

>>Tara Clark: Good afternoon everyone. I am now recording. Good afternoon everyone and welcome to the first FTA CTE webinar on best practices, deploying low or no emission buses. My name is Tara Clark with FTA. I would like to thank Steve and Dan and the team, Mark at CTE for putting this webinar together with us. When I had the idea, I had no idea to what type of format or anything and I just pitched it to them and they just took it and ran with it and I really think you guys are going to get very, very good presentation today so thank you again.

A little background on the Low-No program. The grant program originated in FTA Office of Research and Innovation in fiscal year 2013. Under the fast Tech the program was moved to the office of program management. \$55 million a year is available until fiscal year 2020. Eligible projects include purchasing or leasing low or no emission buses, constructing or leasing facilities and related equipment, rehabilitating or improving existing transportation facilities to accommodate low or no emission buses. For fiscal year 2015 was the first year that we managed the program in program management and I think it was a success. We received 101 projects from 32 states requesting a total of \$446 million. And we were able to fund 20 projects from 13 states.

Some information on the program so go to the Lo No page at www.transit.DOT.gov which is the FTA website. I know everyone is wondering about the fiscal year 2017 program. The notice of funding opportunity for fiscal year 2017 is under development. No timeline for release as we are in a transition phase. Forgive me, I think I have an echo. Sorry. Is everything, okay? Can everyone hear me? Someone said there was an echo. Speakers, how am I sounding out there?

>> Sound great.

>>Tara Clark: Okay.

>> Very good.

>>Tara Clark: I will keep on going. As I was saying, the notice of funding opportunity for 2017 is currently under development. We do not have a timeline for release yet. As you all know, we just elected a new President and he just took office so actually yesterday our secretary was confirmed. So we are hoping with her in office we can now move forward on some of our programs. But in the meantime, please sign up to receive Low-No -related information from gov delivery. I know a lot of you already received gov delivery, the e-mail blast because you are here at this webinar so I just want to let you know now we have a Lo No topic for Low-No program so please feel free to go in and to just add that to your subscription. So the purpose of this webinar is to provide information on the low or no emission buses industry particularly on battery, electric and hydro fuel cell buses. I will not take any questions related to the Low-No program or to the fiscal year 2017 NOFO. Once the notice is released, we will host a webinar specifically on the notice. The purpose of this webinar is so that you guys can get an overview of the industry and kind of pick the brains of some of the

agencies that have already implemented zero emission buses are added them to their fleet. So I want to make sure that you guys get as much information as possible. As I said CTE has prepared a wonderful webinar, wonderful agenda and that means that I will not take any questions. Of course, you can always e-mail me questions on the general program. Again I cannot tell you in 2017 when it will be released. It's Tara.Clark@DOT.gov if you want to ask general questions about the Low-No program. So with that I am going to turn it over to Steve Clermont and his team and panelist at CTE.

>>Steve Clermont: Thank you for that kind introduction and thank you for the opportunity to present on FTA Low-No Grant program also like to thank CALSTAR for their presentation last week as it provided a great overview on zero emission bus technologies and insights from several transit partners. Our goal today is to complement.

CALSTART's presentation and focus on best practices for completing FTA's Low-No grant application as well as deploying zero emission buses again my name is Steve Clermont with the Center for transportation and environment and joined by my coworker Jason Hanlin as well as the zero emission bus handle which includes Rolando Cruz, and others who are representing another of transit agencies as well as different zero emission bus manufacturers. We hope to address all of the questions at the end of the presentation, but please feel free to use the chat feature at any time to pose your question throughout the presentation. If possible precede your question with a person's name and if you would like to directed to a specific individual during the presentation.

First, I want to give you a quick overview of CTE as we are advancing the slides here. Just to give you a little background of our organization the Center for transportation and the environment. CTE is a 5013's a member -based nonprofit foregoing -- organization founded in 1993. The mission is to advance clean sustainable technology for demonstration and deployment and research of alternatively fueled transportation. We offer a full suite of services to assist transit agencies with their zero emission bus projects to meet the requirements of a full project lifecycle from writing grant applications to analyzing revenue service performance and everything in between. That is required to successfully deploy zero emission buses. Are zero emission bus methodology is based on years of expanse helping transit agencies get funding for battery, electric, and fuel cell buses and helping agencies with their deployment projects. While we have many other transportation projects that are not shown here, this map highlights the zero emission projects which includes eight TIGGER projects, six Low-No projects on a number of projects funded through other grant program such as the National Fuel Cell Bus Program and the Clean Fuel Program.

So based on our experience we have identified five critical success factors for transit agencies to understand as they approach the zero emission bus project. Zero emission buses represent a paradigm shift for transit so it's essential to become familiar with all aspects related to the technology. First and foremost is understanding the

technology from battery electric buses with depot and en route charging to fuel cell buses with hydrogen fueling. Next is familiarizing yourself with the manufacturers operating in the market and the types of technologies offered by each. CALSTAR provides a good overview of these technologies and the vendors last week so we will not spend any more time on this topic today. Feel free to reach out to us if you need any information on the EP technologies or vendors in the market. Third is understanding your requirements. And this is very important. Routes, topography, and operational profiles are different for every agency and what works for one agency may not translate into your agency. So it's critical to match the right technology to meet the specific needs of your agency. Jason will spend more time on this topic in a moment.

Next we will also spend some time discussing best practices for the FTA Low-No grant. This is really critical if you want to be successful with your application. And finally, Jason will also present some best practices for deploying zero emission buses. It's very important to understand what it takes to deploy this technology before you embark on such projects. This slide provides a list of battery, electric, and fuel cell bus manufacturers, integrators, and suppliers. It's similar to the list presented by CALSTAR last week so we won't spend a lot of time except to note that Gilly gives added as well as a few other CTE members. Please e-mail us if you have any contact information on any of these vendors. -- need contact information on these vendors. Next is a graph of cumulative bus sales for battery, electric, and fuel cell buses since 2009. As you can see, these buses have followed a typical growth curve for any type of advanced technology. Whether it be computers or cars or buses. TIGGER and other programs were essential in funding several pilot and demonstration projects and programs to get the market started. For more recently the Low-No program has helped to accelerate growth in the market as we can see this exponential growth curve. This growth curve represents commercial acceptance of technology and readiness in the marketplace.

