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CALIFORNIA ENERGY COMMISSION
LEAD COMMISSIONER WORKSHOP

In the Matter of:	)	Docket No. 15-MISC-04
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Fuels and Transportation Technology Merit Review: Manufacturing and Workforce Development	)	WORKSHOP: RE: Fuels and Transportation Technology Merit Review: Manufacturing and Workforce Development

NOTICE OF LEAD COMMISSIONER FUELS AND TRANSPORTATION TECHNOLOGY MERIT REVIEW WORKSHOP: MANUFACTURING AND WORKFORCE DEVELOPMENT

CALIFORNIA ENERGY COMMISSION
THE WARREN-ALQUIST STATE ENERGY BUILDING
ART ROSENFELD HEARING ROOM - FIRST FLOOR
1516 NINTH STREET
SACRAMENTO, CALIFORNIA 95814

MONDAY, AUGUST 6, 2018

10:00 A.M.

Reported By:
Peter Petty

APPEARANCES

COMMISSIONERS:

Janea Scott, Lead Commissioner, Transportation

STAFF:

Tami Haas, Fuels and Transportation Division
Tim Olson, Fuels and Transportation Division
Akasha Khalsa, Advanced Fuel Production Office

PRESENTERS:

Kent Leacock, Proterra
Peter Ward, Alternative Fuels Advocates, LLC/Efficient Drivetrains, Inc. (EDI)
Mike Simon, TransPower
Deborah Donahue, ChargePoint
John Frala, Rio Hondo College

REVIEWERS/COMMENTERS

Margaret Mann, National Renewable Energy Lab, NREL
Debra Sandor, NREL
Frank Ramirez, GO-Biz

PUBLIC COMMENT:

Ethan Sprague, FreeWire Technologies
Lisa McGhee, San Diego Airport Parking
Erick Karlen, Greenlots
Patty DiNapoli, Cyber Switching, Inc.
*Oleg Logvinov, IoTecha

I N D E X

I N D E X (Cont.)

P R O C E E D I N G S

AUGUST 6, 2018 10:02 a.m.

MS. HAAS: We'd like to begin our workshop today to discuss Manufacturing and Workforce Development Project successes. The workshop will be led by Commissioner Janea Scott, who is the Energy Commission's Lead Commissioner overseeing transportation topics and issues. My name is Tami Haas with the Fuels and Transportation Division.

The workshop should last until about mid-afternoon and we'll have one break at the lunch hour. Feel free to use the restrooms located on the first floor outside the hearing room and the snack vending machines on the second floor. In the case of emergency, we'll proceed out the P street doors, turn left and head over to the park at 9th and P.

This workshop is one of a series of activities conducted as part of an ongoing Energy Commission function which we call the Technology Merit Review. We will focus on the merits of manufacturing and workforce development projects co-funded by the Commission's Alternative and Renewable Fuel and Vehicle Technologies Program, or the ARFVTP.

Previously, we completed merit review workshops on biofuels and biomethane production plants in September 2015, medium and heavy-duty vehicles in December of 2015

and electric vehicle chargers in April of 2016.

To begin, Commissioner Scott will provide some overarching remarks and Tim Olson and I will describe the context for our programs, historical spending and upcoming plans for the future. You can see from the agenda that the rest of the workshop will involve a series of presentations by funding recipients and comments from independent reviewers after each presentation.

The agenda lists the order of each presentation and review session, which should last no more than 40 minutes for each segment.

After all the presentations and review comments are completed, we have scheduled an open general comment period toward the end of the day. If you would like to speak during the general comment period, please fill out a blue card available in the room and hand it to me, or if you are participating remotely identify yourself by WebEx or the phone.

I would like to remind you that a verbatim transcript of the workshop discussion will be made available in our public docket. Audio and PowerPoint presentations are broadcast and shown on WebEx. Please speak into the microphone so everyone can hear you clearly. The transcriber would appreciate getting a business card from speakers and commenters to ensure correct spelling of

names. You may also submit comments in writing to an e-filing process for inclusion in our docket as noted on this slide.

The agenda and copies of the PowerPoint presentations are available on the table near the hearing room entry and will be posted on our website under the Transportation Alternative Fuels/Technology Merit Review.

Now, I'd like to introduce Commissioner Janea Scott to begin the workshop. Thank you.

COMMISSIONER SCOTT: Great. Thank you and good morning.

Good morning, for those of you who are sitting around the table, you have to pull your mic a little bit closer to you than it is right now and just push it so it turns green and that's how you know that it's on.

So anyhow it's my pleasure to chair today's merit review workshop, highlighting the progress and success of the Alternative and Renewable Transportation, Manufacturing and Workforce Development programs, funded by our Alternative and Renewable Fuel and Vehicle Technology Program, or the ARFVTP.

We look forward to hearing testimonials from some of the funding recipients who have been willing to share their experiences, insights and remaining challenges. And we encourage others to submit comments in our public

docket.

Manufacturing and workforce development transcends several alternative fuel, vehicle and infrastructure categories and our previous funding a wards reflects that diversity. The information provided today will help us deliberate on the structure and deployment of upcoming funding solicitations for related topics.

We also appreciate the contributions that all of our award recipients have made to achieve multiple policy and business objectives. And today we will hear from five co-funding partners about their experiences and insights including descriptions of successful projects, key reasons for progress and success, and how obstacles were overcome, the significance of their efforts to advance the electric vehicle market growth, pitfalls for all of us to avoid, successful business models, insights about market expansion and some of the remaining challenges that we face.

We also appreciate the participation of distinguished members of our Merit Review Panel, who will have opportunities to make comments, ask questions and probe into the details of each project.

The commitment of time spent by the presenters and reviewers is of great value to us and especially note that many of you have traveled long distances to join us, so thank you very much for that.

I also want to thank Tim and Tami for putting together a great day for us. So thanks everybody for joining the workshop and I'm very much looking forward to the presentations, comments and recommendations. And with that, I'm going to turn this over to Tim Olson.

(Colloquy re: set up for slide show.)

MR. OLSON: Okay, we're going to share this presentation. Tami's going to do the front end of this and then I'll come in after that.

MS. HAAS: Okay. The origins in the statute, the ARFVTP was established by the California Assembly Bill 118, in the year 2007. The program was set up to develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the state's climate change policies.

In addition, the program has complementary goals of improving air quality, increasing alternative fuel use, reducing petroleum dependence and promoting economic development.

Some of the guiding policies and goals, California has enacted a number of recent laws and regulations in its efforts to combat climate change, including the ones listed on this slide. Perhaps the most notable of there are AB 32 and SB 32, which set statewide greenhouse gas emission reduction targets. To outline the

approach that California will take to achieve these targets, the California Air Resources Board developed the State Climate Change Scoping Plan.

Similarly, Senate Bill 1383 and the California short-lived Climate Pollutant Reduction Strategy sets targets to reduce emissions of pollutants such as methane. Other state policies, such as the Low-Carbon Fuel Standard and zero emission vehicle deployment targets set supplemental goals that will help meet the state's climate change commitment. Achieving these goals will require investments that achieve both short-term emission reductions as well as long-term transformation of California's transportation sector to zero emission technologies.

Projects to date, the Energy Commission has provided over $750 million in funding through the ARFVTP. I would like to focus your attention on the manufacturing and workforce numbers, showing investments of $93.5 million to date.

Manufacturing and workforce development, the feature funding focus, the 2018-19 Investment Plan approved at the Commission's May business meeting included an $8.5 million allocation to support manufacturing operations and workforce training needs for zero emission vehicle infrastructure. This category will fund projects that

expand instate manufacturing facilities for ZEV infrastructure, as well as provide workforce development support for these and other types of ZEV infrastructure related projects. These types of projects will create jobs and provide an economic benefit for the state while indirectly supporting the ARFVTP's infrastructure investments.

We also expect to pursue opportunities in this funding that specifically benefit low-income and disadvantaged communities to further the state's equity goals.

Manufacturing and workforce development, the current funding allocations, for the current year, 2017-'18, $4.9 million was allocated to manufacturing while 3.4 million will go to workforce training and development projects. Plans for these funding allocations are under development and will be released later this year.

And now I turn it over to Tim Olson.

MR. OLSON: Okay. Thank you, Tami.

So from this point I'd like to present some of the findings of a workshop we conducted on May 4th, 2018, in Long Beach. It was specifically on manufacturing and workforce development related to zero emission vehicle infrastructure, meaning electric and hydrogen, so kind of a focused area. And trying to get some insights about going

forward where the stakeholders thought we should concentrate future efforts.

And so just to start that out, two of our panel members here -- I'll introduce the panel members after this presentation -- but two of our panel members represent the National Renewable Energy Lab and specifically the Clean Energy Manufacturing Analysis Center. And they've done a lot of different studies on battery technology, solar photovoltaics, a lot of power generation, wind power.

And looking specifically at what key factors stimulate and reflect the growth of manufacturing or expansion of manufacturing in those other areas and we thought they had some good insights on that. This is what their studies show. I'm summarizing 200-page studies in one three bullets here, right?

But the key factors that I picked up from their work that we think is true in the other areas, in this case manufacturing of other products here in California, is that number one there's a demonstrated demand for the products. That number two, to achieve the best price reduction that achieving economy of scale manufacturing, there's a certain threshold for individual products. But achieving that is a key thing and that gaining access to capital to finance, in essence cheap capital, to finance that manufacturing. Those are the three things that I characterize in my

reading of their studies.

And so we were using that as kind of a framework for the ZEV infrastructure. If we're a market, if we're a consumption market for those products in this state, how much of the manufacturing could be here? And then if you take that idea, we want to expand that to all the other alternative fuel categories and products that we are using here and buying in large numbers. We tend to be a large part of the market.

So that first point, demonstrated demand and growth, this is an indication. This is what we presented in that workshop on May 4th, indication demand growth, in this case electric vehicle, passenger electric vehicle growth in California. And you can see it's on an upward trend. It isn't nationwide, but at this point I think this is at the end of June 2018, 420,000 electric vehicles in this state. And I think we're over 21,000 charge connectors and some of those are dual bollards. But you can see it's about 45, almost 50 percent, of the U.S. market.

This is an indication, at least for California, demand growth and kind of in response to that kind of finding the NREL came up with.

So in that I'm going to kind of go through some of the findings of that workshop now. We had identified,

from our surveys of about 30 companies and those who participated, use of the areas that the stakeholders thought we should focus on or they are prospects for manufacturing or workforce development. And remember this is just around the ZEV infrastructure and many of the companies here do some of that, but they also make vehicles and vehicle component parts and we're interested in that insight today.

So you can see hydrogen, renewable hydrogen production is one of those areas that is a requirement. A third of all hydrogen used in the state in transportation, if the state government infrastructure is involved in it, it has to be renewable. There is a desire for renewable hydrogen. There are a couple of different ways of doing that. It's one of these things that's an emerging market. And our idea here is be at the front end in manufacturing too, both the technology and the fuel.

We also found the next two items, software design and distributed energy. That networking was a key thing for business models, combining the electric charging with grid management, demand management, storage. They had markets on renewable electricity that that data sharing and that information and networking through engineering and software development was a key factor. And so we include that in the supply chain of manufacturing. That's just one

of the elements.

And then also you have at kind of the back end of this case, battery technology in passenger vehicles. When they're ready for change out they still have about 80 percent life and then there's a market for that.

We also found in this service maintenance, installation, power upgrades. These were factors in either making a product or service that in essence, we should include in the definition of what we do, in the future.

And then of course the support infrastructure for all that electric vehicle. This goes into the utility systems, so look holistically is the message we received.

And this is kind of continued on in this theme. Where do we stand in manufacturing in this state compared to other manufacturing? We found, I'll give you kind of a brief rundown through our interviews three different kind of areas. One, large-scale manufacturing trying to reach a low-price point, but very little of that in California, almost all of it outsourced. Those companies basically said, "We're not interested in being in California. We already have our manufacturing lines set up."

Another group of companies, "We have part of our manufacturing here in the state, part in outsource, but the more market growth we see here the more we want to manufacture in the state." And try to figure out how to

compete on different stages of the supply chain is a factor.

We also found that a couple of companies, "We're doing everything in California, every single component." And those tend to be startup companies looking for differentiation in their product. We also found that from that workshop that the partnerships with some existing organizations was very important. You're going to hear about some of that partnership today with Rio Hondo College, John Frala will give you some background on that, in interacting with some of the companies here too. And then also just in some cases, just training organizations tend to be local regional.

Some of the barriers, this is just a -- we're expecting to hear some of these same kind of barriers and challenges raised to us today from the group of you. And for the most part California was seen as a higher-cost market compared to other U.S. states and international markets.

And there was an interest in focusing on some land use planning changes and CEQA just to get projects on the ground, get permitting done. And that quite often location of the plant is really important on just maintaining a decent cost of living for workers. And that there's certain hot spots in Southern California and the

Bay area where that's really difficult to do that.

Access to capital is noted here and I'll let some of the presenters today kind of wade into that a little more.

And then this kind of point of long-term commitment to policies, that as many of you know our program here, the Alternative and Renewable Fuels and Vehicle Technology Program is authorized through 2024, but we've got to go through an annual approval in the budget process and other funds are year-by-year. And some programs need extensions, so that kind of telegraphing and signaling that we're going to have long-term commitments in important. It's difficult to do that with federal programs at this point.

And then of course this last item, inconsistently and slowness of local decision making. We heard a lot that it was an awareness building, that constant awareness building of what the attributes are of these different technologies that had to happen and, of course, turnover in those government positions. That there's a constant education that has to happen.

I'm not going to go through all these details of the recommended actions, but for the most part I think you're going to hear today some similar comments that I think in terms of -- we're going to take these comments to

heart. We're taking this workshop today as an input into how we configure our future program configurations. And listening to all of these ideas.

And I think one thing to keep in mind here, these recommended actions, in essence there's no single agency that can do all of these things on its own. And there's a tendency to silo programs and I think what was not really spoken in that previous workshop is the need for crossing those silos and interacting between different organizations. And that's probably something we'll spend some time on. And that's kind of the presentation from May 4th.

So if you have any questions on that, or let's maybe we should just move on to the next.

So before we do that, I'd like to introduce all of the parties here today. And remember Tami's comment was we're going to have a sequence of presentations and then we've asked our peer review panel members to -- they had received information in advance to make comments, raise questions. But the rest of you can also make comments or raise questions too and that discussion process will be facilitated by Commissioner Scott.

So to the first presentation will be Kent Leacock, from Proterra. That's a bus manufacturer, electric bus manufacturer here in California. I'll let you

go through your kind of background in detail.

Joh, next to him in the panel is John Frala from Rio Hondo College. He's involved in developing a lot of trainee programs. Of course, Commissioner Scott is next to him and Deborah Donahue from ChargePoint, sitting next to Commissioner Scott. ChargePoint is, as many of you know, an electric vehicle charger manufacturer, operator, installer, maybe a financier too. Peter Ward representing Efficient Drivetrains, Inc.; that's an engine development company, a hybrid technology. And Mike Simon has a seat here next to Tami, from TransPower, Inc. He has not arrived yet, but will be here.

And then our peer review panel is Margaret Mann, from National Renewable Energy Lab and also Debra Sandor from NREL, the National Renewable Energy Lab. And then sitting up front here close to the front is Frank Ramirez, of the Governor's Office of Economic Development, so that's who our group is today.

And Kent, you are welcome to either come up here or sit down there and do your presentation.

MR. LEACOCK: Good morning everyone, I'm Kent Leacock. I'm the Senior Director of Government Relations and Public Policy for Proterra. I also happen to be I guess, the primary liaison between Proterra and the California Energy Commission as it relates to the grant

that we won to establish manufacturing in southern California. That's where we ended up choosing to establish manufacturing in Southern California, in the City of Industry, for a number of reasons. We'll just go ahead and get started here.

Just to give a little bit of background, as you may or may not know Proterra is an electric bus manufacturer. We manufacture the actual battery packs that go into our bus out of our corporate headquarters that's located in Northern California, in Burlingame. We manufacture the battery packs starting at the cell level then building them up and incorporating a energy management system, battery monitoring, telematics, whole works.

Those battery packs then get drop-shipped to our bus manufacturing facility in Southern California as well as our original bus manufacturing facility in South Carolina. That for the most part they are geographically assigned for their manufacturing process. Obviously, South Caroline handles the eastern half of the country, Southern California handles the western half of the country, but there are adjustments made based on kind of order and volume of orders in various states and various transit agencies.

We have a pretty experienced leadership team. Our CEO was at Tesla. From Tesla he was recruited to

Kleiner Perkins, a pretty premiere investment bank located in Silicon Valley. And then he led the investment, while at Kleiner Perkins was one of the lead investors into Proterra. And then was asked to come on board as CEO, in a response to a level of stagnation that was taking place about five or six years ago.

The rest of our senior management team has a lot of experience in the automotive world, GM. And our chief operating officer ramping up our manufacturing is from Tesla; CFO, PricewaterhouseCoopers; our Chief Legal Officer from the gaming world, EA, and then Rocket Fuel. And then our Chief Commercial Officer came from an alternate fuel company that some of some of you may be familiar with, Propel that did biodiesel and ethanol and then he was in the investment world.

So just a quick photo of some of our folks here. That's our battery manufacturing. The battery pack manufacturing team, right there in the middle, and that was at the completion of the first full-on production battery pack.

So as I mentioned we have a battery manufacturing facility in Burlingame, California. And that's where they build the battery packs. What you're seeing is an actual module being constructed there, in Burlingame. And then we have our bus manufacturing facility in L.A. County.

Now, why are we where we are right now? And the fist component I think of that, is that battery prices have come down dramatically. We were paying over $1,000 per kilowatt hours just eight or nine years ago. And now we are at a stage where we are down around in between $200 and $300 per kilowatt hour.

Now, that is a result of a couple of things. One is the growth in the passenger market. Scale in passenger vehicles have helped drive down the cost of energy storage. And then as well as Proterra's growth and ability to develop a very favorable contract based on volume for our own cells, our own lithium ion cells.

And here's another big factor and it's almost interesting how well it corresponds in terms of the -- this is the overall battery electric bus market, not Proterra. It's the entire universe. As you'll see from 2009 to about 2014 it was limping along. And as the growth in passenger vehicles happened and the cost per kilowatt energy storage went down our growth in that industry started to escalate and then has been ramping up. And in fact, the transit bus market has now passed the passenger vehicle market in terms of electrification, electric buses versus electric vehicles, as a percentage of the overall market of new car sales or of new bus sales if you will.

We've already reached greater than 10 percent

share of the total transit market. The electric bus industry or zero emission bus industry, I should say, includes fuel cell versus what's happening in the passenger world. But it's a lot easier to change the mind of one fleet manager than it is individual passenger vehicle purchasers.

So this is just to give you an idea of where things are headed kind of across the U.S. We have fleets across the U.S., transit fleets that is, that are committed to going 100 percent electric by a date certain. And it varies, but you've got the two largest transit agencies in the U.S., New York and L.A., both committing to 100 percent electric by a date certain followed by another of the top ten in Seattle and San Francisco. But just so you know it's not a phenomenon of all the big guys. Very small agencies, Park City, Utah, for example; Stockton, California; San Joaquin RTD; LADOT that serves just Downtown L.A. and complements the service of L.A. Metro that serves all of L.A. County. They're all committing to going 100 percent electric by a date certain and once again that's a phenomenon of the ability to have a decision maker or two versus individual decision makers in the passenger vehicle market.

So just to give you an idea of Proterra's growth, and why we felt it mandatory that we establish

manufacturing in the western half of the country. Back in 2015 we had nine customers, if you will. Fast forward to now we've sold over 625 buses to 70 customers across the U.S. and in Canada in 32 different states.

As you can see from the small snapshot of California, from a few customers to more than you can count here, they're so overlapped. We've really grown our market here in California, but it's extended up the coast and now we're even in what you would consider traditional oil and gas strong beds of Texas, Louisiana. We have four customers in Texas, two in Louisiana and now we've started embarking on growth in the Midwest here through Illinois, Michigan, Ohio, throughout the south and we've grown a lot of customers in the northeast as well.

Just a different way of looking at all the different customers that we've secured across the U.S. and we recently won an award in Toronto, Canada. And we have now a few commercial customers including Jones Lang LaSalle leasing company, Baltimore Gas and Electric. And a number of airports: Raleigh-Durham, North Carolina Airport; San Jose International Airport and soon you'll be seeing our buses also at Sacramento Airport.

So we have some interesting developments in our drive train. We have two different versions: dual power, single power. And the reason that's important is that it

allows, coupled with our battery packs, which are modular and scalable you can see three kind of different energy sizes that are applicable. It's the exact same design, it's just a different enclosure, exact same module that's being built. And that's important because it allows for our existing manufacturing facility to serve multiple opportunities.

