**Andrew:**  Good afternoon, everyone. Thank you all for joining us this afternoon and hope that everyone on the East Coast has managed to stay dry so far through the tropical storm. And so we have an exciting webinar for you all today, and so a couple of logistical items before we get started. First, we are recording this webinar, so if you get cut off or if you would like to go back to it, there will be a recording available in the next few days on the N-CATT website. And then also we will post a transcript afterwards as well. And we definitely encourage questions. So please use the Q and A box on your toolbar while you are watching the webinar. Feel free to send in questions any time throughout the webinar. We’ll either answer them at the beginning or we will answer them during the Q and A section at the end of the webinar. And so we will have three different slide shows and then Q and A section.

And so with that, we'll get started here. And so first I want to introduce N-CATT. I am Andrew Carpenter. I'm the deputy director of N-CATT, the National Center for Applied Transit Technology. We are FTA’s newest technical assistance center operated of Community Transportation Association of America in Washington, DC. And so we are in a cooperative agreement with the FTA to provide small urban, rural and tribal transit agencies with practical and replicable resources to help with applying new technologies in their systems in their communities. So we have found that larger systems have their resources and the staff available to be able to test new ideas, explore new things. So we wanted to make sure that we could scale that down to small urban and even smaller agencies with different needs different capacities and nonetheless would like to push their agencies forward.

So you can find us at n-catt.org and that is where we'll post this webinar and we have lots of other resources available on our website. So we have white papers, fact sheets and other information. So we have a no wrong door approach to information that helps you understand the technology world that's out there and how you can apply that to your transit system. And so we want to get as much of that information out to you as possible and then easily digestible manner. And so part of that is through these webinar series. And so we have two-parter for August. We have today's on electrical utilities. And then on August 18th we have a webinar on hydrogen fuel cell buses. So both of these will be very interesting. I'm excited to learn a lot about this as well.

And so with that, I'm going to hand it over to the experts in this field. And first up, we have our colleagues from CTE. We have Alison Smyth who is an engineering consultant and electric utility specialists. Alison provides project management and analytical support for advanced transportation projects, including battery, electric and hydrogen fuel cell electric vehicles. Alison has BA in Chemistry from Carleton College and a master's in oceanography from Texas A & M University. Very jealous of what those projects would have entailed whereas mine was just all research papers when I went to college.

So we also had Amy Posner, who was an engineering consultant at CTE. She provides a management and technical support for advanced transportation and clean energy products, including the development of better electric and hydrogen fuel cell buses or products. Ms. Posner has a bachelor's in engineering and chemical and biomolecular engineering from the University of Pennsylvania. As well as a masters in sustainable energy engineering from the University of Maryland.

And also with CTE, we have a Maggie Maddrey who is an associate at CTE. She provides administrative support for CTE managing and engineering consultants for clean transportation projects, including battery electric powered vehicles. And Maggie also assists project managers with reporting, tracking action items and other tasks. And so Maggie has a bachelor's in environmental science from Barry College.

And so with that, I'm going to hand my screen over to our CTE colleagues and I will let them take it away. And so as reminder, just send in any of your questions through the Q and A box, and we will answer them in due time.

**Alison:**  Thanks, Andrew. So my name as Andrew says Alison Smyth. And what we're talking about today is really with electric vehicles and real transit systems, building relationships with your electric utility to ensure successful deployment. So I just wanted as Andrew also said this, but just note that today we're going to be talking about battery electric vehicles and working with utilities. And there's an upcoming webinar on August 18th focused on hydrogen electric vehicles and how hydrogen can be a really interesting solution for rural communities. And then there are white papers associated with both of the governor's that will be posted in upcoming week.

So what we're going to be talking about I’ll just get a quick overview about who CTE is. An overview of zero emission vehicles, including those that are particularly relevant for real agencies like cutaways. I will talk a little bit about working with your utility during a free electrification process, what kind of framework you might use for building those kinds of partnerships and then hear it from some case studies on how people have done this in the field. So about TTE we are a 501 TTE nonprofit engineering and planning firm, and our focus is really on commercializing new clean transportation technologies and ensuring that they're deployed successfully in the field. So we work with a number of transit agency, mostly transit agencies is that 90 active projects working on clean vehicle deployment across the country.

So the next slide is a map just showing where we are working so you can see it really is a large portion of the country of mixed from large agencies to small agencies so we really see quite a breadth of ways that these projects can go and we are involved in kind all phases of a zero mission bus deployment. So we've been involved with these kinds of projects since the very first prepare a bus when it was really a prototype vehicle through what we call our smart deployment process. So that's where people are actually putting vehicles on the street, getting their first couple of electric vehicles through fleet transition planning, where people are starting to think about how do we go from diesel fleet to a fully electric fleet. How do we do that? And so we are there to help operators kind of figure that out. And then, as part of all that, what’s really key is education and outreach just as what we’re doing on this webinar today to the white paper. So we want to make sure that everyone has the knowledge that they need to be successful with these technologies. With that, I will hand it over to my colleagues.

**Maggie:**  Thanks, Alison. Yeah, this is Maggie Maddrey. I will start off this by giving a brief overview of zero emission vehicles as they are relevant to rural agencies and then Amy is going to touch on the framework for how to establish a partnership between utilities and agencies. And then we're going to have a presentation with Van from Advanced Transit and Jennifer from BEIC. And they're going to discuss a real world example of zero emission vehicles in transit. And then finally, we're going to have Brian from in NRECA talk more in depth about electric coops. Just one of the three types of electric utilities that I'll touch on briefly.

So to get started, we'll talk about some benefits of zero emission vehicles. As you can see with the graph from the right, transportation contributes more to the greenhouse gas emissions in the US than any other sector. And so with zero emission vehicles, you're typically producing zero tailpipe emissions, and you're not relying on fossil fuels to operate. And so, because of this, deploying zero emission vehicles is going to help reduce air pollutants, resulting in cleaner air and healthier communities. Vehicles, zero emission vehicles are the propulsion systems are more efficient than conventionally fueled vehicles and then they’re also cleaner and quieter so the lack of an internal combustion engine is going to make the vehicles quieter and it removes the need for oil changes, which just makes them a cleaner vehicle to work on from a maintenance side and then potentially lower operating costs. In some markets electricity for charging battery electric vehicles may be less expensive or less volatile than purchasing fuel for diesel vehicles. This results and potentially lower operating costs.

So it's crucial for agencies to make sure their electricity costs are cheaper than their current fuel prices in order for it to be a smart business case for them to deploy zero emission vehicles. Given the fact that you know these ZEVs are have a higher capital cost than conventional vehicles right now. So that's why communicating with your utility is going to be important for you.

