more recently. NREL's sustainable campus is a model for energy efficiency and renewable energy applications, attracting about 25,000 national and international businesses annually. The 327 acre campus is located in Golden, Colorado. Next slide, please.

NREL's mission is to advance the science and engineering of energy efficiency, sustainable transportation, and renewable power technologies. And then more recently, really with a heavy emphasis on providing the knowledge to integrate and optimize energy systems. Next slide, please. As you can see with this slide, NREL has a key focus of developing intellectual property that when utilized by companies can make them more competitive or with the intent of making them more competitive. Partnerships for developing that IP can vary depending on the needs. Next slide.

Even though – because NREL has such a narrower focus than many of the other labs, it is a smaller lab, but it actually, because of its applied nature, has usually some of the most partnerships established out of the National Lab system. This is a key emphasis of our lab. Partnering with your company is our primary goal – is a primary goal of NREL and the stats on this slide demonstrate that focus. Next slide.

NREL works with hundreds of partners within the industry, government, academia, small businesses, international

organizations, and nonprofits, to advance the use of clean energy technologies in the marketplace. This is just a snapshot of a few of more than 400 plus companies and organizations with which NREL has partnered to bring energy efficiency and renewable energy products into the marketplace. These partnerships cross 46 states and 30 countries. Next slide, please.

Now shifting focus to more specific partnership opportunities, I'd like to discuss a primary element of NREL's mission and that is enhancing energy systems integration. Next slide, please. Before we go too far into energy systems integration, let's just first discuss energy systems. An energy system, in particular our future energy systems, is the set of interacting interdependent resources that work really well together to deliver reliable energy sources with minimizing the environmental impacts of that energy delivery. Next slide.

Now energy systems integration, really it's the process of optimizing the energy systems across multiple pathways and scales. We're evolving as a nation with that ability to optimize to greater and greater scales. Yesterday, we were doing this on islands and villages, if you will. Now we're doing this at a much larger scale, large campuses, and now we have partnerships with cities where we're doing these in districts. And now on the next frontier is really city-wide, and so the optimization capability technology enhancements are needed in order for us to scale up. Next slide.

Now in order to offer innovative technology solutions that will provide us the ability to optimize for the next paradigm of the grid, if you will, is to use an approach where we're able to perform hardware testing with our partners to give those partners rapid feedback on opportunities to enhance their products, work side by side in identifying ways to advance those products as one aspect. Another aspect is to provide advanced modeling and simulation so that it allows you to do rapid what if scenario analysis. Again, all in the name to allow you to more rapidly bring products to the marketplace.

And then the next step is really – or facet is field deployment where we actually put those in real world environments and in those real world conditions understand where the technologies perform really well and where are areas or opportunities for improvement. And so working all three of these main facets together with a continuous learning and improvement approach allows us to more rapidly enhance our partners' technologies or

work with them in their enhancements of those technologies. Next slide.

The keystone of these energy systems integration efforts is a very impactful facility. The facility's name is the Energy Systems Integration Facility. It's the largest R&D facility on the NREL campus and it's NREL"S first DOE designated user facility. What does a user facility mean? That means that its primary purpose is for it to enhance private sector technologies in a collaborative fashion. Part of that is NREL provides access to the ESIF as a national user facility to study clean energy technologies at all scales. It does that through an annual call for requests in which research and development projects can be requested and for – through DOE's support. That's one aspect, but there's many other partnering possibilities to make use of that ESIF facility so that it enables your company to enhance your technologies in addressing the next paradigm of the grid, if you will. Next slide.

The key aspect of the energy systems integration facility or ESIF is that it has a large micro grid built into the backbone, if you will. It contains two large AC busses as well as two large DC busses and really allows you to place technologies of the many different categories that fit within energy systems integration and apply real world scenarios at the megawatt scale so that you can be assured, and utilities and energy providers can be assured, that those technologies can overcome the challenges with the next paradigm of the grid, where we will have far more intermittent power supplies as well as two way flow of delivery of power and energy. Next slide.