And couple that with what we've decided to do in the charging world. One of the things that we learned from our customers was that they had little or no experience in electrification infrastructure or charging and they were constantly asking us, "Well, we need this. We need that." In the transit world there's a requirement to be "buy American" compliant. And what we were learning more and more was that at scale where these transit agencies are going into 100 percent electrification, there weren't solutions that were scalable. Because the individual pedestal for each bus, or one pedestal for two buses, would start to take up too much space in their bus yards, where they already cram their buses in. So we were looking at various ways to be able to scale the technology.

And if you saw from the growth or our bus sales, where we're over 600 buses sold, we are constantly increasing our production and growing every year in the manufacturing. We knew that we were fast going to

overwhelm the bus yards with the current charging solutions that were out there.

So here's a mockup of how this will be deployed and we're already doing some designs with a few customers out there. Those containers that you see were the containers that you see in the prior slide, that will then allow for tight parking with overhead what they call either panograph or pantograph technology coming down to the bus, being able to charge them hands-free at night. Bus yards didn't want to get into plugging individual buses in at scale. When they were doing one-sies and two-sies, even 20 or 30 buses no big deal, but when they've got to do 500 buses in a yard it didn't work for them. And also taking into account potential demand charges, energy storage, there was a lot of, if you will, computer software and automation that had to be planned for and designed to allow for charging at scale as well as taking into account what the energy needs would be.

So now to circle back around, why was it important that we have these modular and scalable battery packs? And why did we have to come up with an efficient drive train, not just for our buses? Well, because one of our goals was always to do technology transfer. We always felt that buses were the beachhead, if you will, of the heavy-duty sector. And that electrification would happen

in multiple areas.

As you saw recently with an announcement from Tesla, that they were going to be building an electric bus. There's a company out there called FOR (phonetic) that started making electric buses. And the growth in the school bus market has happened.

So we started off with transit, our heavy-duty battery packs, drivetrain and our bidirectional vehicle-to-grid integration capable charging systems, also scalable that's going to become important later on. But here you have now we've recently made announcement in other sectors of where we're going.

I can say now, and I've been cleared by our General Counsel to say that we are, right now as we speak, building a battery-electric school bus in partnership with one of the major manufacturers as their very first pilot electric school bus. That will have, when I showed you the scalable battery packs, that will have the smaller energy storage battery pack available to it. And it will be able to do vehicle-to-grid integration.

And I mentioned that was important, because people used to ask us all the time about school buses. And we would say, "Well, the numbers don't pan out. They don't run enough miles the way they do in the transit world," 36,000 miles on average or more for a transit, dramatically

less for a school bus and so the cost of electrification wasn't there.

But we're now seeing utilities looking at creative ways to support school bus electrification in that they sit. These huge fleets of thousands of buses sit, 85 percent of them sit all summer long. If they're electric they can be charged with solar and used as distributed energy instead of a coal-fired peaker plant, for example. At the time when everybody comes home at the peak time and around between 5:00 and 7:00 they can be cut on, energy put back into the grid instead of using a coal-fired peaker plant. And we've actually had conversations with a specific utility back east about that.

So our first announced technology transfer was with Van Hool, very similar to transit buses, and it made sense our first foray into technology transfer would be in a bus but a completely different bus. It's the coach buses that you see if you ever go to the Bay Area and some other locations. They have these very well laid out, what we call "Mac Daddy" buses where they have big relaxing seats. They've got Wi-Fi. They've got USB plugs. They've got screens. They've got luxury seating, bathrooms, the whole deal and Van Hool is a manufacturer of scale with these buses.

So we have not officially started shipping

battery packs made in our sync transit bus factory over to Van Hool. They're a slightly configuration to work with the layout of the Van Hool coach bus drive line, but it's the exact same modules, the exact same enclosure, just a different size, modified. And then in more of those of a different size, the exact same assembly line. So it's really working out well. This is the first technology transfer.

The next one we just announced and we've already secured a customer here in California for it is the first battery electric double decker bus that will be built and then sold here in California to Foothill Transit down in Southern California. They service a big chunk of L.A. County.

Once again this is a partnership with Alexander Dennis, where we will be doing technology transfer, building the battery packs, right in Burlingame California. Then they will be incorporated into the Alexander double decker bus that's going to be first sold to Foothill. And I would imagine that there will be multiple customers for that technology down the road. If you see that far right, it's kind of a tough eyesight thing, but on the far right at the bottom of the bus you'll see those are battery packs in a configuration across the back of the Alexander Dennis bus. And in the middle you can see them installed here and

then across there.

The ability to have a different size and configuration with the same modules inside allowed that to happen. They're built on the exact same assembly line that we built the first big battery configuration that I showed you, that first big battery pack.

So now we move to Southern California. I'm sorry, this is the battery factory, still up in Northern California. We're just saying there that it's co-located with engineering and R&D. We have some level of automation. We had job creation that we didn't anticipate out of that and this battery manufacturing plant was an important milestone in Proterra. And it was an important step in our relationship with the CEC and the grant. We can manufacturer 500,000 kilowatts of energy per year out of there and that's more buses than get sold in a year. But we built that facility with overproduction capability for technology transfer with what you're seeing.

This is some of the testing and validation that takes place in our Silicon Valley lab. To the far left you'll see battery packs that look like they've had multiple little problems. Well, those are indents from bullets. We took them out. We had a transit agency ask, "Well, what if your battery packs get hit by gunfire? We operate in very urban environments, in Detroit and

whatever." And so we went out and we tested them that way.

The middle is a drop of a single point. It's to replicate -- our engineers figured out how high it had to be dropped form and it's to replicate a bus getting hung up at a single point of contact with the entire weight of the bus sitting on top of the batteries.

And then last, but not least, is the vibe test that simulates the road-going capabilities of a bus. It's got a configuration software that allows it to simulate 500,000 miles of road jostling and bumps, etcetera. In the space of two months we can do a million miles worth of testing on that battery pack and how it's built, connectors, circuits, all that stuff to make sure that it's ruggedized and it's not going to fail.

The last thing we want is a battery operated electric bus on the side of the road, because after five years a connector rod vibrated itself loose, because we didn't do full on validation safety and testing. So we have other tests that we do including extreme temperature, excessive moisture. We have a chamber where we put the batteries in where it's hotter than anywhere on planet earth, colder than anywhere. All the while cycling the batteries for their lifetime, testing, as well as adding humidity into the chamber.

Once again a great milestone for us, the official

opening of our factory. We're up and running, but we were able to have Governor Brown come to our factory. But what's even more telling is this is where we were when we took possession of the building late in 2015, I believe. And here we are now on the right in 2017. That is a full blown bus factory that has now started producing buses and every quarter we are increasing the manufacturing out of that facility.

So the additional milestones that I wanted to just lay out. You know, we have been able to grow our investor base from the initial venture capital funds to major corporate investors like General Motors, like Southern California Edison. We have a mix of really interesting and innovative investors that have been patient with us that have supported our major capital-intensive efforts.

Winning the CEC grant for advanced manufacturing and then coupled with that the development of our own battery and drivetrain team that resulted in that ruggedized technology, that has been a significant boon to us with our manufacturing capacity. Because previously we were sourcing our battery modules from a third-party, turning them into a pack and those modules were actual passenger vehicle markets. And that's what we were kind of counting on as what's going to be our long-distance bus.

And now the next milestone is the ability to transfer our technology to other sectors, capitalize on the overall acceptance and growth of transportation electrification in the heavy-duty sector. And the fact that the people that are buying from us know that transit buses are the workhorse. We now have transit buses, battery electric transit buses that are doing 100,000 miles a year in Park City, Utah. They've been out on the road six, nine years now, and are holding up much better than their fossil fuel counterparts.

So here's some of the performance results we've had if you look at them as it relates to the grant where we made -- we had some certain goals. So in fact we've already exceeded the job creation goals from the grant agreement. And these are all full-time jobs with competitive benefits. We offer on-the-job training for career advancement. They get equity ownership. Every employee no matter where you start, what your position is, you get stock options. You also get a matching 401K plan, paid time off and ten paid holidays, so every employee's an owner.

We've already exceeded our financial match commitment, which is going to go to my comments in a little while about things are always more expensive than you think. And we've been scaling our operations to meet

customer demands by opening this facility. And like I said that was a key factor in Proterra's growth. And in fact, we are looking at further growth in L.A. County to meet demand in bus sales and technology transfer sales.

The other thing that I would mention, not only are we building a definitive electric school bus we are also going to have to look at building another bus, and that would be a 60 foot articulated bus. We get requests for those all the time and that's on our road map down the road that we would ultimately have to expand our manufacturing to be able to do that.

So lessons learned. Clearly one of the lessons that we learned, and we knew it coming in was that it made sense for Proterra to be in California because of the programs, the opportunities, the public policy that takes place in California. And it's obviously the CEC, I'm standing here now, but it's also GO-Biz, the Office of Economic Development. It's also within GO-Biz the California Competes Program. It's a tax benefit program. There are sales tax programs for advanced manufacturing, there's multiple programs. There's a number of state workforce development programs. I'm going to talk a little bit about those in a minute, but that is the key factor.

And one of the things that I want to talk about also is the fact that the proactive communication with the

CEC is my bullet point number two, because everything takes longer and it costs more than you think. But more importantly than that is that we realized early on that batteries were going to be the kind of building block of our buses. Even though the majority of the CEC money was dedicated for the Southern California facility, CEC worked with us to adjust our grant to allow some of that money to be spent up in our Northern California facility, because we made it. And we communicated and they understood that those battery packs had to be built to be able to do that level of technology transfer that we were looking for and to feed the factory. Because without the battery packs the factory wasn't going to get anywhere.

So now other important things, winning that grant sent a signal to the investment world. And in fact we've had subsequent money raises that are getting easier and easier. And access to capital in advance of need and on fair terms can make a big difference between success and failure. It allowed us to, if you will, overspend our production at the time in anticipation. Now, we have to scale -- now our production is trying to catch up and that's a combination of training, employees and just physically having the ability and the capability within the factories to continue to push out buses.

Supply chain goes right after that. We've had some

challenges with supply chain. We thought we had future proofed our supply chain. We had second, third suppliers and still we had supply chain issues, where we literally were slowed down where if we produced say 20 buses in a month we had a next month where it was down to 8. And that was a supply chair issue from producers and suppliers that we thought were going to future proof our issues.

Another thing that you need to understand is that there is going to be workforce challenges no matter what. Because we ran the impact problem of recruiting employees that are needed yesterday to fill open roles to get going, versus developing the employee base that we'll need for tomorrow. And as a startup we didn't have the band width to really do both within our HR Department. They were scrambling to fill open positions, so we could get the factory up and running. Because the other factor you have to take into account is great the buses are flying off the shelves. We're selling them like crazy. But if we can't build them in a timeframe that's competitive with our fossil fuel competitors, they're going to start to throw up their hands and start looking the other way or maybe going to our competitors for their bus sales. So we had to be able to scale manufacturing, so that they could have a similar timeline on the production of their buses. All the while dealing with supply chain issues, all the while

dealing with kind of what everything that's involved with starting a new factory.

But I'd say that one of the biggest lessons that we learned, and that's why we did this whole battery thing, that's why we embarked on the higher level of energy storage was that our customers kept saying that, "Your initial buses are great, but they just don't have the range that we need." And then we had a design where we were going to have about 130 miles of range, 120 miles on the range bus. That was using the modules from the third party. Once again our customers said, "You know guys, that's not going to cut it. We need a bus that can do over 150 miles, so that we don't have to worry about the change from electric to fossil fuel. And we don't want to have to think we're going to buy two buses for every one bus."

And that's when we embarked on that battery building. We hired a battery team. They started developing our own stand-alone battery system that would allow for enough energy density and storage of energy to be able to get that range. Because a lot of it is just simple math in terms of mileage per kilowatt hour of energy and how much kilowatts of energy you could hold on the bus. And we weren't there with the third-party modules. We had to do it on our own. And that, as I said that was one of the things that working with the California Energy

Commission helped us do that in switching our emphasis from the initial, from the factory to the battery factory. And then focusing the emphasis on the bus factory in turn.

So, next steps. We've got to continue to scale our manufacturing through a combination of workforce and automation. Human capital and equipment capital expenditures will increase and continue respectively. Specifically, we're going to go for sustainability through increased vertical integration of our supply chain components.

And it may not seem like much, but for example, wiring harnesses were one of those challenges that I talked about. The buses were getting held up by wiring harnesses. They were being manufactured outside of California. We want to bring that in-house. It aids sustainability having them shipped or trucked to our factory. It'll be job creation and it will help shore up certainty in our supply chain.

We want to deploy lift assist machinery for enhanced safety and increased bus production. Back when we were maxing out building maybe 20-30 buses in a year versus over 40 in a quarter, it wasn't a big deal to have guys lifting these heavy windshields on the buses, because it just wasn't that many. Now, it becomes a safety and a increased production issue lifting many of these heavy

components, wrestling with windshields. There's lift assist out there. There's a lot of things that are out there that are what we need to deploy, but balancing how many employees we need and other factors I could go into huge growth in IT. And all that needs to happen in terms of vehicle-to-grid integration, chargers, talking to the buses, buses talking to the chargers. And having them be OCPP compliant, which is open standards that allows for anybody to use our chargers and any buses to use our chargers. And our chargers to charge interchangeably, because as much as we'd like to think customers are only going to buy our buses, lots of customers are embarking on buying three different electric buses at the same time. They don't have to buy three different chargers to charge all those buses. So we have to make sure that there's a high level of interoperability.

We work with EPRI. We work with all the different kind of Society of Automotive Engineers, SAE, and most of the standards organizations that are out there to ensure that that happens. So on top of the lift assist machinery we've got to also increase our battery pack manufacturing, because of this growth in technology transfer. You may have seen a little locomotive in my earlier picture. I didn't really discuss that, because that's a project that we are looking at as an opportunity

to build the first ever battery-electric locomotive.

And of course trucks are on our road map of the future. We are in conversations, but we are not at the stage, where, as I said, in the school bus, we are actually building a school bus for a major manufacturer.

Then the other thing we want to bring in-house is we don't want to outsource our paint shop and we don't want to outsource metal fabrication. It's amazing that brackets could end up holding up your production line, but they can. And then tubes for cooling and we want to be able to bend those tubes and do them ourselves. It's a lot easier to get bolt straight tubes than bend it at specific angles at specific lengths manufactured and shipped to you. Those are simple things, that may seem simple, but they are incredibly important.

And then as part of our sustainability efforts, there's a lot paint shops out there that have been grandfathered over the years and are spray painting in some pretty, I'll just say less than environmentally friendly fashions. We would start from scratch. We would be held to the highest standards available out there now for paint shops, which would increase sustainability, grow jobs. And once again secure our it's not quite supply chain, but it would secure our manufacturing capability rather than waiting for somebody else to paint buses to our customer

specifications. We would be able build that into our build schedule.

And then there's new product manufacturing planning and development, because right now we don't even know what we may need two years from now to develop internally.

So workforce of the future development, and one of the things that I'm going to just touch on, I don't want to steal his thunder. But we were very successful when we first got started working with Rio Hondo College in terms of hiring veterans and having people with the electrical and mechanical training that we needed to staff our factory. We have to grow that if we're going to grow our employees. We have to extend it beyond our bubble in L.A. County, the City of Industry area. We need to push that out.

We're going to be growing our battery manufacturing facility, so we need to have development of the workforce of the future as well as our current needs, later this year, this month, next year. But if we are going to grow the way we project growing we are going to need to be able to employ hundreds and hundreds more employees. And it behooves us to make sure that they walk in the door trained, so that they are ready to start working relatively quickly. And then through on-the-job

training programs get trained up, so that they can become electrical associates II, III and potentially supervisors.

We are already seeing some of the early folks that we brought in getting promoted to supervisors. Well, where are their replacements going to come from? You know, we're almost to the point where, as I said, you're going to have challenges that you don't encounter.

We thought locating down in City of Industry area, in the heart of what I will say scaled back airline industry, heavy manufacturing, aerospace, all that, we thought we'd have a wealth of employees. But when we established and as things have moved on the economy is booming here in California and workers are getting snapped up everywhere. Electric manufacturing is booming. Workers are getting snapped up across the board. So we are competing very hard.

Now because of the attractive employment package we offer we believe that we've been able to attract premiere talent, but I'll just say it's getting extremely competitive out there. All employers are now starting to offer very attractive employment packages. And so we have to start developing these folks early on whether they be vets, whether they be folks out of high school, whether we are going to transition them out of underemployment into superior employment.

One of our supervisors was an engineer that was working at a mattress factory. He joined our company as a Mechanical Associate II, went right to III and now he's a supervisor and he's thrilled that he's now really taxing his level of education and skill. You know, he was an engineer at a manufacturing company for mattresses and now, he's working in kind of advanced technology. So that's just one little microcosm of what we've experienced down in Southern California, in terms of workforce. Thank you.

COMMISSIONER SCOTT: Great, thank you very much.

Let us turn -- this is very insightful and informative. I think what we'd like to do now is hear from our reviewers and then please others around the table if you have questions or comments for Kent please go ahead.

Margaret, would you like to start?

MS. MANN: All right, thank you. That was a very informative presentation. I really enjoyed that.

I guess one of my questions is you described your supply chain. And you currently call it battery manufacturing, but it's the packs where you're assembling purchased cells into packs that are specifically designed for your application. I was curious about the relationship you have with the battery cell manufacturers. Is that a contractual relationship? Is it multiple options over time? Where are those battery cells made and then do you

see differences in the quality of the battery cells that you purchase?

MR. LEACOCK: I'll start with your last comment. Absolutely, we saw a difference and that's why we partnered with the company that we chose. When we first embarked on doing that, that's why I said we start at the cell level. We don't manufacture the cells. We did a bakeoff between major manufacturers and I can name them: LG Chem, Panasonic, Toshiba, Samsung. We had teams of those folks running in and out of our corporate headquarters all the time early on a few years back.

We ultimately chose the LG Chem out of South Korea even though we had previously been buying our modules, as I mentioned, from LG Chem out of Michigan, and they sent a team out. But the cells that performed the best, that stood up the best under testing were the LG Chem cells. And we do have a supply agreement with them that actually triggers price reductions based on volume as well. So we have that set into the contracts, because we clearly anticipated that we were going to have growth.

The bakeoff, if you will that we did, yielded a number of surprises. Our engineers walked in thinking that one of the manufacturers was going to be the winner, because they had previously worked with them and just thought that they were going to have the best cells. But

they didn't, so they were very unhappy that it turned out not how they wanted. But they had to choose the best option.

And in fact I would say, I think it's safe to say that cells that we're using now aren't the cells of the future. We are already looking at, or we're getting sent to us next generation cells by all the manufacturers, because now they're all seeing how dramatic the growth has been in the electric bus sector and in the heavy-duty sector, here in America. So now they're approaching us, "We've got the next greatest thing!"

And so the beauty of our R&D facility that I showed is also we have individual cell testing machines, if you will, that do the same kind of shock, vibration, humidity, heat, cycling, all that stuff. So we're now testing the cell of the future regularly. And that cell of the future, I would bet, won't be in a bus 15 years from now, because there'll be some other bus. You know, one of our battery engineers said, "Kent, if anybody tells you they know what the next battery cells are going to be for sure then you know that they're lying, because nobody knows."

COMMISSIONER SCOTT: Other questions, Margaret or Deborah?

MS. SANDOR: I'll defer to (indiscernible).

COMMISSIONER SCOTT: Okay, and Frank? We go to Debra and then Frank.

MR. RAMIREZ: Hi, it's great to be here, Janea. Thanks for the invitation, appreciate it.

Great presentation, Mr. Leacock, I have just one question about workforce. I understand that's an issue and I'm glad you're working with Rio Hondo College on that.

Have you identified what the key jobs are going to be within the next five, ten years, in your industry? And have you developed any pipelines or any specific plans for meeting those needs? I mean, thinking forward and related to that is how closely are you tracking filling jobs with the disadvantaged communities?

MR. LEACOCK: I would say, I hesitate to talk about ten years from now, but I will say for the next five years we know where the growth will be. It's been clearly identified as the mechanical associates, electrical associates, as well as software engineers and then mechanical engineers, engineering supervisors, engineering managers. It's really all in that technical phase.

And then the other job creation will be just organically in any organization the HR group is going to grow. The IT group is going to grow. But as it relates to the skilled kind of workers I think you're talking about, we are looking at working with organizations like Rio Hondo

College that specialize, for example, in getting us folks from the community, veterans, etcetera.

We've also worked previously with Good Will Industries to draw from disadvantaged communities, draw from the community. And quite frankly that's really been our focus is to do job fairs and work with community-based organizations, to draw from the community and ensure that we have an extremely diverse workforce.