Next we will go through some key -- what we defined as some key best practices for applying for the Low-No grant. And first, off it a partner up. The Low-No program is a discretionary competitive grant program. As such your application is competing against every other grant application from every other agency. The FTA Low-No grant allows you to name your team members including bus manufacturers and project management consultants. The competitive nature of the grant itself means that it meets all third-party procurement requirements. This means that there is no further need for the agency to conduct another bid process for buses or project management services. So why is this important? Well it certainly reduces the amount of time it would take from receiving the grant to moving zero emission buses into service as quickly as possible. This is a key goal for FTA. Furthermore by bringing in a experienced project management consultants we are minimizing the risk for FTA. Again they want to see low risk programs. They want to see these buses being deployed. So it's in your best interest to assemble the best team possible in your application.

Next leveraging other funding sources. The Low-No grant program allows for a minimum 15 percent cost share on buses and 10 percent on charging infrastructure. And all of the cost for project management and infrastructure can be included in your grant. Certainly bringing more money to the table is going to be an important evaluation criteria. So what has been successful for many agencies is to leverage other federal sources of funding like 5307 which can be used for the base cost of the bus and that way you are eliminating your request to incremental cost for the bus so why is this important? This just means that FTA gets to fund more electric bus projects or fuel cell buses projects with their Low-No funding. So Lo No investment per bus equals more deployed buses. It also means that you are taking your 5307 funding off the table for maybe the planned purchase for the diesel bus and are now using it for zero emission buses.

Finally, committing to ZERO emissions. These projects cannot be a pilot or demonstration pilot project. So when FTA is not looking for agencies that are dipping their toes in the water or just trying to test the technology. They want agencies that are making a serious commitment to ZERO emissions not only for the current project, but for into the future. So it helps to have some sort of way for demonstrating that commitment be at a board resolution, a regional transportation plan that articulates the need for ZERO emissions or an Asset Management Plan that indicates your desire and your plan to purchase zero emission buses in the future. Again FTA's goal is that these are commercially proven technology is no longer being tested and looking for agencies to make that long term commitment. I would now like to turn this over to Jason Hanlin to take us through best practices for deploying the zero emission buses?

>>Jason Hanlin: Hello everyone I want to first give a shout out to all of our current past project partners and really to the pioneers in the industry who are out there. Without you guys and without the projects that you guys have done and living through all of this, we certainly would not be where we are now and certainly would not have this base of knowledge that we are kind of passing on or going over today. In working with these projects, these deployment projects, we have kind of -- we have looked at a structure and tried to look at the things that are unique about zero emission buses over conventional technologies and buses. And we realize that to do this as we move towards mass adoption we definitely need to utilize information early on in the process to make smart decisions and handle these correctly and get the best possible life cycle cost out of these vehicles and the best performance.

So before I kind of get into this step wide process, I just want to quickly remind everybody about kind of how complex the spaces or how varied the spaces. There's a lot of different approaches to meeting your needs, your transit agency needs for operations and performance and addressing the trade-offs that are associated with zero emission buses. There's a lot of approaches from even within battery electric buses, from small batteries on route charging for buses that can stay out all day if it's done correctly to buses with large batteries and utilized depot charging. With longer range. And then to considering fuel cell buses to meet your needs. There's basically a big space here and all of these buses and all of these approaches are great approaches

and can reap a lot of benefits however, I really do need to make sure you kind of understand that space and even if you have gone and you are not trying to decide between a couple of different options and you actually -- you've already partnered with an OEM, it is still good to completely understand how the buses going to operate in your environment, your particular environment. So when we look at this aspect, it is pretty heavy on the front end information gathering and looking at trying to drive data-driven procurement deployment decisions so that transit agencies can make informed decisions. There's a lot of variables and a lot of aspects that need to be considered with these buses. Like I said like a especially with battery electric buses like a range and charge time has to be a consideration and there's a lot of variables that affect those aspects. From passenger loads to seasonal effects to battery degradation. And there's a lot of questions that need to be answered so I think if you take an approach, incorrect approach, you start to see the landscape of how and where you can use these vehicles.

So kind of the first part of that is assessing the technology the way that we typically approach it is to take a simulation of modeling and simulation approach so that, you know, we do have bus models, computer models of bus powertrains as well as we are able to pull duty cycles or the actual duty cycles that the bus will be operating on. We use a program called autonomy that we have adapted to the bus industry. This program and the previous program P-SAT is used in the light duty market in the passenger vehicle market with those OEMs. So we are able to run a lot of conditions and scenarios and do parametric analysis and understand how to answer those questions that we just looked at and those concerns. And also to compare the difference technologies and feed our trade-offs on down the line. So that kind of brings us to the next portion of this which is it's really important to understand your electricity rates and fuel costs, hydrogen fuel costs. With electricity rates they can vary widely from utility to utility throughout -- and location throughout the country, but also within a utility you can have the option for different rate structures. And even within those, you know, those can change out to our over the day especially related to demand charges. So it's really critical that you understand how that is going to play out over a day, over a week, over a month, and over a year. And ensure that you are in the correct rate structure. And/or that you have deployed the correct hydrogen fueling station or has the optimal capacity that you need because that will certainly affect your business case. Then of course, doing a business case which you guys are pretty familiar with doing, lifecycle cost analysis, but just keep that in mind that a life cycle cost analysis is really only as good as its input and assumption. That's why it's important to do a proper evaluation.

