

EV-GRID INTEGRATION WORKSHOP: SUMMARY REPORT

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EV-GRID INTEGRATION WORKSHOP SUMMARY

This document summarizes the recommendations and proceedings from an in-person workshop held in Boston on February 20, 2014. Representatives from state agencies, the electricity and charging industries, and non-profit organizations gathered to discuss the key issues around integrating electric vehicles (EVs) with the electrical grid. The workshop was organized by the Northeast States for Coordinated Air Use Management (NESCAUM), with help from the Center for Climate and Energy Solutions (C2ES), the International Council on Clean Transportation (ICCT), Natural Resources Defense Council (NRDC), and the University of California at Davis (UC Davis). These five groups jointly produced this summary report. The outcomes and recommendations described herein are for deliberative purposes only; they should not be construed to reflect consensus among states, workshop participants, or other organizations.

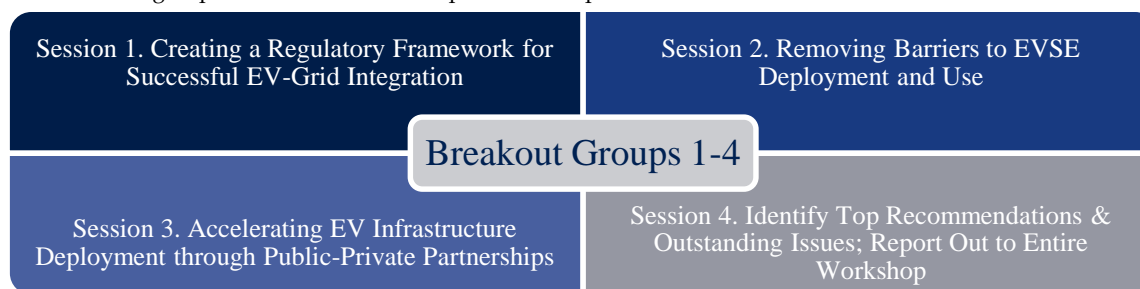
Eight states (California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island, and Vermont) recently signed a memorandum of understanding (MOU) committing to support continued zero-emission vehicle (ZEV)² market growth, with a goal of 3.3 million ZEVs on the road in the eight states by 2025. As a first step, the governors created the multi-state ZEV Program Implementation Task Force and directed it to develop an Action Plan by the end of April 2014.

The workshop's objective was to identify actions to support accelerated commercialization of ZEVs, for consideration by the states as they develop the Action Plan. The diverse group of participants included representatives from state public utility commissions (PUCs), state air agencies, state energy offices, state departments of transportation (DOTs), electric utilities, charging infrastructure providers, academic institutions, and the non-profit sector.

Organizers designed the workshop to foster productive and engaging discussions. Workshop participants were divided into four groups and discussed key issues related to EV-grid integration. Each group was tasked with discussing three main topic areas: (1) creating a regulatory framework for successful EV-grid integration; (2) removing barriers to charging equipment deployment and use; and (3) accelerating EV infrastructure deployment through public-private partnerships. Ultimately, each of the four groups reported on their top three recommendations and any issues they identified that warranted further investigation. Each group was assigned a discussion leader and a facilitator (see Table 1), to moderate and to capture salient points and final recommendations.

Figure 1: Workshop Structure

Each breakout group discussed three main topics and then prioritized their recommendations.



² In this document, ZEVs include battery-electric vehicles (BEV), plug-in-hybrid electric vehicles (PHEV), and fuel cell vehicles (FCV).

Table 1: Breakout Group Leaders and Facilitators

GROUP	LEADER	FACILITATOR
1	Ashley Horvat, Oregon Department of Transportation	Gustavo Collantes, UC Davis
2	Christine Kirby, Massachusetts Department of Environmental Protection	Max Baumhefner, NRDC
3	Elaine O’Grady, Vermont Department of Environmental Conservation	Luke Tonachel, NRDC
4	Analisa Bevan, California Air Resources Board	Nick Nigro, C2ES

Summary of Priority Recommendations

Below in Table 2 is a synthesis of the top-priority recommendations to help accelerate the commercialization of EVs from the four breakout group discussions. Reflecting the common, prevailing themes that emerged from the discussions, the overall workshop recommendations have been distilled down to seven top-priority recommendations. The recommendations fit within four broad categories and would help address the primary issues and barriers identified in the workshop. Detailed recommendations, and the associated discussion and rationale, from each individual breakout group are presented in the subsequent section of this report.

Table 2: Priority recommendations from EV-grid integration workshop

CATEGORY	RECOMMENDATION(S)
<i>Create a Consistent Electricity Regulatory Framework</i>	States should request Public Utility Commission proceedings with broad-based outside engagement for commercial and residential rate design, the level of regulatory oversight for electric vehicle charging providers, consumer protection, siting and cost allocation of public charging, and the role of utilities.
<i>Establish Common Codes, Standards, and Data Collection Methods</i>	States should establish requirements for electric vehicle supply equipment (EVSE) readiness in new building and parking facility construction, and encourage similar requirements for retrofits.
	States should encourage automotive dealers and motor vehicle registration departments to notify electric utilities of new electric vehicle purchases.
	States should collect and categorize data in a consistent way for vehicle purchases, charging station installations, and charging station usage.
<i>Provide Incentives for Electric Vehicle Infrastructure Gaps</i>	States should create a deployment strategy plan and seek funding to prioritize electric vehicle charging, including DC fast charging and workplace charging.
<i>Provide a Forum for Information Sharing and Promotion</i>	States should create targeted task forces to share learnings from pilot projects, promote clear and consistent pricing for vehicle charging, and assess ways to extend the benefits of electric vehicles to low-income families.
	States should engage national organizations like Department of Energy’s EV Everywhere and Clean Cities Programs and AAA to promote the states’ activities.

Details of Breakout Group Recommendations

Each of the four groups developed three priority recommendations for the multi-state ZEV Program Implementation Task Force to consider including in the forthcoming ZEV Action Plan. Some repetition exists in these recommendations because each group operated independently and drew their own conclusions on which actions the states should consider for inclusion in the ZEV Action Plan. The recommendations described in the following section reflect the views and opinions of the discussion groups and not necessarily those of the states or the authors of this report.