So now we're talking about rural transit agencies specifically. They tend to have slightly different fleet makeups when compared to urban transit agencies. So they differ in that heavy duty transit buses aren't as prevalent as you can see here than they are with urban agencies. And so they're still used but cutaways and vans and mini vans are going to make up a larger part portion of many rural agency fleets. So we'll just kind of dive into each of those a little bit into a brief overview. So there's a pretty large variety of both battery electric and fuel cell electric have a duty transit buses on the market today, and they all range in – they have varying links and battery capacities and ranges, but we'll just kind of gloss over them briefly so long range battery electric buses, they have bigger battery packs. They're going to go farther on a single charge. They're typically going to charge at the depot overnight with lower power charges and then compare that to fast charge battery electric buses and those tend to be a little bit more expensive in the long range option. Then they're going to have smaller battery packs, and they rely on your periodic shorter interval on route charging with higher power chargers.

And then you see fuel cell is another option, and these are more expensive than the battery options. But they are an easier one to one replacement of diesel vehicles because of their longer range. And like Alison mentioned for this white paper in this presentation, we don't focus on hydrogen but there is another webinar in white paper that focuses on it in rural communities. So be sure to check that out if you're interested.

So next, cutaways have entered zero emission vehicle market more recently than heavy duty transit buses, so they're less fully commercialized options out there, and we don't know as much about these vehicles, but a couple that are on the market currently you can see that the battery capacity ranges from about 100 to 150 kilowatt hours, and the ranges could be from about 80 miles to double that at 160. And these vehicles are typically using bubble 2 charging primarily a 20 kilowatt-ish chargers and then DC fast charging as well. And these prices for those vehicles is kind of a big range right now, but around 170,000 to 270,000 there. And so then next, the electric passenger vans are in a pretty similar boat as the cutaways with being newer to the market and not as many available currently. These prices are going to average around 170,000 to 190,000. You can see here the battery capacities and the ranges are pretty similar. But all these markets are maturing rather rapidly, with different models and manufacturers entering and exiting the market and the new technology being introduced. So it's important to try and stay up to date with the latest offerings, and Amy will touch on that a little bit later.

So next we just wanted to point out that it isn't just transit agencies that are considering electrification. But it's also you have school districts then local and county governments, as well as state governments and also a trucking companies. And so these are other types of fleets in rural areas that are considering the deployment of electric vehicles and taking lessons learnt from one fleet type in your area will most likely translate to another fleet type and there could be opportunities for shared charging infrastructure between different zero emission fleets in your area. So it's important to just engage with other fleet operators in your area when planning to or deploying zero emission vehicles.

In the next, so why work with your electric utility in the first place? And there's a couple key reasons. So one is just understanding each other's constraints. So you have agencies and utilities they're going to have different priorities and so you’ve got agencies that are more focused on getting their passengers where they need to be and meeting service needs on time. And then you have utilities that are just wanting to minimize, the want to minimize their impact on the grid and keep demand ad costs low and so these aren't always going to match up so it’s important to make sure that both parties understand priorities and constraints of each of one another so that you can work together moving forward.

So that's one reason and then another reason is your electric cost as an agency is going to go up and your right is going to change with the deployment of battery electric vehicles. So keeping the electrical as low as possible while still meeting required service is going to be key for agencies. Utilities are there to help you as an agency understand how your rate will change and the options you have to keep your costs low, and this will then help you determine the best way to charge your vehicles with keeping costs low. And then making smart investments. So electrical infrastructure upgrades will most likely be needed once you reach a certain threshold of electric vehicles in your fleet, whether that's in the short term or in the long term in the future. So based on your short and long term electrification goals, your utility can help you plan for when those upgrades will be needed and when it makes sense to actually conduct the upgrade, so it could mean doing some additional construction earlier on in order to make it easier in the future to deploy more vehicles.

So it's important to work with your utility in order to speak the same language and understand the rate changes and charging approach effect that it will have on your costs as an agency as well as understand at what point will you need more infrastructure to support more battery electric vehicles. So talking about utilities, there's three different types of electric utilities in the US. You have public power, rural electric cooperatives which are oftentimes called coops and then investor-owned utilities. So an agency could be served by any combination of these coops are rural electric cooperatives are the typical utility structures in more rural areas, and so that's the one that Brian is going to speak about more specifically later on.

But with these different types of utilities and the different governing structures within each utility, as you can see here, there isn't a one size fits all solution for a rate that will be beneficial to transit agencies when deploying so that's why close coordination with your specific utility is key to figure out the most advantageous programs for your agency. So with that I'm going to kick it over to my colleague, Amy. She's going to talk more about the framework for building partnerships between agencies and utilities.

**Amy:**  Thanks, Maggie. I don’t need myself. Yeah, I’m Amy Posner, engineering consultant with CTE. So I'm going to focus the remainder of the of our presentation on the framework that we have suggested as a part of our white paper for how rural tribal trans agencies can kind of work successfully with their electric utility. And from all the work that CTE has done with different trans agencies across the country, a strong relationship between the transit agency and the electric utility really cannot be understated. It's really critical for successful projects and both parties definitely want these kind of zero emission vehicle deployments to be successful. And so the strong partnership is really advantageous to make sure that you are as trans agency you're kind of optimizing and minimizing your operational costs and also providing us much benefit to Asset Management for the utility as well.

So we have slides for each one of these steps. I'll walk through them briefly. But kind of the overall process at the trans agency for working kind of establishing and building a partnership with the utility kind of follows this process, the four steps that you see in the middle are meant to be kind of more of an iterative steps that you would repeat during each individual vehicle deployment. But it's important first, to kind of set the goals for your entire agency for electrifying your fleet and then kind of understanding what your long term goals are breaking the sound into incremental deployments. Probably your first employments going to be one or two vehicles and then growing from there. And then you'll follow this kind of cyclical illiterate of process to assess the technology that you need for your deployment. Set up kind of your exploratory meeting with your utility, identifying funding sources and then working with their utility to kind of optimize your rate and you're charging schedule. Then eventually you will kind of realize your goals for a successful project.

So the first step first kind of setting your fleet electrification goals. It's really critical to kind of set up a project team that you're trans agency that's going to have both internal staff as well as kind of some external stakeholders as well. But it's important to get with your project team to understand, kind of where does your trans agency see themselves in the long term with respect to fleet electrification. Do you think it's possible that your entire fleet will be electric vehicles in the future or based on your trans agencies kind of specific priorities? Is that maybe not feasible currently with what you know about the market?

So it's important to kind of establish your long term goals and then break down kind of your long term vision for zero emission vehicles into smaller, incremental deployment projects. So the table that you see here on the slide is a template that we provide in the white paper to help you kind of design those incremental deployments. So figuring out what time line for the deployment of the vehicles you're considering, the number and types of vehicles, are they going to be those bigger, long range better electric buses or cutaways and van, school buses? What type of fueling? Are they charging? Are they going to do on route? Are you going to do kind of the level 2 charging or DC fast charging at the depot? Where you going to use hydrogen? Estimating kind of the electrical capacity that you'll need for each deployment, identifying your possible funding sources and then kind of establishing what is your criteria for evaluating success of each deployment.