Another example of partnership opportunities is one that's a little bit closer to my specific domain, commercial buildings research and residential buildings research. On here, we – our goal is to empower software developers to provide new software products to the marketplace. And so the Department of Energy, with many National Labs, NREL being a key developer in that process, is developing a tools ecosystem such that software developers can benefit from the ability to predict energy consumption. And now in the world that we live in, it's now no longer just about how much energy is being used. It's also about when energy is being used. And so this analytics ecosystem provides that ability and many companies now are leveraging those capabilities.

And so in this ecosystem, we have the engines, if you will, that are the physics based models that get the thermodynamics, fluid dynamics, heat transfer aspects correct so that you can understand

that physical phenomenon, but then we also, through a platform called Open Studio, both of the – both the engines and Open Studio are open source tools – provide the software development kit such that software providers can provide applications, build applications. And there's many examples of where software developers are developing those applications to serve their clients. In addition, that Open Studio software development kit also provides software providers utilities the ability to offer up integrated services or often times we call that software as a service models as well. And then finally, in order to predict accurately, it's really important that you get the inputs correct. And so another part of this ecosystem is to provide credible inputs so that we have trustworthy outputs. And all of this ecosystem main intent is so that we get consistent, reliable, rapid, and transparent predictions of energy consumption. Next slide.

An example of the number of companies that are benefiting from this open sourced DOE resource that really empowers these company's business models is provided in this snapshot. Again, a partial list. In addition, this also includes the other National Labs that are key contributors to this overall platform and with that, I end here and I look forward to your questions.

Eli Levine: Thank you very much, Bill. I really appreciate it. Knowing that we want to maximize time for everyone's questions, and thank you to all of you who have turned in questions so far, I'm going to turn it over to George Hernandez from Pacific Northwest National Lab. George, take it away.

George Hernandez: Okay, turning off the mute. Hey, welcome everybody to cyber land. This is hard to do. I'm used to two way conversations. Next slide, please. Is that even my slide? There we go. Again, as I was introduced, I'm George Hernandez, Pacific Northwest National Labs. I work in the division of the lab specifically around tech transfer and grid integration. Next slide, please.

I'm going to briefly go over – can you – I didn't realize there was a – can you open that slide up all the way? There you go. Keep going. Very briefly, the Pacific Northwest National Labs was originally created as one of the two labs in the country that were involved in creation of the two bombs. I know that sounds kind of scary, but the one thing that represents is the lab itself is very diverse and has traditionally been involved in what I would say fundamental research, biological, nuclear, and earth sciences.

One of the divisions of the lab, the division that we are in, is EED and there are separate entities within that, that provide lots of technical expertise, specifically around buildings and grid. It's important to understand that in the last 40 years, the lab has moved – has created a division that is doing a lot more applications. So taking that fundamental research and moving it to the marketplace, very similar to the space program, but the majority of the lab is still involved in fundamental research that probably doesn't have much applicability to better buildings, but is there in case you're interested. Next slide, please. Hello? Next slide, please.

The area of interest that has the most applicability for better building partners is electricity infrastructure and building division. This is kind of an eye chart. There's a lot of different things in this division, but the things that probably should ring true as far as the usefulness of the lab, this division of the lab, is the area around – in and around buildings, controls, optimization, and analytics. The Pacific Northwest National Labs is very strong in energy analytics, very strong in energy infrastructure, and very strong in controls and building optimization. You can see, if you look at the bottom of this chart going across the columns, you'll see that it's very heavily staffed with PNNL as you might understand, but there's also a very broad mix of people who have a wide variety of applications experience so that they can understand and try to apply these technologies.

As I mentioned earlier, there is – there was – there is a program that has been underway for a while at DOE where the scientists at the National Labs, and PNNL has participated, and undertake a process where they try to understand and know what the end result of their research would be. That provides a stronger more applicable delivery of the information. It's been a problem over the years that many National Labs end up publishing a report and giving presentations to their peers, and makes – and it's very difficult to pick that information and use it in the marketplace. PNNL is very strong in application and tech transfer, and it's displayed, if you look at this table, all of the different areas where we work. With that being sad, if you want more history on the lab, lots of websites, lots of cool stuff. I would like to move into probably one of our highest profile projects at the lab in this division. Next, please.