Group 1

Group 1 focused its main recommendations on strategies for deployment of an efficient charging infrastructure. States must have a regulatory framework in place that enables a competitive charging infrastructure market and encourages innovation. States also play a unique role in lowering the cost of EV-grid integration through building codes and information sharing as more EVs hit the road.

- 1. Governors should challenge PUCs to open a docket to take further input from stakeholders, develop strategies, and remove barriers to support EV adoption. Electric utilities should take an active role whenever possible, particularly on DC fast charging for regional corridors.**

Many state PUCs have not taken initial steps towards enabling a vibrant charging infrastructure market. For instance, five of the eight MOU states have not made it clear under what conditions a charging service provider will be regulated as an electric utility. States could consider strategies to incorporate smart charging (e.g., time of use (TOU) rates and other peak demand management strategies), mitigate effects of demand charges on infrastructure deployment, and facilitate the consideration and adoption of innovations from smaller players (e.g., start-up companies).

For electric utilities, an active role may mean providing services, minimizing installation costs, offering rebates, and forming public-private partnerships. One unique opportunity for utilities is DC fast charging along transportation corridors. Utilities are capable of making large investments with longer payback periods, as is necessary with DC fast charging. PUCs should ensure that electric utilities do not enjoy undue competitive advantages and that they provide support to third-party investors, for example by providing needed information.

- 2. States should create a common model building code, and update relevant state building codes to require that new residential and commercial buildings be ready for charging stations.**

Often, the bigger component of the cost of installing charging infrastructure is not the equipment but the installation itself, which may require construction work. Making new buildings and developments “EV ready” is more cost effective than installing a charging station after construction. Through building codes, states have an opportunity to require this relatively small additional cost in order to make the deployment of infrastructure and, as a consequence, owning and operating of an EV, more accessible. Building code amendments may include requirements on panel capacity, laying the conduit for wires, way finding and parking signage locations, integration of EV charging spaces into ADA accessible requirements, etc.

3. States should create a deployment strategy plan and seek funding to prioritize EV charging (including DC fast charging and workplace charging). States should also encourage motor vehicle registration departments to create and use a standard information template to help track and report on EV registrations to aid in state and utility infrastructure planning in a timely manner.

States can play a key role in planning and deploying a cohesive statewide or regional charging infrastructure. They have the unique power to convene stakeholders to engage and share challenges. Through state agencies, they also have access to data that can be used to help understand complex questions related to issues like travel and charging behavior and EV-grid integration. This knowledge will help to site charging stations in ways that effectively support EV owners and encourage larger segments of consumers to adopt EVs.

States should explore the use of existing funding sources like the Regional Greenhouse Gas Initiative (RGGI) or the Congestion Mitigation and Air Quality (CMAQ) program to support charging infrastructure deployments. In addition, EV charging infrastructure could also be supported through innovative financing mechanisms like those utilized in the solar industry and other energy efficiency markets. More generally, states should provide policy certainty for technologies and private finance innovations that can help with funding infrastructure (e.g., tax credit certainty for several years in advance).

States can also help with infrastructure planning by making EV registrations more transparent. One challenge for utilities and grid operators is projecting additional electric loads. States can help by making charger location information more readily available to the key parties, like electric utilities.

Remaining Issues: Group 1 identified the following issues for further investigation:

- The Group identified workplace charging as a critical strategy for deployment. It wasn't identified as a priority over the top three mentioned because of existing work underway to elevate workplace charging nationally. However, the group suggested that the eight governors hold a high-level event with key employers, similar to California's "Drive the Dream" event in 2013. Participating in events like this and efforts like U.S. Department of Energy's (DOE) Workplace Charging Challenge will set the stage for increasing numbers of private and public employers to get involved, assess EV charging potential, and install more charging equipment.
- The Group suggested that setting up regional councils such as California did with their ten regional EV councils would help accelerate initiatives throughout the state by embedding champions that understand the intricacies of their respective areas in several communities.

- The Group stressed the critical importance of timely and efficient data sharing to inform strategies and policies. The states should consult with stakeholders about the types of data needed and best strategies for collection and analysis.
- States should work to increase customer awareness of EVSE locations to mitigate concerns about range among potential new EV buyers. States should develop guidelines to ensure signage is highly visible and consistently deployed, and should encourage local jurisdictions to do the same.

Group 2

Group 2 focused on the steps that states can take to ease concerns over EV range and more efficiently integrate EVs with the electrical grid.

1. States should consider providing subsidies for DC fast charging and assist with system network planning.

As more EVs have hit the road, consumers have extended the range they travel and will need greater access to public charging to provide “range confidence.” Because the market is still small and the business case for public charging, especially for DC fast charging, is still evolving, some amount of public subsidy is warranted in order to enable a more vibrant EV market.

2. States should encourage a move towards a pricing structure where electricity is sold by a unit of energy with transparent pricing rather than per charge.

As the EV charging market expands, states are in a unique position to enable the development of a competitive market. Third-party charging providers need certainty that they can sell by the kilowatt-hour in order to give them more operational flexibility. Pricing by the unit of energy also sends a signal to consumers to charge at home rather than at work or in public places, which can provide a cost savings. And since off-peak times are generally at night when people are home, home charging can also lead to more efficient EV-grid integration.

3. States should encourage electric utilities to conduct outreach to consumers about the benefits of EVs to the electrical grid.

Encouraging electric utilities to educate consumers directly on the benefits of EV-grid integration will increase awareness and encourage EV adoption.

4. States should encourage automotive dealers and motor vehicle registration departments to notify electric utilities of new EV purchases to facilitate strategic service planning and better manage the electricity distribution system.

One of the key challenges to EV-grid integration is the effect of large new loads in residential neighborhoods. In order to prevent local electricity distribution issues, like transformer problems, electric utilities must be made aware of the location of new EVs. One priority is for the electric utility to be informed of locations for EVs that can charge at a very high power rates (e.g., Tesla Model S). State motor vehicle registration departments or local automotive dealers are the most

likely holders of that information and are best suited to alert electric utilities when and where a new load should be expected. Automobile manufacturers could also be a source of this information, particularly for vehicle identification number (VIN) decoding.