Like Maggie mentioned, there's not a ton of deployments with the cutaways and the passenger vans with the full battery electric versions of those vehicles currently. So you know, are you going to try to pilot different technology to figure out how each will perform in your service area and kind of watch the market grow? So they're all kinds of things to consider while you're breaking down your long term goals into more incremental projects. And in order to help understand what your estimated electrical capacity needs will be for each incremental deployment, we've provided this calculator in our white paper. It's a pretty simple Excel spreadsheet. It'll be embedded in the white paper, but you can basically insert the number of vehicles or really the number of chargers that you would need to support your plan fleet and an estimated power for each of those chargers.

And we provide some examples based on kind of what we're seeing in the industry for each type of vehicle as an example. But the powers are editable, and the number of chargers and vehicles it can all be customized to kind of help you understand what your electrical capacity might be needed to deploy that number of electric vehicles, and this is great information to take to your utility to kind of help them understand what kind of demand you might be looking at.

So the next step is to kind of assess the technology and figure out what vehicles will make the most sense for you to deploy in your service area. Maggie provided some information on the available models. We’re expecting that to change a lot in the next few years especially with the cutaways and the vans, the zero emission vehicle market is really changing quickly. So it's likely that if you deploy a couple vehicles this year. When you go to deploy more of the year following, there will be other options for you. So it's really important to understand kind of which vehicle is right for you, which charging infrastructure is right for you, and kind of re-evaluating the options whenever you're beginning a new deployment by reaching out to manufacturers or other transit agencies or fleet operators in the area to kind of understand what other options are for you.

And something that's definitely different with zero emission vehicles and battery electric vehicles when compared to conventionally feel vehicles is that there are so many different factors that can affect the total range of the vehicle. So the temperature, the driving style, the passenger load, how many hills there are on a route countless other factors will impact basically how far your vehicle will go on any given day. And also that you can see how old the battery is will impact how far that vehicle can go on any given day.

So any type of route or charge modeling that you can do to kind of understand if a vehicle manufacturer says that their vehicle can go 150 miles, that may be true under certain conditions but can it go 150 miles in your specific service area? So there, there are pretty sophisticated tools out there to do modeling. The CTE does a lot of her modeling for transit clients. But there's other ways that that you can kind of assess performance and estimate performance in your service area. So we recommend doing kind of a screening of different blocks or routes in your service area to see what might be suitable for electric vehicles at a minimum based on the manufacturer provided range and kind of understanding how the total range will change throughout the life of the vehicle as the batteries degrade.

Any kind of modelling that you could do that incorporates charging can help you understand what your class might be based on when you need to charge in order to meet your service. And after you kind of have an understanding of kind of the plan for your initial smaller deployment projects and what types of vehicles you're looking at, that's a great time to have kind of an exploratory meeting with your electric utility. And we have kind of a guide in the white paper to understand kind of what types of information as a transit agency you'll need to bring to the table and what to expect kind of in response from your from your electric utility. But definitely like Maggie said, you want to make sure everyone speaking the same language, make sure that you bring information on your short and long term electrification goals. What funding opportunities you've been looking at? What's your plan charging approach? Discussing any carbon reduction goals either through local, state regulations or guidance and your requirements that you would have for resilience. So do you need a backup generator? Do you want to have on site storage in case there's a power outage? Things like that.

So it's really important for your utility to kind of understand what your timeline is, what your needs are for each deployment so that you guys can work together to figure out what it makes sense to provide infrastructure upgrades, how you guys can work together to optimize your charging strategy to minimize your costs. All of those things basically, to kind of make the process is painless and cost effective and successful as possible and while we call this kind of an exploratory meeting. It's critical that you coordinate with your utility kind of throughout the deployment process.

Funding is definitely going to be critical for most agencies when considering the deploying zero emission vehicles. Like Maggie mentioned they're currently higher capital costs than conventionally fueled vehicles that you're purchasing. There are a number of federal and state funding sources for zero emission vehicles that we're aware of that we’ve helped other transit agencies get awarded money through FTA. Has a number of options, the Volkswagen mitigation trust. These all options to help offset the cost of the zero emission vehicles. And I know kind of we’re all in kind of a new normal these days, but the federal sources kind of are maybe more reliable source of funding for vehicles in the next few years, and we don't expect those to kind of go anywhere which is great. So if you are kind of concerned about any impact like COVID would have on deploying zero emission vehicles, these programs should be sticking around and especially for the rural agencies, it's critical to kind of coordinate with your state BOT as well as kind of speak to other stakeholders, your local state RTAP manager your tribal leads on and your electric utility whenever you're looking for or applying for funding. Because utility probably knows up other programs that are available or might have some programs that you could apply for to help offsets some cost with infrastructure or the buses himself.

I'm going to try speed through the rest of the slides a little bit. The next set is optimizing your rate and optimizing kind of your electricity costs with respect to charging. So this slide just kind of we're going to kind of focus on demand costs in a second, but kind of summarizes what you might expect to see on your utility bills. It's almost certain that your electricity rate will change when you deploy your first zero emission vehicles. You’ll expect to see some fixed costs. It’s kind of a monthly fee from the utility. And energy cost, which is going to be a cost per kilowatt hour. Basically, how much electricity are you going to buy? And these rates can vary by time of day or by season. Might be more expensive in the summer or might be more expensive during peak periods.

Similar with demand cost, but with demand this is basically driven by how fast you fuel your vehicles. So this is going to be driven by the kind of the rated power of your charger. And if you have some of those level 2 chargers at about 20 kilowatts compared to one of those on route chargers that can be 300, 400 kilowatts, that's what's going to drive your demand charge. It’s how fast you're charging your vehicles as well as how many chargers you’re simultaneously using and this will also typically vary by time of day or by season. So your utility probably might have a peak period where electricity demand across the entire service areas is higher to try to avoid charging in those certain times. And then there's always taxes and fees, which are going to very definitely by markets anywhere we say from 5% to 30% of your bill.

We touched on this a little bit. But it's really critical to work with your electric utility to find the best charging strategy that works with your rate schedule because the number of chargers that you have going simultaneously will have a big impact on your bill. So this is an example of kind of a larger fleet of transit buses on the kind of how charge management can help you limit your peak demand but still allow you to have all of your buses charged, all your vehicles charged by the time that you need them. So the chart on the left shows kind of what the power at a facility might look like if the vehicles go out, they come back in, they’re immediately plugged back in kind of regardless of looking at the rate schedule in the peak period. So you have this really high peak in the afternoon which usually will correspond to a peak period of your utility, but with charge management and that can mean anything from really sophisticated software to some someone walking around and plugging and unplugging vehicles or making sure vehicles are not plugged in until outside of the peak period. You're able to kind of flatten that curve, flatten that peak to limit the demand for your facility for the day. So basically kind of cutting your cost in half if you're able to limit charging in that peak period.

