Tim Unruh:

Hello, I'm Tim Unruh, Program Manager for the Department of Energy's (DOE) Federal Energy Management Program (FEMP). Thanks for joining us for FEMP's First Thursday Seminars. If you've participated in previous seminars, welcome back. If this is your first time, you can access our earlier seminars at any time by visiting the FEMP website. Energy expenditures in our country are more than 1.2 trillion dollars. Working to reduce *(Audio Skip)* on foreign fuel, while also reducing our energy costs should be a priority for us all. Today, we have the technology, practices and progress to make energy efficiency cost effective. Now is the time for all of us to take action and make our operations as cost efficient as possible.

With new developments at home and abroad, the President has challenged the federal government to lead by example and meet aggressive goals to reduce the use of carbon based energy and increase renewable energy production. FEMP is producing this training to help you reduce costs associated with energy. To this end, FEMP assists facility managers by offering resources and training for cost effective energy management practices and smart investment decisions. FEMP training can help you identify, plan and implement sound financial and technical solutions for a broad range of energy projects, no matter how large or small.

We hope this seminar, and the others in this series, will help you reach your energy, water and greenhouse gas reduction targets and reduce your energy costs. Working together we can reduce the energy costs of facilities, improve the compensation and fuel economy of fleets, employ the federal building stock as an example for innovative efficiency methods and utilize new technologies to increase energy security. Moreover, we can accomplish these goals through the use of *(Audio Skip)* funding tools, such as energy savings performance contracts and utilize energy service contracts to stimulate the economy, create jobs and reduce costs. I invite you to visit the FEMP website for additional resources, technical assistance and guidance and to call on our customer service representatives and specialists to share their expertise.

Enjoy today's session. Log on to our previous seminars and be sure to register for the ones to follow.

Kathy Hyland:

Hello. Welcome to the FEMP's First Thursday Seminars. I'm Kathy Hyland, and I will be your moderator today. This is the fifth course in this series and will focus on federal fleet infrastructure and electric vehicles. If you have not already printed a copy of the learner guide and handouts, you may do so now. You can do that by accessing the website on your screen, www.femp.energy.gov/firstthursday. You can also print them out after the seminar. The materials and *(Audio Skip)* of this presentation are available 24 hours a day, 7 days a week.

Now let me cover the objectives for the training today. It is our hope that after completing this training you will be able to one, explain how electric vehicles (EV) fit into the overall greenhouse gas (GHG) emissions and petroleum reduction strategies. Two, list four types of electric vehicles and compare them to other vehicle types in terms of cost and *(Audio Skip)*. Three, discuss the basic requirements and options for creating or expanding an electric vehicle recharging infrastructure. Four, discuss present and future options for the acquisition of EVs and charging infrastructure. Five, incorporate EVs into a multi-year fleet strategy. Six, discuss federal reporting requirements for electric vehicles. Seven, access FEMP resources for EVs and EV infrastructure.

Our format today is simple. There'll be a presentation followed by a question and answer session. And we really encourage your questions. From time to time on your screen, you will see an email address, a fax number and a phone number so you can pose your questions. If you'd like to speak to the instructors live, you can phone in your question and someone can speak with you directly. So we really encourage you to do that.

We have two instructors today. Our first instructor is Mark Reichhardt. Mark serves as FEMP's lead for fleet management and also supports the greenhouse management and sustainability programs. His professional experience includes six years as an engineer in the automotive industry and recent rotational assignments to the Council on Environmental Quality or CEQ and EPA's Climate Leaders program.

Our second instructor is Julian Bentley. Julian is a Senior Energy Strategy Consultant with LMI, a government consulting firm in McLean, Virginia. He assists federal agencies in developing and implementing comprehensive strategies to maximize alternative fuel use, improve fleet fuel management, reduce fleet greenhouse gas emissions, *(Audio Skip)* consumption and met regulatory requirements. Mr. Bentley's current efforts, including supporting DOE's National Renewable Energy Laboratory in evaluating and implementing requirements on federal fleets in the areas of petroleum reduction, alternative fuel use and advanced technology vehicles.

We also have with us live from Washington, DC at the DOE, FEMP fleet experts Brad Gustafson and Amanda Saul, who will be able to answer your questions later in this seminar.

Before we go on to introducing Mark, I'd like to quickly go over our agenda for today. We're going to talk about FEMP's Fleet Management Program in general first. And then we're going to talk about why electric vehicles and the federal fleet infrastructure. We're going to talk about how to acquire electric vehicles, how to integrate electric vehicles into your multiyear strategy. We're going to talk about reporting. And finally, we're going to talk about resources.

So without further ado, I am turning this over now to Mark.

Mark Reichhardt: Thanks very much. What we do in FEMP is – actually, let me step back and say that, you know what electric vehicles are, and what we're here to talk with you today about. But it's only one aspect of what we do in FEMP's Fleet Management Program. And so I want to take a step back and give you an overview of all the services that we do provide.

So our mission is to assist federal agencies with meeting or exceeding the federal requirements for petroleum reduction. We do that in several ways. One is by providing guidance that interprets the Legislative and Executive Order requirements. And for example, last year under Section 12 of Executive Order 13514, we released fleet management guidance. Now we not only provide interpretation, but then practical experience of how do you implement these requirements. And so we have a complement to the guidance, which is the Fleet Management Handbook under EO 13514.

We also provide agencies with assistance with fulfilling requirements. We provide funding for the maintenance upgrades and training of the federal automotive statistical tool. FEMP reviews the waiver applications from agencies, which are submitted under EPACT section 701, in order to determine whether or not alternative fuel is available to these vehicles or not.

We also facilitate the agency's submission and completion of their score cards to the Office of Management and Budget (OMB) each six months.

A big part of what *(Audio Skip)* is technical assistance and fleet assessments. So I'll mention just a few of the things that we provide. And there are certainly others. But the vehicle acquisition optimization tool is something that we've developed with the National Renewable Energy Laboratory. And it's now provided as a service to agencies. It can help an agency optimize the size and composition of its fleet, and the location of those vehicles in order to maximize petroleum reduction and still meet mission goals.

The fuel use analysis tool is one that we're developing and is available to agencies. It analyzes data from agencies as to where their drivers are fueling up and where they might have opportunities to be using alternative fuels, as opposed to traditional petroleum.