The next step, here are some things again that are kind of unique about deploying zero emission buses. One of the biggest ones is currently is managing and coordinating infrastructure with the vehicles on the number of vehicles and the expected fuel consumption that you are going to see. And then even practically how do you do that in terms of procuring or basically managing that, who is responsible for it, where it is going to go, whether on route or at your depot and kind of answering those questions and coordinating and making sure they get deployed around the same time is really

important.

One other thing that I would like to emphasize as if you are doing battery electric buses to engage your utility early in the process.

Step three deployment planning, really the unique things about this one is I mean there a lot of this is pretty standard for you guys spent understanding who is going to do the training and understanding both the hydrogen and high-voltage related aspects of the training and ensuring their component especially under maintenance and first responder training.

Secondly PR and communication. These buses provide a huge amount of benefit and you want your riders and the general public to understand and know that you are stepping out doing these things that are good for the community.

And then implementation is pretty straightforward. You know, I think in some cases you might want to do shadow service to understand exactly as you put these things out to match them with the on route fueling infrastructure.

Finally, key performance indicators, it's really important to track and analyze the performance and benefits of these vehicles whether it is cost related, performance related so that you can go back and basically understand where you need to make adjustments, make training adjustments, maybe go back to your staff, yours planning staff or your drivers and make some adjustments in the way that they are being operated. It's also good to really understand the benefits and go back to stakeholders and for instance, your board who have decided to undertake this challenge and have hard evidence of the benefits that you are receiving because of the vehicles.

So I think that is it for my part. We've got a great panel discussion coming up. We have tried to pick a group that kind of spans the gamut from bus technologies and providers, both fuel-cell and battery electric so hopefully this will give you a good idea of how to approach this.

>>Steve Clermont: Thank you, Jason. We are going to give each of our panel members about five minutes to talk a little bit about their projects and some of the tasks or items that they found were critical for successful deployment of vehicles. So first I'm going to turn it over to Rolando Cruz. Rolando is the chief operations officer for Big Blue Bus. He was also up until recently the project manager for the deployment of 10 battery really electric buses at Long Beach transit. Rolando.

>>Rolando Cruz: Thank you, Steve. Just wanted to cover some of my experiences as a Project Director while I was at Long Beach transit and as Steve mentioned, that project included buying 10 40-foot electric buses from BYD and I was involved in this project as a Project Director from the inception of writing the scope for a TIGGER and it took us three times writing it to get the grant to awarding and final implementation of the battery electric bus program and I use the word program because not only did we buy

buses, we knew at the inception that we were getting involved and needed to do some infrastructure work for charging and were considering both depot and in route charging. As you can see by these pictures, the ultimate result was that a ward of the BYD electric bus on the bottom and the depot in the left center and a charging system that was put on the bus stop. And in that project we had to do an entire rehab of the bus stop so that Long Beach transit could make a grant. Next slide.

So my intent to day is to share three quick takeaways if you are considering new technology propulsion projects. First, you can see that the program award here was that the end of 2011. It did take us three attempts before we got the award and so my advice here is if you want to do a project, keep on writing. Reach out to those of us who have already done and what we did to help us become successful in getting the grant and then how we can help you because we want to promote new technology. Secondly is that the technology and the experience in doing this project is different than just buying a bus. As an organization we know, transit agency, we all learn from each other. So it is wise not to do it by yourself. As I mentioned, I knew we needed to do some kind of electricity infrastructure and I knew that the technology was changing quickly and I needed help. Our organization at the time needed help. So as a result we solicited a Program Manager and ended up awarding a contract to CTE. CTE helped Long Beach transit start with a market survey educating us with the options that were on the market. That helped us lead to an evaluation that included the route modeling, electricity rate modeling and a full lifecycle cost comparing diesel, CMT and the battery electric bus options as discussed earlier. When I was working for LBT we made the best decision that was best for LBT at the time. My team learned a lot from the experience of others as we reached out to those that were doing projects and talking to them. Finally, I would say again don't do it alone and I think that is my theme I'm trying to leave off. This is new to all of us in the industry. I just sent -- definitely want to encourage you to reach out to each other so we can help each other out in our industry we as transit agencies are not competing with each other and we can continue to benefit from each other's experiences. So good luck on your venture and let me know what I can do to help. Thank you.

>>Steve Clermont: Great. Thank you so much Rolando. Our next panel member is Al Babinicz. He is the CEO and general manager of Clemson area transit. They've been operating six battery electric buses as a result of a TIGGER grant and were recently awarded a Lo No grant for another 10 battery electric buses. Al.

>>Al Babinicz: Thank you. Good afternoon everyone and thank you, Steve. I want to take the opportunity to thank FTA and CTE for hosting the webinar and we appreciate very much being able to participate in it. Clemson area transit dipped their toe and fell into the entire pool if you will, and committed our services in Seneca to become an all-electric public transit fleet. So it started back in 2012. Cat is currently leading these two projects as Steve mentioned. The project in Seneca got off the ground in 2014 after Seneca received a TIGGER grant and replace the entire diesel fuse fleet of buses with zero emission battery buses from Proterra. It was the only provider -- eligible provider at that time for us. The city of Seneca, the city of Clemson,