It's really important to kind of incorporate any lessons learned from coordinating with your utility from deploying vehicles into future deployments. The data that you get from deploying your vehicles is going to be critical to informing what your future needs are and how you can kind of reach your long term electrification goals. We always recommend kind of doing whatever data monitoring that you can. These are some examples here where on left kind of tracking daily average temperature and their kilowatt hours per mile of vehicle because that could certainly fluctuate especially because of any HVAC loads those tend to have a big impact on your energy efficiency. So on very cold or very hot days, you're going to be using a lot more energy to go the same distance than on more mild or temperate days.

And we also recommend kind of tracking performance against other fleet types of conventionally fueled vehicles on kind of tracking costs or fuel economy comparatively. And it's critical to kind of again keep in contact with your electric utility really working together to ensure that your deployments are a success. Before we turn it over to Jennifer and Van, I want to let everyone know that we have the TTE has a free virtual version of our international zero emission bus conference this year. It’s going to be September 15th through 17th. There's a number of really great sessions. I believe there’s definitely some on utilities as well. So I definitely encourage you guys to register at zedconference.com. Definitely don't want to miss it. Here is me, Maggie and Alison’s contact information. But with that, I will turn it back I think to Andrew.

**Andrew:**  All right. Thank you very much. That is an excellent introduction to all of this. And so now we would like to bring it into the real world for everyone. And so next up, we have some colleagues from Vermont. We have Jennifer Wallace-Brodeur from VEIC and Van Chestnut from Advanced Transit. So, Jennifer is the director of Clean Transportation. She sets the strategic direction for transportation work at the organization and oversees. A staff of consulting professionals and leads clean transportation policy development for VEIC. And Van has served as the executive director of Advance Transit for 32 years and counting and Van’s transportation career spends 40 years, is a proud recipient of a founder's work from CTAA, The Community Transportation Association of America. And Advance Transit's been fare free since 2002 and has developed a highly productive fixed route service that is well supported by the local community through a broad mix of public and private sponsors. So with that, Jennifer and Van the floor is yours.

**Jennifer:**  All right. Thanks so much, Andrew. Thanks for having us. Van and I will be sharing information and lessons learned from Vermont Transit electrification projects including Advance Transit.

**Van:**  Okay, what I said was great. Sorry you missed it. Anyway, happy to be here. I’ll tell you a little bit of Advance Transit. We are a 5311 Rural Agency. We’re a private nonprofit. We serve six municipalities in New Hampshire and Vermont, and we are fixed route. We have little under 900,000 riders per year in non-COVID times of course and small ADA complementary paratransit operation to go with that. So our fleet is all diesel currently except we do have three diesel-electric hybrid buses and I'll talk a little bit more about that as we get further into this. But we've got about 48 employees. Currently 32 buses in the fleet. I'm going to skip over other things, and we'll get deeper into what we're doing and what our experiences have been with electric vehicles to date that has led us to the point that we are now. So we'll just skip over the generalities and I'll join you again hence we get into the nitty gritty.

**Jennifer:**  Thanks so much, Van. So a little bit about the VEIC, were a sustainable energy nonprofit organization and we work on projects that advance our mission to enhance the economic, environmental and societal benefits of clean and efficient energy used for all people. We're based in Burlington, Vermont, and provide consulting services across the country. We have long recognized that transportation is the largest source of greenhouse gas emissions and our clean transportation consulting group focuses on vehicle electrification. We believe strongly that electrification of transit is one of the most powerful strategies we can implement to reduce transportation sector emissions. To that end, we've been really fortunate to be actively engaged with the Vermont Agency of Transportation or VTrans and the transit and utility partners to build awareness and greater understanding about electric transit buses, secure grant funds, assist with vehicle procurement, project implementation and evaluation of electric vehicle performance.

So I wanted to just provide a little background on why transit electrification has been a priority in the state of Vermont. Reducing greenhouse gas emissions and transportation energy use through vehicle electrification are priorities for Vermont. There are several key policies that have laid the groundwork for VTrans and other state agencies to move forward with these new technologies. I've laid out a few here. I think some on the transportation side, our most recent long range transportation plan lays out a strategy for the state to advance new technologies including electrification and use of alternative fuel, heavy duty vehicles. And the Vermont Public Transit Policy Plan also set schools for efficient energy use, improved air quality and coordination with economic development efforts.

We also have some key energy policies that come into play as well. For example, the 2016 State Comprehensive Energy Plan, [00:44:20] reduction and total transportation energy is by 20% from 2015 levels by 2025. So that's pretty quick. And a reduction in transportation admitted GHDs by 20% by 2025. In this plan, adoption of renewably powered vehicles for public transportation is identified as a key strategy for reducing transportation energy use and emissions.

The state's energy policy is further strengthened by Vermont's renewable energy standard, this requires Vermont utilities to engage in energy transformation projects that reduce fossil fuel consumed by their customers. Vermont utilities are now required to meet annual fossil fuel reduction targets equivalent to a percentage of their annual retail sales. And in many cases, they're engaging in transportation projects to meet these targets. And then last but not least, in 2018 the Vermont Legislature passed a bill requiring that BW settlement funds be invested exclusively an electric vehicle replacements for older diesel vehicles and maximizing the 15% that states are allowed for electric vehicle charging infrastructure.

So all this background is sort of key context for why Vermont has been moving aggressively forward on transit electrification. With that said, VTrans took a pretty I think, cautious and prudent approach to moving into the technology. They basically wanted to understand more about electric buses before they went forward with seeking funding and deploying buses. So in 2017, we were able to secure a demonstration BYD bus they allowed us to bring that to the State of Vermont for about 6, 7 weeks so we could try it out in real world operating conditions, which was a real [00:46:39] and a really important step in the evolution of electrification of Vermont. So during that time, we deployed that bus in Advance Transit territory as well as Green Mountain Transit territory up around Burlington and the University of Vermont also tested it out.

So we work closely with our utility partners, Green Mountain Power is an IOU privately-owned utility that covers a big chunk of Vermont and Burlington Electric which is a municipal electric company based in Burlington that services Green Mountain Transit. We work with them to design and implement a pilot including finding temporary charging solutions for the demonstration bus. The overall aim of the pilot was to answer questions about electric buses and their ability to perform in Vermont's climate, topography and operating conditions. And during the pilot VEIC, with the help of the transit agencies, and the electric utilities tracked vehicle performance, fuel efficiency, operating costs, and driver perceptions.

And what we found, we have some key findings. We found that all electric buses were more fuel efficient than diesel buses, but that efficiency varies by operating environment. So we tested the bus in on sort of higher speed, highway routes, as well as stop and start town routes, town type routes, and were able to find that the bus was most efficient when it operated at moderate speeds would stop spaced at least a half mile apart. When it travelled at various slow speeds, and stops space roughly every a thousand feet. The bus was not able to capture energy through regenerative braking, which is really key thing to electric bus efficiency. And then also, when it was traveling at high speeds on the highway, it tended to be a little less efficient. So that was really helpful to better understand of the nuance of the operating conditions and how that could impact efficiency.