The station locator tool is a great GIS map that's used to identify where alternative fuel stations are located, as well as traditional gasoline stations. And the fleet atlas is one that superimposes federal fleet locations onto that map so that you can determine where your vehicles are and where they can access alternative fuel.

We also facilitate the development of infrastructure for alternative fuel. And we do that by sharing *(Audio Skip)* and agency says yes, we share information regarding the vehicle locations. So that federal or excuse me, so that fleet petroleum providers can know where there are untapped markets, and why they would want to put E85 pumps, for example.

Now while FEMP is primarily a technology deployment operation, we also have a research aspect to what we do. One example is the vehicle monitoring project that we're doing with Idaho National Laboratory. And that will help us understand better where there are opportunities to replace traditional vehicles with electric vehicles, as well as where there are opportunities for reducing idling.

FEMP does a lot with information sharing. We chair the INTERFUEL working group that meets each month. And we also provide a Federal Fleet monthly newsletter.

And hopefully you know that we provide training. We'll be doing a dozen sessions at the Fed Fleet Conference this year at the end of July. And we provide webinars, such as this one, on electric vehicles.

So transitioning now from that broad overview of FEMP services under the Fleet Management Program and looking more at electric vehicles now, we realize that more clarity is needed in order to determine how to report electricity that is used to charge EVs. That electricity comes through facilities. And so part of it is facility energy. And it's also used to fuel fleet vehicles. So then it's fuel. So we'll be coming out with guidance as to how to separate those two and how to report them appropriately. We expect to have that done by the end of this fiscal year. And in the meantime, we'll certainly share drafts with you and appreciate your feedback for that.

So I'll hand it back now to Kathy Hyland.

Kathy Hyland: Thanks, Mark. I'm now going to turn it over Julian *(Audio Skip)*, who will deliver the next part of our program.

Julian Bentley: Well, thank you, Kathy. Hello and good afternoon. And good morning to those on the west coast. I am Julian Bentley from LMI, a contractor to FEMP. Today I will be providing an introduction to electric vehicles and how and if they fit into your overall fleet management strategy.

First, let's start talking about some of the benefits that electric vehicles provide and the challenges to their deployment. Electric vehicles can have many potential benefits. First, they are very effective at displacing petroleum use. Each mile driven by an electric vehicle reduces the national security and economic impacts with using foreign oil. Second, they can be very effective at reducing fleet greenhouse gas emissions. Electricity from renewable sources is one of the few fuels available today that can completely eliminate fleet greenhouse gas emissions.

Electricity is much cheaper than conventional fuels. And maintaining electric vehicles is much cheaper than maintaining conventional vehicles. Both of these help to greatly reduce the operating costs associated with using fuels. And finally, the federal fleet can fulfill the President's vision and lead by example in helping to develop the electric vehicle market.

These potential benefits however, need to be weighed against some of the pitfalls and challenges of deploying electric vehicles. First, today, the incremental costs associated with *(Audio Skip)* requiring electric vehicles are very high. They can be $20,000.00 more than a similar conventional vehicle. Although many manufacturers are introducing electric vehicles into the marketplace, production volumes are low and getting these vehicles into your fleet may be difficult. Integrating electric vehicles may be difficult for some organizations. Fleets will have to manage a lot of the organizational resistant issues that go with implementing new technologies. And finally, as employees start to transition to electric vehicles of their own, federal fleets will have to set up guidelines, if any, for employees to use the charging infrastructure on federal fleet sites.

Now let's talk about the different types *(Audio Skip)* electric vehicles, how they work and the drivers of the electric vehicle market. This slide shows some of the common terminology for electric vehicles, which also refer to them as EVs. There are four types of EVs. HEVs or hybrid *(Audio Skip)* like the Toyota Prius. PHEVs or plug-in hybrid electric vehicles, like the Chevy Volt. BEVs or pure battery electric vehicles, like the Nissan Leaf. And low speed electric vehicles, or LSEVs, which are also referred to as neighborhood electric vehicles or NEVs. These are low speed battery electric vehicles. There's also ZEVs or zero emission vehicles, which are vehicles that emit no tailpipe pollutants. EVSC or electric vehicle-supply equipment, o r the charging infrastructure for electric vehicles. KW or kilowatts is a measurement of demand of electricity. And GHG or greenhouse gas, which we'll also be talking about a lot in this presentation today.

The type of vehicle we most commonly thinking of when we think of electric vehicles is a BEV or battery electric vehicle. BEVs are vehicles that are propelled by an electric motor only, which is powered by batteries. These batteries are charged by plugging into the grid or from a renewable source and electricity from regenerative braking.

LSEVs or low speed electric vehicles are pure electric low speed vehicles. They are similar to regular battery electric vehicles except typically they are limited to streets with posted speed limits less than 35 miles per hours. They weigh less than 3,000 pounds. The top speed is limited to 25 miles per hour. And they recharge through a standard outlet.

Low speed electric vehicles do not meet the Energy Policy Act of 1992 definition of vehicles and, therefore, are not considered vehicles in the federal fleet world. However, the electricity used in these vehicles can be counted to federal fleet alternative fuel use increase goals.

HEVs or hybrid electric vehicles are vehicles that are propelled by both an internal combustion engine and an elective motor. HEV batteries are powered from energy recovered during regenerative braking. These batteries use the recovered energy to assist in powering the vehicle, improving overall vehicle fleet or vehicle fuel efficiency.

There are two main types of hybrid electric vehicles. Parallel and parallel series. Parallel hybrids include the Honda Insight and the Honda Civic. Parallel series hybrids include the Toyota Prius and the Ford Escape Hybrid. These differ based on how and when the vehicle uses the internal combustion engine and the electric motor. The major difference is that in parallel series hybrids the vehicle can be solely powered by the electric motor. This typically occurs at slow speeds and at short distances.

Parallel hybrids are much more effective at using excess power from the internal combustion engine to charge the batteries. Typically parallel hybrids are much more effective at highway speeds and parallel series hybrids are much more effective at city driving or stop and go conditions.

The final type of electric vehicle is the plug-in hybrid electric vehicle or PHEV. These vehicles are a combination of a hybrid electric vehicle and a battery electric vehicle. The car is fueled partially by electricity from plugging in, like a battery electric vehicle. But is also powered partially by an internal combustion engine, like a hybrid electric vehicle. PHEVs are classified by their all-electric range. Such as a PHEV 10, which has a 10-mile range and a PHEV 40, which has a 40-mile range.