Remaining Issues: Group 2 identified the following issues for further investigation:

- TOU rates should be explored to encourage off-peak charging.
- PUCs should not regulate third-party EVSE providers as electric utilities.
- Increasing the availability of workplace charging is very important. States should look into ways to provide recognition to leading employers, such as an award by the governor.
- States should wait and see if the private industry is able to resolve concerns about EVSE interoperability without state intervention.
- Electricity rate design related to demand charges can be a barrier to infrastructure deployment in certain applications.
- Stakeholders need better monitoring and analytic capabilities to conduct evaluations on the effectiveness of policies and actions. States should engage research institutions in this effort.

Group 3

Group 3 identified recommendations to help establish a consistent electricity regulatory framework, lower the cost of deploying charging stations, and encourage states to learn from each other's activities. The Group also identified some issues that warrant further investigation as the EV market evolves, including how to establish long-term incentives that capture the public value of EVs.

- 1. States should request PUC proceedings with broad-based outside engagement that focus on a variety of EV-related topics such as: commercial and residential rate design, the level of regulatory oversight for EV charging providers, consumer protection, siting and cost allocation of public charging, and the role of utilities.**

State PUCs can take a number of actions to encourage EV and charging infrastructure deployment that also benefit the electrical grid. For instance, encouraging off-peak charging can enable better utilization of existing electrical grid assets. Although TOU rates are not the only way to ensure that off-peak charging occurs, it is a good near-term way to manage charging. PUCs should also encourage competition for charging services and help maintain fuel costs savings as a major selling point for EVs.

- 2. States should establish requirements for EVSE readiness in new building and parking facility construction and develop best practices; states should also encourage requirements for building and parking facility retrofits.**

States can play a major role in lowering the cost of charging infrastructure deployment through building codes. There are “no-regret” policies that states could establish, such as including EV charging conduit in new buildings to lower installation costs. States can also help gather and share comprehensive data on charging station installation costs, especially for commercial installations.

3. States should convene a forum for ongoing information sharing, particularly with respect to pilot projects and policies. This forum can include a regional summit for a broad range of stakeholders to share information on best practices.

States have a unique power to bring stakeholders together to share information and track progress on ongoing pilot projects and the implementation of new policies. For instance, Connecticut and New York have created Green Banks to help fund clean energy deployment, like charging infrastructure. As other states consider new innovative finance ideas, like those offered by Green Banks, a regional summit could be a useful forum for states to learn from each other about what is and is not working.

Remaining Issues: Group 3 identified the following issues for further investigation:

- Electric utilities need to know generally the extent and locations of the deployment of EVs and charging infrastructure. Technical solutions may exist, such as the use of smart meters.
- States need to develop the case for EV deployment considering economic, environmental, and grid factors. For instance, states could calculate the public value of publicly available charging or workplace charging to justify a long-term incentive.
- States should identify ways they can help foster charging station interoperability to encourage a regional, ubiquitous, and low-cost billing method for EV charging.

Group 4

Because the EV market is evolving quickly, states must be nimble in how they approach policy and actions to promote the technology. With that in mind, Group 4 developed recommendations in three categories: targeted task forces, promotional and educational outreach, and data. Group 4's recommendations help to create an adaptive structure that will allow states to identify changing needs over time related to vehicle charging infrastructure.

1. States should create targeted task forces to focus on sharing learnings from pilot projects, like experimental electricity rates, and other advanced activities; clear and consistent pricing for vehicle charging; and methods to capture the public value of EVs to help low-income families.

A lot of activity is ongoing in states and it can be very difficult ascertain what each state is doing, what they have learned, etc. As a result, the sharing of quality information and findings in order to limit the duplication of work and ultimately identify common, best practices is essential. For example, several states are developing or implementing TOU rates to shift demand for charging loads to off-peak periods. Successful integration of EVs and the electrical grid is dependent on managing the additional load through incentives, such as TOU rates.

Clear and consistent pricing for EV charging is a key way to realize the economic benefits of EVs; consumers are currently being charged on an energy unit, time, or other basis. Products like

the DOE eGallon tool make it easy for consumers to compare the fuel cost of EVs versus gasoline vehicles. Eligibility to price EV charging on an energy-unit basis varies greatly by state and pricing methods should not closely resemble existing pricing methods used by electric utilities.

States should identify ways to enable more low-income families to own and operate EVs in order to realize two of the key benefits of EVs: reduced local air emissions and greater certainty for operating costs compared to gasoline vehicles. Some EV incentives may prove more cost-effective than existing public funding aimed at local emission reductions. Currently, EVs cost significantly more upfront and low-income families do not typically buy new vehicles. At the same time, low-income families must pay a large share of their income for transportation fuel and generally live in areas with greater pollution from vehicles.

- 2. Lead agencies for the ZEV Implementation Task Force should engage other state and local agencies, like state DOTs and metropolitan planning organizations (MPOs) to leverage the expertise of these public agencies and engage national organizations like DOE's EV Everywhere and Clean Cities Programs and AAA to promote the states' activities.**

Transportation agencies (MPOs and DOTs) are a critical resource for planning and deploying EV charging infrastructure. Transportation agencies have a comprehensive understanding of vehicle travel behavior and can offer insights on locations where EV charging spots could be most used. These agencies are also the leader in planning and building road infrastructure and can leverage that expertise to streamline charging station infrastructure installation.

National programs out of the federal government and consumer-oriented organizations can promote the states' efforts to deploy charging infrastructure. The missions of these organizations include public education and they are generally considered a trusted source of information. They can amplify the message of the states' by drawing media attention or reaching large membership bases.

- 3. States should work together to collect and categorize data in a consistent way for vehicle purchases, charging station installations, and charging station usage.**

Data collection and coding is one of the primary categories where states can collaborate to leverage each other's work for the good of the entire EV market. One of the critical barriers to successfully integrating EVs with the grid is knowing where they are being deployed – referred to as notification. Electric utilities need to know this information, along with when an EV charging station is installed somewhere, in order to make sure the local grid (e.g., the local transformer) can handle the additional electric load. In addition, data on how EVs are recorded at state motor vehicle registration departments vary and can make it difficult to compile and analyze vehicle deployment data. Finally, data inconsistencies also exist in how charging station utilization is collected and stored. States can work together to make sure all these data are recorded in a consistent way to make comparisons, analysis, and other analytical activities easier to take on.