I have a -- I don't have it in that presentation. I should have put up my screensaver that has a snapshot of the workforce that's down in the City of Industry. And it's about as diverse as you could possibly imagine. I would say that the specific focus is really on finding a diverse workforce from the community and we are in the midst of, I would say in our surrounding area there's a lot of what are going to disadvantaged from the EnviroScreen perspective. Is that what you're using as your definition of disadvantaged communities, more or less?

MR. RAMIREZ: Yes.

MR. LEACOCK: Okay, so we draw from -- that surrounds us and so it's easy to draw from disadvantaged communities, because we're smack dab in the middle of that designation and we're trying to draw from the community as much as possible. We've done job fairs with elected officials, Assembly Members here and L.A. County

supervisors in L.A. So that's really what we've found to be the best avenue toward drawing from the communities, working with organizations like Good Will, local community colleges and the elected officials that are very much motivated to help their disadvantaged constituents, if you will, secure good jobs in our industry.

MR. RAMIREZ: Thank you

COMMISSIONER SCOTT: Debra?

MS. SANDOR: I had another supply chain issue. You said that you have had trouble getting all different types of components and I was just wondering what do you think are sort of the main issues that you have with that? Is it because there's competition for those components? Is it because you're getting them overseas and they're not getting here in time or what do you think are some of the big issues that maybe we could address and make it so that's not holding up the bus production?

MR. LEACOCK: Right, well I guess the first issue was quality and ability to fulfill their commitments to us. And that hurt us and that was an entity that came to us from one of our Board Members at GM that said, "Oh, these guys are going to be great for you." Well, they weren't great, unfortunately. But it was a lesson that we had to learn.

We've also encountered quality issues from

offshore manufacturers, and specifically the wiring harness for example. Once we had the design that we needed, our engineers came up with it, the manufacturer wasn't executing to the level of quality that we needed. And in fact, we had to pull the buses off the assembly line, snatch out the wiring harnesses and go back in with all new ones. That the manufacturer had to employ kind of an upgraded process to match the ruggedness that we needed, that we were designing in with our own components, which is why we want to do that ourselves. Because when you have a battery electric bus the wiring harness is used for every aspect of the bus from the batteries all through everything.

So when that fails basically the bus is dead in the water. It's not like a fossil fuel bus that the motor will keep going if the headlights go out. There's so many telematics and electronics in there that it's a crucial component and we learned the hard way how crucial it is to bring it in-house.

And then as I said the other thing is just some of it is literally logistics. We have some good manufacturers. When I was talking about say brackets, we have good manufacturers for that. But they're based on the East Coast and they were supplying our East Coast factory. And so it's an efficiency economies of scale type of deal

to not have that stuff shipped all the way across the U.S. to our factory in California. If we could start building that in-house with a kind of machine production shop it will help trim costs.

Because we're at the stage now where our guys are looking at 25 cent cost reductions here, a dollar cost reduction there, because the number of brackets that go into an electric bus, or any bus for that matter, can add up. And once again, we're driving down the cost of the bus itself. I didn't have it in my presentation. Many of you may have heard this. A few years back, our buses cost $1.2 million. We're now under $800,000 depending on options, which surprising enough, you can add 150,000 in options to a transit bus.

But anyway, so every little bit counts. And so it's been a combination of everything, supply chain, from quality, from over extending the manufacture of that component, because they were used to us ordering a certain level. All of a sudden we quadrupled our orders and they were overwhelmed. And it's interesting that when we took possession of the factory, we were anticipating that, but you can't start ordering in quadruple without the bus orders to go with it and without the buses being made. So then all of a sudden we went from 0 to 10 to 20 buses being built in just one factory alone and couple that with the

other more established factory also doubling and tripling their production. All of a sudden we're ordering dramatically more of the pieces, if you will, that are necessary and they were like, "Well, this is great, but we can't meet that demand."

So it was those type of things, so many components of supply chain I think are fixed and or in the process of getting fixed, but some of them we want to do it for quality control and for sustainability reasons as well. And it'll be job creation. Why should we have brackets built in -- I don't want to name the state, because I just don't want to -- but why should we have brackets built some place other than California? Or wiring harnesses built someplace other than California where we can incorporate that into our factory and build it there, which is one of the reasons why I kind of made the mention that we're being looking at expanding manufacturing. Because it'll be a great thing for us and for California if we outgrow that facility in the near term, because we anticipate outgrowing it.

COMMISSIONER SCOTT: I have a question for you. Now, you mentioned the quadrupling of the number of buses you can make and therefore the supply chain kind of needing to keep up. How closely do you work with the folks who are bringing in those types of supplies, like the brackets for

example, that you mentioned where okay it looks like in quarter three we're going to double what we're doing. We need you to be ready to double as well. Or do you have those kind of relationships with the supply chain folks?

MR. LEACOCK: Yeah, we have a whole new -- when I joined the company our supply chain was maybe 2 guys, now it's about 12 guys. So yes, they now do regular supply chain road shows even where they fly around. And once again they fly around the country to different suppliers. You know, how great would it be if they could cut in half their flights, because they were building it right in our factory? But for now, yes we do have those kinds of relationships.

But even with that and even telling them that they can't always respond. They can't just -- and it's the same problem we're having. It's a great economy out there. They can't just all of a sudden add workers to increase their production, add skilled workers to all of a sudden dramatically increase their production, on the turn of a dime. And so like I said things are kind of complementary. It's getting better. We've established those type of relationships.

And there's always going to be a huge supply chain for the buses, because we're never going to build tires, the chrome wheels, the seating, the fair box stuff,

the windows. There's a whole host of supply chain that we will never want to bring in-house. But there's a number of things that we think makes sense and would be kind of a good return on our investment to bring in-house, in the manufacturing process.

COMMISSIONER SCOTT: Any last questions for Kent, before we turn it over to I think John is next. No, Peter's next. Yes, please just go ahead.

MS. MANN: I would like to ask a real quick question. You've done a very good job of talking to other states and focusing on the California issue, what about international suppliers? You know, the elephant in the room that there are a lot of international suppliers and of course the biggest developing markets in this space are international.

So twofold: to what extent are your relations duplicate, triplicate, contractual internationally? And to what extent are you also looking to provide business services or components to the international market?

MR. LEACOCK: So, I think you're -- when you say "our kind of international," because in the transit world, we have a "buy America" compliant obligation that we have to meet. So the major component that we source from overseas is our cells, from South Korea and those are the lithium ion cells.

As it relates to selling our product and technology internationally that's being done. That's the Van Hool relationship. They are based in Europe. Alexander Dennis is a London -- they're the London double decker bus manufacturer of choice, if you will. We recently did a deal where we will be selling buses to Toronto, Canada. And we're in conversation, Toronto's -- Canada itself is on a big push to go greener, so we're in conversations with multiple cities in Canada. We've had the Canadian Minister of Transportation come visit our manufacturing facility.

So I think we're taking baby steps as it relates to international sales of our supply chain. And we are constrained and happy to be constrained in terms of our shall we say international supply chain for parts for our buses, because of the buy America compliant requirement. And that extends to our chargers, anything that we build or anything that we source on behalf of our customers has to be buy America compliant if they want to be able to use federal funding to purchase it. And 99.7 percent of the transit buses sold in America are used -- are purchased using federal funding, so it's almost a virtual require -- it's a requirement that we source and build in America, using American parts and components other than, as I said, maybe 15, 20 percent is from offshore. And that really is

the big chunk of that is our battery cells.

COMMISSIONER SCOTT: Thank you. Thank you for giving us all of this great information. I think it will really help us. We're thinking through the most effective places for the Energy Commission to put its dollars as we're looking at manufacturing for zero emissions vehicle infrastructure and also into the workforce training component.

So, am I turning it to Tim to introduce Peter or shall I introduce Peter?

MR. OLSON: Well, I just want to make one comment that Peter Ward is our next speaker from Efficient Drivetrains. He is replacing Jean-Baptiste Gallo, who is traveling and couldn't make it back here. So Commissioner, I also wanted to mention that I wanted to thank Larry Rillera who helped put together a large part of this. He's suffering a trip in Hawaii with his family right now. (Laughter.)

So Peter, if you can join us up here.

COMMISSIONER SCOTT: While Peter makes his way to the podium I will extend my thanks to Larry for helping put together a great workshop for us today.

MR. WARD: Good morning, everybody. My name's Peter Ward. I'm really pleased to be here today and thank you all for coming out. It's a particularly interesting

day for me, because I used to be in this building for about 34 years and was the former program manager for the program that's funding some of these projects. It's a really interesting dichotomy. I've been on one side and now I'm kind of on the other side helping a client, actually one of my first clients and my longest-standing client is Efficient Drivetrains.

Basically, we're here to express that EDI is very, very grateful to the Energy Commission for the funding that we've received. The Energy Commission is by far the largest public partner that Efficient Drivetrains has gotten in its short life. Efficient Drivetrains was established about ten years ago by a fellow named Joerg Ferchau and with the help of Dr. Andy Frank from the University of California at Davis. Dr. Frank was a key individual at the Institute of Transportation Studies there at UC Davis and has a large patent portfolio.

So I'll go on from here. Basically, I was the Program Manager at the time I first met Joerg Ferchau and that's in 2007 is when I first started. But I met Joerg in 2011 when I was the Program Manager here. He came in for a meeting, met with me and others here at the Energy Commission.

I thought he had a very creative market segment that he was hoping to develop. And then as was followed up

in 2013 when I received a phone call from Joerg to ask if I could help advise him. That was after my first year of layout after I retired from the Energy Commission. And I was really happy to get his call, because I really thought the technology here has a very perfect fit, if you will.

At the time, they were establishing the hybrid electric vehicle drivetrains for medium and heavy-duty trucks primarily, meaning that segment that is in between fully electric light-duty and fully electric heavy-duty. And this allows the vehicles to operate on zero emission for all electric in city areas, but also has the advantage of having fuel onboard. And typically I've been advising them to use renewable fuels like renewable natural gas and renewable diesel whenever possible to get the longer duty cycle and the longer mileage you need for many of their applications.

EDI was established with a $150,000 loan from the City of Dixon and established their first facility out in Dixon. I remember visiting there. There were about five people there when I visited Joerg and Dr. Frank.

That one location really basically started all this, and I just want to add that $150,000, that the loan from the City of Dixon has been fully repaid at this point.

Fast forward to 2018 I don't know if many of you have heard, but this was outstanding news from this very,

very small company, fledgling California company. It now has over 50 employees and contractors and is growing. It has recently been purchased by Cummins, which was basically one of the goals of the founder, Joerg Ferchau, when he first had ideas of developing such a company.

Over 200 EV and PHEV drivetrains are deployed or are on order in the U.S., China and Taiwan and growing. Several strategic partnerships with OEMs, particularly Blue Bird, Thomas Built, Freightliner, etcetera. And it was, as I say, acquired by Cummins and part of its Electric Power Business Unit.

This is EDI's technology offering, which as I came to know it is kind of the fitting in the middle of all electric light-duty and all electric heavy-duty. But the drivetrains that they are producing can be all electric or they can be hybrid series and parallel.

It's interesting, because at the time that they were developing this there were certain challenges, like Kent mentioned, about the cost of batteries to attain fully electric viability and in duty cycle. And so this has kind of come of age, to the point where it has been identified as kind of a medium step to get to all electric drive. But certainly can be one that utilizes the low-carbon fuels that we're hoping to develop here in California as well to go along in tandem with all electric drive.

The technology offerings are the EDI PowerDrive, plug-in hybrid electric vehicle system. It's the industry's first zero emissions drivetrain solution, four modes of operation: EV, EV Plus, parallel HEV and series HEV.

The EDI PowerDrive EV, it's a full-power electric drive train and vehicle electrification solution. The same parts as components as the plug-in hybrid electric vehicle product line for economy and ease of service and maintenance.

That's kind of a theme that I think you might recognize throughout this. When Joerg envisioned this company, it basically wanted to take on just enough to make sure that his technology is viable. In other words not having to produce their own batteries, produce their own motors, produce their own -- all the other components. But actually at the time the market was developing many of these components, batteries, motors, had advanced significantly to the point where he could utilize those and we were also seeing cost reductions at that same time.

The EDI PowerSuite is the software and this I think is the crucial part of what EDI is trying to do. And that is the brains behind the unit that actually can allow the vehicle to operate in the most efficient and lowest emission mode at all times without the driver having to do

anything: software controlling the complex drivetrain and battery system functions, telemetrics for diagnostics, fault management in communicating with the operators.

This is to a large degree the patent portfolio of over 40 patents that Dr. Frank brought to the EDI experience. Dr. Frank is still the Vice President at Efficient Drivetrains, Inc. And from what I understand he appears just about every day at their facility in Dixon, which is close to UC Davis where he has retired as a professor. But this is the component, the work that Professor Frank did in all of those years is really kind of a secret sauce that EDI enjoys. They have additional patents that they have developed on their logic and software and that is kind of the thing that separates them from others in the market.

The complete range of technical services that EDI has is the vehicle electrification and integration of EDI's solutions, telematics and a low volume production of initial vehicles was allowing them to perfect their technology as they've gone along.

As I mentioned their business model was one that initially attracted me, because it was not an overly ambitious business model. It was one that was designed just to do the drivetrain. I know it's a little bit unheard of, in the last ten years we've seen companies come

and say, "We're going to be doing it all. We're going to be doing the electric vehicle. We're going to be doing the body, the brakes, the steering wheel, the batteries and the motors. And we're going develop them all for our system."

I think the wisdom came from Joerg realizing that the advancement in all these technology applications are different components was sufficient. And the price reductions were resulting, so that you could actually shop and provide and do basically test all these different offerings that were out there and choose the ones that best fit your technology option.

And so what they have done is they've built and testing PD7000ev modules. And they fabricate and test the harnesses and cables and programs the PowerSuite software. Freightliner and Custom Chassis build the school bus chassis. They install the PD7000ev kit into the school bus chassis, so they're relying on their partnerships to take their critical part of the vehicles itself and installing it in their vehicle. So the product that EDI produces is one that can be modified and fit into just about any transmission space, on available vehicles.

They test the EV-powered school bus chassis. They were responsible for that at Freightliner. And through the partnership they've had with Thomas Built Buses, Thomas Built Buses builds school bus bodies and

interiors, installs the body and connect systems, finishes the school bus and completes the final end-of-line school bus test.

That's one example of one of their partners. Another one in the school bus area is Blue Bird, which is an association that now EDI is enjoying and they have an order now for 200 drivetrains going to Blue Bird's new EV school bus.

Advanced Vehicle Manufacturing Facility grant is one of many reasons that EDI is very grateful to the Commission. The solicitation was established in 2014. It was awarded in February of 2015. The contract was executed in April of 2015. Energy Commission's funds was nearly 3 million, EDI cost share was almost $4 million into that.

Amendment no. 1 was executed in 2017. Amendment no. 2 was approved in 2018. Both were no time cost extensions and both were resultant of equipment list changes to better answer the company's evolution in a fast-changing market. This is probably one theme that you're going to hear is in this particular area, and in other areas of advanced technologies and in renewable fuels, it's a very fast changing market. I think Kent attested to that as well in his presentation. This is something that you have to be very nimble to respond to if you're a company and you have Board of Directors and Investors, you have to

be able to nimbly respond to market changes in the existing market.

And I think them basically just relying on the drivetrain itself avails them the capability of being able to respond in a much more responsive fashion. The project will be completed by March of 019. And there's a significant amount of change that's also going on at EDI, as we speak right now. I'll show some pictures in a minute.

Some of the lessons learned. In the fast changing market, as I mentioned the companies need to change and adapt to survive. The original focus on the continually variable transmission, the plug-in hybrid electric vehicle drivetrains and the vehicle control software as I've mentioned.

The prototype demonstration, we had prototype demonstration vehicles. As a matter of fact the first grant was with the PIER Program here at the Energy Commission where a natural gas vehicle could be equipped with the plug-in hybrid electric vehicle system. And that vehicle has been completed, of course, and is in operation today.

EDI's current focus on formal and expansive EV and PHEV drivetrain offering. The low-volume vehicle production is basically their market at this point. They

don't have the large wherewithal of a large manufacturing facility. It is small. Dixon was much smaller. They've even grown that space, but now their manufacturing facility in Milpitas, California, which was funded by this grant is fully operational at this point and there is no available space in that manufacturing facility right now.

You guys current focus on formal expansive drivetrain offering and the strategic relations with major OEMs, this is something that has been critical to them. And they've had many different projects with different OEMs over time. And there have been expressions of interest by several of the OEMs and as I say resulting in the agreement signed last month with Cummins to purchase EDI as their operating electric drive unit within Cummins.

A fast developing technology industry requires a more streamlined public private partnership process. And so the company such as the size of EDI has a little bit less of the capability of bringing in investment dollars than other larger companies. And so the streamlined process with the public private partnerships with the Energy Commission as a partner is really critical.

Sometimes the contracting process can be delayed. I just want to mention it, because I've been here at the Energy Commission and I understand from the beginning of this program how difficult it is to do the job that these

folks at the Energy Commission do. This is an area that there is no guidebook. There is no "how do you do this in the future?" Much this program was learning by doing. And as the Program Manager I'll confess it now, I was just learning by doing. I didn't know that much when I started. I'm not sure I know that much now, but nevertheless I do think that that's critical.

And the folks that work in the Energy Commission on this advancing program are to be commended. This is not an easy job and there's not a lot of thanks that's given and a lot of the time these folks are a little reluctant to share the public space and to be recognized, but I want to recognize them right now, because they are critical to the success of these companies. Not just the programs, the companies transfer -- the programs transfer down to companies. And there are real live people in those companies that are trying to do a similar work that those here at the Energy Commission are engaged in.

Time to approval of a contract and the approval of the necessary amendments puts stress on the individual project partners and can disrupt the project teams. This is a point that I've seen with several projects that, and as hard as it is to balance all of the funding opportunities here at the Energy Commission, it is very difficult when some of these companies are put together

around a solicitation. In other words, they develop partners, technology companies and say fleets that all need to be engaged in this process.

And sometimes those partnerships are a little brittle and sometimes they are very impatient. A lot of these folks are ready to go when they write the proposal. And at that point, that's just when the work begins, because then it goes through the solicitation process. The proposal is developed. Luckily, they're selected and then the time to contract is critical, because in that time I've seen projects being brittle and kind of fall out. And so it's really important to have kind of a certainty or assurance of how long it takes to get under contract.

Likewise in this fast-changing world, and particularly in EDI's case where their requirements for their manufacturing facility changed one example is they had a chassis dynamometer suggested in their initial proposal. And in the intervening time from getting under contract and starting and engaging and completing the manufacturing facility, they realized that the need for a chassis dynamometer facility was really not as relevant as the manufacturing space they could have on their floor.

So rather than take that space away and the large investment that the State of California was going to be helping with they decided prudently to go away from the

chassis dynamometer. And so now they have an engine dynamometer that's going into the manufacturing facility, but that is freeing up money that they could put in their manufacturing line. And that makes them much more attractive to investors obviously, but it also makes them conform to what the needs are in developing the manufacturing that can meet the demand that they are seeking.

Requirements for data collection, particularly in this particular grant have become a little bit more difficult to understand, I have to say. With a manufacturing facility unlike maybe some of the other vehicle demonstrations that we've seen, the required testing or six months of data collection is kind of hard to get your arms around. Basically, I think everybody wants to see a live and engaged and very busy manufacturing facility. And in a way that is how the grant can be defined whether it's a success or not. But there is the boiler plate of six month's data collection that is in most of the agreements and perhaps in these areas, and particularly in workforce development, maybe there would be better measures of success.

The current equipment and materials list requires amendment. That has required amendment twice now at this point. And there's another concern that the equipment

lists that are listed all the way down to $100 items is perhaps too detailed and perhaps burdensome. Perhaps it could be done in units and I'm certainly willing to discuss that with anyone, because it does get down to the point where it becomes really time intensive for the grantee and the recipient to be able to comply with all the requirements that are in the existing grant.

For the future manufacturing grants they should be anticipated to change, as I've mentioned. And I really think that's important, because if you think it's going to stay the same you're probably going to be wrong. But if you think it's going to change you will probably always be right. And I've found that to be true in this particular project and in others that EDI has done.

I really want to thank the Energy Commission for its resilience as EDI has asked for that resilience to make sure that as the project goes forward, the Commission can adapt to the needs that EDI is seeing.

This is a give and take discussion, back and forth with the Energy Commission. And I think EDI has enjoyed that, because I think both learned from this. I think the Energy Commission is able to learn from what is really happening in the industry. We are in the Energy Commission building and the folks in this building cannot be everywhere at once. So I think it's important that that

input comes from their project partners and in a way that can be readily used and adapted here at the Energy Commission to make the program better and more nimble.