The two main types of plug-in hybrid electric vehicles are parallel series and series. Parallel series plug-in hybrid electric vehicles include the Toyota Prius plug-in hybrid electric vehicle. Series plug-in hybrids include the Chevy Volt, which is also called an EREV or extend range electric vehicle.

Parallel series plug-in hybrids operate very similar to regular hybrids except a lot more electricity is stored in the batteries. Series plug-in hybrids are powered solely by the electric motor with the internal combustion engine operating as a generator when the batteries are running low.

Right now the electric vehicle market is in its infancy. The growth of the electric vehicle market will be driven by four primary factors. The first factor is geopolitical drivers. One effective strategy to reduce our dependence on oil is to use electric vehicles, which is, of course, electricity. Also, as oil prices increase, electricity used in electric vehicles will become a more cost effective means of transportation.

The second is environmental drivers. Mitigating greenhouse gas emissions, especially from the transportation sector, will become more and more important. Electricity, especially that from renewable sources, is a very effective strategy at reducing fleet greenhouse gas emissions. Also, air quality impacts from increased congestion will also drive the movement towards zero emission vehicles, including electric vehicles.

The third driver is technology drivers. This includes improvements in technology, as well as economies of scale will improve the business case for electric vehicles and drive EV market growth. And the fourth and final driver is consumers. Consumers will drive the market acceptance for electric vehicles. This will happen when they're cost comparable to conventional vehicles. And also, operationally similar to conventional vehicles. This means increased availability of charging stations and also increased convenience.

This graph shows the U.S. hybrid electric vehicle historical sales from 1999 to 2009. In the first decade of hybrid electric vehicles the market grew tremendously, f rom almost no vehicles in 1999 to over 300,000 vehicles a year in 2009. We expect a market for other electric vehicles to grow similarly over the next decade.

This graph shows our projections for sales of hybrid electric vehicles, battery electric vehicles and plug-in hybrid electric vehicles over the next five years. We expect the market for hybrid electric vehicles to continue growing to over 1.2 million vehicles per year in the next five years. This is due to increased cost effectiveness of hybrid technologies, as well as persistent high gas prices.

Both the PHEV and BEV markets will exhibit high growth rates through 2016. Driven primarily by range anxiety, which we'll talk about in the next few slides, consumers will likely prefer plug-in hybrid electric vehicles to battery electric vehicles.

The market for electric vehicles will largely be driven by the cost and performance of batteries. This includes battery energy density, abuse tolerance, estimated life and, most importantly, cost per kilowatt hour. The graph on this slide shows the battery price points in cost per kilowatt hour where electric vehicles become cost comparable to conventional vehicles. We estimate that the current cost for batteries are currently between $375.00 and $1,000.00 per kilowatt hour. At this price point, hybrid electric vehicles are cost effective.

PHEV10s become cost effective when the price point reaches $500.00 per kilowatt hour. PHEV40s become cost effective at $300.00 per kilowatt hour. And battery electric vehicles become cost effective when battery costs are between $100.00 and $150.00 per hour.

Battery costs are falling quickly as orders for those batteries increase. Meaning that plug-in hybrid electric vehicles and battery electric vehicles may approach commercial viability soon.

The market for electric vehicles is all affected by consumer range anxiety. Or in other words, consumers are scared of running out of electricity. This means that the electric vehicle market will develop as the number of electric vehicle charging stations expands. Early most of these charging stations will be at consumer homes or at the workplace, such as fleet depots. As the market develops, more electric stations will be needed at work, as well as at public places such as stations and parking spaces. Range anxiety means that consumers may prefer plug-in hybrid electric vehicles over battery electric vehicles until charging infrastructure expands.

Comparing the total cost of ownership, or TCO, is the best way to figure out when electric vehicles are commercially viable. At today's gas prices, hybrid electric vehicles are reaching cost parity with conventional vehicles. As gas prices rise and battery's cost decrease, battery electric vehicles and plug-in hybrid electric vehicles will begin to reach cost parity, likely after 2016.

This graph is a graph developed by PRTM Management Consultants, which shows when cost parity occurs for hybrid electric vehicles, battery electric vehicles and plug-in hybrid electric vehicles for different vehicle segments and uses. On the left are the different vehicle segments, such as passenger, class one and two, class three, class four and five and class six and seven. And on the top of the graph is the year when the technology will become the lowest total cost ownership technology. In gray is the internal combustion engine. In light green is the plug-in hybrid electric vehicle, or excuse me, is the hybrid electric vehicle. And in dark green are battery electric vehicles and plug-in hybrid electric vehicles.

As expected, high use vehicles tend to reach cost parity earlier. But this graphic also shows us that medium and heavy-duty vehicles also reach earlier cost parity. This is likely due to low fuel economy leading to high fuel use in these segments.

We have presented an overview of the types of electric vehicles and the electric vehicle market. Now let's look at incorporating electric vehicles into the federal fleet and how electric vehicles help meet federal fleet goals.

Electric vehicles can be a very important part of a federal fleet management strategy. They are very effective at displacing fleet petroleum and make sense in locations where other alternative fuels, such as ethanol and biodiesel are not available. Federal fleets can also use electric vehicles in meeting their EPACT 1992 alternative fuel vehicle acquisition requirements. And electricity used in electric vehicles counts towards Executive Order 13423, alternative fuel use increase targets.

Electricity can also help save costs. Electricity typically costs $3.00 per gas gallon equivalent (GGE) less than gasoline. And finally, federal fleets can lead by example in reducing our dependence on foreign petroleum. Almost all electricity is produced in the United States.

Now let's look in detail in how electric vehicles can help meet your federal fleet requirements. First, electric vehicles can help agencies comply with the EPAct 1992 alternative fuel vehicle acquisition requirements. Acquisition of electric vehicles, including battery electric vehicles, plug-in hybrid electric vehicles and plug-in hybrid electric vehicles provide alterative fuel vehicle credits towards meeting that goal.

Second, electric vehicles can help agencies reduce fleet petroleum by displacing petroleum with an alternative fuel. This helps agencies meet the Executive Order 13514, Executive Order 13423 and EISA requirements to reduce fleet petroleum by 2 percent each year.