Remaining Issues: Group 4 did not identify specific solutions for three important issues: electric utility ownership and operation of charging stations, the unit of measurement for sale of charging services, and how to accommodate underserved communities. For the latter two issues, Group 4 recommended targeted state task forces be set up to tackle these problems, in part because they require input and thought from a wider group than was at the workshop. Regarding electric utility ownership and operation of charging stations, there was disagreement over the scope of utility ownership. The group agreed electric utilities should be able to own and operate charging stations for their company fleets and for demonstration purposes.

Conclusion

The EV-Grid Integration Workshop focused on electricity regulatory frameworks, barriers to charging station deployment and use, and opportunities for public-private partnerships. From the workshop participant discussions, it is clear that action by states in several areas could help to support and accelerate a thriving ZEV market in the United States.

Although the workshop structure called for each breakout group to operate independently, noticeable overlap existed in the groups' recommendations. For example, all four groups agreed that state PUCs should take an active role in EV infrastructure policy and that states should update their building codes and require new parking to be "EV ready." The need for stakeholder coordination, information sharing, and electricity regulatory reform were included in the recommendations from each breakout group.

As states move forward with constructing and implementing a coordinated ZEV Action Plan, workshops like the EV-Grid Integration Workshop will continue to be essential to ensuring that policymakers are operating from a common knowledgebase, learning from each other's experiences, and enabling a vibrant national ZEV market.

- TOU is definitely critical not just in reducing cost, but avoiding the increases in costs that could occur.
 - The value of TOU depends on the base rate. If cheap electricity base rate, the value of off-peak is marginalized/minimal.
 - TOU rates are not the only mechanism that can ensure off-peak charging. TOU rates are a near term way to manage charging, technology is the long term way.
 - Customers look at TOU more like a stick than a carrot.
 - TOU can help ensure achievement of “\$1/gal gasoline equivalent” pricing.
- **Does TOU actually help EV sales?**
 - No, in some cases, it could even add complexity to the equation and discourage sales.
 - TOU does not drive sales now, but this could become much more important with mainstream (i.e., non-early adopter) consumers that are more cost-conscious, more reluctant now.
 - The incentive for drivers should be “this is the right thing to do” for environmental reasons – not price, because the cost reduction isn’t significant.
 - Tesla owners said they don’t care about costs – but they were interested in reducing carbon footprint.
 - We need cheap billing for EVSE because fuel cost savings is the number one selling point of EVs.
- **Should we encourage whole-house and/or separate metered TOU rates?**
 - TOU as “whole house” offers most of all the benefits; use of pilots to collect data, understand charging behavior, etc. is important.
 - Jurisdictions may have other rationales for separate meters (e.g., LCFS).
 - Most of pilot project participants for PEPCO are using a separate EV meter.
- **How to promote awareness of existing TOU rates?**
 - Simplicity is important. 11 c/kWh vs 5 c/kWh.
 - Annual commitment requirements are a challenge. Consumers see it as a big barrier especially if they are unclear about the benefits.
- **Is nighttime off-peak more or less likely to be green/renewable?**
 - Very different situation across the states
 - RPS can have an impact (e.g. wind in NY and CA, and hydro in OR).
 - Key factor is whether it is a regulated market (does grid have to take the power).
 - Intermittency of wind, e.g., is only part of the equation.
- **Other comments**
 - Important to create a docket where PUC takes feedback on what it can do to promote EV adoption (including TOU, regulation, etc.).
 - Power sector will change significantly between now and 2025, so rate structures should ideally consider where the grid is headed.
 - For some consumers, cheaper electricity is valued higher than face value of savings.

- EV integration is in line with other efforts to deploy the next gen of demand response technologies.
- Studies done by some utilities have shown that capacity of charge (high kW demand) is big concern; 20 kW charging will create greater local grid impacts regardless of time of use.
- Drivers need to be able to charge as fast as they need but not faster.
- Keep it simple, cheap, and flexible (e.g., start the off-peak rate after 8pm).
- Rates could target the balancing of load between off and on peak.
- Hard to show customers savings for EVs when using whole-house TOU.
- Advanced Metering Infrastructure (AMI) deployment is a barrier for TOU rates.
- EV-only rate is easier than whole-house rate because it's less risk to the consumer.
- Decoupled utilities don't have the same incentive to favor EVs.
- Allow utilities flexibility to offer different TOU rates.
- Inform consumers about charging control applications already in the vehicle.
- Charging timers need to have programmed end time, not only start time, to avoid creating a new peak.
- History of states coming together to drive EZ-Pass type of collaboration with a shared banking system. Subway cards are another example.

Regulation of retail charging services

- **Under what conditions should EV service providers be regulated as utilities?**
 - Charging service providers shouldn't be regulated as utilities unless they act like one (e.g., wholesale electricity procurement).
- **Under what conditions should utilities be allowed to own and operate EVSE?**
 - Burlington Electric is installing EVSE, in response to encouragement from individual EV users and Utility board leadership
 - Utilities are a monopoly-provided service, so no they shouldn't be allowed.
 - May be a solution where a charging provider cannot fulfill its infrastructure commitments (e.g. ECOtality).
 - May be useful/necessary to fill gaps in corridors, especially with DC Fast Charging.
 - Utilities are in a better position to recover DC Fast Charging costs over the longer term. They don't need to operate the stations.
 - Hard for utilities to do promotion for pilot projects when they compete with an EVSE service provider.
- **How do we ensure customer access to clear and consistent pricing information?**
 - Charging providers should be able to price in any unit (per time, per kWh, etc.) – whatever works in these early market development days.
 - Charging metric: “per kWh” makes most sense generally, but “per charge” and monthly subscription models are being tried and might be a workable too. Perhaps hybrid or time-based, plus an additional cost after some limit (e.g., to keep EVs moving away from spots) might make sense in some places.