And that is that a product – a software product that is called VOLTTRON. Sorry for the name. Engineers are very good at research, not very good at names. And if you want to look up VOLTTRON and you type one T, you will get defender of the

universe and not PNNL's software platform. VOLTTRON is – next slide, please. What VOLTTRON is, is VOLTTRON is an open source software platform commonly called an energy operating system.

This software technology allows users to develop custom applications for just about anything that talks. If you have an electronic device, a meter, a fan, a pump, a light, a distribution system, a PV system, you name it, you can connect to it using this platform. And not only connect to it, you can actually collect that information, make decisions, and take action locally as well as regionally. What we're doing is we're really pushing the edge of computing to the limits using very low cost Linux devices such that you can develop a solution, which the labs are in coordination with partners, so that you can provide applications that are useful for you, whatever you're trying to deliver. Next slide, please.

What it really is, it's an operating system for buildings, in this case. It's open sourced. It's flexible. It provides a lot of resources and tools, but like an operating system, it doesn't do much until you develop the applications. The Pacific Northwest National Lab and other National Labs have been very busing developing applications that can be deployed both in buildings as well as electricity infrastructure. Next slide, please.

It's really tailored to driving the cost down. Most control systems today cost tens of thousands of dollars. The fundamental software is open sourced, so this is basically free. Take this software please and use it. And it's written in Python and sits on top of a Linux operating system. Next slide, please. It has a variety of connectors. It has drivers, DLL's, databases, whatever you need to do. It has a whole set of security applications so that you can deliver your solutions in a very secure fashion. Next slide, please.

But most importantly, it provides an ability to connect devices to create systems. One of the highest profile solutions today is called transactive controls, which is a way to connect buildings with utilities so that buildings and building owners can transact with utilities in ways that have never been done before. Instead of just having somebody call you up and say do something, it's your building, this can now be managed electronically and derive values in a very automated fashion. Next slide, please.

The most useful application developed today, and there's a number of them, is something called intelligent load control. If you're familiar with demand response, this application allows you to do

advanced demand response where you can not only just provide an automated way of switching the loads on and off, but you can also provide a characteristic to each one of those loads so that it's not just switched on and off, but it's switched on and off intelligently. For example, if you happen to have somebody in the office that just can't have anything happen to their space, you can provide a constraint on that load, let's say their VAB box, so that when they're in the building, it doesn't participate in demand response and moves onto the next load. This is a very useful application that we've been using to deploy for both demand response as well as advanced control systems and advanced solutions in buildings and industrial applications. Next slide, please.

One of the coolest things we're doing today is developing something called a connected home where you can take a hundred dollar device that you can buy today, it's commercially available, plug it into the wall, and anything that can talk electronically, any of your IOT devices, can be connected in a solution that not only provides automation for the homeowner, automation for the utility, but can do it in a way that manages energy efficiency as well as provide services to the grid. You can do demand response. You can do ancillary services. You can actually interact with your neighbors and decide who is going to do what based upon the conditions of the space. It's very new. We're deploying this today in a number of utilities and pilots, but it's something that is going to – I think going to be broadly applied because – next slide, please.

What we are trying to do is we're trying to make these applications more useful. Part of the problem we have today with control systems is they're developed by engineers who like to control things, but don't really like to talk about much. And the problem is that most users don't get that, particularly in the residential market space. They like to use social things. You can imagine that application using VOLTTRON to deploy home energy management system such that it could be tracking a piece of equipment.

Let's say your air conditioning unit, provide some automated diagnostics to say hey, the refrigerant is getting low on the system. I need to call somebody up and automatically repair the system. It could further say hey, your system's wearing out. You know what? There's a sale down at Home Depot on your light bulb, so go pick those up and here's a coupon to go do it. That's kind of brainstorming, but the object is to provide a more flexible user

application that people understand so that they move away of the command and control.

I'm sure if any of you have ever tried to program your thermostat, you realize how difficult that is. Imagine taking that same type of application and applying it to your electric vehicle or applying it to your portable tank system. If it's as difficult as programming your thermostat, you'll probably never use it. This application has the promise of providing this in a real functional, easy to use way and getting into it is very low cost. Once again, the commercial price, not from the lab, but from a commercial vendor, is $100. Next slide, please.