all partnered together and the partnership is critically important to the success of the project. We worked together to create the first all-electric zero emission public transit system in the country and we continue to be all in and have successfully converted all the deal bus -- diesel buses to electric. The TIGGER grant was the largest award of its kind at the time and we currently operate six Proterra buses and to en route fast chargers. A lot of that experience and that project lead us to make further commitments and led us to the success of the second project we are involved with now. This time in Clemson, South Carolina. CAT bus was awarded a Lo No grant in the middle of 2016. And it was the largest Lo No grant funding of any transit agency in the U.S. Now this grant will purchase 10 additional battery electric buses with options for 28 more buses. The 100 emission buses will be operated mostly on Clemson University campus and surrounding areas making Clemson University the first university in the nation with an all-electric ZERO system. CTE is the designated project manager for the Clemson project as they were for the Seneca project. So we are building success on success and on CTE experience as well as our partners, Clemson University, South Carolina Department of transportation and of course, the FTA. CAT 2016 successful Lo No grant application named three OEMs. There were three qualified OEMs at the time and we are talking to BYD, Proterra and new fly at this point, in time. As I mentioned CTE as the project manager for the project and starting in March, on March 1, 30 days from now we will be testing and demonstrating the three buses, at least the three Proterra and flyer in the local environment and demonstrating by all OEM so that test will go for 3-4 weeks and it's part of our due diligence for that. So over these years and over this time we worked hard to build success on success. I might add that we are proving that the zero emission buses are really a great future option for public transportation. This morning, are all electric battery bus number one ZERO three that operates between Seneca and Clemson University reached a national milestone record of 100,000 miles of uninterrupted passenger service so we are delighted with the performance of the buses. The performance did not just happen. We had a lot of input in developing performance standards for the buses so they would guarantee this kind of success and reliability. Because again we were not just dipping our toes and, we went all in in Seneca and bought all electric fleet to replace and all diesel fleet. The reason this is critical and important is because even though it's small, Seneca, sort of a beta test site if you will, the reason it's important even today is that it is scalable for much larger systems. And we've had system from around the nation and around the world Paris, France, Canada, and other places come to Clemson to see the operation and use the metrics and the data in the information provided and our experiences for their evaluations and they are a much larger system than we are. So we have some best practices and some have already been mentioned. CAT's guidance for the grant, I will touch on that. To start with, carefully read the Federal Register. It may sound simplistic, but in our experience whether it is TIGGER or Lo No, Lo No notice maybe different than the one before. So find out what you can do, what you can't do because it can be critical to the success of your application. Secondly, have a good plan. Lay out the site, how you are going to do this and what you are going to do. In order for most of us to do that you have to bring in good partners. I like the idea of naming your team and we did that in this application. We filled it with folks with expertise in the business and they are hard to find, but CTE is

best in class. We are delighted to be able to continue our work with CTE for the fifth or sixth year is our interest and commitment to this and people like Steve Clermont and Dan are champions in the business, best in class without a question. Thirdly have a local match commitment in place. Not promises, but commitments for local matches and this is what FTA wants to see a commitment to the project long term. Board resolutions, letters of commitment, more than just promises and seeking funds to do a demonstration or create a small interest in it.

Finally, CTE is the project manager along with the three OEMs that we mentioned as project partners. We've got leaders in the industry, electric buses and creators and thinkers like CTE so we are delighted with that. We negotiated electric bus performance into our contracts and this is really critical because FTA wants to see that expertise as much as we did at the time and continue to express interest in it. Finally test and demonstrate the E bus performance when they arrive and if possible in the beginning of the RFP process, if you can test the buses and make sure that the claims, the OEMs are making, will work in your environment. Every environment is different. It's not a cookie-cutter approach. That leads us into our guidance or suggestions and best practices for the deployment of it. Again goes back to having a good plan for the deployment. You need experts around you to help you create that plan. Again the OEMs themselves are eager to demonstrate their technologies. CTE again is best in class. It is a sure fire way for deploying any new technologies. The second item would be under the deployment side is be careful never to separate the charging infrastructure from the bus deployment. We have been hearing about zero emission buses and bus and bus and bus, but very little discussion takes place and the surprises are usually on the charging infrastructure side. You can't separate one from the other. Coordination is key. There are utilities involved in OEMs involved. There is a transit system and property locations involved if it's in route or if it's in your depot, the charging infrastructure, so a lot of moving parts so never lose sight of that. So again CTE is experienced in deploying buses, the notion of route study modeling, University of Texas initially was used for our topography checks. Operational profiles and range simulation. All of these things, duty cycle become critical to the success of your operation because each operation is different. So working with utilities, the rates and demand charges and options are different in Seneca as they are in Clemson and required different approach to the successful deployment. And finally shadow testing should help with a successful deployment. Training and not just the drivers, first responders, even board members require comprehensive understanding. And in conclusion, you will be successful deploying these buses and share your success and involve your partners in your success. Thank you.

>>Steve Clermont: Thank you so much and congratulations on your 100,000 miles milestone on that bus and as a side note, Clemson route seven did not use a drop of diesel in well over two years so congratulations on that as well.

I would like to now turn it over to Eve Ng. A senior capital planning and grants specialist with ACC transit who runs the largest fuel cell fleet in the country and they've been recently awarded a grant for battery electric buses.

>>Eve Ng: Hi, everyone. I am Eve Ng from AC transit and here today to share our successes in zero emission buses. I think you've already gotten a lot of detail so I will tell you what we are off to today and what we will be up to in the near future and maybe a little bit on points that have not been made. We have an established fleet of hydrogen fuel cell buses we will be expanding and also adding battery electric buses in the near future. So in the current time we have 13 hydrogen fuel cell buses. They are 40-foot buses and have nearly 18,000 hours of service in the last five or six years and some of them are close to 20,000 hours on one of them are champion at over 23,000 hours. With sites in Emory and Oakland we store liquid hydrogen on-site to fuel the buses and we have additional liquid hydrogen delivered to supplement our volume. The hydrogen program has been supported by several grant partners as you see my list there. We have partners at the federal, state and local level as well as OEMs. These partners -- federal, state and local have funding opportunities and all of our partners really help us put our program on a firm foundation. The funding comes mostly in the form of grants and is passed through funding. I want to make a note although most of the funding is for grants we also receive substantial support from our local utility provider. They gave us a great rebate with our program.