We also found that the electric transit buses consistently less expensive to operate as compared with the diesel bus. And this was something that VTrans and the transit agencies definitely wanted to prove out. It's something that has promised, but they actually wanted to road test it and see if this was actually happening. They were also, as I mentioned, more fuel efficient as compared with a diesel bus. Despite the variances and fuel efficiency across the pilot, say on the electric bus consistently demonstrated that it was more fuel efficient than a diesel vest even with those variations as I mentioned before.

We also wanted to see how the drivers felt about the buses. They are key people interfacing it with it every day and wanted to know how they felt driving a new electric bus. And once they get used to it, there was pretty positive response to how operated and there was pretty strong acceptance by drivers of the electric buses. And then finally, we also wanted to test out whether they were seeing emissions reductions, and we definitely found significantly fewer emissions than a new diesel bus even when they were experiencing relatively low efficiency. So a lot of the benefits that CTE was talking about early in their presentation, VTrans wanted to test out and get data on in Vermont conditions, and we were able to validate many of those benefits which was really important for all of the partners, the utilities, the transit agencies, and VTrans starts to move forward with more specific projects.

So I wanted to mention that it's that pilot and what was developed as a part of the findings that we had. VTrans had started to move pretty rapidly towards getting electric buses into various transit agencies. So they've been quite successful at securing low and no emission vehicle program funding for projects with Green Mountain Transit, Advance Transit, most recently with Rural Community Transportation at Green Mountain Express, which are mainly rural providers. And in addition, Marble Valley Regional Transit District is receiving two buses through VW settlement pilot program that we're administering for the State of Vermont. So with that, there is a total of 14 buses planned, electric buses planned to be deployed in Vermont with two currently deployed in Green Mountain Transit’s territory up as I mentioned around Burlington, Vermont.

So I'd like to turn it back over to Van to talk a little bit about his project, which received funding a couple, I think it was in the 2019 round. And he can talk a little bit about what they're planning in their service territory.

**Van:**  Thank you, Jennifer. First, I want to give a little bit of background about our experience with operating electric vehicles. First of all, Advance Transit has been operating three diesel-electric hybrid buses for about a decade now. So with that, you have many of the parts and pieces on a bus that you would have in an electric vehicle and that you have the regenerative braking. But then you still have all of the internal combustion parts as well. But you do have batteries, you do have the opportunity to electrocute yourself if you're not using the proper safety protocols. And so we've gained some good practical experience. I won't talk too much about the economics of hybrid buses unless you have questions about that during the Q and A. But so we had that experience and then I think about seven years ago the Two Rivers- Ottauquechee Planning Commission in Woodstock, Vermont approached Advance Transit and said, “Would you be interested in participating in a demonstration project? Partners would include the planning agency, but also the National Park Service, Billings, Rockefeller National Park,” I'm not sure I got the name exactly right and Woodstock is one of the smallest national parks in the country but still they are one. And, they said, “Well, we've got some money in a grant and if you're interested.”

So we spoke to our chief maintenance technician and said this is really your decision. It's economically neutral for our agency. However, if you feel you can do this, fine. If you feel you can't, fine. That will be our answer. He says, “No, I’m game. Let's do it.” So part of the deal was that if we were to do this, we were going to lease some older [00:54:25] electric battery powered buses from Hartford, Connecticut, where they had been deployed in a parking shuttle and then later mothballed. So we tracked a couple those up, and got them operational. The charging cabinets were almost as big as a small bus that went with those and to make a long story short four weekends, four summers in a row, we ran a very limited circle. And honestly, from a practical standpoint, it was mostly just [00:55:05] interest for locals. The people enjoyed it very much. It wasn't terribly practical in terms of the transportation that it was providing. But for us operating battery electric vehicles and learning a lot of things that go with that was extremely valuable experience and that along with our [00:55:26] experience I think position is very nicely for being competitive in the Low No Program. And in this round, the largest grant given was $3 million. There were three of those given out, and Advance Transit was through the State of Vermont was awarded one of those, so we're very excited about that.

So anyway, that's how we got here. And then the third thing that we did Jennifer already described was the demonstration project where we operated UID bus for a month in winter. We were very eager to see how it would perform. And in addition to the things that she mentioned, that might affect range and passenger comfort and that sort of thing, we were very curious to find out about traction. So one day we had a snowstorm and one of our managers saw the opportunity to take the bus out in the snow and was operating it. He wasn't carrying passengers, but he started to head down a hill, not huge hill, but this was a 40-foot bus and as he applied the brakes, he felt the rear of the bus began to swing around and so losing traction and in control. And never mind what that does to regenerative braking and all of that.

So we knew that in a lot of these buses there would be an override switch to turn off the regenerative breaking. And because this was a demonstration bus the switch was there that was inaccessible. So we got a hold of the manufacturer and they explained that, and then he was able to turn that off and go back out, and more or less operate the bus as a conventional diesel bus would operate and with the same kind of control. So if you're operating where you have snow and ice, you want to make sure you expect the bus for that switches readily accessible to the driver so that they could turn that off because you're going to be able to keep good control of the bus and obviously as Jennifer pointed out, that's going to perfect your range. So that that's our experience going into this.

And our original proposal was to purchase four 35-foot buses. The $3 million awarded was a little bit less than what was requested, and we didn't believe we would have enough to purchase four 35-foot buses, plus upgrade the infrastructure to our building. So we said how about if we purchase two 35-foot glasses and then goes to of the smaller cutaway buses such as was shown earlier and program. And so that's what we ended up doing. We got the approval to do that. So we're very excited because we're going to be able to deploy two of these in our 88 paratransit program operating in both states and as well as having the larger buses on fixed route.

So I think this was the last round of the Low No Program where you were able to name the partners because most of our bus fleet is Skellig. We did want to name Gilligan's partners in this project. Another reason for doing that was Rotera has already being deployed in the Burlington area. So this gives us a chance to get another manufacturer's bus on the road in Vermont because we want to get more real world experience. So we'll be negotiating with GILLIG but then we will go out for open procurement on the smaller vehicles. Green Mountain Transit is going to purchase a couple of similar vehicles. And we know there's some other agencies now that are being awarded funding. And are going to look at that. So we're going to put together a consortium and do a statewide procurement of electric cutaway vehicles so you’ll be able to order off that contract over the next five years and there’ll be different sizes and configurations available through that procurement. So that's the work that we have ahead of us. And we're very excited to work with our partners VEIC, Green Mountain Power, and the State of Vermont, as well as GILLIG and whoever is going to manufacture the smaller vehicles. So I'm going to stop there and be available for questions in a little while. Thank you.