Use of electricity counts as an alternative fuel helping agencies meet their alternative fuel use goals. This includes the Executive Order 13423 requirement to increase alternative fuel use by 10 percent compounded annually. Similarly, EPAct section 701 requires all dual fueled AFVs to use alternative fuel when it's reasonably available. FEMP is still working on the applicability of EPAct section 701 to plug-in hybrid electric vehicle.

Section 246 of EISA requires each federal agency to install renewable fuel pumps at each of their federal fleet refueling centers. Electric vehicle charging stations, when sourced with renewable energy or renewable energy credits, are considered to be renewable fuel pumps under this requirement.

Electric vehicles also help agencies meet their greenhouse emission reduction goals. First, EISA Section 141 prohibits agencies from acquiring light-duty and medium-duty passenger vehicles that are not low greenhouse emitting vehicles. Almost all electric vehicles as classified by EPA as low

greenhouse emitting vehicles. Electric vehicles' low greenhouse gas emissions also help agencies meet their Executive Order 13514 greenhouse gas emission reduction targets. Finally, and probably most importantly, electric vehicles should be considered an important potential component of each agency's comprehensive fleet plans. These are required by Executive Order 13514 and EISA Section 142.

Executive Order 13514 establishes petroleum and greenhouse gas emission reductions as a core competent of federal fleet management. It also provides three driving principles to accomplish this goal. The first is to reduce vehicle miles traveled or VMT. The second is to increase fleet fuel efficiency by replacing existing vehicles with higher fuel economy vehicles and also through operational changes. Acquiring hybrid electric vehicles and low speed electric vehicles are an important component of this principle. The third driving principle is to maximize the displacement of petroleum with alternative fuels. This includes electric vehicles and electric vehicle charging infrastructure.

For the driving principle increasing fleet fuel efficiency, electric vehicles can help in two ways. First, hybrid electric vehicles can help reduce petroleum and greenhouse gas emissions by almost a third compared to a similar non-hybrid vehicle. Hybrid electric vehicles are most cost effective in locations where alternative fuels, such as ethanol and biodiesel are not available.

The second way is that electricity is a far more efficient fuel than petroleum. Electric vehicles on an energy content basis get three times more miles per gasoline gallon equivalent than conventional fuels. This slide shows two examples. The first, the Nissan Leaf battery electric vehicle, gets 99 miles per gallon gasoline equivalent. And the Chevy Volt plug-in hybrid electric vehicle gets 93 miles per gasoline gallon equivalent when operating in pure electric mode compared to 37 miles per gallon when operating as a regular hybrid.

Strategies to acquire electric vehicles to displace petroleum use can be effective at any fleet location regardless of the number of vehicles or the availability of alterative fuel. However, electric vehicle strategies are most effective at smaller fuel locations and those locations without access to alternative fuels. While ethanol and biodiesel strategies are most effective at higher use fleet locations.

We have identified four major steps for identifying optimal electric vehicle strategies at each fleet location. The first step is to identify conventional fuel vehicles that are not candidates to be replaced with alternative fuel vehicles or diesel vehicles capable of using biodiesel. Determine if the fleet location will have accessibility to alternative fuel or biodiesel and then evaluate vehicles that are not candidates to be replaced with alternative fuel vehicles and diesel vehicles.

The second step is to identify optimal vehicle strategies based on fleet location characteristics. For example, high annual mileage with a range of less than 100 miles daily may be a good candidate for a battery electric vehicle. Similarly, campus locations are typically good candidates for acquisition of low speed electric vehicles.

The third step is to evaluate the availability of electric vehicles to replace conventional fuel vehicles. This includes determining the availability of battery electric vehicles, low speed electric vehicles or plug-in hybrid electric vehicles to replace conventional fuel vehicles that are not candidates to be replaced with alternative fuel vehicles and diesel vehicles. And most importantly, ensure that those electric vehicles meet minimum requirements needed to accomplish mission tasks.

The fourth step is to evaluate life cycle costs for acquisition of electric vehicles. Determine whether the electric vehicles match fleet requirements and can be acquired at a cost reasonable compared to conventional vehicles. And if they are not cost competitive, investigate whether funds can be made available based on compliance with federal fleet petroleum reduction mandates.

In this slide we compare different types of electric vehicles to gasoline vehicles on five primary operating criteria. Hybrid electric vehicles offer up to a 50% boost in fuel efficiency at a price premium of roughly $3,000.00. Operating savings are roughly 4.5 cents per mile, which leads to a break-even point of roughly 70,000 miles. Hybrid electric vehicles have no range or fueling concerns. Plug-in hybrid electric vehicles offer a 200% increase in fuel economy, but are priced premium of up to $18,000.00. Operational savings will range from 7.5 to 10 cents per mile depending on the amount of gasoline or electric use. Like hybrid electric vehicles, plug-in hybrid electric vehicles have no range concerns. However, refueling electricity will take hours instead of minutes.

Battery electric vehicles provide the greatest increase in fuel economy, 230%, but again, at a very large price premium. With operational savings of about 10.5 cents per mile, the break-even point approaches 200,000 miles. Range today is typically limited to less than 100 miles. And again, battery electric vehicles take hours to refuel.

Electric vehicle can greatly reduce fleet greenhouse gas emissions. This graph compares the carbon dioxide fuel related emissions for gasoline, ethanol and various electric vehicles. As shown in yellow, corn based ethanol, or E85, reduced *(Audio Skip)* greenhouse gas emission by 21% compared to conventional gasoline vehicles.

In light blue, hybrid electric vehicles can reduce greenhouse gas emissions by about a third. All of this from improved fuel efficiency. In medium blue, plug-in hybrid electric vehicles can reduce greenhouse gas emissions by 43%when sourced from the grid. This increases to 86% when the electricity is from renewable sources. And in dark blue, battery electric vehicle can reduce fleet greenhouse gas emissions by 50% when plugged into the grid. And the holy grail of greenhouse emission reductions is a battery electric vehicle source based on renewable electricity. Which reduces emissions by 100%.