Next slide. So what we are going to be doing in 2018 is getting 10 more new hydrogen fuel buses in this project will cost a total of 13.\$5 million which is a substantial reduction over the years. We were successful in being awarded 4.\$8 million from California air resources Board through their air quality improvement program and also the bay area air quality management District is chipping in \$1 million as well as some district funding. So we submitted this project as part of a consortium partnering with CTE, Orange Co. Transit Authority, New Flyer and Lindy and this collaborative effort works well as the previous presenter mentioned. We get a lot of support through the vendors through economies of scale and large orders and it was definitely great to have CTE as the master coordinator of the project shepherding us through the process and CTE also with managers to keep our application consistent and relevant. And so that contributed a great deal to our success.

And finally, we are also -- next slide. Finally, also in 2018 we will be getting five new battery electric buses and this is new for us. We will also be needing to get some depot charging equipment along with the buses for total project cost of \$6 million. We were awarded the FTA Lo No funds to purchase these buses and the charging equipment. And again we are going to be partnering with CTE and new flyer to deliver this project. We will be using the same new flyer buses as we will be getting for the 10 hydrogen buses and they will be delivered around the same time so this will be a great opportunity for us to enable testing. We will be able to test the battery fuel cell equipment in the same environment and from the same manufacturer and we are really excited to be able to do this data collection and contribute the research to the industry as we are in the paradigm shift as Steve mentioned in his introduction.

That is how the ZERO emission program in a nutshell and I can speak more to the grant writing process or any other questions if you want to post that to me and I'll be

happy to answer them. Thanks.

>>Steve Clermont: Thank you so much. You are involved in some pretty exciting projects there.

Before we go on to our last speaker I want to remind everybody if you have questions, please use the chat feature and right after the last speaker we will get into the questions.

Our next speaker is Rashidi Barnes. A senior manager of transportation for County connection in central caustic County and they've deployed battery electric buses using wave inducted charging and recently received another grant for additional battery electric buses.

>>Rashidi Barnes: Good afternoon good morning to people on the West Coast. Thank you for having us. To let everyone know a little bit more about Contra Costa County and what we are doing we are 30 miles northeast of San Francisco in the heart of Contra Costa County. We currently are 100 percent electric feet. We have 121 diesel/hybrid or a mix of hybrid buses as well. In 2012 we were awarded the clean grant if you will -- clean fuel grant for 4 electric buses. We used those to replace 4 buses that we have on the circular 3-mile loop that services Walnut Creek in Northern California.

Fast forward 2016 we were awarded a Lo No grant on a combination funding. We've been working with CTE on both projects and as some of the presenters stated before they've been a great Shepherd in getting us to the point of where we are at now. I'm going to talk a little bit more about the operational component of it because it is a change of paradigm for a company that has only been in existence for 30 years and we need to change the organizational culture that started from the top with our general manager pitching our goals and ZERO emissions to the Board of Directors and the Board of Directors buying into that and we just had to stay persistent with that. So we were awarded in 2012 the clean fuels grant, we searched for a partner that we knew was very viable in the industry. Since we are local and Gillig was local it was a natural fit for us. And one thing we wanted to do was work with BAE as well because we have hydrogen a lot and we've worked with BAE in the past and it was a natural partner between Gillig and BAE. And finally, we worked with wave, brought them in and they helped us out with installing a wave inducted charging at the Walnut Creek station. So our service -- about 90 percent of our buses interact with a BART station. Because we are a feeder system with Bart we had to work closely with Bart to make sure we can utilize their property for the construction purposes. Some of the presenters have talked about some of the things to focus on in the beginning and the local utility, it is very, very early in the process that we need to do more. In my prior life I worked with some Proterra deployment and that was a big thing we had to focus on in Southern California was getting Southern California on board with the project.

Another operational thing I think needs to be discussed is training. We have 171

operators and we have a lot of people who have been driving buses for a long time. It took them a long time to get past the fact we were now driving a different type of bus. Training with maintenance staff. That took some time as well for us to get them over that hump. We had to sit down with all three of our unions as well and make sure they felt comfortable with the new technology because as soon as someone starts talking about battery technology, people are scared of what they don't know. They hear about high voltage, they hear about all these different things that could happen, but until we sat down with all three unions and disgusted they did not feel comfortable until after that. One thing we did operationally is created a new SOP. When you do when your state is charged on the vehicles less than 50 percent in what you do when you have these flashing red lights? So we had to not only change the mindset of our operators but our dispatchers. Our supervisors now who report in the field. You have to maintain those vehicles to get them back on the road when there you have minor issues and make sure we retrain them and get them up to speed on what they needed to know. So we worked closely with wave and with Gillig and BAE to make sure that they were able to provide us the information we needed to disseminate to the front line employees. And then lastly, two more things I will say. You have to stay committed to the process. You have to keep writing and keep writing. Your ultimate goal is to become ZERO emissions you have to stay committed to it and one thing the general manager did is pressed on and pressed on and when we got a board to buy into the project as well as our city that we interact with, it was full speed ahead. And then lastly you have to stay flexible. One thing we have learned is things will change on the fly. Your utility it might not be available to talk to you today but they will talk to you again in a month or so or when you're grant process held up because of some other union issues. So a lot of things can occur so you have to be flexible in this process. I thank you, CTE and FTA for putting this on and if anyone has any questions give me a call or submit them.

>>Steve Clermont: Thank you so much Rashidi and it sounds like you're a good learning experiences with your project as well. Before we get to the questions, I want to thank Tara for everything.

I feel like our program today it was brief and we are just scratching the surface here. We could talk for hours and days on these topics and there is so much to learn, but hopefully what you are taking away from today is that zero emission buses are commercially viable, they are ready on here in the market is expanding. The market would not be growing unless transit agencies like yourself would be successful in the deployment and getting the technology out there. So obviously they are providing a benefit and are being successful. Secondly I think you heard from several folks, Jason and several panel members understanding the technology and understanding how to use it in your routes or in your service is critical for success. Don't under estimate the level of effort that takes. And finally, Lo No is a great opportunity to start transition so I highly encourage each of you to submit an application and get involved and to move toward zero emission.