The data collection and analysis task should be reevaluated and modified, especially in this particular area. But it might be a good idea to take a look and see what type of data would be most beneficial and not just that which is usually in the contract, a six-month period and that sort of thing. But just to maybe refine that and modify it to be more responsive to the particular funding opportunity that's made available.

And finally the equipment materials budget could be more flexible. And I understand the balance between fiscal and accounting and making sure that the program runs as expected. And so that is the challenge right here, is to make sure that the modifications could be allowed without triggering a formal amendment process, which for these small companies the time that they have is really a part of the capital. I know Kent mentioned financial capital, human capital and in a way time capital. Capital is very critical for this, because you can lose time that is very valuable. And as I say some of the partnerships that you strike can become very brittle in that time of waiting.

The success for EDI from its association with the

Energy Commission, is outstanding. I have to say it again. We've had several successful grants and are under contract for several others right now. But the major partnership that the Efficient Drivetrains, Inc. has struck with the California Energy Commission is, I would say the number one factor in making EDI much more attractive to investors and to secure lines of financing.

A partnership with the Energy Commission made EDI more attractive to these investors. And I do believe that the current grant we're talking about, the Manufacturing Workforce Development Grant was one that Cummins really honed in on. They were really interested in this, because the capability of EDI is not just in their IP, but it is what they have established as far as relationships and the manufacturing facility itself right square in the Silicon Valley.

This solidified EDI's presence in California. It created 50 jobs, paid $16 million in salaries and benefits and paid patent royalties of over $2 million to the University of California system. It has attracted $13 million in foreign investment. So this partnership was such a positive shot in the arm for this fledgling company that you really can't overstate the importance of the partnership that EDI has with the Energy Commission.

An important piece of the fulfillment in this was

a part of Cummins' due diligence. They visited the facility. They, basically I understand the EDI folks, they were there for a couple of weeks and every day. And just checking their operation to make sure that everything that was presented was validated and they were able to do that. But they were confident of that because of the process that EDI had entered into with the California Energy Commission, which is basically for many companies in this fledgling area a valuable third-party evaluation vote of confidence for those companies.

This supports high quality job creating and retention in California. A matter of fact, I understand that there are several Tesla engineers and technicians that are now working at EDI, because Tesla is just a couple of miles down the road. So in that area there's an awful lot of high technology, high capability people working in the industry, this general industry of electric vehicle transportation. But it can be cross pollinating, because of the location and to see that California has fostered such a kind of an incubator within its own state is a real benefit to the State of California.

Training in the specific areas targeted at advanced vehicle deployment. At EDI, they have basically, in every one of their proposals, provided an aspect to access the workforce development component. Whenever

possible they're trying to hire from the local area and from feeder programs such as the one that John has and others, that could be very beneficial. I think that is a critical part of the pie here, is that the training and the workforce development in California is going to find that these folks that are going through these programs are going to find likely good jobs in this sector. Because it is a very competitive sector, but it is a growing sector and this is an area that California has become known for over the 20 years I'm familiar. But at this critical stage, when California is leading the way in many of these advanced vehicle technologies, I think it's really critical that California keep the pace of workforce development and workforce training and advance it whenever possible.

Because in EDI's case, which is a completely California company including not only the people that work here, the location, but also the IP patents portfolio from the UC Davis system, has been critical for them. This is truly a localized company. Yes, they do sell many units to China, for example, and they've gotten investment from China. But they've never forgotten their roots here in California and again remain to be very grateful for the association they have with the Energy Commission.

Some of the specific skills targeted for their advanced vehicle development are control systems, the high

low voltage electrical, the lithium ion battery testing, the drivetrain dynamometer testing and PEMS testing, which is the Portable Emission Management System.

And here's a view of what EDI looks like these days. It used to be quite open. You had several PG&E trucks. They've done several PG&E trucks over time, straight with PG&E without any funding. And they've had the power takeoff unit with PG&E that has become fairly famous. It was in the Lake Fire where they deployed that vehicle up to the headquarters, the Red Cross headquarters in Lake County, during the fire. They were able to, from that vehicle power the displacement center, if you will. A lot of the folks that were displaced by the fire were there. They could do everything from be in a lighted room to charging cell phones, which we've become so dependent on and are critical to let people know that they're all right.

For several days, this PG&E power takeoff unit was providing up to 100 kilowatts to these dislocated folks in the midst of the fire emergency. But now as you can see, and I know Kent mentioned the difficulty with the wiring harnesses, and you can see in the lower left is a picture of their wiring harness fabrication part of their manufacturing floor. Above that is the software testing that they're doing and in the middle of large battery pack that's ready for shipment. And on the right, these are all

part of, I think the Blue Bird shipping of the 200 units for their Blue Bird EV school buses.

Right now EDI is producing about one per day of these units. And they hope to increase that up to 2,000 drive systems per year. And that's as soon as next year. Obviously the association with Cummins is going to help support that and make sure that they can smooth the way to make sure that they can achieve that type of production. And I think that everybody at EDI is really quite confident they can do that especially with the vote of support that Cummins has given them by acquiring them in total.

EDI will operate as an existing unit within Cummins. And many of the folks that are at EDI right now will still be operating that unit for Cummins.

Some of the components in the system that they are using right now at their facility are the battery test lab, the metrology lab, the development test lab. And the drivetrain dynamometer, as I mentioned is not a chassis dynamometer, so they've downscaled that, but that makes it much more useful for the products that they are shipping. Because they are not shipping vehicles they are shipping the drivetrains, so that's more important to have that on a dynamometer. The emissions measurement system they will have that capability as well. The PowerDrive system production, they're going to reach 2,000 systems per year

next year. And they will be training their technicians and they will be added as needed.

As I mentioned, Jean-Baptiste Gallo is not able to be here. He's traveling actually, he's going back to Indiana and as part of their incorporation, their incorporation training into Cummins. And he's sorry he couldn't be here today, but asked me to help out.

That's his presentation. I'm happy to answer any questions that I'm knowledgeable of. If I'm not, I'll take your questions down and I'll make sure that we get you an answer as soon as we possibly can.

I know we're holding you from lunch, but while we're waiting, remember the breakfast you had? Wasn't it fulfilling? You're really not hungry now? Okay. (Laughter.) So thank you very much for your attention. I appreciate it.

COMMISSIONER SCOTT: Great, thank you very much Peter. Let's turn to our panel of reviewers. Margaret, would you like start again with questions?

MS. MANN: Sure. Thank you, Peter. I wanted to know a little bit about how Cummins supply chain is going to be made available or even insisted upon within EDI. I guess what I'm saying is can EDI benefit from the existing Cummins supply chain, or how different are those two supply chains?

MR. WARD: Well, they are much -- really different I think, because you have one company of 50 employees that is just now trying to absorb a company with 57,000 employees and I hope they'll be able to do that seamlessly. But I do think that all kidding aside, that EDI is going to benefit directly from the existing supply relationships that Cummins has in this country and around the world. I can't imagine that it could do anything but benefit from that. I don't think we have much detail about that and I don't know if I had the detail I could even mention it. But that's what I'm assuming. And I think that most people from EDI are assuming that the doors will be open for supply chain relationships that they could not access prior.

COMMISSIONER SCOTT: Debra?

MS. SANDOR: Thank you.

So I had a question I didn't quite understand, so you have facilities in California and then also in China? Are they all producing the same drivetrains or what is the role of the facilities, if that's what they are, in China?

MR. WARD: The facilities in China are basically I think to install the drivetrains into the existing bus platforms. Like I said they have 200 plug-in hybrid electric vehicle platforms in buses right now in China. And I think that was pretty much the extent of it as a

joint venture over there with Chinese companies to be able to provide their drivetrain and then to assist them in installing it and operating it.

So the two facilities that they have wholly and completely owned by EDI or now Cummins are the one in Dixon, California which was the start, close to Davis. And now the one in Milpitas established by this grant.

MS. SANDOR: I guess I was also curious about the split. How many drivetrains go to China versus how many stay in California or the U.S.?

MR. WARD: They're going to be focusing primarily on the U.S. market. I think what they initially did with China was because they had capabilities in China and they were getting investment from China. That they provided some of these drivetrains to trucks and buses in China based on those relationships.

I think that was at a time when EDI needed that type of foreign investment to survive and to continue. But I do see now the world has changed significantly with its purchase by Cummins and I think that Cummins is obviously a worldwide supplier. And so I think there'll be lots of different supply chains involved with them and different customers and clients all across the world. But probably not based on the associations that EDI has struck, primarily in China to date. So it might be a whole new

slate of customers and developmental areas for this drivetrain.

COMMISSIONER SCOTT: Frank?

MR. RAMIREZ: Thank you. As you mentioned China, I can't help but think about the tariffs that are coming, or that have been impacting a lot of companies and industries. How do you foresee that impacting yours? I know at least out of the Port of L.A., I don't know where you ship out of, but at least 20 percent of their activity is being impacted by these tariffs. I'm curious if you're doing your proper risk assessments and so forth to understand that potential liability.

MR. WARD: Well, because they're not -- I don't think they're really sourcing steel from China at this point for their production here in California. And for Cummins, I don't imagine that's going to change. So I'm not sure they're affected by that. Of course, there's an added price. Any time you have a tariff you're going to be paying more even at home for that commodity.

I think that I'm sure that they're going to have to deal with it, because it is unfortunately this new level playing field, this new normal that we've gotten with these tariffs. Most suppliers and most manufacturers will have to deal with this in the same way.

Now with Cummins, the primary for EDI, I think we

might have a better buying power situation. They might have a better supply chain situation that will protect them from some of the negative consequences of these tariffs. I believe that can only be benefitted from a 50-employee company to this larger 57,000-employee company. I think they'll be having a better reach and a better capability of sources of supply for raw materials and for the components that need to be put into these drivetrains.

MR. RAMIREZ: And then, thank you, and in the way of workforce developments I appreciate what you're doing. And it sounds like you're moving in the right direction, in working with the community colleges and other organizations. I'm just curious though, a smaller entity such as yours, are you thinking about efficiencies in your production and as it relates to say artificial intelligence or electrification of your activities and how that relates to potential workforce in the future?

MR. WARD: Yeah. I think they are obviously monitoring all the AI. And with Cummins I'm sure they are probably ahead of the game and they probably are not telling anybody where they are on that. But I think you'd be remiss not to pay attention to what is happening in that field.

I think that the IP, and the patented IP that Professor Frank has developed over 40 years at UC Davis,

puts them in an excellent position to better understand how the logistics -- and how the logic behind these vehicles and the system. I think they'll be able to adapt that better than maybe other companies that have not had that experience. I think that puts them in an awfully good spot, because this has been 40 years in the development of this now overnight success.

MR. RAMIREZ: Thank you.

COMMISSIONER SCOTT: I had a question for you, Peter, on the six months of data collection. And one of the reasons as you know that we require that information is so we have great information about the projects, how they came along, again some of the lessons learned and successes that you've been kind enough to highlight here. But also to capture benefits. When we put together our benefits report that we're reporting back it's usually part of the Integrated Energy Policy Report. And so the most obvious one I think is jobs.

But I think we would certainly be open to other metrics for success in the manufacturing space that we ought to be thinking about or articulating or highlighting as we go through the benefits. Because you are correct in that it's not going to be a reduction of greenhouse gases, for example, right? But there are other great benefits to this, which is why the Legislature put this as a component

of the program.

And so to you or to any of the others, and I know it's lunch time so maybe I'll let you noodle on that and we could talk about it a little bit after lunch or if folks who are listening on the WebEx, you know we're always open to those ideas. And so if you've got ideas about the best way to kind of capture the benefits of bringing manufacturing like this to California I think we're really open to it and would love to hear it.

MR. WARD: I think we'd love to discuss that with you for sure.

COMMISSIONER SCOTT: Okay. Great.

And then let me just remind folks before we break. Thank you, Peter, very much for your great presentation and Kent as well.

Tim is holding a blue card in his hand here. If anybody on the public would like to make a comment please fill one of those out. Give it to Tim or to Tami. They'll get them up to me and that's how we know you'd like to make a public comment. That'll be at the end of today's workshop.

We have out front where you picked up your presentations, there's a list of restaurants in case people are looking around for places to go and grab lunch. And so it's 12:00 o'clock. We'll start back up again right at

1:00 p.m., so see you then.

MR. WARD: Thank you.

(Off the record at 12:01 p.m.)

(On the record at 1:10 p.m.)

COMMISSIONER SCOTT: Welcome back everyone, this Commissioner Janea Scott. We are going to continue with our afternoon of our Technology Merit Review for Advance Technology Vehicle Infrastructure Manufacturing and Workforce Development. And we're going to start our next presentation is from Mike Simon, the President and CEO of TransPower. And I'm not sure if Tim wants to do further introduction? No, he's good.

And then just to update our times a little bit, Mike, we'll start with you of course at 1:10. Maybe your presentation goes until about 1:35-1:40. That leaves us 10, 15 for questions and discussion. And then we'll just push each of ours up by about 10 minutes, so Deborah, that'll put you at 1:50.

MS. DONAHUE: Okay.

COMMISSIONER SCOTT: All right. So Mike, thank you for being here. Please take it away.

MR. SIMON: Perfect. Well, thank you, Commissioner Scott. I really appreciate your graciousness hosting us here and all the support you and all the other -- your colleagues, Tim and everyone have given to

TransPower over the years.

It's always a pleasure to come here and to give you an honest update on what we're achieving. I'll try to be as honest as possible about successes and failures we've seen, because they say you learn more from your failures than your successes. And I think that the best way for the Energy Commission to understand where it's future investments can be best directed are at solving problems that aren't yet solved. So I will try to focus on -- I'll try to promote what we've accomplished, but I'll also try to balance that with candid disclosures of areas that where we feel additional investments are still needed for us and the industry to get where we want to go.

So for those who aren't familiar with TransPower, we develop and manufacture electric and hybrid and fuel cell propulsion systems, targeted at the largest and heaviest vehicles on the road. And we also have a secondary business, taking the batteries that we use in these vehicles and the power conversion technologies and adapting them to stationery battery energy storage applications.

We were founded in 2010. We were jump started by a grant from the California Energy Commission that was awarded that year, which started in early 2011. Our most recent major development is we entered into a long-term

strategic partnership with Meritor, last November. Meritor is one of the world's leading manufacturers of axels and brake systems for commercial vehicles, including large trucks and is a publicly traded $4 billion a year corporation.

As of last count, we have approximately 75 employees or will at the end of this month, including employees we're hiring right now. We'll have about 75 employees total at the end of August.

To put that into perspective, last August we had 32 employees. So we've more than doubled our California workforce here. Basically all these employees are based in California. And our projected revenue for this year is $15 million.

I've summarized on slide 3 here the collaboration that we've had with the California Energy Commission. Listed in quotation marks are some of the specific projects that have been funded. These aren't even all of them. But I group them into three phases and you'll see me returning to this theme. It turns out that the development and perfection and commercial ramping up of these technologies that we're developing is turning out to be a 12-year battle, 12-year game plan. And we're about six-and-a-half years into that, so we feel we're a little more than half way there. And when I say a 12-year game plan

that's to get to the point where we're producing hundreds if not thousands of drive systems per year. So we're projecting that we're about half way to achieving that goal. The first, and I divide this 12-year horizon into three 4-year segments. The first four years from 2011 to 2014 we were basically developing, doing a lot of learning, developing basic technologies, basic components and demonstrating proof of concept.

And over that period with the Energy Commission funding, we received and funding from other sources, mostly public agencies, we deployed a fleet of seven electric drayage trucks and a 1 megawatt battery system. Three of those drayage trucks are operating today. Three will be upgraded to fuel cell trucks and the seven will be upgraded to a better electric truck, during the next year or two.

The middle phase, the middle four years of our evolution from 2015 through the end of this year I basically characterize as expanded manufacturing. And during this period, we pursued funding to expand both the number of vehicles that we have out on the road and also the types of vehicles. And you see some of those types of vehicles pictured here. There's a drayage truck on the top, a yard tractor below that, a reach stacker below that and a refuse truck below that. And these vehicles are all in various stages of service and operations.

The refuse truck is not yet in service. Our first refuse truck is complete, has been undergoing road testing and recently we decided to upgrade the battery pack on it, but we hope to have that vehicle operating, actually up here in Sacramento within the next 60 days or so. And it's the first of three refuse trucks that were funded by the Energy Commission under the Heavy-Duty Electric Refuse Truck Project that you see.

So under the four middle Energy Commission grants, we are building a total of 13 vehicles. Of those vehicles, 9 are currently in operation, the 10th is one more yard tractor that will be delivered also here in Sacramento that will be operating at the Farmers' Rice Cooperative. And that will be delivered around the end of this month. And then the three remaining vehicles are the three refuse trucks. And that'll bring to 13 the number of CEC-funded vehicles that we are building in this middle phase.

Starting next year, we see our emphasis shifting to commercial scale up. And this is really where we see the next big investment, where we think the next big investment should be made is in developing the technologies to really enable these demonstration vehicles. We will have approximately 40 or 50 vehicles in operation by the end of this year, first quarter of next year. But we need

to produce that many vehicles, or that many drive systems, every few months, instead of every six years.

So to get to that level, a couple of things need to happen. Number one, the components and systems we've developed need to be made absolutely bullet proof. They need to be made super reliable, made to achieve a high level of reliability and a longer mean time between failures than we've seen in the field so far.

And secondarily, we need to drive the cost down. We need to drive the cost of these components and technologies down, so that it will stimulate demand for large-scale deployments.

Without getting too technical, the products that TransPower has developed interface with all the major components. We don't manufacture our own electric motors. We don't manufacture our own batteries, but we produce almost everything that connects those types of components together, including controllers at the system level. And we kind of show it in a pyramid fashion to show the hierarchy. We then have an inverter charging it that controls the motors and also charges the batteries in an innovative combined package. A powertrain controller that does shifting, with the automated manual transmission we use, the battery controller. And then various other accessories for power steering and braking and battery

management and so on. And I could spend an entire hour talking about this slide, but I just wanted to give you sort of a glimpse of what it is we develop and manufacturer and purchase from suppliers around the world.

I'm going to focus on four Energy Commission grants we have in process right now. We actually have a couple of other smaller grants in various stages of (indiscernible). The four big ones, each of these four projects that we have were funded in 2015 during the last big round of awards for medium and heavy-duty vehicle demonstrations and manufacturing. We were fortunate enough to win three vehicle demonstration grants and one manufacturing grant, all valued at about $3 million. So the next four slides will show you how we've been spending this $12 million over the past three years.

First of the four projects I'm going to talk about is the project we call Advanced Battery Electric Port Vehicles. And the contract number is shown there. The goal of this project was to develop five electric vehicles and put them in service at the Port of San Diego. These vehicles are all operating right now at the Port of San Diego. The two trucks and two yard tractors are being used by end users, by terminal operators. The reach stacker is in final stages of testing. It is functional. It needs a bit of additional controls, refinements, but we expect that

to be used in routine use within the next few weeks.

In terms of these types of vehicles the 50,000 miles is a broader number. We haven't achieved that many with these particular vehicles. But actually, in terms of the types of vehicles shown there we've actually accumulated almost 150,000 miles of actual operating use to date in the last three, three-and-a-half years. And we expect that number to start to increase exponentially with these additional vehicles that are being deployed. All the five vehicles shown in this slide were basically delivered this year. The two electric yard tractors being operated by Dole, you can see a picture of one of those tractors down below. And the two electric trucks, one is being operated by BAE systems and the other by a company by a company called Terminal Lift. And the reach stacker is also being operated by Terminal Lift.

Since we received this award, the Port of San Diego has gone on and acquired several additional awards from the Energy Commission and others. So we're proud of the fact that we helped stimulate their interest in electric vehicles and other companies are now supplying electric vehicles to the Port of San Diego as well.

Also, I think as a direct result of this, we were able to receive an award from the California Air Resources Board for seven additional electric vehicles that are being

operated at the Port of Los Angeles. And of those seven vehicles four have been delivered, two electric trucks and two electric yard tractors.

The only reason why they haven't been in use is because there has been a process of getting UL certification of the charging equipment we installed. That certification was just received a couple of weeks ago and now it's just up to the Port of L.A.'s building inspection group to go out. Hopefully they'll do that this week. And Pasha, which is the terminal operator will be able to use those four vehicles.

We also will be delivering three electric forklifts, high tonnage electric forklifts, which will be a new vehicle for us. The first of those vehicles is scheduled to be complete in about a week or two. And three of them will be delivered before the end of the year to the Port of L.A.

Dole is so impressed with the electric tractors that they've received from us that they are talking about possibly seeking funding to electrify their entire yard tractor fleet in San Diego.