- More consideration about pricing for a captive market, e.g., on a freeway. This is a special case where pricing should be straightforward to give more transparency.
 - Enforcement is necessary for consumer protection. For instance, a “weights and measures” check as is done with gasoline makes sense.
 - EV drivers are the best messenger for price right now.
 - Auto dealers need to be armed with information from the electric utility.
 - State agencies that already engage with consumers (e.g., energy efficiency program like MassSave).
 - Trusted third parties sources: AAA or Department of Energy’s EV Everywhere or Clean Cities Programs.
 - Consider adding gallon of gasoline equivalent (GGE) to consumer’s utility bill.
 - Consumers should know how they’re going to be charged before they use a public charger.
 - Concern expressed over charging service provider bill that resembled an electric utility bill (i.e., price per kWh plus other service charges).
 - 10 cents/kwh = \$1 gasoline gallon equivalent. Anything over 24 cents/kwh is more costly than gas compared to a Prius.
 - Transparency: price/kwh is good because consumers knows what they’re getting for what they’re paying.
 - Price transparency enables competition – market driven (apps show prices by trip).
 - Quebec has free workplace charging for the next 3 years. Encouraging people to charge at home (8 cents/kwh) and at work, not in public stations (\$2.50/session).
- **Other comments**
 - Regulation of price should not be necessary. Otherwise, business case for new providers would be very difficult.
 - More time in the parking spot to charge can mean more time for shopping. So, free charging can work, e.g., Walmart customers spend \$1 per minute
 - If you put in the Level 2 or DC fast charging, you need an ubiquitous billing system. Even if the price is low.
 - HydroQuebec’s approach is to charge, not a lot, but never provide free charging (economic incentive).
 - If you put in the free chargers and then put in a pay policy later, people will hate it and revolt.

Cost-effectively integrating vehicle charging into the grid

- **Can we reliably inform utilities of new EV loads in residential neighborhoods?**
 - CA new law now authorizes DMV to share data, with privacy safeguards.
 - Many states do not currently have the IT capacity to be able to share this information.
 - Notification is important to do transformer planning, upgrades. Utilities sponsored this legislation in MD and CA. Likely need legislative action to make this happen, due to consumer privacy protection.

- Having better data transfer from DMVs to utilities on EV sales by geographic location is important, but not a top priority. It is increasingly important as more EVs get out there. We need to be able to track this to optimize new infrastructure too.
 - “Get an EV, notify us, we’ll give you \$25 off the bill.” - will work for some people.
 - EPRI doing research to see if smart meters can recognize a vehicle on the grid.
 - Don’t need to get every vehicle, but need the wide understanding of the deployment picture.
 - Use “big data” to identify EVs based on load changes.
 - Standardize PEV identification in RMV databases (e.g., does it have a plug?).
 - Utilities concerned about clustering, especially Teslas charging at 10 kW.
 - DC Fast chargers require their own process for alerting the utility. 30-50 kW.
 - Local permitting officials could submit information to utilities. Early experience with this approach not promising (e.g., CT).
 - In CA, DMV gives utilities monthly report on location of new EVs. But has been challenging to implement.
 - WA gets data every 6 months, a lot of work, database not set up for pulling EV registration data.
 - Suggestion: Manufacturers could share info on using VINs to identify PEV. This could make it easier to pull info from vehicle registration database.
 - Suggestion: one-year price guarantee for EV customers – in order to get price guarantee they have to share EV info with the utility.
- **Do demand charges present a barrier to EVSE deployment and use?**
 - Yes. Peak demand charges can be exorbitant. This is a barrier to deployment. New kinds of rates may be needed; perhaps PUCs could give recommendation to utilities.
 - Tesla seems to be making their fast charging systems work well. In some cases, they are using battery storage on-site to take off the peaks.
 - Portland General Electric offers a special exemption rate for infrequent, but high, charges (Schedule 38).
 - Legacy rates make DC Fast Charging very difficult or impossible for some utilities.
 - Maybe there is role for the industry to play in helping get a legislative fix for this.
 - Utilities won’t want to waive demand charges for EVs.
 - CT has proposal on a pilot project for demand charges.
 - For commercial fleets, demand charge is cost of doing business, and still cheaper than diesel.
 - Demand component is typically a big part of the bill for DC Fast Charging (\$1.80/kWh).
 - Demand charge calculus designed to apply to a typical customer demand range.
 - If you do something, do it as a pilot. Load profile and cost of service studies will give more insight.
 - Batteries are a very expensive solution to the demand charge problem
 - Pricing \$7/session is a bad model. If people need five minutes of charging to get home, charge for five minutes.
 - **What is the role of smart charging on integrating EV into the grid?**

- Smart EVSE can send two-way signals to help manage load. Utilities want smart ones that all communicate.
 - At this point, smart EVSE only work with proprietary clouds that are very expensive, and don't work with utilities.
 - Every car is collecting a lot of data and someone is paying for access to it. Data is always part of value equation. Cellular is a common way to share these data.
 - Packaging the set of functions needed in the EVSE is the barrier. Dumb EVSE has very limited communication.
- **Other comments**
 - EVs should be able to participate in grid services like demand response and frequency regulation. Vehicle-to-grid (V2G) could be a revenue generator.
 - Need to study consumer acceptance for Demand Response strategies. (Feared scenario – car is not charged when you need it during the middle of the day).
 - A certain number of EVSE are going in without permits through people doing dryer plug EVSE.
 - Data on charging use is necessary to make sure policy evolves with learning.
 - There will be no system-level electricity delivery issues until 2020s.
 - Issues in the near term are around local distribution system (e.g., transformers).
 - See recent NARUC resolution on alternative fuel vehicles addressing many of the issues discussed here.
 - No such thing at this point as “charging from renewables” - everything is grid-integrated; but increasing renewables increases air quality and climate benefits of EVs.
 - We don't want charging to happen during the time when solar PV is going offline.