**Jennifer:**  Thanks so much, Van. And I will -- one more. We've got one more slide to just talk about which I'm not sure why it's not switching. Here we go. So I think we are here to talk some about the relationship of utilities, and we have been very fortunate in Vermont that the utilities have been active and eager partners for transit electrification projects. They have committed support and cost share for each of the Low No applications that I mentioned earlier, so that's been really critical I think to some of our success here in Vermont. VEIC has played a role in helping to facilitate utility, communication and engagement. I think it's a new partnership, I think, for both the utilities in the transit agencies in these types of projects, and so having some support to bridge the gap between the sectors can be helpful in understanding what each utilities priorities are, the transit agencies priorities are and what their key considerations are in terms of their operations. It’s very important to understand those from the outset, and it's that is just a critical role that we've been playing but I think it is important for anybody going into a project like this.

I think it's been mentioned, but it can't be repeated enough. It's critical that utilities be brought in a soon as the transit agency is thinking about a project. You can't bring them in too early. And I just also wanted to mention this rundown ways in which the utilities are helping here in Vermont and can help with projects that you may be pursuing. At the outset, they helped with evaluation of where the buses are parked and fuel to understand what electrical upgrades will be needed and then helping to facilitate some of those upgrades to be made. They provided guidance on charging infrastructure and obviously helping their transit agency customers understand the rates and coming up with a plan for how the buses will be charged and particularly to help avoid charging at those times where you can incur demand charges as Amy talked about earlier. Because of the renewable energy standard, the utilities in Vermont are able to provide cash cost share or incentives towards the purchase of buses and charging infrastructure. We have a program as I mentioned earlier that really facilitates that, but I think that's something an opportunity that can be explored within any utility. So that's something that you should put on the table.

We are working closely with the utilities, VEIC, and the utilities in partnership to evaluate the bus performance. So we are monitoring electric usage and flagging issues for the transit agency. The Green Mountain Transit, in this case as we're seeing maybe higher costs and anticipated trying to dig into that, understand why that's happening and adjust charging strategies as needed. Some utilities are considering a special rate for charging buses that hasn't come to fruition yet but there's been talk about that. And there is also interest in vehicle to grid applications in which the battery from the bus would be discharged either to a building or to the grid to help with various grid issues such as smoothing peaks or serving a storage for renewable power as renewable energy generation.

So we, as I mentioned, we're fortunate to have utilities that are interested in these conversations that have come to the table. But I think it's critical that everybody think of them first when they start to think about transit electrification and start to have all of these conversations with them. And with that, this is how you can reach us. Really appreciate the time and the opportunity to share of these projects with you and we're happy to answer any questions either today or you can reach out to us subsequently. Thanks so much. And I'm going to stop sharing.

**Andrew:**  Alright. Thank you, guys. So definitely great to learn more about this. And speaking of questions, Marina Miranda sent in a good one in the Q and A box. I think we'll save that for after Brian's presentation, but just wanted to -- But now Marina and then draw your attention to that. And so with that, I'm going to move us on to Brian Sloboda who's the Director of Consumer Solutions at the National Rural Electric Cooperative Associations, Business and Technology Strategies Department. Brian is responsible for managing the association's research efforts and the area of distributed energy resources. He's been there for 23 years and has degrees in political science and speech communication from Fairmont State College. So, Brian, the stage is yours.

**Brian:**  Thank you very much, Andrew. Can you hear me okay?

**Andrew:**  Yes.

**Brian:**  Perfect. And I want to thank Amy for running the slides for me. My IT department does not like Zoom, so I'm being naughty today using Zoom. But Amy if you go to the next slide. [01:06:27] coops and what Jennifer said about utilities and Amy and Maggie about utilities are absolutely spot on and I'm going to expand on that a little bit. As you see on the map, this is our service territory. There are 900 electric coops in the United States, and we're serving the vast majority of the country. Now we are different. We are not for profit. And in most of these states we're not governed by state regulatory bodies. It's really governed by the locally elected board. So if you're a transit agency and you're served by electric coop, you have a voice in governing that cooperative. But it’s important to remember that the bylaws of that coop is going to function a little bit differently than the investor runs and you need the community dealing with and that could play a big factor if you start to adopt electric transportation. It's not a negative. This is something not to be aware of. It will come out of those conversations, and I think in general was spot on you need to talk to the utility early and often. So next slide, please.

So, a couple of things to consider. And RTA worked with the Edison Electric Institute, which is the trade association for the Investor owns an APPA which represents municipals and we prepared the document you see in the image on your screen 10 things to consider when electrifying your bus fleet. Number 1, absolutely and engage the electric utility early often as soon as you think you may be thinking about electrifying any part of your top utility. They're going to need to do some analysis on their side of the system. They're going to need to look at how you learn to using the energy and when you’re going to be using it. And you have to really start to think of the electric fuel very different than the fuel you're using today. If you think about it now, to get diesel you got to drill wells, you got to transport it, refined it, stick it in tanks in your yard, and you can buy it in bulk when prices are low. Right? That's a lot of folks do especially we have a big fleet. But electricity is very, very different. Electricity is delivered in real time. So if you think about a near actual house that you flip on that switch on the LED light bulb comes on, the electricity is manufactured just a nanosecond before you turned on that light.

So that real time delivery is going to come into play and when you charge and how you charge the bus. Utility typically have something that's called a peak, and that peak is the time of day when electricity is the most expensive for that utility. For most utilities, it's right now. It's going to be in that 2 p.m. to 6 p.m. window. There may be a little bit different there depending on where you are, but typically 2 to 6 p.m. that's the most expensive time of day, because that’s when everyone's using electricity. That’s when your air conditioners are on in the summer, that’s when their heat pumps are on in the winter time, offices are running full blast. Everyone is using it, and absolutely do not want you to use power because it is expensive, it puts a strain on the grid. So it takes that conversation with utility to charge off peak.

The ideal time from a utility perspective to charge something like a bus, you're looking at midnight to 6 a.m., that is the time of day when there's very little electricity being used because everybody is asleep, right? That's kind of makes sense. It's basic supply and demand. So trying to work with utility and there are some utilities especially in the southeastern part of the country they’re going to have another peak roughly in the 5 a.m. to 8 a.m. The time frame in at winter time that might be something that you really [01:10:44] make sure you’re not hitting that time a day. So you really have to think about a little bit differently and find those sweet spots. Typically, since you are a commercial customer, charging on peak is going to cost you significant more than charging off peak. In some cases, you could be talking 3, 4, 5 times the difference in price. So, next slide.

Now there's a lot of issues to consider here. This is really a relatively new technology. It’s a disruptive technology. It's technology that obviously is electric utility extremely supportive of. The fact that using our product, the fact that the emissions are lower, the fact that you look at America’s [01:11:36] of how we produce electricity. More wind, more solar, more hydro today, we really are a much cleaner product today than we were a few years ago.