The second of the four projects that I'm spotlighting is our Heavy-Duty Electric Yard Tractor Project. The goal here was to build five electric yard tractors. The major immediate accomplishments as we

adapted a variant of our dive system to Kalmar's new T2 tractor, which is a new tractor model they just came out of years ago. And even more significantly, this is the first time we used Nissan LEAF batteries, which are so far, from what we've seen, superior to the batteries that we used in all of our prior vehicles.

And if you want to understand what works, our successes and our failures, it's the batteries. Everything, 90 percent of the problems we had with the vehicles we put on the road over the past five years are one way or another related to batteries either batteries or battery management, or DC-DC conversion to get the high voltage from the battery pack down to a low voltage for the accessories. With the Nissan batteries we are expecting those problems to be diminished greatly, because the battery quality is so much greater and requires less balancing and less sophisticated controls. And we think that's also going to drive costs.

Best of all, these Nissan LEAF batteries are manufactured here in the U.S., in Tennessee. So prior to that we imported nearly all of our batteries from China and so we believe we're one of the few companies that's actually using a completely manufactured in America battery solution.

And the five electric tractors being deployed on

this program are being deployed in disadvantaged communities up and down the San Joaquin valley and Sacramento. One is with Ikea. One is with Harris Ranch. One is with Grimmway Farms. One is with a Blue Diamond Almond facility, here in Sacramento. Those four tractors are all operating on a daily basis. And then the fifth will be delivered, as I mentioned, to the Farmers' Rice Cooperative.

For the long term this project has had a huge impact for us and the industry. It resulted in Kalmar, the largest manufacturer of yard tractors, signing a five-year supply agreement with us last year. They are now, Kalmar, marketing these electric tractors worldwide. In fact they want us to install our system into a European model of their tractor, by the beginning of next year.

And Kalmar has made a commitment to have electric versions of all of its products. They also build reach stackers and forklifts and other types of cargo handling equipment. They're a global company. Their parent company, Cargotec, is based in Sweden. And Kalmar has committed to electrify its entire product line by 2021. So these projects are having a huge impact, huge impact.

The Electric Refuse Truck Project is not as far along as the other projects, partly because we really focused on these. We didn't expect to win four all at

once. So we've had to sort of spread our efforts out a little bit and we prioritized those first two projects. But now we're ramping up on the refuse truck to get these three trucks all deployed by the end of this year.

And you see the first truck there. It's been exhibited at several trade shows. It's a Peterbilt truck. Peterbilt is extremely enthusiastic about this project. And again in terms of impact, lasting impact, this resulted directly in Peterbilt selecting us to provide drive systems for 12 electric drayage trucks, which it has gotten funding from the ARB to build. The first of which is shown there. All 12 of those trucks are going to use Nissan batteries. In fact all three refuse trucks are going to use Nissan batteries.

We also have a project with Peterbilt to build two fuel cell drayage trucks.

And most recently, a project to build seven beverage delivery trucks that will be operated by a major beverage company. I don't think that project has been publicly announced yet, so that's all I can say about it.

We have proposed to build additional refuse trucks with Waste Management. We're waiting to hear from a different funding agency about the result of that funding request.

And finally, the fourth of the major projects I

want to -- by the way I want to give a shout out for the prior three projects to Marc Perry, who's been managing those three projects and doing a heck of a job. And we love working with Marc, very dedicated.

And similarly on this project, the Heavy-Duty Electric Vehicle Manufacturing Initiative, Don Coe has been managing that. And he has been just a pleasure to work with for the last four years and we really appreciate all the guidance and support he's given us. So thank you. I really want to commend your staff on the tremendous assistance they've given us.

This manufacturing initiative has just been tremendous. You can see on the top, some of the machine tools we purchased using this funding. And there's a vertical mill. There's a water jet cutter that uses a stream of water that can cut through six-inch thick steel. There's a metal bender shown there and also a custom tester for inverters that was designed and built by EPC Power here in California.

That last item is important because EPC, which designed the inverter charging unit we use in all of our vehicles, is not a manufacturing company. So after they designed it they outsourced the manufacturing of it to a company in Alabama. And when we found out that these inverter charging units that we were buying were being

built in Alabama, we asked EPC if they would just license the technology to us, so we could build those inverter charge units here in California.

And so we've shifted that manufacturing from Alabama. We've actually in-sourced jobs from Alabama to California and we build all of our inverter charge units right here in California. And that piece of test equipment you see in that lower left photo in the top half is the tester, what we do the final testing of those inverter charging units with before we install them in the vehicles.

What this grant has given us is a foundation that helps to track Meritor's investment in our company. And that's an investment in the tens of millions of dollars. And the goal that Meritor has is to scale up to hundreds and then thousands of drive systems per year, starting next year. So we think that this grant has established a great foundation and in future rounds of funding, we'll be looking for support to truly ramp up to these much higher numbers.

Our vertically integrated business model is that we will manufacture and source the hundreds of components. Each of these drive systems has anywhere from 800 to 1,400 different parts and components that some of which we build and some of which that we buy from suppliers from around the world. Mostly in the U.S. though.

We assemble those into three major subsystems: the Motive Drive Subsystem that turns the wheel, the Battery Subsystem that stores the energy and a Power Control and Accessory Subsystem that connects everything and controls everything. And we sell them to major truck and tractor and school bus manufacturers such as those shown here.

We also convert vehicles. We have a separate second facility that we established just to do vehicle conversions. Altogether we have 70,000 square feet of production space now. We do vehicle conversions, because some of these big truck manufacturers are not ready yet to do the conversion out on assembly lines. So until they're ready to do that, we are the vehicle converter of last resort. And we can do a turnkey conversion and we believe we not have the capacity to convert up to 150 vehicles a year at our facilities.

I'd like to just take a moment to talk about the stationery energy storage that's kind of a bonus technology that we developed. Early on, we received a contract from the Energy Commission through the PIER Program that we called "Grid-Saver". And we developed FAST energy storage system, a 40-foot container, which you see in the lower left corner photo. You see the interior up above that. That was tested at Sandia National Labs. In fact the photo

in the lower left corner was taken at Sandia. It was the largest battery system ever tested by them. It was connected to the grid and showed the ability to put power in and out of the grid.

Since then, we took the same basic modular battery technology and we've adapted it to a Subway Traction Energy Storage system, which is currently operating in New York City. You can see six cabinets there in an aerial view. Three of those cabinets have been operating. One has been operating for over two years, 24-7. The next two were delivered earlier this year and have been operating since about March. And then the last three were just delivered a few weeks ago and are being connected as we speak. The entire system, expanded system of six cabinets will provide 700 kilowatt hours of total energy storage, which is enough to move ten subway trains to the next station if there's ever a power outage.

It also on a day-to-day basis, storage energy that's captured from subway trains when they slow down and enter stations and then releases that energy to help them accelerate, saving money. Once all six cabinets are installed, we're going to do a study to see how much money it's saving New York City Transit. But we believe it's going to save them hundreds of thousands of dollars a year and pay for itself within a few years.

Okay. In the early days of our development, the major issues that we're confronting the adoption of electric technologies by really big 80,000 pound trucks were basically they didn't work. They didn't have enough power. They just didn't work. And when they did work they only worked for a very short period of time. We've solved those problems. We have more than enough performance to move 80,000 pound trucks at speeds faster than the CHP would want them going and up the steepest hills. We've driven trucks back and forth between San Diego and Los Angeles over steep grades, taking the mountainous routs through Interstate 15, as well as the coastal routes.

So now the current adoption issues we've seen over the last few years are lack of charging infrastructure, insufficient operating range, which is a function of just battery technology and the high cost of these vehicles. So those are things we really need to work on as a community and solve these problems over the next few years.

The Nissan batteries, because of their superiority, will get an operating range higher by about 50 percent, maybe even double it. But we really need to quadruple our operating range to get to where the trucking industry would like us to go. So we still have a path ahead of us.

To address these needs, as I mentioned, the Nissan Batteries, you can see there those little silver blocks you see are exactly the same battery blocks that Nissan puts in the LEAF car. We just stack them together in our own configuration and use a larger number of them in our trucks. So our latest generation truck can be equipped with up to 440 kilowatt hours of battery power, which is enough go about 150 miles fully loaded. And that's a big improvement over the 65 or 70 miles we're getting today with the older batteries.

We are doing everything we can, also, to reduce the truck costs, simplifying our design. Meritor has a new product I'll talk about that can reduce costs. And of course scaling up to get economies of scale is a major goal of the last four-year plan of ours.

So I've mentioned Meritor a couple of times. This is a slide we both show to show what the synergies are between our two companies. We're a small nimble innovative company that can reinvent itself and reinvent our products very quickly. They're a gigantic manufacturing firm that can produce products repetitively at very low cost. They've got factories across the U.S. and around the world, in fact. And they have a new product, called an E-Axle, which we're helping them to demonstrate in a variety of different types of trucks. It's basically an axle with an

electric motor embedded in the axle. And the inverter for that motor, located right near the axle. That reduces the number of parts that you need and will make it much faster, easier and cheaper to install an electric drive system into a truck.

So we have a school bus right now operating with the E-Axle in it. And we're expecting to -- our plan is to have it operating in our first truck within the next two or three months. And perfecting this technology and adapting it to a wider range of vehicles is going to be one of our major thrusts and where we were going to be seeking support over the next few years to augment the millions of dollars that Meritor is already investing in this technology.

So we see right now, as I mentioned, we have a truck that can get you up to about 150 miles. But we have to sell it for about $400,000, even just to make a modest profit. And where we want to get is we want to double the range and cut the price in half. And that's -- over the next five or six years, that's what we believe needs to happen for this product to really take off and to be sellable without continuing subsidies forever and ever.

We can probably sell a few hundred to maybe a few thousands of these trucks in the interim, with continued subsidies. But eventually we and Meritor want truck operators to be able to come and buy these trucks without

any subsidization whatsoever and have a strong business case for it. And to do that, this is where we think we need to go.

Having said that I also want to express our opinion that it's very important to manage expectations. There are companies that have come out, that have said that they will provide more than 300 miles and that they will provide prices of less than $200,000 and do all this within the next year. And it's taken us six-and-a-half years to get to where we are, so we think that's aggressive. We think that's a bit overly ambitious. We think that's a lot of hype. And it may be good for the near-term of stock values of companies, might help them raise money from investors who are not technically that savvy. But in the long term if they don't meet those lofty expectations, it creates skepticism about the whole industry.

So we think it's important and I'm not necessarily accusing any of these companies of being devious. A lot of them probably just don't really understand what it takes. These heavy vehicles go through a lot of abuse and they have very demanding duty cycles. They're put through hell by their drivers. They drive around ports and very poorly maintained roads with lots of pot holes. And they have shock and vibration effects that are very damaging to sensitive electronic components.

And these are the little details that may not be that obvious if you haven't built trucks or truck drive systems in the past. If you've only built electric cars or if you're a startup company and you're coming up and you've never really been in the automotive industry. If you come to this purely from a software or a non-technical field, or a non-trucking field, these are things that you learn over time. It's why it's not easy. It's why Peterbilt and Kenworth and Navistar are not selling hundreds of electric trucks right now. If it was that simple, they'd already be doing it.

So we believe this is going to continue to be a gradual process and we want to stick with our 12-year plan, see it through. And we think if we manage expectations and we stay the course, we can be where we want to be in four or five years and be selling hundreds of these, if not thousands every year.

So in summary, we're again just past the midpoint of what has turned out to be a 12-year plan. I didn't see it as a 12-year plan when we started TransPower. I thought maybe it would be a five or a six year plan, but even I was optimistic. And the technologies keep changing, which is good. And our key goals now are to improve reliability and broaden, continue to expand into other applications to stimulate greater demand. And in addition to improving

quality, reliability and driving costs down, establish and improve our supply chain. And that's a big part of getting costs down as well.

That will need less to scale up during this last four-year phase and our goal is by 2023 is to really be in high volume manufacturing. And so where we believe resources should be deployed to help us stay on track, is to continue funding small scale vehicle demonstrations. The reason why small scale demonstrations are important is because your fleet operators are just not ready to buy 20, 30, 50, 100 vehicles at a time. Especially now that there're so many new entrants into the market, there are so many new companies that are coming out of the woodwork promoting electric drive systems and hybrid drive systems, fuel cell drive systems. The fleet operators are really confused. They don't know who to believe.

They hear these great claims and they sign up for pre-orders and then the companies say, "Oh well, we were just kidding." So they're basically just willing to -- even giant companies are really only interested in demonstrating for the most part two vehicles, three vehicles, five, maybe at the most ten vehicles at the time. And we're not going to make any large purchase commitments until they really sort this out and figure out who's telling the truth and who's not.

So small scale demonstration programs that build up their confidence are still very important and expanding the number of fleets. And also staying with it, you know, a lot of the tendency in grant funding over the years has been to fund a demonstration project and if the vehicles didn't work you just mothball them and move on to the demo project. We think there are opportunities to take vehicles that have already been demonstrated that maybe weren't reliable enough or didn't have long enough operating range to make the user fully happy. And not abandon them, but actually improve those vehicles, stick with those vehicles and improve the drive systems.

An example of that are three of the drayage trucks that the Energy Commission funded three years ago that didn't have enough operating range. We got funding from the Air Resources Board, through the Greenhouse Gas Reduction Fund to take three of those trucks and replace the batteries with the new Nissan batteries and add fuel cells to them. And that's going to increase the operating range of those trucks from 70 miles to 200 miles. And those trucks are expected to be re-deployed by the end of this year, turning an existing asset that wasn't worth much to fleet operators into a very valuable asset.

And of course infrastructure is very important. Charging, standardizing charging, developing renewable

energy like solar and stationary battery storage to help reduce the cost of electric charging and reduce demand charges and stress on the grid and the capital investments and the training that are needed to get to the high production rates that we're looking for.

So those are our priorities, funding priorities for the next four or five years. So that concludes my presentation. Sorry if I ran a little bit over time, but hopefully that was helpful.

COMMISSIONER SCOTT: Absolutely. That was terrific information, another insightful presentation. Thank you so much for taking time to come here and to present to us.

Let's go to our reviewers and maybe just to switch it up a little, I'll start with Frank and work back over this way.

MR. RAMIREZ: Thank you.

COMMISSIONER SCOTT: You're welcome. Please go ahead.

MR. RAMIREZ: Mike, I didn't hear much in the way of workforce. Can you share some numbers, some larger perspective numbers and what you're doing and what you're going to be doing in the future as you ramp up and create these marvelous vehicles? And in particular, you did mention a group of four vehicles that are within the

disadvantaged communities, I wonder if you can expand on that as well.

MR. SIMON: Certainly, Frank. I'd be happy to. In terms of workforce our most critical need has been for quite some time software skills, software engineering and controls engineering in particular, but also the software skills. These trucks are so dependent on computers, both to control the vehicle and also to troubleshoot them to service them. You know, even with a standard car to get it smog certified it's plugged into a computer and you need people to understand how to use these computers and understand the software. And it's a step above what happens at your smog station to troubleshoot and fix these vehicles. So that's a critical skill.

Most of the other skills, there are readily available talent pools. In fact, we're able to hire standard diesel truck mechanics and retrain them to build our vehicles and to build our drive systems. They have to learn how to deal with high voltage systems. That high voltage safety training is very important. We do that ourselves. But obviously if there were formal training programs and people that were available that already had these skill sets, it would make it less time consuming and expensive for us to train them ourselves. So those are the things that stand out.

In terms of disadvantaged communities, the vast majority of the vehicles that we have gotten funded publically here in California are operated at least part of the time in disadvantaged communities and some of them virtually the time.

The Port of San Diego is right near the Barrio Logan area of San Diego, which is a disadvantaged community, so all the vehicles down there are positively impacting the environment in that disadvantaged community.

The vehicles, the yard tractors that we have operating in the San Joaquin Valley, Harris Ranch and Grimmway Farms and at Ikea's distribution center south of Bakersfield, those are all either in or very near disadvantaged communities. And in fact I think even the two Sacramento vehicles, the Blue Diamond Almond facility and the Farmers' Rice Cooperative, are either in or adjacent to disadvantaged communities.

The Port of Los Angeles, Port of Long Beach Complex also there are disadvantaged communities, based on high pollution scores and cancer rates in the vicinity of the Port's, Wilmington, that area. So those vehicles, the vehicles that go in and out of the Port of L.A. and Long Beach, also operate and drive through disadvantaged communities all the time.

So it's something we always look for. We

understand that's a high priority for the state and environmental justice is very important to us. So we're always looking for opportunities to focus on operating in and near those types of communities.

COMMISSIONER SCOTT: Debra?

MS. SANDOR: Thank you.

I guess I was curious. You have a lot of different applications that you're looking at and now is what you're learning from all these different applications translating back in theory to your component and to system design, or even further back into how you're manufacturing things? So I think it's probably necessary, looking at all these different types of applications, because they're all out there, but just how are you using that information to help go forward?

MR. SIMON: Okay. That's a very good question. Again, I think a lot of the learning that we're doing is battery related. We know that these users need to have super high reliability. So a truck that operates perfectly nine days out of ten is not good enough, because they can't afford to, every other week, have down time. And with the complexity of hundreds of batteries and different vary complex circuits being used to manage the batteries and balance them and monitor them and operating in harsh environments, we found that we have excessive numbers of

failures. Not necessarily the batteries, but of the electronics that's monitoring them. And if you lose communication with a battery pack you don't know what's going on with that battery cluster or that particular battery. You've got to stop and fix that, because if one battery has a problem it can spread to the rest of the pack and create a safety problem as well as damaging expensive batteries.

So we're learning. That's why we searched for new battery solutions that have higher quality batteries, don't require as much active balancing and as much control. And we can use less expensive, less complex and more reliable battery monitoring systems. So we're going in that direction.

We also have learned that the applications that we have targeted are all obviously short-range applications. There's no truck, no battery technology right now that can propel a truck for five, six, seven hundred miles, the kinds of distances that long haul trucks need to cover. So we've been focusing on port drayage, refuse trucks, yard tractor type applications that don't require that type of operating range.

But we've also found that -- one of our premises was that if you go to an operator who has a round trip to the Port of only say, 25 miles, we figure that they would

be happy with a truck that had a range of 70 miles, which is fully loaded where older generation electric trucks are limited to approximately.

Well, we have a fleet operator that we delivered an electric truck to that supports the Port of L.A., Port of Long Beach. It's called National Retail Trucking. It's a big nationwide firm. But their drivers are paid by how many round trips they do each day. And their goal of each driver is to do three round trips every day. So guess what? Our trucks would do two round trips, but we're just about ten miles short of being able to do that third round trip. So after a few months the drivers just stopped using our truck. They wouldn't use our truck, because if they get a diesel truck they can do their three trips and they make 50 percent more money than if they get in the electric truck and only can do two trips.

So we've learned that's why we continued searching for better batteries and higher energy batteries, like the Nissan nickel manganese cobalt batteries. They store about 50 percent more energy than the lithium ion phosphate batteries we were buying from China. So now we have a truck that we're just now building the first ones, but we believe those trucks depending on how many batteries you put on them will allow you to go anywhere from 100 to 150 miles. And we're eager to give one of those trucks

back to NRT and see if it makes their drivers happy. And see if a combination of high reliability and that longer range makes believers out of them and gets them to the point where they want to electrify more of their fleet. So those are just two examples.

COMMISSIONER SCOTT: Margaret?

MS. MANN: Okay. Thank you.

So I guess I have two questions. Can I ask two? So the first is that you have said that you have a goal of 2,000 deliveries per year, about 2023?

MR. SIMON: Well that would admittedly be a homerun for us in terms of number of drive systems sales. But that's sort of at the upper end of what we think is possible for our growth. With Meritor as a partner, they could take the ball and run with it with much higher productions levels than that. But in terms of what I think is the highest reasonable goal for that timeframe would be about 2,000 total drive systems.

If you look at our business plan it's based on selling about 1,500 to 2,000 drive systems a year by that timeframe.

MS. MANN: Okay. Well as Debbie was saying that you have a lot of different vehicles and a lot of different applications that you're targeting and the continued testing of all of those different vehicles and all of those

different types of use environments. How are you controlling and managing that kind of data, especially as technology changes?

So this morning on my newsfeed I read that Nissan just sold their battery manufacture to Envision, which may not change the supply relationship you have with them. And certainly the NMC batteries are considered to be very advanced, but battery technology is going to evolve. So how with vehicle testing in all those different environments, as technology's changing, are you planning the direction that you're going to move in?

MR. SIMON: Excellent questions. First and foremost, it's important to understand that TransPower doesn't expect to ever get out of the experimentation mode. We do virtually I'd say almost all, maybe 90-95 percent of our business right now is related to small scale trial and error type demonstration projects. And so when we talk about $15 million a year in revenue, 14 million of that is coming from these types of small scale demonstration projects where the goal really is still product, evolution, testing, gathering data and so on.