I'd like to close that. I'm trying to be fast here to make time for questions, to say that this is something that's very innovative, one of the many projects that's derived from the Pacific Northwest National Labs. And interestingly enough this application was developed with something called distribution management systems. It was originally developed by the utilities. It's very cyber secure and provides all the capabilities that you would see in a modern grid, all the way down to the end uses and end loads in every kind of a building out there today. Thank you very much.

Eli Levine: Wonderful. Thank you very much, George. Thank you, Bill. Thank you, Rochelle. We have roughly 11, 10 minutes here. I want to use that time to fire off some questions to you guys and then I'll encourage – we're keeping tracking of your questions here. Should you have any other questions here, ask away and we'll try to answer as many as we can. The first question is how long does it typically take to establish a collaborative research agreement? Does it differ depending on the type of agreement. I guess, Rochelle, I can start with you and then Bill and George, if you have anything you'd like to add, feel free to chime in.

Rochelle Blaustein: Thank you, Eli. You're absolutely right. It does depend on the type of agreement. There are very complex things that are very expensive that we do, that necessitate much more complicated agreements that may take longer to negotiate. We understand that not everything is like that. We also have other agreements like a fast track ___ that has some requirements such as it can't be more than $3 million total for the work and it can't be more than $1 million in a single year. And this is a streamlined version. There's very little to negotiate. Most of it would be very moderate modifications, if any at all, and these can be done quite quickly. We do have a menu of options out there and folks can make whatever the business decision is for the tradeoffs they need.

Eli Levine: George or Bill, anything you want to add? Otherwise I can move to the next question.

Bill Livingood: Yeah, the – it's actually pretty straightforward. It's most important to contact the lab directly and sort of brainstorm through what you're thinking. And if you can jointly develop a problem statement and a potential solution, that gets floated up to the Department of Energy and they decide if it's something that they'd like to pursue. And it's not that difficult to do. What is difficult to do is to come and say we need help. That's very hard to develop, but if you have a specific problem, it's much easier to present that to the Department of Energy so they understand and figure out how to help you through the national lab.

Eli Levine: And Rochelle, if I'm mistaken, the Office of Tech Transition's website has a point of contact for every lab that can make that first step of reaching out the lab a little bit easier. Is that correct?

Rochelle Blaustein: Yes, it does, absolutely. That would be the right person to contact initially.

Eli Levine: Great. Now another big question that we got is if our company does research with the national lab that yields a new technology or process, who owns the intellectual property?

Rochelle Blaustein: I'll go ahead and start that one as well, Eli. This also depends on the type of agreement. We have SPP's where the intellectual property may indeed entirely belong to the business partner and not the laboratory. Under ___, we are bound by statute that if we are an inventor, we would be owner or co-owner of a patent. It depends on the type of agreement. Again, we have a menu and as we just heard, contacting the laboratory and indicating what your requirements are, not only in terms of a research plan, but in terms of business needs, is a critical first step.

Eli Levine: Great. George, a question for you. How might a county who is trying to reduce energy usage use VOLTTRON without significant tech savviness? Could PNNL aid in this process?

George Hernandez: Yes, absolutely. One thing to understand is that an application like VOLTTRON is extremely flexible. It's kind of if you can think about it, you can do it. Three years ago, another Department of Energy project funded the development of a plug and play solution. So you – the – and it was proven. It was an alpha delivery that you could walk into a small commercial space, plug this

device into the wall, and automatically connect to any of the IOT devices out there. And there's quite a few of them. Fundamentally, thermostats and lights and a few other things. It would automatically identify those devices and install them and get the control system up and running automatically. That is the goal and that's what we're trying to get to. Depending on the complexity of your system, we're not that far away from doing something that and have demonstrated that it is possible.

Eli Levine: Wonderful. Bill, do you have any similar thoughts for how might a county take advantage of Open Studio?

Bill Livingood: You have a couple different pathways. Utility programs are leveraging the Open Studio platform for administering energy efficiency programs. The one pathway is partnering with the utility that serves with your county and offers up energy efficiency programs. There's a number of examples that perhaps offline I can provide and how that helps streamline the delivery of those energy efficiency programs and extends their reach. That's one pathway.