We have given you a lot of information comparing different electric vehicles. As a fleet manager it's very important to use this information to make informed decisions about when and where electric vehicles make best sense for your fleet. For example, hybrid electric vehicles are going to make best sense where alternative fuel is not available, stop and go driving situations, and where a range and electric charging infrastructure are concerns. Plug-in hybrid electric vehicles work best in high mileage situations where charging infrastructure is not a concern but range is. And battery electric vehicles work best with high use, availability of charging infrastructure and short range needs.

Now that we have introduced electric vehicles, let's talk about electric vehicle infrastructure or EVSC and having your fleet become plug-in ready.

Kathy Hyland: Before continuing with the second half of Julian's presentation, let's let him take a break for a minute and review some information about upcoming and archived First Thursday seminars.

[Music]

Julian Bentley: Now that we have introduced electric vehicles, let's talk about electric vehicle infrastructure or EVSC or electric vehicle supply equipment and having your fleet become plug-in ready.

Electric vehicle infrastructure includes more than just electric vehicle supply equipment, or EVSE. It includes connecting transmission wiring to your EVSE, connecting your EVSE to your vehicle using the right plug and ensuring your vehicle connects to the electricity to charge the batteries. Currently there are two main types of electric vehicle charging options, level one and level two. Both of which have established standards.

Level one uses a standard electrical outlet, 120-volts. The charge time is typically 15 to 20 hours for a full charge. And this works best typically for low speed electric vehicles and plug-in hybrid electric vehicles with low ranges, such as a PHEV10. Level two uses a 240-volt dedicated circuit

similar to the dryer outlet in your house. Charging is roughly four times faster than the level one charging option. However, it requires installation by an electrician and special equipment. This is best for battery electric vehicles and plug-in hybrid electric vehicles with larger ranges.

Level three offers a much faster charging option, where 80% of the charge may be completed in 30 minutes or less. This may provide an experience somewhat similar to a gasoline station. However, standards for level three have still not been met.

The final charging option is battery swapping. This involves vehicles having standard batteries and going to a station to replace depleted batteries with a charged one. Again, this can provide a quick recharging option easing range anxiety.

In the next three slides we talk about steps needed for planning and implementing electric vehicle charging infrastructure at each site. Following these steps will help ensure your fleet transition to electric vehicles and electric vehicle charging infrastructure.

First, fleets should identify their electric vehicle charging needs. This includes determining what access vehicles will have to the EVSC, how many vehicles will use the electric vehicle charging infrastructure and the frequency of use, charging speeds needed to meet the fleet needs, including long term parking or regular use, employee charging or daily charging, and continual fleet operations. And other electric vehicle-charging infrastructure needs, such as currently available infrastructure nearby, time of use and concurrent use by a large number of vehicles.

The next step is to assess potential electric vehicle charging sites. This includes where to locate the EVSE and the parking spaces for vehicles to charge in, the availability of power and its requirements, cord and walkway management, what type and model of EVSE you wish to choose, what data to collect off the electric vehicle charging infrastructure, specifically to help meet your federal fleet reporting needs, concerns to address the Americans with Disabilities Act and lighting for nighttime use.

Once these decisions have been made, fleet managers should follow a process similar to the 12-step checklist that’s provided on this slide to implement EVSE at the site. This includes working with a contractor, and a utility inspector to make sure the electric vehicle charging infrastructure is installed correctly and to plan.

All electric vehicle related equipment should meet current electric vehicle standards. All vehicles acquired from vehicle manufacturers will follow the standard SAEJ2344 or guidelines for electric vehicle safety. The connection from the electric vehicle charging infrastructure to the vehicle will meet the standard SAEJ1772 or the plug, the EV conduit charge coupler standard. And all EVSE that you acquire should meet Underwriters Laboratory 2594 standard for the cords, the stations and the power outlets, a nd any C standards 625 for its installation.

Infrastructure adds more cost to deploying electric vehicles in your fleet. These costs typically range for about $500.00 to $15,000.00 per station. These costs will vary based on the number of stations at your fleet location, the characteristics of your specific fleet location and the type and functionality of the EVSE.

This table shows some of the typical components of electric vehicle infrastructure costs. These include the charging and billing unit, a pad mount, commercial feeder and cable pull, a main circuit breaker, termination of usable switches, trenching and saw cutting, conduit and wiring and labor. The takeaways from this table are that there are many different potential cost items associated with installing electric vehicle charging infrastructure. The costs for each are highly dependent on the site characteristics and needs at your site. The EVSE charging unit alone may only be a small component of the total cost of implementing electric vehicle charging infrastructure.

We have talked about acquiring infrastructure, now let's discuss *(Audio Skip)* for your fleet. This May GSA awarded three contracts for light-duty electric vehicles. These conclude the Chevy Volt plug-in hybrid electric vehicle, which has a pure electric range of 40 miles; the Think City pure battery electric vehicle, which has a range of 113 miles; and the Nissan Leaf battery electric vehicle, which has a range of 73 miles. All of these vehicles are available on the GSA contract.

Fleet managers can also acquire other electric vehicles from GSA. There are two medium- and heavy-duty trucks that are battery electric vehicles available on the GSA schedule. The first is a Smith Newton battery electric vehicle truck. This battery electric vehicle truck has 100-mile range and has an incremental cost of $61,000.00. The second is a Zero Truck battery electric vehicle. This also has 100-mile range and an incremental cost of $117,000.00. It's important to note that even though these incremental costs are high, because of the high fuel use in medium- and heavy-duty vehicles, these actually may be cost competitive type products.

In the federal fleet world, low speed electric vehicles are not considered vehicles and are available on an equipment schedule, GSA schedule 23V.

Just last week GSA announced its EV pilot program. This pilot includes the purchase of 116 electric vehicles, which include the Volt, the Leaf and the Think City. These vehicles will be leased to 20 federal agencies in 5 pilot cites. Those pilot cities are Washington, D.C., Detroit, Los Angeles, San Diego and San Francisco. GSA will also coordinate with these agencies to install electric vehicle charging infrastructure at federal building locations in these five pilot cites.

This slide shows the deployment plans in the U.S. market for battery electric vehicle over the next year. We can expect the introduction of many new battery electric vehicle models in the market over the next few years. These include the Ford Focus electric near the end of this year.