If we get to the point where we want to be in five years in 2023, and we're producing 1,500 drive systems a year, our revenue will go up by a factor of 20. We'll go from a $15 million company to a $300 million a year

company. But we still expect to be doing at least $15 million a year worth of these small scale demonstrations and learning type activities, because we don't think the technology's ever going to stop moving. We think the technology's going to continue advancing and improving. And we believe that we're going to have to continue improving the electric truck product to stay competitive. And that as we do that, the number of different applications that find use for it will expand.

There are users right now that even if our truck can do 100 to 150 miles still that's not enough for them. There are users that their threshold might be 200 miles a day or 300 miles a day. So we want to be around and still, when the battery technology gets to the point where you can do a 200 or 300-mile truck and that might be in three years, might be in five years, we want to take that battery. And quickly design a pack that works in the types of trucks that we're pursuing and prove that it works. And once it does, then roll that out as a new product in our pipeline.

So we see there being a constant need to continue to innovate and test new products, because there always will be new technologies and products coming out.

A second major part of that is in addition to maintaining that innovative prototyping or demonstration

side of our business, side-by-side with the manufacturing side.

The other aspect of our strategy is the modular design that lets us plug-n-play. We've tried to design an architecture where we can plug in a different type of battery and you don't have to change the rest of the system, the rest of the drive system can remain pretty much the same. So that's another important part of the strategy.

COMMISSIONER SCOTT: Do we have any other questions from our around the table of our panelists here? Okay great.

Thank you so much, Mike. This is great information.

MR. SIMON: Thank you.

COMMISSIONER SCOTT: Let us now turn to our next presenter, who is Deborah Donahue, the Vice President and Operations Manager of Charge Point. We're just a little bit behind, so how about 1:55 until about 2:20, 2:25 for yours and then we'll leave 10 to 15 minutes for questions. Thank you.

MR. OLSON: Well, I don't seem to have your item on here.

COMMISSIONER SCOTT: And while they're pulling that up, I will remind any folks from the public if you'd

like to make a comment, please go ahead and fill out one of our blue cards. Make sure you give it to Tim or to Tami. They'll give it to me and that's how we know that you'd like to say something when we get to the public comment part.

And also the folks who are following on the WebEx, I know that there's a hand raiser feature that will get to Akasha and she can read those questions out.

Just a second while we get the presentation and we'll jump in with Deborah.

(Off mic colloquy to set up presentation.)

COMMISSIONER SCOTT: Maybe while they're loading up that presentation for our folks that are sitting around the table, I don't know whether you have any burning questions for one another while you were watching and listening to the presentations. I have a whole laundry list, but would love to hear from you as you've built your trucks or built the buses or build the drivetrains. If you heard that something that someone around the table said that sparked an idea or a conversation point, we'd love to hear it. Yes, please go ahead.

MS. DONAHUE: I have a question while they're pulling that up. I'm wondering for the vehicle guys, do you anticipate having to figure out your own end of life strategies for the batteries or how do you think that will

shape up?

MR. LEACOCK: We already have a list of entities that want to take the bus batteries anyway in the second life. Each one of our battery packs has about 110 kilowatts of energy storage and so when they get swapped out by the transit agency they'll still have 80 percent of that 110. And they were made -- in the conclusion that you saw, they're made to be stacked and they're already environmentally sound, so that with 11 of those battery packs, you've got a megawatt of energy storage.

So we have multiple opportunities out there. We've had cell phone tower companies talk about buying them for backup power, instead of having a diesel generator. We've had them for -- our own customers want to take them and put them in place for demand charge mitigation at their bus facilities when they think they're going to be charging at scale. That's almost a substation level of energy needed, so they're hoping that there will be second life batteries that they could put into place. Because, you know, to buy them new it's prohibitively expensive. But in their second life there is a lot of reduced cost and a lot of opportunity there.

And when they're finally kaput they're made 100 percent environmentally recyclable. So we've got two companies that will actually buy those off the hands of the

owner of them in their second life and recycle all the rare materials and the aluminum, 100 percent. So we already have a complete solution all the way to the very end.

COMMISSIONER SCOTT: Just see if Mike wants to weigh in on that or not.

MR. SIMON: Well, we're not as far along in the planning or end of life as Proterra is, so we haven't worked out all those solutions. But we do, because of our stationary energy storage product line, we do envision either selling the -- if we don't use the batteries ourselves in stationary energy storage systems that we design and manufacturer, we think they'll be sellable for end of life. The same Nissan LEAF batteries we're using are being provided by Nissan for other types of stationary end of life uses. So we're pretty confident we'll have the same opportunities.

COMMISSIONER SCOTT: I have some follow-up questions, but I see that the presentation is queued up, so let's now turn to Deborah to provide her presentation from ChargePoint.

MS. DONAHUE: So ChargePoint is headquartered in Campbell, California just south of San Jose. We are about ten years old. We have now around 300 employees in California. We do all of our designs, our manufacturing and planning is all done in California. We have over 30

patents for our products and growing.

We currently counted as close to 30,000 charging ports in California. I know that number is a little different than was reported earlier, but we count a dual as two, because we're servicing two cars at the same time. And I think your official numbers, you count it as one.

And then we have a significant installer base in California, where we have California people doing the installations. So beyond our own requirements, we're also creating jobs for installers.

So the goal of our project was developing what we call our onramp module. And what this did was allowing competitor's products, other third party EVSE suppliers, to connect to our network. So that they did not necessarily have to create their own network and create their own communications technology, as well as developing our internal manufacturing capabilities. This allowed us to invest in -- for manufacturing we were able to develop all of our own test protocols, develop our own quality systems, so that we were able to make sure that the products that we were putting out were high quality and reliable.

So the Onramp Program is more than just a communication with the unit, because it allows it to be a managed station. So we can set the pricing on the stations, so that our hosts don't have to have that

capability or worry about it. You can charge drivers. We can do a check at the end of the month for all the money you've collected, but you get to set the pricing on the station. Some people make them free. Some people will charge enough cost to break even. Some people will try to make it a profit center for them.

We also give the complete reporting and analytics. You can see what cars are using your stations, how often they're using them, what is your utilization? Do you need more stations because you have people waiting for them? Our software tools can do things like we create wait lists. So if your stations are all being used a person can use their card and get in line and be notified when a station becomes available, so that they can go out and move their car and get their charge.

So to date we have ten different stations that we have integrated onto our network. This has allowed, especially early on when we were not in the DC charging space, we were able to get a lot of DC stations on to our network through this Onramp Program. So what we do currently is we supply, we're on our second generation of our onramp hardware. Our first generation was just a communications board. Now we sell an actual module with a display and all the user interactions. So it's very easy for a hardware manufacturer to integrate that into their

product and instantly be able to sell a ChargePoint enabled product.

This also has allowed us to work with the CEC on their corridor project, where we're putting in 107 DC charging stations throughout the State of California, in order to facilitate that long-range driving for EV customers.

Some of our future innovations that we're working on is we're so much more than a hardware company. And as we see where EV charging is going and the demands that it puts on the grid and the needs for our customers, we are looking at how do you service a world where everything goes to sleep? And that's not just the bus operators, the heavy-duty equipment operators, the long-haul trucking operators. But we're seeing that in the next few years as we get to autonomous cars you're going to have so much of the light-duty vehicles are going to go to fleets where you simply have a subscription service, you call your autonomous car, it shows up at your house, it's fully charged. So the infrastructure will need to be there for those cars to be taking themselves to a charging point and recharging, so they can be redeployed.

So in order to do this we recently purchased a small company named Consensum (phonetic) whose focus is on energy management. So this allows us to be able to manage

those peak charging points, so that we can try to shave off those peaks ourselves as opposed to having the utilities invest in more generation. This also allows us to work with second life batteries and have some onsite energy storage to do that. We can also integrate with building management systems, so that we can manage the HVAC system if you need to have that turned down a few degrees in order to shave those peaks as well as the EV charging stations in order to shave off those peaks.

So some of the challenges that we see in that space is like I said the high demand charges are really going to penalize people who are trying to make their fleets electric. It could cause it to the point where it is more expensive to use electricity than it is to use diesel or gas for your fleets. So we see that as a big challenge.

Like I said, we are tracking that from an energy management system that can try to mitigate that. But also working with the utilities on what kind of programs they can do to eliminate those demand charges.

Some of the other challenges are there's a complex amount of systems involved here. The vehicle's state of charge needs to be read by the charging station, so we know which vehicles need to be charged the most. As most everyone knows, batteries as you get to peak charge,

they start charging slower. So you want to have less power going to those stations and more power going to the vehicles that have less charge. So you need these really complex software systems to be able to manage all of that.

All right, so our next generation hardware is focusing on the DC space. And our focus in this space was on scalability, reliability and field serviceability. As you get into the fleets and the corridor charging, the highway charging, it is so important that these units have high reliability and high up time. So our products are built very modular, so if a station were to go down it's within minutes it can be repaired by spare parts.

Also with being modular, we have the ability to constantly be upgrading stations. So you can start today with a 50 kilowatt station, but when you need to go in a few years to 150, 350 kilowatts, you don't have to throw away that old hardware. You just can expand upon it and get those higher rates of charge.

So a manufacturer for this, we have as was mentioned earlier our model of manufacturing in the past was we did use contract manufacturers. We did a little bit of light manufacturing in-house. We had all of our own manufacturing engineering, our own quality engineering and our own development. But we did leverage partners for manufacturing.

As we got into the DC space, realized how much more complex that was to build those and a lot more cutting edge technology that was going into those. So we decided to bring our manufacturing back in-house. We leased a 27,000 square foot facility in Campbell. And right now, we're doing 100 percent of all the electromechanical assembly for those in-house. We are getting our printed circuit boards are assembled by a local partner in San Jose. And our sheet metal is also being produced in California.

But we're quickly hitting the maximum of our capacity, so we're looking at what our next steps are for scaling. With our current growth in our current facility, we have increased over the last 18 months by 200 percent on our non-production manufacturing people. That's the manufacturing engineers, qualities engineers, supply chain folks, materials management people. And our actual production people we have increased by 300 percent, so that is our line operators, our technicians, our quality inspection people.

And then we've also had to put a significant investment in manufacturing and test equipment. To test DC charging stations, you basically need the equivalent of a bus to be able to have a load on that station to make sure it would be able to charge those units. So just the amount

of power that's going to our facilities has required a lot of investment.

So then what are some of our challenges? As I mentioned, we are already planning for our next facility and deciding where that will be. Do we expand on the current facility? Do we open another facility? Do we move more of our production to contract manufacturers? And the things that are going into our equation and analysis of that is number one the high cost of labor in our area does make it difficult to manufacturer in the Bay Area.

But then we're weighing that against if we moved somewhere in the Central Valley, do we have a much harder time getting skilled labor?

The other challenge that we have is we are getting to the point where not only is it electrical improvements on our buildings and our real estate, but we are getting to the point where our utility companies are having to upgrade transformers. And then we're getting to the point where they're having to upgrade the substations. The substations in our area can't even handle the amounts of power that we use in our facilities. So we're working closely with them in figuring out how do we manage those really high rates of power. And that's with our current generation products as we're looking forward at future products like trucks and we're working with companies on

the EVTOL space, the electric vehicle flying cars. How are we going to charge things that need charge on a very quick turnaround?

And then finally it was touched on earlier, the duties and tariff's problems. We have that problem not only on products that we do need to import from out of the country, which some of the technologies that we have are advanced enough there's no one in the United States who's making them or there's things that have commoditized to the point where there's not a lot of manufacturing in the U.S. and we have to bring from outside of the country, but also we're seeing this problem on exports. That they're starting to have retaliatory tariffs.

Canada recently initially was going to tax our AC charging stating stations going into Canada. They decided at the last minute to roll that back and didn't do it. But if some of our concerns that we have is we're going global, can we continue to do all of our manufacturing here in California? Or do we need to worry about -- I actually just hired my first trade compliance person, because we're looking more at having to do things like duty drawbacks and managing our import duties whereas in the past everything was pretty much duty free coming in and going out of the country.

So then just some of our general concerns about

the market in places where we think the state and trade organizations need to focus. So number one is, it was touched on earlier, high reliability of charging stations. When electric vehicles first started people, especially with light duty your primary point of charging is your home. And you're not always completely dependent on the public infrastructure. But as you go to freeway charging and you go to fleets, it is so critical that you have high up time on this charging.

Ease of servicing, if it does go down how can you get it fixed in a manner of hours by having spare parts locally, trained professionals and also product that's designed in a way that it can be service that way? There's quite a few products right now where it takes almost an engineering level person to service them. We focus a lot on our design allows for a technician-level person to be able to go out and service these, do the actual failure analysis back at our facility, but get the unit back up and running very quickly.

We have seen issues with electrical grid compatibility, especially with some charging stations designed out of the U.S. that come into the U.S. have not adequately covered the requirements for what the power is like coming off of our grid. And it can cause stations to trip. You know, you have so much safety built into these

stations that if it sees weird things on the grid it can't filter out those things. So the stations need to be able to filter that out.

And then we talked about energy storage. And as we're looking at second life of batteries and other ways that we can manage the power, so that we don't hit those demand charges.

And then scaling the solutions, we have already started looking at what a charging connector will look like for even higher rates of power. Everyone's looking at doing cooled cables to get the next generation. For the next generation after that we have built a prototype of what it would look like for once you get to megawatts of power that you're trying to deploy, as opposed to kilowatts.

And then we struggle a bit, and internally we have the scales to be able to do a lot of compatibility testing in-house. Our labs are all built big enough now that we can get a bus into our lab to do compatibility testing with chargers. But in the U.S. there's not a good third party that you can go to for interoperability between cars and chargers. Someone eventually, at some point needs to manage that certification of interoperability so that you know exactly where the problem is. Is it with the vehicle or is it with the charger?

And then the next generation communications between the vehicles and the chargers is still in its infancy and it's still being developed how much that can do, the 15118 Standard and will all charging stations have it? Will all cars have it and what are the capabilities that you can get as you start putting that technology in and what would be the standard, so that every car gets the same signals, every charging station interprets it the same way.

All right, and then just in general how we foresee us supporting the California policy goals. As I said, we are deploying chargers in order to be able hit the Governor's target for 250,000 EV chargers by 2025 including a large number of DC chargers.

We are working with the car companies everywhere we can to get more light-duty vehicles out in the market.

While there is three different standards right now on light-duty vehicles, we support all three and will continue to, but would be easier if there was one standard for charging. We also do it on our DC charging stations. We will support any standard, but it would make the market easier and cheaper if there was just one standard.

And then we really believe all charging stations should be smart and should be networked. Early on, when we first started the company there were many competitors who

were looking at it as just another outlet, which worked when you had 50,000 cars on the road. But the volume of vehicles on the road now, the amount of power that you're using, it's just not scalable to not have every station to be managed. So that not only can the network of the stations be managed, but as the utilities get more and more into managing the grid through stations, they'll need that capability to be able to communicate with the stations.

I'd just like to say thank you to the CEC for their support over the history of our company, not just in funding, but also as a partner with the state and understand the state's objective.

COMMISSIONER SCOTT: Great. Thank you, another interesting and informative presentation. We got so much great data today. Thank you for making that.

And actually I might start with a question, so sorry to go a little bit out of order here. But a question I have when you raised kind some of these general high power charging concerns, are you finding that there is the workforce available to be able to work on some of the things that you'll need as you go that direction? You mentioned like the cooling cables and other things like that.

And then from the manufacturing side are there key components of that, that are not in California, but it

would be helpful if they were. Or if there was a manufacturing component to that that you'd love to see in California, what would it be?

MS. DONAHUE: Yeah, it would be nice. You know there are some technologies that just don't exist in California any more on the scale we need. We do all of our aluminum manufacturing is done in the U.S. But there's no one in California who does it at the size that we need, so we do have U.S. partners for that.

We talked earlier about just the labor force and echoing we could always use some more software engineers. We are always desperate for more. We're desperate for more power integration engineers. It is a specialty that there are not so many people who have a lot of experience there.

On the manufacturing side in the Bay Area it's always been difficult to find good people. But it's been a little easier on the manufacturing side I think, because we're an interesting technology. And it's so much of the Bay Area is board in a box manufacturing, so I get a lot of people who are just fascinated about more of a challenge. So we are able to find the people, but there are some niche places where we have a hard time like people who are experienced with charging cables and cable manufacturing. And the Proterra folks talked about bringing it in-house.

I think a lot of the traditional companies,

building those kinds of things were not used to building things to support this level of power. And on our side, if the cable is plugged in and out repeatedly -- you know, a lot of cables are plugin once, get it plugged in really good and you're set, but something that a customer interacts with on a day-to-day basis, and plugged in and out, gets dropped on the ground we've had a hard time finding people who can really deal with that level of complexity.

COMMISSIONER SCOTT: Great.

Margaret?

MS. MANN: Okay. Thank you.

You talked a little bit about commoditized components and one of my concerns with this type of hardware is that it is, it could be summed up in the future as a bunch of commoditized components. And I'm wondering what your plan is to avoid that. I love that you're working so hard on the software side as well. Going forward, do you think that it'll be more assembly of commoditized components, supported with hardware that you could maybe sell to other companies?

MS. DONAHUE: Our design is novel enough everything in it was completely designed ourselves, because of as I said the ability to treat it as many different sub-assemblies that can be swapped in and out.

We've put a lot of work into things like blind connects, so that nobody has to be screwing things in and out; wing nut kind of assembly, as opposed to torques driver assembly, so it's really easy to assemble onsite. So we have a few years, we think of anyone catching up to where we are on that design. And it just doesn't lend itself, because it's not -- the AC charging stations are small enough and cheap enough that if one fails you can just swap it out.

As you get into DC charging it's a much more complex beast. And you don't want to just swap those things in-and-out. So at some level there are pieces of it that are commodities like displays and things like that. But we anticipate that in the next few years, there's no one else who has as comprehensive of a solution.

And the other thing our stations, because we do the software ourselves, we do the design ourselves, there's a lot of focus on the unit being able to self-diagnose itself, send us messages when it's not working or is working sub-optimally, so that we can get out and service them. So we don't see it as a hardware component, we see it as a system and a service that comes with the system.

COMMISSIONER SCOTT: Other questions, Margaret?

MS. MANN: No.

COMMISSIONER SCOTT: Okay. All right, Debbie?

MS. SANDOR: I have a question that is maybe a little bit out of the scope of this, but I'm just curious. So you're talking about a super network kind of system. Are you doing anything to like protect against a cyber security kind of event? So I mean because really everything, if that's your whole goal to make it all be super connected then what we thinking about that at this point in time in order to prepare for anything like that?

MS. DONAHUE: Yeah. So we actually have a security firm that works for us and audits that as well as our stations do take credit cards. So we are PCI compliant, to be able to take credit cards. We actually -- we would prefer not to take credit cards. I know there's a push for people being able to anonymously use a station by using their credit card. But that's some of the complexities. If it takes a credit card is there a way that it can be hacked and someone could get that credit card information? So we prefer that someone uses an account.

We've done a lot of focus on making that as easy as possible. You can use your smart phone and activate a station with your smart phone. It's very easy to sign up for an account. We want to know who you are because we look at it as service. Like I talked about, if you get into a wait list we want to be able to send you a text

message telling you your car is available. If you plugged into a station that may be set to as soon as you're done charging, they'll start charging you a higher rate, because they want you to move your car we want to be able to send you a message to let you know that's happening.

So we would prefer that people sign up for an account, because it's more secure and we then can communicate with them.

COMMISSIONER SCOTT: Frank?

MR. RAMIREZ: Just briefly, I'm just curious what is your process in working with locals either community groups, community colleges in the workforce area?

MS. DONAHUE: I don't think we've done enough, actually frankly. We have really just started scaling our production people this year. Our HR team, I've been really pushing them to engage more with the community colleges at a minimum, to be doing more outreach. We were just talking today about what more we can do. And it's just been an area that we have not explored as much as we should and we will do more over the next year.

COMMISSIONER SCOTT: Mike, it looked like you might have had a question?

MR. SIMON: I was just going to point out that my -- just as you got up to the stage, I got a text saying that my car's finished charging at that the charge point.

Maybe it was an omen. (Laughter.)

COMMISSIONER SCOTT: Okay. Great, thank you for your presentation, lots of really good information.

Okay and so now we have last, but not least, John Frala Professor, Alternative Fuels and Electric Fuel Cell Vehicles at Rio Hondo College.

And while they're queuing up his presentation again if you are a member of the public and would like to make a comment, please fill out one of these blue cards. If you're on the WebEx just do the hand raiser feature and that's how we'll know when we get to the public comments that you'd like to say something.