We will go through some questions now that we have received from the chat section.

The first one asks do any operators have any actual battery electric bus performance data to share availability reliability fuel economy et cetera? So I would say definitely, yes. A lot of the grant programs especially TIGGER and Lo No we have worked on we have always conducted a data collection analysis and reporting exercise and provide that information to the transit agencies, so feel free to contact any transit agencies that have done this or we could assist with that project to get access from those transit agencies. In addition, the national renewable energy labs have done a tremendous job collecting data from transit agencies across the country and they periodically issue reports on that information as well speak to one report you can get right now is the foothill report if you go out and look for that. Download that one.

>>Steve Clermont: There are a few questions related to the program and if you have program related questions and want to reach out to Tara Clark directly on this.

>>Jason Hanlin: Actually do any of the panel members have data available that, you know, you guys can point to? -- point the audience to?

>> CAT bus has data experience for the first two full years of our operating of an all-electric bus fleet. So we are happy to share that information with anyone that wants to requested vis-à-vis e-mail. Unless you want some high points now? Is that what you are looking for?

>>Jason Hanlin: I would say let's arrange to get the information and collected and send us an e-mail or send you an e-mail directly with that data and you can organize that. There's also another question directed toward Eve. Are you procuring charging systems from New Flyer or from a different vendor?

>>Eve Ng: Hi. We are not entirely sure at this point, in time. We will be purchasing a new system, but presumably -- I guess not sure exactly whether we will do this through new flyer or separately at this point, in time.

>>Steve Clermont: Thank you. There's a question of the panel, what have been the various hardest parts of your deployment and your paradigm shift some what's the worst situation and moments and the biggest pushback? Alright so lots may be Rolando, do you want to take that first?

>>Rolando Cruz: I think again, Rashidi talked about some of the issues that we face both on the technician side as well as the operator side and so definitely in the deployment there had to be a lot of conversation and education so I think from the inception we had to get educated ourselves as a Program Manager and project managers and we had to understand what we were being faced with and then once we understood it we needed to be more collaborative been talking to others because they're absolutely is a fear and a lot of individuals of the new technology and the way to address that fear is through communication, is through getting them to understand that it is like anything else so it just takes time and information sharing.

>>Steve Clermont: Eve or Rashidi or Al do you want to on to that?

>> My thoughts is Clemson would be to negotiate performance into your contract sent into your agreements and that has to be based on some knowledge of it in order for you to educate the board. One of the first things we did in the beginning is we visited foothills to see how their operation was working. We learned a lot from the mechanics and the general managers and maintenance personnel and we came back and built that into our specification and into our plans. You know, we did not wrap our arms around the environment -- the environmental benefits which are tremendous by the way,, but we put our faith in saving money and saving dollar at the local level on fuel and maintenance first. And we looked at the environmental impacts as a bonus if you well. And the board members that we talked to and the leadership that we talk to understand numbers and we are able to show them savings subsequently we have been able to prove technology and the savings and it and we are saving a significant amount of money, but as an example dollar per mile on the maintenance cost. But in addition to that environmentally we are saving the equivalent of planting 40,000 trees and eliminating to thousand pounds of greenhouse gases and all that but start with the money savings on fuel and maintenance first then work -- then use the environment as a bonus and they will support you.

>> Thank you, Al. Rashidi anything else to add as far as what was the hardest part of your deployment or worse situation and how you dealt with that?

>>Rashidi Barnes: One of the things that I would say is like Rolando said, communication is key. We brought in first responders, fire departments, police. We wanted to make sure they understood how to interact with vehicles if something was to happen out there in the field. Another key for us I think was partnering with a local OEM in Gillig because they are 30 miles away, if we do have an issue, they have been very good in responding and quick to respond when there are issues. So that has helped us a lot as well. And knowing that they will put the thumb on or the press on CAE and wave if need be has helped us a lot when we've had any kind of issues with the vehicle. Or the infrastructure.

>> Steve, if I could add one last point, this is Rolando. I think as everyone is thinking about the technology recognizing that what you implement maybe different than another similar bus model that was implemented two years ago. So the training will be essential. The documentation is developing and so you've got to understand that especially right now that they are going live and we are trying to implement more and more and more and hopefully overtime that will become better, but we have to understand that there is still some newness to it and you need to be involved in the training documentation. You need to understand all the pieces so be ready to get vested.

>>Steve Clermont: Very good. And Al one more thing I would add, the one common challenging element to other projects we've been involved with is really on the infrastructure side. And they tend to be very complex projects. Not that they are

difficult in and of itself but so many more players that are involved. You have the bus manufacturer involved, you have the charging infrastructure manufacturer involved. You have the architect and engineers and contractors who are bringing civil, mechanical or electrical engineering to the table and on top of all of that you have the permitting authorities the city or the county or whatever. So there's a lot of challenges and it's very difficult to maintain a schedule when you have that type of complexity involves so we often find it takes more time to get the infrastructure in place then to build the bus. That's something to keep in mind. Eve, I will give you the next question that comes from Debbie. We have a hydrogen fueling station and we have our tax refund from the state for D cell and also have gone through the process to be tax exempt for CNG. Do you know of any tax exemption for hydrogen fuel? So Eve, are you aware of any in California?

>>Eve Ng: Actually no scale we are not aware of any tax exemptions for hydrogen fuel about what we do have is the cap and trade program so we get credit for the cap and trade program to the hydrogen production and that has led to some cap and trade revenue down the road probably.

>>Steve Clermont: All right. Peter asks is there a notable difference in break line and lights going from diesel to CNG and of course, the premise here is that with battery electric buses or fuel cell buses you have regenerative braking capability so the premise is that your brakes will last a lot longer. Rashidi or Eve, is there something you can speak to from experience which would indicate that is true?