This slide shows the deployment plans for plug-in hybrid electric vehicles in the U.S. market through 2012. We also can expect to see many new plug-in hybrid electric vehicles. These will include the Toyota Prius plug-in hybrid electric vehicle, which has a pure electric range between 12 and 18 miles, and the Ford Escape plug-in hybrid electric vehicle with a 40-mile range.

Now that we have talked about acquiring both electric vehicles and electric vehicle supply equipment, let's talk about how we incorporate electric vehicles into the overall fleet management strategy. There are five steps for incorporating electric vehicles into your fleet strategy.

First, federal fleet managers should identify where electric vehicles make sense. These are locations where alternative fuel is not available, low speed electric vehicles for campus type settings and hybrid electric vehicles, battery electric vehicles and plug-in hybrid electric vehicles for small sub-fleets.

Second, fleet managers should build charging infrastructure to support vehicles. Third, and only after completing infrastructure plans, should fleet managers acquire electric vehicles. Again, GSA is the preferred source for acquiring electric vehicles. And they should be deployed only where the electric vehicle charging infrastructure is available to support them.

Fourth, once electric vehicles and infrastructure are deployed, fleet managers should collect vehicle fuel use data for reporting to ensure they have the data necessary for meeting federal fleet requirements. And fifth, and finally, as experience grows with electric vehicles, fleets should expand deployment as needed.

As fleet managers plan for electric vehicles, they should always consider these five questions. Do electric vehicles make sense for my specific fleet characteristics? If so, what type? How many charging stations will I need for my fleet location? What is my electric vehicle acquisition plan? How will I install and maintain electric vehicle charging infrastructure? And how will I fund an electric vehicle strategy?

In this section, we will talk about how electric vehicles impact the many federal fleet reporting requirements. This graphic shows the various federal fleet reporting requirements during each year. Electric vehicles will have the largest impact on the fast vehicle cost and fuel reporting in December, the agency annual fleet compliance report that's required by February 15 of each year, and the EISA Section 246, renewable pump installation reporting and FAST that is required each June.

In December each federal agency must report fleet fuel use and FAST. All electricity used to charge battery electric vehicles, plug-in hybrid electric vehicles and low speed electric vehicles is counted an alternative fuel. Electricity generated either from regenerative braking or the internal engine by hybrids is not counted towards these alternative fuel use targets.

This slide shows how to measure electricity used in electric vehicles for onsite electric charging stations. Having the capability to collect metering data and electricity for electric vehicles by each vehicle is optimal. However, there are methods to measure electricity use without metering data. These include first, using the FEMP measurement and verification standards that are used also for buildings. Second is the use of informally metered data, such as kilowatt. And third, multiplying mileage by calibrated vehicle efficiency factor, which is typically supplied by a vendor.

For electric charging stations used offsite, optimally transaction receipts will have the electricity consumed by each vehicle. However, without this information, fleet managers can still estimate electricity use in their vehicles. This can be accomplished by first, multiplying mileage by calibrated vehicle efficiency factor, again supplied by a vendor, o r using the charge time and the kilowatt demand of the charging station.

Here are some sample calculations for estimating electricity-use using mileage and a calibrated vehicle efficiency factor. All of these calculations are used based on a 12,000 mile per year vehicle usage. The Nissan Leaf vehicle efficiency factor, which is provided by EPA, is 34 kilowatts per 100 miles. Therefore, the estimated electricity use over 12,000 miles is 4,080 kilowatt hours. The Chevy Volt is slightly less efficient with an efficiency factor of 36 kilowatt hours per 100 miles. These estimated electricity use over 12,000 miles is 4,312 kilowatt hours. And finally, the Gem low speed electric vehicle has an efficiency factor of 16.9 kilowatt hours per 100 miles, which is provided by DOE. The estimated electricity use over 12,000 miles is 2,028 kilowatt hours.

Agencies are also required to report and FAST their acquisition of alternative fuel vehicles to measure compliance with EPAct 1992. The different types of electric vehicles receive different acquisition credits in meeting this requirement. Battery electric vehicles are considered to be dedicated alternative fuel vehicles. Therefore, light duty battery electric vehicles receive two credits, medium-duty battery electric vehicles receive three credits and heavy-duty battery electric vehicles receive four credits.

The National Defense Appropriation Act of 2008 classified both hybrid electric vehicles and plug-in hybrid electric vehicles as alternative fuel vehicles. These vehicles each receive one AFE credit in meeting the *(Audio Skip)* requirement. And finally, low speed electric vehicles are not considered to be vehicles by the EPAct of 1992. And therefore, they do not receive any alternative fuel vehicle credits.

EISA Section 246 compliance is reported in FAST each June. Under EISA Section 246, agencies must install renewable fuel pumps at each of their covered fleet fueling centers. Electric vehicle charging infrastructure meets this requirement if two conditions are met. Either the electricity is sourced from renewable generation or renewable energy credits are purchased equal to or greater than the electricity used in the vehicles. All agencies should report their electric charging infrastructure in FAST each year and indicate whether the electricity is from renewable sources or not.

Executive Order 13423 *(Audio Skip)* agencies must acquire plug-in hybrid electric vehicles when they become cost comparable to non-plug-in hybrid electric vehicles on a lifecycle cost basis.

Although plug-in hybrid electric vehicles are available commercially, they are not on a comparable cost to non-plug-in hybrid electric vehicles. GSA will issue a fleet order when this requirement is applicable.

The final electric vehicle related reporting requirement is EISA Section 141. This requirement prohibits agencies from acquiring vehicles that are not classified as low greenhouse gas emitting vehicles. Agencies must self-report on this requirement. Almost all battery electric vehicles, hybrid electric vehicles and plug-in hybrid electric vehicles are classified by EPA as low greenhouse gas emitting vehicles.

Finally, I would like to share with you two resources that can help you in deploying electric vehicles and electric vehicle charging infrastructure. The first, the Alternative Fuels and Advanced Vehicles Data Center, or AFDC, which is available at www.afdc.energy.gov. This site provides geographical locations of all alternative fuel infrastructure in the United States, including electric vehicle charging infrastructure. The GEO EVSE Forum, developed together with Google, offers the most comprehensive geo-database of EVSE locations or *(Audio Skip)* charging infrastructure locations in the United States. The AFDC site also has pages *(Audio Skip)* of *(Audio Skip)*, as well as case studies of deployment of electric vehicles in fleets.