Take it away, John.

MR. FRALA: You'll be surprised how many people confuse Hondo and Honda. (Laughter.) Because we have a Honda program, so people just assume that. Well, okay. Thank you very much for inviting me up here today. I learned a ton here today, that I'm going to take back and use myself.

I'll give you a little bit to go on, so I love this picture here. I call this spaghetti. This is an Orange County Rapid Transit bus. And our technicians have to go in and figure out where those wires go, because one of those relays isn't working. On some of the buses, the older buses, there could be 35-40 different relays

controlling different things in a bus unlike a passenger car where you might only have 2 or 3 of them. So our program has been around a long time trying to figure this stuff out. We have about 65,000 square feet, as far as it goes. I have seven laboratories and nine classrooms. Our average daily attendance is somewhere between 600 daytime and about 500 night time. We run six days a week on campus.

We have nine degree programs and 12 Certificate of Achievements total, so everything from American Honda Acura up to heavy duty equipment with John Deer and Caterpillar.

My area of expertise on campus is alternative fuels, which started 25 years ago. We were doing compressed gasses and auto gas, which was very new to California. So in total right now, we have about 1,000 graduates up to that program that are in the 25 years. Of the 1,000 program graduates, we are in contact with about 300 students right now. So I could tell you where a lot of my students are, what city, what county, what state they are in. And even what country they are, in some instances. We have a lot of them who have moved over to the UK now.

The newest program, which came out of a grant that we had here, the CEC is helping us with the equipment to put together an Electric Car and Hydrogen Fuel Cell

Program. And when I started approaching people with idea they were like it's not going to happen. It's fad. It's like everything else in automotive. You're going to see these in a couple of years and they're going to disappear. Why are we investing in this? And pig-headed as I am I said, "Now, I'm going to prove you guys wrong."

And so with the money that I got from my grant through CEC, I've had two individual ones, we started off the electric vehicle programs, bought the test equipment and put these things in place and went out, starting hitting up the manufacturers. And lo and behold we found out that a lot of the transit agencies, Proterra being one of then, were then able to provide our graduates to these programs already. So as they're building their programs we are able to supply this workforce already that's trained with the fundamental skills, the safety, the high voltage safety skills, and certification that did not exist.

So when I went to the State Chancellor's Office and I said I want to do this degree they said, "Great. Give us some job data." Well there was no job data, because it didn't exist in EDD's culture. So I had to physically go back and do my research with the manufacturers and the bus transits. SCRTTC which has been a big supporter of us, because there are about 39 transit agencies now involved, they gave me a lot of data. I went

back to EDD and they said, "Can you write it? You write the job requirements, you write the job scope." And we put it together and we had it done within four months.

It was posed on the web within six months and I had my degree done within six months after that. So it's the fastest one that we've ever developed on campus. And we were getting students hired in the first year of a two-year program. So we had to go back to the employers and say, "Here's a contract saying you're not going to job out my student. He needs to finish his degree."

So I've had many, many challenges here. Just because of the scope of what these people are needing now. As you guys all know, as some of us -- I've been driving an electric car myself for over 15 years. I don't go to gas stations. Well, I do for my wife. She's still afraid of batteries. But I don't go to gas stations on my own personal vehicles. I own seven vehicles on campus. So I have a very big pool that I drive every day including a Miura all the way down to a Coda. I still have a Coda that works.

So as far as my students go they have a wide variety of what they're learning. And we're being able to place these students in current technology with current skills. So when the Chancellor's Office came back and said, "We would like to offer you guys a chance to have a

bachelor's program at a community college," we were chosen one of the 12 in California. So I have a bachelor's degree in automotive technology. I also have a bachelor's degree in business and marketing for automotive.

My students are coming out of the electric program going right into the bachelors program for automotive technology. And I have them placed right now at Tesla, at Proterra, at American Honda. Porsche is driving them faster than I can get them through the program. So we've had multitudes of success, based upon what this small little grant was that we got and how we were able to take that and stack it on top of other grants.

After we got the first grant and we got the equipment in place to start doing battery testing and certifications, the industry came back to us and said, "Can you expand on that and give us some stuff for doing the motors and doing some other things like this," which was non-existent at the time. And so we've gone back and we've been able to put this together and do hands-on training, physical training with the vehicles, taking them out of the cars and doing the testing, battery balancing, things like this that were again were nonexistent for many, many years.

It's been the last five years we've been able to perfect this and get this into certification through the ETA, or SAE is working with us right now on another grant.

The auto gas came back very big with Blue Bird. So we went back to Blue Bird and gave them some training on what they could do. And in the picture on the lower side this is Train the Trainers for a trainer back east in Indiana at their plant, where we actually invited college instructors from all over the United States. And lo and behold only two of us from California showed up. Everybody else in California wanted to do electric. But back east and mid-states natural gas and auto gas is still a very big part of it.

So I've been able to leverage this, not only to students, we've been able to get the instructors who don't have access to this training to be able to do this and so it's now expanded nationwide, starting off of one of the grants that we got here through the CEC. So not only is California benefiting from this, we've been able to expand this nationwide.

How technical does this get? This gentleman right here is working with a pipe that holds 10,000 PSI of compressed hydrogen. I've been able to go back to the manufacturers in the industry that provide these fittings to the bus manufacturers, the truck manufacturers, get with them, put together a certification that my students are coming out of the program with an industry recognized certification on high pressure piping. Again, it did not

exist before 2010. So now when they go to the job interviews and stuff they can come in and say "look, I've got a 30 hour OSHA card. I've also got certification on cryogenic fuels, high pressure fuels and electronics."

So the newest one we're working on right now is for high voltage safety, which does not exist in the U.S. So that was where the second grant from the CEC came in. We've pretty much got it together. We're going through the finalized staging of it right now. We will have an industry recognized high voltage safety course that can be duplicated anywhere at any of the colleges and/or some of the manufacturers, depending on what needs they have.

So I heard this from a couple of you today that the high voltage safety stuff still needs to be finalized or maybe constructed better. We've already got a template in place. We should be able to modify that to what you guys are doing. And this will be an ETA or SAE recognized certification. So again, ETA is an international certification that goes into Europe. We've expanded into Germany and the UK already on some of the certification stuff.

So this is kind of a list of some of the grants. I've got the arrows here pointing on it. This is a 1.7 kilowatt fuel cell that is powering that test board that that student's working on. We make our own compressed

hydrogen in the classroom, 125 PSI out of electrolyzed water and make it into a hydrogen gas. So students learn how to create the gas, they put the gas in the fuel cell that they built and now they're testing the output of that fuel cell on a test board to make sure the components are working correctly. So they see more than just components. They actually see the whole process, the safety behind it, and why they're doing it.

So this is kind of a small grant. Now one of the things I bring up to a lot of people. They look at this and go this is just fantastic that you've been able to do this. But my program is not funded by the Chancellor's Office in California. I have a non-funded two-year degree program. So my alternative fuels, both degrees, gaseous fuels and electric vehicle and hydrogen, are only funded by the grants that I write. So I've been pretty lucky that I've been able to do a little over $2 million in grants since 2010.

And that's real important to my students because these guys are leaving not flipping hamburgers. These guys are making life living skills, but they're also making a wage that they can go back and support their family with, with benefits and things like that depending on which companies they go to work for. And I'm very proud of that, that my students are getting that chance to do that.

Our campus is located in very -- a couple of the cities are very low-income and very low skills. And I'm able to take these students that are first year, sometimes first students ever in a family to go to college and give them that skill that they can go back and provide not only for their family, their parents -- sometimes in instances they're buying their parents a house, which they never had in the United States -- but are able to go back and supply for the family and bring up their kids.

So some of my students that I've been able to stay in touch with, one of them just got hired on at American Honda. Now he is the Senior Project Engineer for the new Clarity. So that student graduated in 2004, as a Honda pack student. And we've been following it through. He's got his master's degree now in mechanical engineering. He is now working for Honda, making well of $200,000 a year. And just I can't even tell you how many success stories I have like that.

And this really drives a point. You guys come up with this great technology, these great ideas, but if we don't work with our community colleges or work with the people here who's going to fix these things? Who is going to see these things in the yards of in the fleets or in the customer's eye who is going to repair these things. And this is where I really -- I cherish the fact that I am

lucky enough to be able to come to these meetings or go to an industry like Proterra.

We were there the first day they opened the door in that plant. There wasn't even a paint stripe on the floor and we already had students line up to go to work for this gentleman. They are still there. A lot of them got promoted. And we've got another batch of students going back in there.

So right now we've been able to do this. Now, the question is, is my leaps and challenges? Well, yeah. We've had a lot of challenges. We are teaching technology that at one time didn't exist. It was a pipe dream. We've been able to prove through a lot of it, through National Science Foundation, which mainly gives us research grants. We have a technician-based grant, the first one in the United States for electric cars and fuel cells. So we were the first community college to graduate 32 students with that new degree based upon the grant that came out of the CEC and NSF. And I can't say thank you enough to you for the support and what you guys have done.

This last slide here, where are they going to work right now? This is our first graduation group. We are the first Tesla training facility in California. They went through 19 different community colleges and it came down and they chose my college as the college to start

their start program here in the West Coast. There are two colleges right now. One is in South Carolina. They were number one. And I was number two, by two weeks. I've had over 32 graduates right now. And every one of them is working at Tesla.

The program we put together there, much different than most automotive programs. Tesla comes in. We interview them. They will only take a student if he's got an associate's degree or came through my program. He is then hired as a Tesla employee and paid $18 to $21 dollars an hour while they go through the 12-week program. From there they get to choose any training facility in the United States that Tesla has to go to work for.

As you can see in the picture I have more females in this semester than I have ever had. The females are eating this up, because it's not a filthy dirty product any more. It's mainly computer based. You guys are all talking about the need for laptops and engineering and things like that. This is where they're headed, because 99 percent of the work on a Tesla is done on a computer before the customer even hits the store. And so this is the technology we're doing right now.

Some of the people that we're working with I put on here Stratus Fuels, who makes the fuel stations for the hydrogen fuel stations, they've got two of our students in

there. They are station managers for their products, for their new projects. They're also now wanting me to bring back a training scenario, how to maintain one of these fuel stations, because right now it doesn't exist. What do I do if there's an emergency? And this brought into the Fire Department, CAL FIRE and CHP, we do first responder training also for any of the alternative fuels. So I've trained a little bit over 900 CHP in the last ten years and CAL FIRE similar, around 945 nationwide or statewide, I'm sorry.

So the program is not just about working on cars. We're also doing first responders, safety, high voltage safety, product safety, high pressure cryogenic safety.

Some of the awards that we've had are in the state here, California Community Colleges in 2004 gave us Outstanding Program, which was the first vocational program to get that award. California Community Colleges has given me Instructor of the Year in 2010. I've had two national awards from the American Association of Community Colleges: Innovative Programs and Outstanding Instructor Programs also. And then the California Automotive Teachers has also awarded us with an Outstanding Program award. So we've accumulated the awards from the things that we've been able to capitalize on.

And getting the students really prepared for the

next type of technology that's out there. I keep telling them, "You're not going to be changing oil. You're not going to be changing spark plugs. You're not going to change brakes." My Prius has 186,000 miles on the original brakes. I have not driven that car that hard because the electronics do all the braking. So these guys need to understand that they're not going work like a regular technician. They've got to work with their mind. They've got to work smart, not work hard.

COMMISSIONER SCOTT: Thank you very much. The was a great presentation and a lot more terrific information for us to bear in mind.

Let's start with our reviewers, although I have a bunch of questions for you as well. Frank, you want to start this time?

MR. RAMIREZ: Thank you. That was a great presentation. May I have your card?

MR. FRALA: Sure. (Laughter.)

MR. RAMIREZ: That was my first question. On scalability, is your program scalable to other areas of the state?

MR. FRALA: I get probably requests every month right now, since we've had the NSF grant. Because part of my NSF contract is that I have to be able to expand this to other schools. And yes, it is.

The newest school that we just expanded to is Macomb Community College in Warren, Michigan. Their first semester of Electric Cars is my program reduplicated in Michigan. So yes, I have no problem in sharing this with anyone. I've already gone through the struggles. There's no need for them to do that. And we can walk them through it all the way down to how do you place a student in this technology.

MR. RAMIREZ: The second question is how much do you deal in the heavy-duty space?

MR. FRALA: A lot. John Deere is now doing fuel cell. They are also doing compressed gases and electronics. Hyster is now doing electric fuel cells for Ikea in California, the same plant they were talking outside of Bakersfield. All their forklifts are hydrogen fuel cells now, so we've got students even going to that marketplace.

MR. RAMIREZ: And finally, I know there are programs that I've known at the end of the program there are no guaranteed jobs for these folks. And that's one of the most frustrating things for young people.

MR. FRALA: Oh, yeah.

MR. RAMIREZ: It sounds like you don't have that problem.

MR. FRALA: I do not have that problem right now.

As long as you folks keep inventing this stuff and bringing us to a zero emissions I'm just a happy camper right now, because I live this stuff every day. I drive the technology and I thoroughly believe in this technology.

I remember growing up in California, where we could not see across the street. The smog was so bad we could not go onto the playgrounds and play and I don't want my grandson to grow up in that kind of world. So I instill in my students green technology, protect your environment, nourish that environment, but also take care of that in your daily commute.

MR. RAMIREZ: Thank you.

COMMISSIONER SCOTT: Thanks, Debbie?

MS. SANDOR: Thank you. It sounds like a great program. I guess my question is I'm wondering where do you get the instructors from. And since this is such a high demand industry, don't they want to go work for a company instead of teach, so I was wondering if that's an issue?

MR. FRALA: Finding a teacher that lives up to my passion of what I do is really tough. I'm growing my own basically is what I'm doing right now. They have to have at least five to six years in the industry to have that experience. And then I can bring them in part time. I currently only have two part-time instructors. I'm looking to find a full-time instructor right now.

COMMISSIONER SCOTT: Margaret.

MS. MANN: Yeah, this is really fascinating. I wish something had been available like this when I was in college, maybe it's not too late for me.

MR. FRALA: It is not.

MS. MANN: It might be. You had mentioned they're not going to be changing spark plugs, but they are doing a lot with their hands, you know, hands-on training for manufacturing assembly. What about computer programming? At what level are they introduced into managing computer systems, programming databases, the kinds of software that the industry is seeing?

MR. FRALA: Day one.

MS. MANN: Can you give examples of the kinds of levels that they work on?

MR. FRALA: We do our own program. I have a simulator in the class. And basically I can download all the Mirai. We take the Mirai out and drive it, put it on a recorder and come back and download it to the simulator. From that simulator, they can now go into the software and see if the car is running efficiently. Is the battery getting fully charged? Can they make modifications on it? So they actually do onboard diagnostics and then come back and do changes.

On the Tesla side, they're taking a situation,

explaining it to a software engineer who makes a patch. They then have to take that patch and download it to that car successfully. And then they have to go back and double check it to make sure it's right. And if they didn't get it right, they've got to go back in, clear it out and do it again. So they're doing all kinds of code writing. They're doing software downloading. They're doing programming on the vehicles themselves.

And then it's different than an automotive program, because my student's got chemistry for batteries. You have physics for the cars, the brakes, the engines that drive those vehicles. They also look at aerodynamics of the vehicle. If this molding is not sitting correctly what's that going to affect? Because that customer -- I'm no different than any other electric car owner I know when two-tenths of a kilowatt is different in my car. And it could be something as simple as at tire under-pressurized. So they're learning more than just automotive, they are learning the physics, the chemistry. They have to have algebra. They have to have physics and they have to have some of the higher end math to work on these vehicles.

COMMISSIONER SCOTT: So you mentioned that you can put these together in a way that is exportable to any other community college around California or around the country, which is fantastic. And that you've got pretty

much a strong demand for that everywhere you go, which is fantastic to hear. You mentioned that it's a little tricky to get instructors. How is it to get students?

MR. FRALA: I have 24 seats open and I have 48 students right now. I've had -- it's a good thing to have. I've had to double up my work load for the next semester. I never run that many students. And my Dean is like, "Okay. They're here. They're paying their fees. Let's get going." So this semester, probably more than any other, I've got a double work load here, so I've had to go out and get two other teachers to do this.

The next semester I'm looking at 96 students that are already holding seats. So the demand is here. They're seeing that the jobs are here and they see that a lot of these guys are really involved in the technology. And this is great. And I can't tell you when, but they're all asking me when do I get to work on autonomous vehicles? (Laughter.)

COMMISSIONER SCOTT: That's great. I think anything that we all can do working together to kind of help tell the story that there are jobs here. And I think I heard everybody in the industry say how much they need more people to come in. They need them faster. They're kind of stealing them from each other. And so making sure that students know that not only are there great jobs to be

had, but there's great programs to train them to get these jobs.

MR. FRALA: That's correct.

COMMISSIONER SCOTT: I think everything we can all do together to tell that story will be really wonderful.

MR. FRALA: Well, what you've done for my college and my program I can't thank you enough.

COMMISSIONER SCOTT: You're welcome.

MR. FRALA: Because this really jump started the whole process, just the very first grant that we got from you. So a lot of it is credit on you guys too.

COMMISSIONER SCOTT: Well, thank you. I'll pass that complement along to my great team at the Energy Commission for putting together such a great program.

I have one other question for you. And you mentioned it at the beginning and if it's putting you on the spot, just say so. But you mentioned that you had heard some great things from folks around the table today that you wanted to take back. Is there like a new program that you're planning to set up or a new skill set where like "Oh yeah, I've got to add that in."

MR. FRALA: I'm always very curious and fascinated about the battery technology. And to hearing that they're taking the Nissan batteries and what they're

doing to those.

We have a golf cart. And we've converted it over to a 3 kilowatt fuel cell. And I use Ford's lithium ion battery packs in it. And it's about 18 volts. And that's one of the projects the students have to do is take all of the 600 pounds of lead acid out of it and put this fuel cell in there and run it on hydrogen that they make. So I'm thinking of expanding this now to Nissan batteries and Ford batteries and possibly some LG stuff.

Golf charts are cheap to buy. They're $200 apiece. And you can really get the student to understand all the technology through from doing that. So yeah, you're right. There's a new project.

COMMISSIONER SCOTT: Excellent.

Well, are there questions from around the table for the professor?

MR. LEACOCK: I have a question.

COMMISSIONER SCOTT: Please.

MR. LEACOCK: Based on I guess it was Frank's question when he asked me how many of our employees we're getting from disadvantaged communities and I just intuitively say, "Oh, a lot," because they are, but -- so I'll be curious, are you tracking your students, where they're from? Because I guess one of the challenges that we had in many kind of at the state level programs was the

paperwork level.

MR. FRALA: Yeah.

MR. LEACOCK: And so we actually didn't -- we weren't able to follow through on one particular program at the state level, just because the paperwork was daunting for a as yet to be profitable commercialized company. We're no longer a start-up, but still we just didn't have that level of kind of admin support. And you know like I said, we were racing to fill jobs. And anyway to make a long story short, we would love that. Is that something that you guys do or that you have built into your program, like kind of a plug-n-play reporting as well? Because I envision that that's going to be a questions that I frequently get, I've already gotten it a number of times. And I'd love to be able to have something more than, "Oh yeah I'm sure it must be, because (indiscernible)."

MR. FRALA: No, you have to have data for that. And the answer is yes, I track my students through LinkedIn. I have my own group on LinkedIn that when my students come into the program they have to create a professional profile and they have to keep it updated every semester. So when you as an employer want to look at that profile you can see the skills, what classes they've completed and how far they're through the program. And that started about two years ago.

Now the Chancellor's Office has started a new program that is going to be more proactive of where our students are coming from. Right now, it's two years behind in its data. They're trying to get it up within six months now, so that really helps a lot too.

MR. LEACOCK: And when you say where they're coming from, I'm actually talking about where they're actually from in terms of as a resident of where they actually live versus maybe where or what high school or whatever. So you're talking about that level of kind of demographic data. Because I don't need it by -- obviously I wouldn't even want it by person. I would just want it by amount of people from particular areas.

MR. FRALA: Yeah. We can do that now. It didn't exist five years ago, but it does now.

MR. LEACOCK: Okay. Great, great. And so I guess the last question I would ask is I know that Southern California community college system has the ability to tie in and potentially transport curriculum. Do you have any interaction with Northern California and Central Valley Community College to do that kind of curriculum transfer as well?

MR. FRALA: Yeah, we're working with American River College right now and Sac State is working on it and then I've got some stuff that we're working on with Skyline

right outside San Francisco Bay.

COMMISSIONER SCOTT: Are there any questions from around the table? Okay great.

Thank you so much for your excellent presentation, John.

MR. FRALA: Thank you.