Discussion Session #2: Removing Barriers to EVSE Deployment and Use
Improving access to charging infrastructure and services

- **What is the optimal strategy for deployment of different charger types?**
 - It's about building a skeleton network so that people have confidence to drive long distances.
 - EPRI helped MA figure out where the state needs fast charging; coordinating with neighboring states.
 - In Seattle, people are using fast chargers much more than Level 2 chargers.
 - Range anxiety seems to have disappeared for Tesla, but not other EVs.
 - DC fast charging is one of the key ways to drive high levels of adoption once other car models are there.
 - NYSERDA is investigating single-phase-to-DC fast charging. The use of solid state transformers is expensive but enables siting of charging stations in a much broader range of locations.
 - Consumers tend to undervalue DC fast charging and overvalue Level 2. Even though fast charging sounds expensive, it is still cheaper than gas.
 - Level 1 is practical for some places like hotels, workplaces, and park-n-rides where cars will be there for 6+ hours. Otherwise, Level 1 isn't practical.

- Fast charging is important on corridors, interstate travel, and in destination areas
- Assess utilization as one factor for determining optimal locations.

- **What can regulators do to promote interoperability?**
 - Standardization of software and system of payment is important.
 - How to handle the “hand off” between two networks (i.e. “roaming”)?
 - States should use some sort of national standard.
 - States designate resources to national standards bodies and other industry coalitions.

- **What types of locations should be prioritized for EVSE?**
 - Establish regional/state councils to coordinate charging
 - Oregon has used a “regional solutions” community champions from cities. Governor tapped champion in various communities.
 - Create regional councils/bodies focused on EV support. They are a forum for stakeholders to engage, share challenges. Can setup an advisory panel to help identify where chargers should be placed.
 - Where is the grid best suited and where there is a willing host?
 - Can federal DOE, CMAQ money be used to deploy charging regionally?
 - Sacramento Municipal Utility District (SMUD) using UC-Davis work to determine charging locations. It can be adapted to each state/regional setting.
 - Fast charging is important on corridors, interstate travel, and in destination areas.
 - Latest in Oregon for DC fast charging pricing:
 - \$5/charge. (ECOtality)
 - \$20/month subscription. Or \$7/charge for nonmembers. (AeroVironment)
 - Highways differ in if and how they can price services at rest areas like EV charging.
 - Widely recognized that DC fast charging is urgent and critical. Though it is rarely used, this clearly is part of increasing consumer confidence, reducing range anxiety, etc.
 - Utilization of public level 2 is considerably higher than DC fast charging in some regions (e.g., Chevy Volts topping off all the time). Examples of Palo Alto stations where there is 80% utilization over weekly period, and vehicles pull up wait for slot sometimes. There clearly is a business case here. Host has to have skin in the game. In the Pacific Northwest, the data shows DC fast charging being used 40% more than Level 2 chargers.
 - Assessing utilization is an important factor for determining optimal locations.
 - California has 10 regional plans. Public-private partnerships can be setup for the cost-shared facilities; then, the private industry will have skin in the game.

- **How can/should states support workplace charging?**
 - DOE’s workplace charging challenge from EV Everywhere Program.
 - Regional hosts (e.g., Chamber of Commerce).
 - Should governors challenge large companies, and lead by example?
 - Last year in CA “Drive the Dream” event was very successful. Companies made real commitments, got to have private lunch with governor and staff.
 - State could recognize leaders and give awards.
 - States develop a go forward plan – learn from CA mistakes.

- In many cases, people don't need EV charging at work because cars have sufficient range; Level 1 charging is often adequate for workplace.
 - Workplace charging at this point is less about function than promoting adoption through increased awareness.
 - Some employers have found that it's an ongoing headache. Employees over adopt, insufficient charging.
 - Private market solutions exist. A service provider can do install/lease a charging station for about \$550/year.
 - A lot of this is HR policy as much as electricity policy.
 - High-level support from Governor to encourage workplace charging.
 - After home, workplace is the next most important
 - Workplace charging increases EV use/miles.
 - Integrate with DOE's Workplace Charging Challenge.
 - Considerations: the type of parking lot matters, in terms of space, throughput of EVs, and this affects the type of charging.
 - Businesses want to manage this, to keep this as an employee benefit, and want to reduce the IRS burden.
 - CA PEV Collaborative case studies "Amping up California Workplaces"
- **Other comments**
 - Etiquette: Difficult for most consumers to accept idea of someone else unplugging their car.
 - Engage with MPOs and DOTs since they understand travel behavior (e.g., National Household Travel Survey).
 - Create regional councils/bodies focused on EV support.

Improving/streamlining permitting processes for EVSE installations

- **What building codes should be created/modified for EVSE support (e.g., EVSE-ready for new commercial, multi-family, single family and buildings)?**
 - Consider mandating "green wiring" – building of new commercial buildings requires wiring for EV charging. Home builders are supportive (once there is EV demand, e.g., in California). Can use thresholds for minimum requirements in the codes, and also have stretch goals that go further.
 - Hawaii mandated wiring for building retrofits.
 - New York City, Palo Alto: new building residential at city level, though NY is impossible at state level.
 - OR now doing a state pilot project to encourage cities to do this, instead of at state level.
 - CEC nearly done with a report on cost to the developers to pre-wire and retrofit housing.
 - Prevent homeowner associations from blocking EVSE installations.
 - Pro-active conduit installation is low-cost, low-risk.
 - Planning for DC fast charging in new construction can minimize cost.
 - ADA design discussion exists in the Clean Cities and TCI work.

- Commercial and public parking structures much cheaper when infrastructure is considered in advance; e.g., mounting plates for sub panels to avoid drilling through post-tension concrete.
 - New York City has a parking structure requirement for supporting new EV charging affecting 1000s new parking spaces.
 - Pre-wire requirements could be added to state energy code where no statewide building code exists.
- **Other comments**
 - If there is statewide building code regulation, adopt codes whereby new commercial and residential buildings are required to be EVSE ready. If state codes is not an option, have a program to nudge similar action at local/city level, or on voluntary basis.