FEMP is currently constructing the Fed Fleet EVSE project, which is expected to be completed by the end of this fiscal year. This site, once complete, will provide fed fleet specific guidance and support on the following: e lectric vehicle supply equipment implementation, electric vehicle deployment and acquisition, best practices and common pitfalls, case studies, as well as reporting. This site will also house a comprehensive database of fed fleet electric vehicle charging infrastructure and electric vehicle deployment projects. This will be completed using project surveys to collect information and sharing location and benchmarking data to help other fleets.

This slide shows some of the contacts, should you have further questions on electric vehicles or electric vehicle charging infrastructure and how to deploy them in the federal fleet. Thank you very much for joining us today for this seminar. We'll be taking questions very shortly.

Kathy Hyland: Thank you, Mark and Julian. In this part of the seminar we'll be happy to answer your questions, so please give us a call to speak directly with one of the instructors or with one of the FEMP experts in D.C. Our first question is from Roger Lukin, who is calling in live. Roger, can you hear us?

Roger: Yes.

Kathy Hyland: What is your question?

Roger: I have two questions actually. First, how do you think battery technology will develop over the next few years? And second, should an agency wait to acquire new EVs to see if battery life improves? Thank you.

Kathy Hyland: Brad, would you like to take that one?

Brad: Sure. Sure, I'd be happy to take that question. One of the things we're looking forward to and we're under the impression that will happen is that the cost of batteries, which is a key component in terms of cost of EVs, will be dropping significantly in the next few years. And in fact, we've actually seen that happening over the last couple of years. So a trend is underway. The cost of batteries is going down significantly. I think Julian reflected that in a couple of his slides. And I would add to that while the internal combustion engine is becoming ever more efficient, there are added costs which are driving that efficiency. So while the ICE is becoming more costly, the battery electric drive components are becoming less costly. Which is a key driver. It's equalizing the playing field, if you will, for the ICE versus the electric vehicle.

And as to the question whether you should wait. I would say that's an agency choice, up to the individual agencies. I would look at EVs, battery electrics and hybrid electrics carefully. I would look for opportunities to deploy them. And I wouldn't unilaterally hold off. I would say do we have applications where it makes sense and work with GSA to get the best deal you can for an EV.

Kathy Hyland: Thanks, Brad. I have a question here. And Julian, if you'll take this one. How do you determine the best type of EV to lease from GSA in terms of overall cost and performance? And then the follow up a question is, are there deals being offered to agencies to stimulating leasing of one type of EV over another type?

Julian Bentley: To the first part of that question, in terms of evaluating which is the best types of electric vehicles, you should look specifically at what you're going to be using the electric vehicle for. So as we talked about before, the battery electric vehicles are going to be best used in high mileage situations with low ranges. Plug-in hybrid electric vehicles can operate very similarly to a regular gasoline vehicle. So if you have longer ranges or just want to operate it without the kind of range anxiety you might find from a battery electric vehicle that may work for your fleet. And also look at *(Audio Skip)* not just in the light-duty segment but also in the medium- and heavy-duty segment. There may be some opportunities based on your specific fleet characteristics where something like a medium-duty battery electric vehicle truck may make a lot of sense. It's important to kind of look at specific use characteristics and try to figure out what the true costs are going to be and where they best make sense.

In terms of where the best deals may be, the one great thing about purchasing through GSA is that GSA with the scale of purchasing for the federal government is able to get a great deal on most of these vehicles, especially with – for example, the recent contract for the Chevy Volt, the Nissan Leaf and the Think City are very competitively priced. As well as the contracts also for the available medium-duty vehicles we also talked about.

Kathy Hyland: Thank you, Julian. We have Navid Ahdieh from National Renewable Energy Laboratory on the line. Navid, can you hear us?

Navid: Yes, I can.

Kathy Hyland: What's your question?

Navid: Yes. I was curious how can our facility best coordinate with the Clean Cities Program to stimulate EV infrastructure in our region.

Kathy Hyland: Brad, do you want to take that one?

Brad: Sure, I'd be happy to take that question. First and foremost, the Clean Cities organization has a great number of coordinators around the country. And I would suggest that you go on the website, the Clean Cities website at DOE and find out who your coordinator is and contact the coordinator and coordinate, work with them directly. If you have any trouble finding that, I would say please come to FEMP and we'll help you make that connection.

Kathy Hyland: Okay. Amanda, I have another question I'd like to direct towards you. It says, what are some of the things to look for when selecting a supplier or contractor?

Amanda: Well, agencies do have one benefit when they're looking for EVSE suppliers and that's that GSA has done an excellent job of pre-vetting suppliers and getting them on contract so that it's easy to have a number to choose from. And then I think Julian did a great job of showing some of the characteristics you should look for and consider when you're decided what you need in your electric vehicle supply equipment. So you should consider what level of charging you need, whether you need level one or level two. And what kind of reporting you'd like to be able to get out of that system.

Kathy Hyland: Thanks, Amanda. We have a call from Richard Ward in Dallas, Texas. Richard, can you hear us? We may not be able to hear – I can't hear him right now. Let me take a question and we'll see if we can get him back on. Brad, let me direct this one to you. It says, do certain types of facility upgrades, renovations and retrofits in buildings make installing EV charging infrastructure more cost effective?

Brad: Well, certainly with new construction you're not going to have to dig anything up or redo to install the conduits and the wiring necessary to install the infrastructure for EVs. So the earlier in the process, in terms of construction, you take action, the less *(Audio Skip)* be. I think that being said, you should look at any upgrade in your facilities and discuss it, the facilities folks hopefully will discuss with the fleet team and see if they are planning to deploy electric vehicles in that area. Work with them and plan accordingly. If you don't have your EVs right now, you can still take action setting aside some space, laying conduit, what have you, to prepare for the EVs without having to tackle the cost of the entire infrastructure upgrade in advance of receiving your electric vehicles. So I think key to this is planning ahead and working across facility and fleet teams at the site.

Kathy Hyland: Right. Richard, I believe we have you to where we can hear you now. What's your question?

Richard: My name is Richard. This is a forward looking question. Assuming these electric vehicles really take off nationwide, has the government taken any type of stance on fuel taxes? What we're paying for any type of fuel right now has got a pretty heavy tax on it for road use and other things. But can someone shed some light on what the thinking is at this point in time?