>>Rashidi Barnes: We here at County connection have been only running our electric bus or buses since November so I don't have data on that yet.

>>Eve Ng: We don't have battery electric buses yet, so we will let you know in a couple of years.

>>Steve Clermont: Anne you've been operating them the longest have you noticed a difference?

>>Al Babinicz: Absolutely. We get two or three times as much break life as we did diesel buses. It is an attractive proposition.

>>Steve Clermont: Very good, very good. He also asks that you are not dealing with troublesome emission gas control is their potential to reduce spare ratios with using this technology and Al, have you noticed any thing you've been able to do on spare ratios?

>>Al Babinicz: I asked that question of our maintenance people today and our spares are fully available, but not used that much except for routine maintenance. So I think there is an opportunity to potentially reduce the ratio. We did not think that in the beginning. In fact, we overcompensated a bit on the spare ratio because we were all in and could not afford to be down or to skew the metrics in data that we were following

by introducing diesel buses as an example as a substitute for electric. It would change the whole profile. We did not need to do that. We found the buses to date to be extremely reliable.

>> I definitely want to chime in on that one because I can remember spare ratio, one of the things is the work that we do on the propulsion system or the brake systems. But we all know as a challenge in the industry that the bus continues to become more complex with the introduction of transportation systems and other requirements so there may be some potential for decline or need to do maintenance for the propulsion system and brakes, but it is being offset by others and so a lot of transit agencies are currently having an obstacle of meeting the 20 percent. So it is a combination of many factors. So please do not tell your board or other people without talking to your maintenance department whether you can reduce your spare ratio.

>> I would agree with Rolando about that. I would just add that a diesel bus today has about 3,500 moving parts. And our electric buses today have about 70 moving parts. So in terms of maintenance and reliability, you can see that is a dramatic gap.

>>Jason Hanlin: This is Jason. I also want to bring attention to FTA just updated the former grant management awards circular. The new circular actually provides for the ability to increase the size of the contingency fleet on a 141 basis for any zero emission vehicles being introduced into the fleet. So this is actually something we wanted to see a while back that we pushed out of a group that assessed risk and barriers to zero emission buses and, you know, this is very recent. So we are still kind of unpacking yet. But it appears that FTA is going to allow if you have zero emission buses that they will not count against -- I think I'm saying that's, right,, they won't count against your spares ratio. I can paste this in the comments block exactly what it says, but it's good news for our industry.

>>Tara Clark: Hi, everybody. This is Tara and if you have questions about these spare ratio forward them to me. We have a Program Manager who handles these questions. I think the answer was great, but just in case you have any more questions, please feel free to send me an e-mail Tara.Clark@DOT.gov. Sorry, guys.

>>Steve Clermont: No problem. Thanks. Several folks have asked about downloading the presentation and Tara has responded that both our presentation and CALSTART presentation will be available on her Lo No website. Next question, what is the capital cost of the hydrogen fuel cell bus. Eve, would you like to take that on?

>>Eve Ng: The press has come down quite a lot over the years when we first started it was 3.\$2 million a bus in the current fleet we have was 2.6 and currently the new fleet that we will be getting next year we are at 1.\$3 million for each bus. So it has come down quite a lot over the years.

>>Steve Clermont: Thank you. Amy, you asked what is the electric power per bus

consumption on average? And that is the question. Do you want to take this on?

>>Jason Hanlin: I think it would be good to hear from the panelist and what they are seen because that obviously varies significantly depending on where they are being operated and how they are being operated and I think that is the danger of the whole thing. In the industry we typically throw around 2.ZERO, 2.ZERO kilowatts and I think a lot of buses are operating around 1.7 or 1.8 kilowatts per mile and that's generally supported with the data that you see the results and that results you can see from Altoona testing you can pull those reports and see those numbers and I think that is what we see in general from a baseline perspective. At L2 now they are on flat ground and no HVAC so kind of optimal conditions and I think in most cases that is generally what you are going to see but we also see with high HVAC loads, hilly grades, unique conditions like special events you can see even up to 4-kilowatt hours per mile. So that get that kind of the heart of why you need to do this analysis or the upfront analysis because that makes a huge difference on your range. And if you are not aware of what's happening with these individual conditions that's where things -- you can get into trouble especially when you consider battery degradation and you don't have that full depth of discharge that you normally have four full energy available to you. But I don't know, maybe, Al, do you want to provide -- do you have numbers on what you guys typically are seeing right now?

>>Al Babinicz: I do not have those numbers with me. We have a pretty heavy load here in Clemson particularly on the campus service. We get standing room only most of the time. So we are very careful about that. We did have for the Proterra buses, we have the University of Texas do some topography analysis because it's quite hilly here and we have a 12 and 16 percent grade in a couple of areas and we were concerned about that. And the models they came back with we used the highest model recommendation so that the highest common denominator in our specification so we could co-mingle and interchange the buses on that service. So we specified the buses to the highest common denominator. Even if some of the routes did not require that, we wanted that flexibility. The modeling is really important. And this is really what CTE is good at. You need to do the route study, the range was there at the beginning. The Proterra buses were getting 30 miles per charge on a fast charge and the average fast charge was six or seven minutes so it worked fine for a while, but now the ranges, they are claiming ranges and hundreds of miles for some of these OEMs. So we are going to have a close look at that because we will be running different distances and adding more services and we want to make sure we use the highest common denominator for all of the vehicles. I hope I answered your question, but I don't have a specific kilowatt hour per mile number that I can share with you. We have it but I don't have it in front of me.