But certainly, from the utility perspective very concerned about batteries inside the buses. We want make sure that the batteries are working and we certainly are concerned about the second life for the battery. There are certainly some options there that when the battery can no longer sustain the bus, there are going to be options where you can repurpose those bad. The reason that can perhaps one day become a great asset for utilities or others. They're certainly regulatory issues involved in things like this, because you all are critical infrastructure. You got to have the buses fueled up and certainly that I just mentioned about utility peak. Really you don't want you filling during that peak. So how do we work through those issues? And when you think about utilities, the utility is really a very risk adverse organization much like transit. We don't take risks. We build assets the last 40 years, 50 years. So when you're coming in with a project like this. One of the first things that the utility is going to do is look at the distribution infrastructure. They don’t look at the utility asset. They're serving your facility and see if they can actually serve that new load and came upon the rate at which you're charging, there could be some investments needed on the utility side.

If you think about an electric car like a Tesla or a Chevy Bolt, putting up a Level 2 charger out there, which is charging somewhere between 9 and 19 kW demand not really going to be a big deal for utility. But when you start talking about larger pieces of equipment like buses and freight trucks and you're looking at chargers that might be 150 kW, that's a big number to us. Or it might be there are some folks looking at a couple of years from now vehicles charged maybe at a couple of megawatts. You're now looking at a potential for significant investment on the utility side. Typically as a cooperative, that means that cost of that investment has passed onto the customer that has caused that issue. Now you can work with the coop and come up with a way to only pay a portion of it, every coop come a little bit different on that. What typically the coop and other utilities will do is look at the future revenue potential off of it and then give you a prorated cost. It's called Aidan Construction. It's not fair to the other customers in the utility if you cost hundreds of thousands of dollars investment, the [01:14:41] typically has to pay for it. And when we built the systems, no one really envisioned the tremendous advancements in electrification of transportation. Next slide, please.

So [01:14:57] created there's a little tiny address there at the bottom of your screen to get this form. The form is also available on the EEI website. Utilities run by engineers. They love their numbers. They love their facts. And this form gives you a starting place to have that conversation with utility. They're going to be interested in how many cars are you going to have there. Or how many buses are you going to have there? What's the capacity of the battery? What are going to be your start and end times for driving? What's the speed of the charger? And what are you going to do in your pilot or your initial deployment? But also, what you going to do five years from now? In an ideal world, we’d be [01:15:41] by then we’ll have fusion reactors, and [01:15:43] brown and smokes capacitor, so we’ll just stick with five years and be fairly reasonable. If you think there's a good chance of expanding election transportation significantly at five years at your facility, then we're going to really build the thing once. The last thing that utility wants to do is go back and dig that ditch up again and put in a bigger hunk of metal to feed your facility. So we really just want to build it once.

So have that kind of in mind you talk to folks. The other thing is the utility may want to talk to the manufacturer of the bus or the manufacturers of the charger. Make sure they have all the technical specs. The utility [01:16:29] service and size to meet the load as well as the realistic [01:16:33] near term load growth opportunity. So next slide, which should be the summary slide. Actually, the most important thing. Pick up the phone, send an email to the first person that you worked with at your utility. The utility wants to be a partner. Utility does not want to be an obstacle in any way, shape or form. But it's important to remember our number 1 priority is safety. Number 2 priority is reliability. As long as those two things are taking care of, serving buses it's going to be a piece of cake. But really, everyone has to be flexible both on the utility side need to be flexible when it comes to [01:17:18] process may be flexible and in terms of when you're going to deploy the buses and how are you going to deploy but also we would like the transit folks to be flexible on when you're going to charge? Time of day is really important if you can have that off peak charging great.

And then Jennifer mentioned the vehicle the grid applications. There's a lot of potential around vehicle to grid, but what I would say is right now, don't let vehicle the grid be an influencer in your decision making process, because it is still very much in the future. A lot of those systems have not been created and really in many instances vehicle to grid could interfere with your quality of service because you got to make sure that you're taking the passengers safely, to their destinations, what vehicle to grid is going to do is allow the utility take energy out of the battery. So when we start talking vehicle to grid, pilots are great that would not factor in any revenue off the vehicle to grid in your decision making process when you look at the long term investments in your buses.

So that's all I have. So Andrew turn over to you. Looking forward to the Q and A.

**Andrew:**  Fantastic. Thank you, Brian. So, I will start the Q and A off with Marina Miranda's question. So In the future, I would like to start a coop in Maine on DC fast charging stations throughout the state, in the highways. However, in the winner, there are some areas of Maine that can get really cold below the temperature in which the battery can function. So are there any ways to address the weather issues in the winter so the whole state of Maine can have access to ZEVs. And how do you deal with temperature getting close to battery freezing point in Vermont and New Hampshire? That's for anyone.

**Jennifer:**  I can start. I don't think we've seen an instance where the batteries can't function due to colds. but I do think that there are definitely cold weather considerations that you have to think about for electric vehicles. Primarily, you tend to reduce or lose range when it's cold. So if there's a couple of ways you can think about getting around that. As a transit agency one is just planning that you're going to see a reduced range maybe as much as 50% reduction on really cool days and plan your operations around that. But I think what is where typical is to actually have oil or propane auxiliary heater that will provide heat rather than pulling from the battery that can preserve your battery. It’s a little bit, I think, more cost effective to look at that. The tradeoff is that they have emissions.

So there are some things to think about on that. You definitely do need to think about your operations in cold weather, but I don't know and maybe somebody correct me but I haven't heard of instances where the vehicles cannot perform because they're too cold and the technology is such that they're actually designed to be protected from cold.

**Maggie:**  Yeah, and we were supporting the Duluth Transit Agency in Duluth, Minnesota, deploys battery electric buses. And so yeah, negative 20 this kind of common in the winter for them there and yeah, just to kind of reinforce what would Jennifer mention, those buses they have a battery management system that keeps the battery temperature regulated. But we did find with Duluth because of the reduced range and the impacts in the winter months. I know Van mentioned this as well. They were losing some of the traction that kind of turned off their regenerative braking. So they do use feel fired heaters, but they were also kind of interested in exploring on route charging, but due to kind of the higher energy consumption that was going to pose some challenges for them. So ultimately, found that kind of charging their vehicles at their depot as opposed to kind of on route charging was going to work better for them.

So, yes, it's definitely something that you have to plan for. It’s kind of with these medium heavy duty vehicles for sure.

**Andrew:**  All right, Thank you, folks. So, a question from Sonia Sweeney, Sorry. Sonia Sweeney. Are there any pilots of vehicle to grid that you can share?

**Maggie:**  I know if I think of a school bus pilot in White Plains, New York, maybe. But Jennifer, you [01:22:32].

**Jennifer:**  Yeah, you're right. It's in Westchester County, Con Edison is sort of behind that. They put together a project with a bunch of partners. But the idea is to deploy five school buses and then to test vehicle to grid opportunities as part of that. So I know they're in the middle of that, so there isn't really a whole lot to share about it, but that's probably the most significant V to G or vehicle to grid pilot that I'm aware of. And I think the utilities are particularly interested in school buses for vehicle to grid because they have more downtime. They tend to have more downtime than transit buses. So there's more opportunity when they're idle and could be serving as a grid asset storage or to discharge. They also tend to have shorter routes. So I think school buses have certainly been where there's been, I think, more talk and more interest in the application.