Kathy Hyland: Amanda, Brad, you want to take that one?

Brad: Well, I'm afraid I can't be of much assistance there. That's a bit out of our purview. I know that there have been discussions of that at DOE and on the Hill, but sorry, I really can't address that question with any authority.

Amanda: But if I could add to that, Brad. I would like to point out that at FEMP we are fuel neutral. So we want to help agencies find the most cost effective solutions based on what the market is determining and what the taxes are set at currently. We're not influencing those, but we're responding to them.

Kathy Hyland: Thanks, Brad and Amanda. Another question. Julian, let me take this one towards you. What is the potential EV market for large trucks and other industrial vehicles?

Julian Bentley: That's a great question. A lot of times we think about electric vehicles we do think about the light-duty vehicles. But there's also a lot of opportunities for medium- and heavy-duty vehicles. Right now there are two that are on GSA schedule. But the real compelling market for the medium- and heavy-duty segment is that the fuel efficiency for these vehicles currently is very low, which means that using electric drive can really save a great deal of fuel and a great deal of cost. So it actually is at a place where they can become cost comparable to non-electric vehicles in a relatively short number of years.

There's also right now the Department of Defense is looking into opportunities in this segment. And because of the ability for the Department of Defense to buy a large number of vehicles, they may be able to drive down some of the costs of acquiring medium- and heavy-duty battery electric vehicles. I think it's a very interesting space. And the potential for electric vehicles.

Kathy Hyland: Thank you. We have on the phone Dick Cromwell with the Clean Cities Program in California. Dick, welcome.

Dick: Thank you. The question is towards Julian. On his comparison to gasoline vehicles, a lot of the numbers he quoted are not on the chart. Or they're different than the chart. And I was wondering if his chart would have an opportunity to be updated to what he was stating today.

Julian Bentley: I can get back to you. We can – if you want to send an email we can discuss some of the numbers on the chart and where they might differ. And definitely – one interesting thing about the electric vehicle market is that it's changing every day. And some slides that we have created in about a month or two they may be out of date. It's a very quickly moving market. And we can definitely discuss that offline afterwards.

Kathy Hyland: Amanda, another question directed towards you. Are there new developments to make FAST reporting for EV inventory cost and use easier?

Amanda: Well, in Fiscal Year 10 for the reporting period we instituted reporting for electric vehicles, for low speed electric vehicles and for their electricity use. So you can already currently report electricity usage and inventory in FAST. And has Julian mentioned, the space is changing every day. So we're very open to hearing ideas and suggestions for making that easier. We do like to think that it's relatively straightforward, but there's a lot of guidance that we need to put out to help with that. And some of the guidance Mark mentioned earlier will be a huge help in helping agencies understand how to do that reporting.

Kathy Hyland: Thanks, Amanda. Brad, let me direct this question towards you. How can agencies support federal workforce commuters who want to drive EVs to work?

Brad: Well, that's a very good question and one that we are asked. In fact, I had a *(Audio Skip)* today on that very subject. There are a couple of factors that agencies need to consider. Number one I would say that's key, we cannot use appropriated dollars to buy charging infrastructure, which is designed to serve the intended service for federal employees and their vehicles. However, so if we have electric vehicles in a certain fleet, we have our charger infrastructure which was put in place to serve those federal vehicles, then it is absolutely fine, in the opinion of the Department of Energy, to allow employees to use that charging infrastructure. And then they will pay an appropriate fee for the use of that infrastructure.

Now I would also add that this is very much an agency independent decision, a nd this is something that DOE has a decision that we've arrived at. And we currently are allowing employees to pull into headquarters we have a couple of charging stations. And they pay the parking fee, the normal parking fee and then a small surcharge to allow them to use the charging infrastructure here. So yes, it can be, but there is some work in terms of the agencies working through some of the legal questions.

Kathy Hyland: Good. Thank you.

Brad: And there we would be – we would be happy to agencies work through that.

Kathy Hyland: Thank you. Julian, let me direct this one towards you. Is special EV training or instruction required for the average driver?

Julian Bentley: Driving an electric vehicle is not that much different than driving a conventionally fueled vehicle, at least the ones that are available today. There is, however, a training that's likely needed to ensure that, especially around fleet operators, are familiar with procedures for charging electric vehicles, using charging infrastructure. To ensure that they don't exceed the range in terms of maintenance requirements and those type of things. So driving, no, but operation, yes.

We are developing some of this guidance in the Fed Fleet EVSE project, which we talked about. It should be hopefully available by the end of the fiscal year.

Kathy Hyland: Great. Last question. Brad, I'd like to direct this one towards you. Do you think the consumer market will lead the government sector in accelerating market transformation towards electric vehicles or the other way around?

Brad: Well, I think a little bit of both actually. And Julian had touched on this during his presentation. In the area of light-duty vehicles, passenger vehicles, the federal government operates some 600,000 vehicles domestically. Which is a rather significant number but a small fraction in terms of the total number of vehicles on the road. And any buying power we would have, while again significant, may not be enough to drive that market single-handedly. Certainly we can influence it, however. In my opinion.

On the other hand, the medium-duty haul arena is a bit different. And in that arena DOD in particular believes that the buying power of DOD alone can influence that market. Influence economies of scale in a major way and drive the prices down, w hich, of course, that alone will ripple through the EV market at large.

Kathy Hyland: Thanks, Brad. And thank you to Mark, Julian, Brad and Amanda. Now I'd like for you to take a moment to complete a brief evaluation *(Audio Skip)* help us determine future training topics and ways we can improve these First Thursday seminars. You can complete a quiz as well to reinforce your learning and print a certificate for your records. You can access this quick evaluation and quiz in one of three ways. If you're watching this today by live webcast, click on the link shown on your screen. If you registered for this course, you can get an email – you will get an email with a follow up link. Or, if you're watching by satellite, go to the website at www.femp.energy.gov/firstthursday and find the quiz and evaluation there.

We'd like to thank Mark Reichhardt, Julian Bentley and our experts, Brad Gustafson and Amanda Saul for joining us today. And we'd like to thank FEMP for sponsoring the First Thursday seminars. Thank you for joining us. We'll see you the first Thursday in July for our next seminar on energy efficiency in datacenters, labs and high tech facilities.

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