>>Steve Clermont: I think that really is kind of a point is that efficiency is going to be very different for each agency so it's very difficult to manage expectations by telling you a specific average number so they will vary. Let's go on to the next question. How do electric utilities help with the infrastructure? How do they set electricity rates? So electricity rates are set before hand and basically are put in place by the utility

commission so generally you will not find that they will negotiate a special rate with you. However, they typically have a number of different rate schedules that you may have the ability to choose from. Or it may depend on how much energy you are using and what your demand is. So as part of the upfront analysis you want to understand what are the rate schedules available to you and how do you incorporate that into your analysis. As far as helping with the infrastructure, to date that really has not taken place. However, most recently a lot of the utilities have become engaged with transit agencies and bus manufacturers that have come to the table wanting to participate as a partner in many projects where they would have a role in either installing or owning the infrastructure. So this is a development that we expect to continue over the next year or so and a tremendous benefit for all agencies going forward.

>> Steve if I could mention that this is something we have to learn because it is a new fuel source and we have to see electricity as a fuel source and know that it is not under your control if it is regulated and that it is going to constantly change. I know when we first started the project, there was a certain rate. Two years later when we went around again with that, the rates changed. And today the rates are different. So they are constantly fluctuating and you have to figure out what is the best rate so that you can lower your fuel costs.

In regards to the infrastructure, your partnership in relationship with your provider, they definitely are moving forward and I know there's already rumor mills for our local provider that they are getting ready to help fund the infrastructure so there is a realization that the partners know that it is a good thing for them to support that effort and I think it is a partnership and you need to include them in the conversation from day one.

>> Thank you, Rolando. Related to that, Peter and Mark asked what is the utility costs increased her bus and that's fairly difficult to say because it depends on the agency, depends how you use your buses and when you charge your buses. Depends on the rate schedules available so this is all analysis that you want to do upfront to really understand how electricity will change the cost of feeling as Rolando pointed out. So if it provides a tremendous benefit, it all depends on the utility schedules in your particular area and how you use the buses and how you charge them. Debbie asks what size bus -- a question for Eve, what size bus will you be getting next year for 1.\$3 million?

>>Eve Ng: I answered on the chat, all 40-foot buses.

>>Steve Clermont: Are any of the fuel cell vehicles feeling at 700 bar, 10,000-psi?

>>Eve Ng: Yes, we are at the 700 bar feeling for our buses and we actually are on site at Emeryville have a feeling station for passenger diesels.

>>Steve Clermont: All right. John asks where is the largest fleet of battery electric buses with depot charging? How would charging departments change to the charging

infrastructure? Probably the answer to that changes on a regular basis. Long Beach will have 10 buses. I think a BTA will have a very large number of buses. Not sure of the number. What is important here is typically you would have -- you may have dedicated parking for a depot charged bus or basically one charger for each bus or you could go to swap buses out of parking spaces you can do that. It's scalability. How many can you charge overnight at your facility? That depends on the level of service for your availability so that's the larger question you want to address is you are analyzing your potential solutions here. Speaking of battery degradation, can any of the operators comment on what they have seen as this has been provided in the published reports. You've been operating buses for the longest period of time. Have you noticed any battery degradation?

>>Al Babinicz: No. To date they are above the curve and some of the literature that we get from a couple of the OEMs we are working with this they can have 10,000 charges a year for 25 years and still have 70 percent useful life on the battery. So this is part of the reason we are going to be doing the due diligence in March and demonstrating and testing buses and trying to get some of that data and some of that that we can use, but we've had fairly good success to date. In fact, it's one of the brighter pieces of data we are coming up with on it.

>>Steve Clermont: Also --

>>Jason Hanlin: This is Jason, it is a little bit different for operators to measure degradation unless you are running out of energy on route and kind of understanding that, it's not something -- it's very difficult to measure. So you really have to test just for that. So it's hard to say, but in general end-of-life is 70-80 percent of original for a battery.

>>Steve Clermont: Ryan asks how long the batteries are expected to last and what do they cost per bus. So what I would recommend is you would take that question to each one of the manufacturers. They each have their own chemistry so they are going to vary and it also depends on how you use them. They will be able to provide you with a cost estimate per bus.

>>Jason Hanlin: They also have different approaches to warranty for the batteries.

>>Steve Clermont: Ron asks are there any transit agencies using energy stores to recharge the battery electric buses to offset the demand charges? We are not aware of any agencies that are doing that right now. I know we have done some analysis on exactly what you are talking about and I think the results of that, at least when we did our analysis a while back was that it would take a tremendous amount of space and cost a tremendous amount of money to enable that to happen, but certainly I think this is an area of interest that many agencies as well as the OEMs have so I encourage people to continue looking at this.

There was a question earlier by accident -- so John writes does anyone know about the

procedure for the VW settlement fund and I am going to invite Wendy Morgan, our development manager who's been investigating exactly that question.

>> Thank you, Steve. So each state that decides to be a beneficiary under the VW mitigation trust has been designated an agency to be responsible for their program and they will develop a state specific plan for how they want to distribute those funds and which projects would be eligible. The consent decree does lay out the types of projects, but states have the flexibility to develop their own plans consistent with the consent decree and it will be on a state-by-state basis on what projects will be eligible and which agencies will manage that.

>>Steve Clermont: Thank you. So we are fast approaching our time limit here. Certainly want to thank everyone for joining us today. Hopefully this has been helpful. Please feel free to contact Jason or myself with any questions that you may have had or that we didn't get to today. We will follow up on anything we have. Tara, I will turn it back over to you.

>>Tara Clark: Thank you, Steve. Guys, I think you did an amazing job. Panelist, thank you guys so much. Thank you all. I think all of the participants have a wealth of information that can help them to be able to make them make good decisions. So again, thank you, thank you, thank you. And if you have any programmatic questions or even questions -- I might not be able to answer much about the next NOFO, but feel free to contact me Tara.Clark@DOT.gov and you have the contact information for both Steve and Jason and with that I will say thank you and wish everybody a good day. Take care everyone. Goodbye.

>> Thank you.

>> Thank you.