Accommodating multi-unit dwellers, garage-orphan residents, and under-served communities

- **How do we ensure that underserved areas have access to charging?**
 - Consider using commercial property installations as a case study.
 - Consider requiring new properties to require charging access.
 - Establish public benefits to buy down the cost of the vehicle.
 - In northeast, all income levels reside in multi-unit dwellings.
 - Encourage commercial charging installations near high-density areas to provide charging to high-density residents.
 - MD has allowed some people to trench at their own expense and install their own charger.
 - Provide highly discounted parking passes for after-hours access to other types of charging.
 - Establish “charging plazas” throughout the city similar to ZipCar to cover more broad area.
 - Industry still lacks comprehensive data on installation costs, even more so for commercial installations than residential.
 - Level 1 is sufficient for all plug in hybrids.
 - Educate consumers (landlords), examples exist in Florida and with CA PEV Collaborative.

Discussion Session #3: Accelerating EV Infrastructure Deployment through Public-Private Partnerships

Promoting customer awareness of EVSE locations and access constraints

- **How can/should states support improved driver awareness of EVSE locations and access constraints?**
 - Signage needs to reflect unique experience driving EVs.
 - Washington has an EV tourism route that is not widely used.
 - Promote public-private partnership for multi-unit dwelling EVSE installations

- Develop signing policy, and deploy signs to promote customer awareness of EVSE locations and address access constraints.

Identifying effective finance mechanisms for charging infrastructure

- **Will a clean energy or green bank help deploy charging stations more cost-effectively? If so, how?**
 - Get Wall Street involved. Solar industry invested, once there was certainty about the regulatory and tax incentive policy. Tax equity component. Sizeable solar tax credit through 2016. For examples, loan loss reserve funds and Green Banks for financing might be important.
- **Other comments**
 - EVSE incentives are mostly year-by-year right now.
 - New York state's EVSE and fast charging is 50% tax credit through 2016 – this is the best that there is (and it is in addition to the federal break). However, the only issue with this is that it is only for commercial entities. Ideally, it would also provide incentives for residential EVSE equipment.
 - Conventional wisdom is that the federal \$7500 credit is the biggest factor in consumer cost proposition.
 - Evaluate the effectiveness of incentives, including comparison to hybrid electric vehicle sales.
 - Sales tax waivers might be especially important, even more so than tax credits. The benefits are realized immediately, with less complexity.
 - ChargePoint offering financing through their channels for projects over \$50k.
 - CT bill allows for PACE eligibility for EVSE (property assessment).
 - EV road-use charges could be re-allocated to support EVSE.
 - Finance mechanisms will become more of an issue as projects get bigger.
 - Need to investigate Green Banks and State Infrastructure Banks and exactly what scope allows them to fund.
 - Not just the up-front cost of financing the infrastructure, but the cost of operating and maintain the charging station is important.
 - New condition of MD funding is to maintain the infrastructure for a certain number of years.
 - Growing desire to own and even maintain EVSE, but cost hurdles are still high; could provide partial funding.
 - Calculate value to the state of public charging or workplace charging to underpin long-term incentive.
 - Factor into community development decisions. NY is doing smarter, greener communities planning/development program with small grants for charging stations.

Sharing data and information for infrastructure planning

- **Can PPPs help foster a regional EV market?**
 - MOU states work w/ TCI on EV network pledges.

- TCI has a list of apps to download that pull the DOE data; also developed a Northeast Electric Vehicle Network logo.
 - PlugShare App is a good app. Many apps only give the address, which might be a large parking lot. PlugShare is crowd-sourced; includes descriptions of location better than NREL/DOE data.
 - Interoperability: don't have real-time status of different stations and whether in use; should be done for DC fast charging; but may not be possible for Level 2.
 - Opportunity to create a uniform, regional billing system like EZ-Pass?
- **Other comments**
 - States should collect data in consistent format to allow for easier comparison. Compiled data should include installation costs for each location. Information should be combined into "living" lessons-learned document.
 - Coalesce around a single source for charging station locations
 - AFDC, Plug-share, others
 - Related to interoperability needs.
 - Need robust requirements for charging station location disclosures (e.g., contract requirement for public funding).

Encouraging innovation and demonstrating new technologies

- **Is regulatory uncertainty holding back the demonstration of advanced technologies like smart charging, battery second life, V2G, and the integration of renewable electricity?**
 - Widespread V2G is at least 10 years out.
 - California V2G roadmap draft is available on website.
- **Other comments**
 - Utility pilots build internal expertise to help encourage innovation and understand new technologies.

Appendix B: Workshop Agenda

- 9:30 am *Registration and Continental Breakfast*
- 10:00 am Welcome, Goals and Introductions
- Develop recommendations for ZEV Action Plan on the role of the electric industry, utility regulators, and infrastructure providers in supporting continued EV market growth.
 - Review MOU and stakeholder process
 - Identify specific actions to support the following goals:
 - Removing barriers to EV-Grid integration
 - Ensuring adequate charging infrastructure access
 - Promoting favorable pricing
 - Facilitating efficient information exchange
 - Walk through workshop process
- 10:30 am Concurrent Breakout Discussions: **Creating a Regulatory Framework for Successful EV-Grid Integration**
- Electricity rate structures and metering options
 - Regulation of retail charging services
 - Cost-effectively integrating vehicle charging into the electrical grid
- 12:00 pm *Lunch*
- 12:30 pm Concurrent Breakout Discussions: **Removing Barriers to EVSE Deployment and Use**
- Improving access to charging infrastructure and services
 - Improving/streamlining permitting processes for EVSE installations
 - Accommodating multi-unit dwellers, garage-orphan residents, and under-served communities
- 1:30 pm *Break*
- 1:45 pm Concurrent Breakout Discussions: **Accelerating EV Infrastructure Deployment through Public-Private Partnerships**
- Promoting customer awareness of EVSE locations and access constraints
 - Identifying effective finance mechanisms for charging infrastructure
 - Sharing data and information for infrastructure planning
 - Encouraging innovation and demonstrating new technologies
- 3:15 pm *Break*
- 3:30 pm Facilitated Group Discussion

- Review group conclusions from breakout discussions
- Identify high-priority, near-term actions
- Formulate recommendations for ZEV Action Plan

4:45 pm Next Steps

5:00 pm Adjourn

Appendix C: Breakout Group Discussions

10:30 am

Creating a Regulatory Framework for Successful EV-Grid Integration

- **Electricity rate structures and metering options**
 1. What is the value of off-peak charging to the utility?
 2. What are the TOU structures that affect consumer decision-making?
 3. Should we encourage whole house and/or separate metered TOU rates?
 4. How to promote awareness of existing TOU rates?