But I would agree with Brian. It is still pretty bleeding edge or cutting edge of however you want to call it. At this point, there's been a lot of discussion, a lot of interest, but not a lot of practical application right now.

**Brian:**  Yeah, I just want time in I think there’s bleeding edge. And I know we have looked at school buses in large part because they do tend to be idle for the entire summer, which is when you do have a lot of the summer peaks and have some benefit. But I would be a little bit concerned doing it on transit bus because yeah, as a utility, you need resources that are dependable. And if your bus can't perform that function typical in the utility contract there's going to be some sort penalty or you won't have to make up that contractual agreement.

So I would be very hesitant to do a vehicle to grid application for a transit bus. I let other folks go ahead and do it first. I've had some talks with some of the truck manufacturers and make class 8 trucks. They're very interested in it. But one most important thing is you need a lot of computer systems communicating between the market, which we have this is this thing up here, which is where all your power plants are the market down to the utility down to your transit bus. There's a lot that needs to be created and I would not look forward to be commercially available for 3 to 5 years. That's why I would really caution. Not to pencil that into your planning, just look at the fuel cost savings and the huge emission savings, as well as some of this quality of life savings from electrifying your fleets.

**Andrew:**  Alright. Thank you folks. So also what is the timeline for deploying ZEV? And at what point during that time line should an agency start coordinating with their utility?

**Van:**  Yes, for coordination, I would say, do it the moment that you think it's a possibility. Because you might end up in a case where the place that you house your buses is not ideal from electrical grid standpoint. And we will mongo two part down this road if they find out it's going to take millions of dollars in distribution infrastructure upgrades to serve the site.

So I would obviously coming from utility perspective, I'm being selfish here. I’ll call them on day one and say, “What do you all think about this? Here's what we're thinking. Give us some feedback.”.

**Jennifer:**  Yeah, I thin, Van, you can confirm or deny but I know at least on the transit side you can take upwards of a year usually sometimes more than that to build your battery electric bus or fuel electric bus. So you kind of consider planning and all your construction and getting your funding. You might be looking at upwards of kind of two years before your vehicles show up. So yeah, that makes kind of the continuous planning, ongoing planning with the utility even more important.

**Van:**  So yes, building is 12 to 18 months. And then the entire process leading up to that from the time you think you might want to get an electric vehicle to the time you do is probably 3 to 4 years depending by time to go through the grants process and everything else or it's also very expensive, so that gives you time to do fundraising. And there's another reason to speak to the utility company right the second you think you might want to go down that road because that could be a financial partner. And in Vermont, the utilities are financial partners in this endeavor as well. So they'll be providing some of the local match that's going to be needed for the project.

**Alison:**  I would just add that one thing that really key is we've been talking about infrastructure from the utility planning side, but it also takes time to put out procurement for design and to put out procurement for construction and it's very unusual that you don't run into something unexpected during an infrastructure build. So really coordinating that infrastructure build all the way from the utility to the contractor putting in the charger to commissioning the charger with the buses making sure that that timeline is coordinated with your bus procurement and bus delivery timeline is critical for figuring out that overall plan and making sure that you have a way to charge the buses once your buses are delivered.

**Andrew:**  All right, thank you folks. So we're coming close to time. So I think one more question is what does the sort of fuel source for the electrical grid matter when it comes to analysis of whether and how much to go electric for your fleet, or does that play into it at all? So if your grid is powered by solar versus coal, how would you kind of incorporate that information?

**Jennifer:**  So from our perspective, I think there's two ways to think about it. It's like total emissions of the bus, and then there's tailpipe emission. So I think having zero tailpipe emissions is really critical in a lot of areas of our country that may be experiencing high air pollution. So that is one of the great benefits of electrification is that they're zero at the tailpipe. But most of the time when you're looking at emissions, you're also factoring in the source of power generation. So obviously, the cleaner the grid, the higher the benefits are going to be overall. With that said, I think you're going to see overall sort of your typically going to see benefits no matter what, but you're going to get more benefits with renewable generation on the grid. So the more we clean up our grid the more benefits there are going to be from an emissions perspective for vehicle electrification.

**Van:**  It's really independent decision. So the bus doesn't care how the electricity is generated. It just wants electricity. But you have oftentimes a choice if you'd like to pay a little bit more to get greener power. In Advance Transit’s case when we were doing the trolley replica buses, a little bit more was paid to purchase cow power. So and that was a great marketing tool for the program. We're able to say well we're actually using cow power and told all about how the cows ended up producing electricity that was ultimately consumed by the bus for the project and also Advance Transit were actually a licensed power producer, we have a solar array on top of our bus garage, and we sell all the power we produce at a premium rate. We've got a long term contract to do that.

That's completely independent of the power that we consume and the price that we pay for it. So there is -- you're going to generally pay more. I think Brian can speak to this better than I can. But things are moving in that direction where green energy is not necessarily more expensive, but in the past it has been, and you always have the choice not to do that.

**Brian:**  Yeah, just real quick that prices come down so much. That in many cases our utilities are able to put in solar cheaper than they can do coal right now. And they typically would most do with the coop is most of the customers were just taking the standard rate. We don't do a lot [01:32:23] the retiring renewable energy credits in particular customer. Typically speaking, the coop is taking those credits filling them at the market because it make more money that way. And as a consumer and utility, that money that coop is making goes back to the consumers. But I think certainly when you look at almost any utility in this country right now, it is much greener today than it was five years ago. That's certainly true with the coops, with the amount of hydro, solar and wind that we have in our portfolio.

And also just one other thing , a lot of the coops we have almost a third of our coops are operating community solar farms. So that if you are a customer that wants to purchase solar and you don't have the site to do it, or you don't want to buy panels yourself and install them. You can buy shares of the coop solar farm and had that power directly credited to your bills. There's a lot of flexibility these days.

**Andrew:**  So really, that sounds like you could be in the webinar that really any of these could. So with that, I know we have reached the end of our time. So I'm going to put up the contact information of everyone that's been on this webinar here. And I would like to remind people to go to our website. Found a bottom there and n-catt.org and so we will put up our white papers on these topics when they're released, and then we encourage everyone to sign up for our newsletter, which you can find on the website when we will announce that we have released these white papers and then you'll also be able to find a recording of the webinar on the website and feel free to reach out to anyone on this slide with any other questions that you have.

So thank you all panelists, for the time today. I learned a lot for sure. So I hope everyone else did as well. And I look forward to interacting with you again going forward and seeing what this industry brings forward, because there's a lot of exciting stuff happening.