Another aspect is NREL does partner with counties, with cities for challenging projects. One in particular is addressing, for example, zero energy districts where counties are looking to optimize at a great scale and what are the best approaches. How should they contract the different construction firms, design firms such that you do reach your zero energy district goals? Open Studio could be a core basis of that analysis so that you can explore all the different cost effective solutions that are available.

Eli Levine: That's great, thank you. Now a question that I think was originally posed to NREL, but I'll open it up to allow all three of you to chime in. The question is phrased as does NREL work with established businesses or also startups? Another question that was asked was what are the opportunities for startups to connect with NREL's entrepreneurial investment network? Certainly, Bill, I'll give you the first crack at answering this, but because we have all 17 National Labs and each have their own unique capabilities and facilities and programs, I'll open it up as well to allow George to speak for PNNL and then Rochelle, if you want to chime in with the broader perspective.

Bill Livingood: Sure thing and Rochelle can do a much better job at this than I can, but those contract mechanisms that she described are applicable to large multinationals, but they're also very applicable to small startups. That's the one pathway. One more innovative, more recent development with NREL in terms of supporting small

startups is the partnership with the Wells Fargo Foundation, where there's an annual solicitation from small startups looking for support to advance their products. You apply to that program and through a competitive selection process, there's a voucher provided such that NREL can work side by side with your technology developers to bring your technology to the marketplace sooner and with qualities that help ensure its success.

Eli Levine: Wonderful, thank you. Rochelle, George, any further thoughts?

Rochelle Blaustein: I would like to underscore that we work with businesses of any size and of any type. We work with nonprofits as well. We've got that menu that I've talked about. We've got smaller, quicker agreements. We've got larger agreements as starting points for working with the laboratories because we do want to encourage startups and small businesses, in addition to the larger conglomerates that know where we live. We're always looking to increase the engagement with startups and small businesses.

George Hernandez: Yeah, I would echo that sentiment. PNNL has been very successful recently in working with very small companies. Clearly, big companies like utilities, it's – that's a no brainer because the solutions are quite broad, but we've had great success with small companies taking bits and pieces of technology and applying them for very specific purposes in small business solutions. And it's worked out pretty well. It makes them feel very powerful because they're using solutions mostly mathematically and analytically based to deliver very smart applications to a very targeted market.

Rochelle Blaustein: We have examples where our laboratories have worked with startups and become very large, very successful companies. We're very proud of that.

Eli Levine: Thank you, guys. That's great. I guess one final question for you guys. Let me look through 'cause I know we have a lot and I feel bad for the folks who – if your question didn't get answered. One thing I'll stress as well 'cause I know we got this question a couple times. We will be sharing these slides. I believe we've recorded this webinar. Everything we've said here is something that's – will be available for you guys and for any colleagues of yours who might have missed the presentation as well. All right, one final question. Our startup has a conceptual redesign for refrigeration, but not the financial means to achieve proof of concept and generate data on performance over time. Could that be done by the National Labs in partnership with us?

Bill Livingood: The answer is yes.

[Laughter]

In fact, interestingly enough, that was done just last year not at any one of our two labs, but at Oak Ridge National Labs with a very large company. It was involved in industrial refrigeration and they vetted and tested and calibrated a supermarket refrigeration defrost application that is now being broadly applied in that space. The answer is yes.

Eli Levine: Wonderful, thank you so much.

Rochelle Blaustein: Eli, let me add to the answer, please. Part of the question referenced that the company did not have the financial means to achieve the proof of concept. That's exactly the kind of thing that SBIR is out there for and our labs are very well suited to work with SBIR recipients.

Eli Levine: That's wonderful. Small Business Investment Research and I know that they have a pretty useful website as well. With that, I wanted to thank our three panelists, Rochelle, Bill, and George, and to thank all of you for spending the hour with us to hear about how to work with the National Labs. We're really excited and as you have success stories. That was one of the greatest things about inviting people down to Oak Ridge, to see the collaboration we're all in afterwards. So as you have your success stories, do share it with us 'cause I know part of better buildings is amplifying your success and the innovative approaches you all are taking. Thank you all very much for participating in this and we look forward to continuing to work with all of you in the future. Thank you.

[End of Audio]