- **Regulation of retail charging services**
 5. Under what conditions should EV service providers be regulated as utilities?
 6. Under what conditions should electric utilities be allowed to own and operate EVSE?
 7. How do we ensure customer access to clear and consistent pricing information (e.g., GGE)?

- **Cost-effectively integrating vehicle charging into the electrical grid**
 8. Can we reliably inform electric utilities of new EV loads in residential neighborhoods?
 9. How can we reduce the cost of installing charging stations in new homes and buildings?
 10. Do demand charges present a barrier to EVSE deployment and use?
 11. What is the role of smart charging on integrating EV to the grid (e.g. reducing/delaying the need for infrastructure upgrades, etc.
 12. What are the knowledge gaps to better inform strategies to integrate EV and the grid?

12:30 pm

Removing Barriers to EVSE Deployment and Use

- **Improving access to charging infrastructure and services**
 1. What is the optimal strategy for deployment of different charger types (i.e., Level 1, 2, and DC Fast Charge)?
 2. What can regulators do to promote interoperability?
 3. What types of locations should be prioritized for EVSE?
 4. How can/should states support workplace charging?

- **Improving/streamlining permitting processes for EVSE installations**
 5. What building codes should be created/modified for EVSE support (e.g., EVSE-ready for new commercial, multi-family, single family and buildings)?

- **Accommodating multi-unit dwellers, garage-orphan residents, and under-served communities**
 6. Are there business models that have been used successfully?
 7. How can market forces be mobilized to solve this problem?
 8. How do we ensure that underserved areas have access to charging?

2:00 pm

Accelerating EV Infrastructure Deployment through Public-Private Partnerships

- **Promoting customer awareness of EVSE locations and access constraints**
 1. How can/should states support improved driver awareness of EVSE locations and access constraints?

- **Identifying effective finance mechanisms for charging infrastructure**
 2. Will a clean energy or green bank help deploy charging stations more cost-effectively? If so, how?

- **Sharing data and information for infrastructure planning**
 3. Can PPPs enable all potential EV adopters to own and operate an EV (e.g., overcome tenant-landlord dilemma)?
 4. Can PPP help give EV owners in high-density urban areas access to charging infrastructure (e.g., night access to infrastructure in commercial parking lots)?
 5. What infrastructure and electricity policies in a state are clearly driving EV sales?
 6. Can PPPs help foster a regional EV market?

- **Encouraging innovation and demonstrating new technologies**
 7. What notable projects have states demonstrated that make it a leader?
 8. Is regulatory uncertainty holding back the demonstration of advanced technologies like smart charging, battery second life, V2G, and the integration of renewable electricity?

Appendix D: Workshop Participants

NAME	ORGANIZATION
<i>Tom Buckley</i>	Burlington Electric
<i>Matt Frades</i>	C2ES
<i>Nick Nigro</i>	C2ES
<i>Analisa Bevan</i>	California Air Resources Board
<i>Leslie Baroody</i>	California Energy Commission
<i>Adam Langton</i>	California Public Utilities Commission
<i>Colleen Quinn</i>	ChargePoint
<i>Sherry Login</i>	Con Edison
<i>Jenny Rushlow</i>	Conservation Law Foundation
<i>Valerie Gray</i>	Delaware Department of Natural Resources and Environmental Control
<i>Morgan Ellis</i>	Delaware Division of Energy & Climate
<i>Kellen Schefter</i>	Edison Electric Institute
<i>Mark Duvall</i>	Electric Power Research Institute
<i>Mark LeBel</i>	Environment Northeast
<i>Cassie Powers</i>	Georgetown Climate Center
<i>Kate Zyla</i>	Georgetown Climate Center
<i>Rebecca Towne</i>	Green Mountain Power
<i>France Lampron</i>	HydroQuebec
<i>Nic Lutsey</i>	ICCT
<i>Kathy Kinsey</i>	Maryland Department of Environmental Protection
<i>Steve Russell</i>	Massachusetts Department of Energy Resources
<i>Linda Benevides</i>	Massachusetts Department of Energy Resources
<i>Christine Kirby</i>	Massachusetts Department of Environmental Protection
<i>Justin Brant</i>	Massachusetts Department of Public Utilities
<i>Justin Fong</i>	Massachusetts Department of Public Utilities
<i>John Gilbrook</i>	National Grid
<i>Andrew Dick</i>	NESCAUM
<i>Arthur Marin</i>	NESCAUM

<i>Matt Solomon</i>	NESCAUM
<i>Steve Flint</i>	New York Department of Environmental Conservation
<i>John Markowitz</i>	New York Power Authority
<i>Adam Ruder</i>	New York State Energy Research and Development Authority
<i>Watson Collins</i>	Northeast Utilities
<i>Max Baumhefner</i>	NRDC
<i>Luke Tonachel</i>	NRDC
<i>Ashley Horvat</i>	Oregon Department of Transportation
<i>Stan Sittser</i>	Portland General Electric
<i>Rob Stewart</i>	Potomac Electric Power Co
<i>Rich Sedano</i>	Regulatory Assistance Project
<i>Frank Stevenson</i>	Rhode Island Department of Environmental Management
<i>Allison Callahan</i>	Rhode Island Department of Environmental Management
<i>Ryan Cote</i>	Rhode Island Office of Energy Resources
<i>Gina Coplon-Newfield</i>	Sierra Club
<i>Gil Tal</i>	UC Davis
<i>Gustavo Collantes</i>	UC Davis
<i>Elaine O'Grady</i>	Vermont Department of Environmental Conservation
<i>Karen Glitman</i>	Vermont Energy Investment Corporation
<i>Asa Hopkins</i>	Vermont Public Service Department
<i>Kathleen Rosen</i>	Voltrek
<i>Tonia Buell</i>	Washington Department of Transportation