COMMISSIONER SCOTT: Let me invite you all to the table and if there were any -- a lot of really good information. So I just want to do a quick ask around our table here of our presenters and reviewers, if there's any question that you really want to ask of each other we've got a couple of minutes so this would be a great time to do that.

COMMISSIONER SCOTT: Yeah. Frank, please go ahead.

MR. RAMIREZ: It's probably aimed more at the Energy Commission, but it's kind of my first round at doing something like this. I'm curious, how you stack your solicitations, so they support each other? In other words programs doing battery versus like Proterra and how do you package them, so that you get one complete package of a product or products that support each other and complement each other? I don't know if that occurs. I'm sure it does, but I don't know enough about it.

COMMISSIONER SCOTT: It does. I need my Program

Manager from that program. Right, I don't know Tami or Tim, if you want to take an answer to that question? I mean I do think we try to be very strategic about how we put together the workforce training that we do here. And we also as you know use workshops and convenings like today to really kind of hear what information or are there components that were missing that we need to be sure to weave in? That type of thing, so that we're also iterating and learning all the time, but maybe I'll turn that to Tami as well.

MS. HAAS: That's exactly what I was going to say is that gatherings like this really inform the program and then we get together and discuss the best use of the money that's available. And we look at where it has been used the most efficiently and has made the biggest impact. So we just try to make the decisions based on those.

COMMISSIONER SCOTT: Other questions for each other? Peter, please go ahead.

MR. WARD: I have a question for Kent. Kent, I was fortunate enough when I was at the Energy Commission to take a ride in one of the first Proterra buses. And it was a fuel cell, basically a generator on the bus that delivered the electricity to the battery. And I didn't see any hydrogen in your platforms these days. I think that's different.

But also I'd like to hear from you, maybe Mike and others that are looking at hydrogen as a heavy-duty application. It just seems to me it always seemed to me that it made better sense as a heavy-duty application for the central fueling capabilities and that sort of thing rather than light duty. Can you opine?

MR. LEACOCK: I think what it boiled down to is that yeah that was one of the first early buses that we built. But our leadership team decided that based on the cost of the hydrogen fueling infrastructure build-out that for transit agencies it didn't make sense.

And also because of the duty cycle of transit buses we felt we'd be able to solve that with battery electric. I think hydrogen fuel cells for long-distance trucking are probably going to be the definitive solution. But in our case, we completely dropped our Fuel Cell Program for the cost, because the electrical infrastructure was already there. The utilities were motivated and we were hoping and it's coming true that utilities and utility commissions across the U.S. would start to see the value of allowing the utilities to build out infrastructure and rate base it, because it would help put downward pressure on rates. And a variety of other ways that would limit the cost to transit agencies and school systems that operate at a loss anyway.

And that's not possible in the hydrogen kind of fuel world. And you know we still have yet to see a great solution for hydrogen fuel cells from our perspective, because most place still bring in the tanks pulled behind a diesel tractor trailer. And utility network was there. In some instances maybe it even requires a transformer, but once again it's still an upgrade that's still going to be all electric. And with the Renewable Portfolio Standard our fuel is becoming cleaner and cleaner and cleaner by the minute. So that was really it. It was as much as a business decision as an operational decision on every front.

MR. SIMON: Well, I'll be honest and say that the reason why we're involved in fuel cell technology today is because there's strong public interest and money available from public sources to experiment with the technology.

And we happen to have resident experts because I and a number of employees used to work in a transit bus world with ISE years ago and we developed a bunch of fuel cell technologies back than when the transit industry was more interested in it. So we're doing it out of intellectual curiosity and because there's funding to cover our costs it's subsidized research from our standpoint. And it covers our bases and if the technology becomes commercially viable we have the potential to be a leader in

that area.

But having said that, I'm personally -- I don't want to say I'm skeptical about the technology, but I think that there are a number of formidable hurdles that have to be overcome for fuel cell technology ever to be commercially attractive for heavy-duty users, for any user really. But for heavy duty, heavy duty is logical because locally driven trucks do come back to the same location, so if you have hydrogen infrastructure you don't have to have it nationwide.

But hydrogen is still very expensive however you -- right now, just if you look at the cost of electricity to electrolyze hydrogen it costs about even in a best case scenario if you have living there like the great northwest or a Canada where electricity is 2 cents a kilowatt hour, it starts to become competitive as a fuel. But if you're paying normal California electricity rates, so 12 cents to 40 cents a kilowatt hour, it's never going to be cost effective to produce hydrogen at those rates.

So it does depend on some breakthrough like using either renewable energy. I think Nikola Motors has an ambitious concept of having giant solar farms around the country that get basically free electricity or amortized at low cost.

And it's going to take something like that plus

reducing the cost of the fuel cells themselves plus reducing the cost of hydrogen tanks plus getting higher density hydrogen on a vehicle, because right now the hydrogen tanks are very large and heavy. So going to a higher PSI and putting more hydrogen within the space available is also something that's going to be necessary for it to really get widespread adoption.

So there's a number of hurdles. But again our philosophy is if there's funding, if it's in the public interest to fund the research we'll use our expertise to try to overcome those barriers over time. But I think hydrogen is one of those things that's always been -- the saying is it's fuel cells are five years away from becoming commercially viable and always has been or always will be. We'll just have to see. That could change.

COMMISSIONER SCOTT: All right, so I'm mindful of the time. If you have other burning questions for each other please be sure to just let us know maybe let Tim and Tami know and we can make sure to get that information to each other. I do want to say a couple of remarks and then we'll turn to our public comments.

One of the ideas that we've had over the last few years is to put something together that's kind of a mini version really of the Department of Energy's Annual Merit Review. We don't have the time or a convention center for

a week long to go through literally every project that we funded. But we do want to have a chance to kind of dig in to some of the projects that we funded in each of the categories, to really kind of take a look at it and see what some of the lessons learned are. What some of the challenger are, what some of the successes and surprises are, so that we can continue to do some iterative learning as we put together additional grant funding opportunities.

And so I really want to say thank you to all of our presenters today for letting us do a little bit of a deep dive into the projects that we have funded with you. And also to our reviewers for taking time to kind of look those over and ask some tough questions to learn a little bit more about the projects.

And I also really want to say thank you to the great CEC staff who work on this all day every day to make these projects come to fruition. They do a terrific job and we're making a difference, which is a really great thing.

And also thank you to Larry and to Tami and to Tim for putting this together, so that we have a great day and a really good discussion with all of you. So I've just really appreciated your time and your energy and your engagement here today and over the last little bit with the Energy Commission.

One of the thoughts that I have as we're looking more into this workforce training component, and also into the manufacturing component for zero emission vehicle infrastructure, is if you see any pinch points coming around the corner to make sure that you flag those for us. Those are things that we might be able to address with potential grant opportunities.

And also on the scale up, Kent had to leave but he talked about being able to do hundreds of buses at a time versus tens of buses. And he showed the canopy, the solar canopy with some storage over the buses. And so we're thinking about what is that scale up look like, and are there again pinch points in either the manufacturing or the workforce that would make it more difficult to scale up if we don't see them coming? Whereas if we kind of look around some corners now again we're able to put a little bit of funding to addressing that trying to get out ahead of those. So I would love all of your thoughts on that and others who are listening in as you put your comments together.

Let me quickly turn to Tim and Tami. What day are comments on this due? And then after that we'll go to our public comments. And I have a couple of blue cards here.

MR. OLSON: So our comments are due two weeks

from now. That would be I think the 20th of August. And the docket is on the Notice. I can't remember offhand what it is, what number it is. But it's a miscellaneous docket. Yeah, go ahead, Tami?

MS. HAAS: 15-MISC-04.

MR. OLSON: And you're welcome to talk to us in person too. So that's the docket for this merit review. Tami and Larry are going to be conducting other workshops prior to their solicitations too, so we're open to that before they go into solicitations any one-on-one meetings if you're interested in that.

COMMISSIONER SCOTT: Great. Thank you very much.

And so yes we are open to your comments. Please make sure we get them.

Today I have Ethan Sprague and he's followed by Lisa McGhee. I don't think we have our timer up, but we ask people to kind of stay around three minutes, so that would be great. Let's see. The podium has a great mic.

MR. SPRAGUE: Great, can you hear me? Well, I'm really excited to be here today. I'm representing a California company called FreeWire Technologies who makes mobile battery charging systems. And we're struggling with all these questions, right? We are about 30 people. We are in a DAC community in San Leandro.

And we're manufacturing batteries and compiling

different components that work like a little shopping cart, it's about that size. And it goes to the vehicle to charge them. We're talking to Proterra's customers. We're talking to work places. We're doing workplace charging at LinkedIn and other places.

And just last week we deployed our first fast chargers at BP gas stations in the UK. And so these are systems that you can put in. No electrical upgrades are required and it can deploy 50 kilowatts of charge.

And so the thing that I'm struck by is that we're really trying to integrate 200-year old industries, transportation and the grid. And what our company is trying to do is enhance the power at the edge of the grid and deliver it off the grid and beyond for the transportation industry.

And as we think about how to grow in scale and get our costs down knowing about programs like this would are really important. And we're really thinking about how do we scale? Is the engineer in Arizona or some other state? Is the B engineer in California better than the A engineer in Arizona or some other state? How do we get the software engineers, the controls engineers that are critical to building these products?

We all have the same -- I hear about the wiring harness issue internally and how do you create the testing

infrastructure to put a battery in 120 degree temperature versus a certain amount of time etcetera. So all of these pieces that a small company like ours needs to scale its manufacturing are sort of integrated. And so if you would think broadly about what you want to get out of your funding, because the software piece may not seem like manufacturing, but it's really important to the application of the manufacturing.

Also flexibility in the contracts, the equipment changes all the time. You know, you have a portfolio of cars that all charge at different speeds and have different protocols for communicating with the battery to get their charge. The grid has different input. And so if you start off with down one path and you have to switch having flexibility in that contract or to amend the contract would be great.

And if you're funding startups for manufacturing they are small organizations that are dealing with a lot of new organizations as their customers. And so if you have a sort of rigid bureaucratic process sometimes that can be difficult in my experience.

I think that was everything I wanted to say. Thank you very much.

COMMISSIONER SCOTT: Thank you.

And next is Lisa McGhee.

MS. MCGHEE: Hi, thank you. I just want to start off with first of all this is very useful to be able to continue to learn about the lessons learned that really come right back down to the end user. And I'm one of those end users. And I experienced transportation electrification already, love many of the benefits, can echo many of the challenges that we've heard from OEMs today.

So it's really, really appreciated, because it's apples and oranges when we compare ourselves in the light-duty sector, which has got a lot of data and we compare ourselves to the medium and heavy-duty sector. And so I ask you this question. Where is the medium-duty data? All that I heard today was a lot about the class 7 and the class 8, which I actually think was really only class 8 to be technically correct.

So I ask you that, because the medium-duty sector is the largest most popular commercially registered vehicle today. Here are some facts. We've spent over 1 billion since 2016 for the CPUC, another 1 billion on the SB 350 pilot that's to come. We spent 309 million on the HFIP (phonetic) since 2009. And on the ARB we're spending 700 million every three years in the three-year heavy-duty sector. That's over $6 billion.

In the HFIP we have 572 vehicle sales today since

2009, 207 exist today and 367 are extinct today. And so I pose that question to you. That's in California HFIP mapping tools as of June 1st, 2018. I pose that because we've been here for nine years and so I'm looking for some of these lessons learned that I hear from these OEMs on robust reliability. You know, fleets need up time. And they really do need robust products that all about confidence. It's not like doing business for 40 miles a day. We're keeping vehicles on the road eight hours a day plus.

In the HFIP we've only got zero class 2B. (phonetic) We've got in the class 3 we've got two OEMs; and four, three, five, class 5, three; class 6, one; class 7, five; class six we have -- or class 8 we have six OEMs.

And so the lessons learned like I go back to it really is something to do with this battery technology. I'd love to hear from the OEMs as what is the weight of some of these modules? And what is the shapes and sizes, because from my understanding these are some of the elements that are creating some uniqueness's to keep these vehicles on the road as well as trying figure out how you can put them in the vehicle. It's very different when you have vehicles that's a 40-foot vehicle compared to a vehicle that's 23-feet, 25 feet. You know there are substantial differences but yet they all still need these

big, big, big battery packs.

So what is it that we're doing for the medium-duty sector? I'd really like to know.

What are we doing for small businesses? Small businesses make up 90 percent of transportation. I don't really see fleets having a seat at the table. I think this is a critical time where we need to move into those that do have some experience in the transportation electrification sector.

What do I see as lessons learned or actually solutions? I do see maybe us going into since I heard so much about rote, (phonetic) we're really kind of maybe outside of maybe one OEM or so that we're still in the really the prototype phase of this technology.

So can we do leasing programs, so that the customers aren't having so much risk when we're trying to learn about the technologies still?

And making sure that we have warrantees that match diesel vehicles. We just went through a lengthened warranty program for diesel. We're comparing trying to figure out what we're going to buy. And all of that is total cost of ownership.

We need standards. The J-3068 was just adopted. It certainly was meant to be for heavy-duty.

Allow retrofits. We do it in school buses. We

do it in the diesel goods movement. Why can't we do in electrification to reduce costs?

Incremental cost is not meeting the program in terms of actual incremental cost.

We need efficiencies in kilowatt hours just like we do in CAFE regulations. When I do the numbers on the transpower for $440,000 for a 440 kilowatt hour battery, and I look at that and I take it down to a 150 mile range, we've got a 3 kilowatt hours per mile. I want to build best/worst case scenario.

Today August 15th, if I think about August 15th, which is one of the worst climate days for loads on the grid, in San Diego from 10:00 a.m. to 4:00 p.m. on the grid is the double circuit adder fee at 90 cents a kilowatt hour.

So I just want us to really pose and then of what have we billed for Christmas week for UPS?

You know, these are the things that we've really got to start building for. I think fleets really have a lot of those solutions, so I would love to see us move in a direction for the next nine years how we're getting closer to fleets playing a part. Thank you.

COMMISSIONER SCOTT: Thank you.

I have Erick Karlen and he's followed by Patty DiNapoli. I'm asking folks to try to stay about three

minutes.

MR. KARLEN: Absolutely, I'll be brief. Thanks to the Commission again for convening us here today on this important topic. I'm Eric Karlen with Greenlots. We're a leading provider of EV charging software and services. We're headquartered in L.A. We have all the business staff throughout California.

As we heard today the Commission is doing really important work in accelerating advance mobility and infrastructure technology, which has yielded some really, really impressive projects and pilots.

Manufacturing and hardware is a critically important aspect of advanced mobility and it's an important topic for the state to be discussing. We just also want to highlight the important rule that software and non-hardware products and such services have been the state's leading technology-driven economy, generally. And also of course in clean transportation.

This sector is also producing an abundance of good jobs for Californians. And it's also driving the state's economic development and leadership role in clean transportation. These jobs range from manufacturing to software engineering to construction to infrastructure development and maintenance amongst a whole host of other types of jobs.

So therefore we also want to reinforce and highlight the action that came out of the May 4th round table in Long Beach. That the round table identified to also support network development and the Commission's support of manufacturing and manufacturing supply chain as a definition of manufacturing.

So I just wanted to throw it out there and thanks to the Commission again for having us here today.

COMMISSIONER SCOTT: Thank you.

I have Patty DiNapoli. That's my last blue card in the room.

MS. DINAPOLI: Hi. I'm Patty DiNapoli from Cyber Switching and the call for network-based platforms is definitely what we're all about. We are a technology manufacturing company. So we do manufacturing the equipment. We're in San Jose. And our expertise is in power management.

The technology that we innovated and patented has been monitoring and managing the power in data centers and labs. And what we've done now is we've just taken that need for power management and put in the EV space, because we take one circuit, one electrical circuit that feeds one charging station, and we make that same circuit feed four or more charging stations. And we rotate the power in a round-robin scenario.

So our focus has been power management. We've been looking at the grid and the impact that's occurring now that the ZEVs are getting ramped up. And not only do we make the dumb charger smart we provide entire building management system monitoring down to the individual circuit. So we've got pilots going in SMUD, San Francisco, MTA, UC Davis. We're being tested down at SoCal Edison. So it's really exciting time for us to help out with this. We've been down at the ACT Expo. And we've been doing this for a long time since the early '90s. And we've got a cloud-based platform that's attractively priced and user friendly.

So I'm not trying to make this an ad, I just want you to know that there's power management needs that need to be addressed right now with network base. And you being able to take control of the power and make decisions rather than being forced to use one circuit to one charger all the time, there's just other ways around it. And so we just wanted to share that with you today, Cyber Switching, thanks.

COMMISSIONER SCOTT: Thank you.

Before I turn to the WebEx, is there anyone else in the room who would like to make a comment? Okay. Seeing none, I'm going to turn to Tim and Akasha for --

MR. OLSON: So Akasha has one person there. And

those on the WebEx, if you want to make a comment, please raise your electronic hand. That's the lower right corner of the participant's panel. And then we'll unmute you.

MS. KHALSA: So, Oleg, please will you pronounce your name properly and speak to us?

MR. LOGVINOV: Sure thank you. My name is Oleg Logvinov and I'm CEO of a company called IoTecha. We are a bicoastal company. We have employees in the Bay Area as well as New Jersey. And we focus on enabling smart charging infrastructure.

We're one of the pioneers of ISO AC 15118, technology that connects vehicles and chargers in combined charging systems. And if you don't know what this technology does it allows you to actually understand what are the requirements in terms of capacity, time of departure, state of the battery, the state of charge, if the vehicle has actually a charge on the vehicle, it can integrate together and understand what is the best strategy.

So we'll provide modules that made chargers smart. And we'll provide cloud platforms that help us to control those chargers, manage them, integrate them with the grid.

But today, actually I would like to speak as with my second hat. I'm also a spokesperson for CharlN Alliance

in North America. And CharlN Alliance, if you've never heard about us, is an organization that unites about 150 manufacturers worldwide. And the focus of the organization is adaption of the combined charging system as a ubiquitous standard for charging electric vehicles.

Combined charging systems supports both AC and DC charging with the same interface, with the same unified communication technology in terms of the vehicle's charger, and more importantly it covers everything from low power AC to 350 kilowatt DC charging. And just recently we've launched a new effort that is focused on defining the next version of the technology for heavy-duty vehicles over a megawatt level charging.

And one of the key goals of this effort is to maintain compatibility, backwards compatibility with the current version of CCS. Scalability and worldwide interoperability are a tremendously powerful driver of economy of scale.

And I would like to reflect on the point brought up in the presentation by ChargePoint. Interop (phonetic) testing is absolutely important. Establishment of interop labs that are independent and can serve the industry and can help roll out equipment on the massive scale, EV chargers and EVs that can talk to each other and interact with each other, is very, very important to enable cost

effective growth of the market.

And as we know from the proceedings of as an example the DGI Working Group, EV is equipped with 1-5 and 1-8 and CCS technologies are coming to market. The vast majority of the manufacturers is supporting this technology. We need to be ready for the wave of those cars and I think one of the efforts that could be very interesting today is establishment of a program, private and public programs that can help that type of development of interop labs.

And in conclusion I would like to thank the Commission for a wonderful review. It's very useful, a lot of very good facts, a lot of very good learning. And I welcome collaboration between the Commission and the CharlN Alliance to establish interop testing on a global scale. And I think California has a tremendous opportunity to lead this effort.

COMMISSIONER SCOTT: Thank you.

Do we have other commenters on the WebEx?

MS. KHALSA: No, Ma'am.

COMMISSIONER SCOTT: Okay. So if you are trying to raise your electronic hand and haven't been able to, we're going to give you just about like 10-15 seconds to go ahead and try. Otherwise, as you all know, we take comments in writing as well. And we'll be looking forward

to those.

As Tim and Tami mentioned, Tami and Larry will be also happy to hear from you one-on-one as well.

And the comments for this particular workshop are due again on Monday, the 20th. And of course, as always please feel free to reach out to our staff. Did anybody electronically raise? All right, just making sure. Every now and again it's a little tricky to make sure you're unmuted and everything.

So with that, then thank you everyone for all of your participation today. Thank you again to our presenters for their great presentations. I really appreciate you coming and letting us dig into your projects a little bit, to our reviewers for taking time to review and ask some really thoughtful questions, and to our terrific staff for putting together a great workshop.

Thanks everyone and have a great afternoon.

(The workshop was adjourned at 3:26 p.m.)

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I do hereby certify that the testimony in the foregoing hearing was taken at the time and place therein stated; that the testimony of said witnesses were reported by me, a certified electronic court reporter and a disinterested person, and was under my supervision thereafter transcribed into typewriting.

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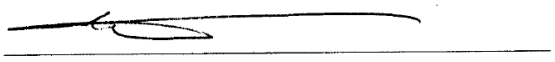

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