ECE 398GG – ELECTRICAL VEHICLES

15. Electric Vehicle Charging Infrastructure

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Electric Vehicle Charging Infrastructure: The Critical Role of Electric Vehicle Supply equipment (EVSE) in Enabling Electric Vehicle Adoption

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Agenda

- Introduction: About Me
- Electric Vehicle Supply Equipment Defined
- EVSE Deployment Objectives and Motivations
- Existing EVSE Business Models
- Policy Considerations
- Q&A

About Me

Nekabari (Neka) L. Goka

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Background

- Energy and natural resource economist
- Distributed energy resource technology policy, demand-side energy management strategy, and power market operations and design in the US, Europe, and Africa
- Formerly managing transportation electrification programs at Pepco Holdings Inc (Exelon operating company) in DC, Maryland, Delaware, and New Jersey

Education

- MS Science &Technology, Energy Economics - Georgia Institute of Technology ‘14
- BA Economics, BA International Affairs –University of Georgia ‘12

“With all good technologies, there comes a time when buying the alternative no longer makes sense. Think smartphones in the past decade, color TVs in the 1970s, or even gasoline cars in the early 20th century. Predicting the timing of these shifts is difficult, but when it happens, the whole world changes. It’s looking like the 2020s will be the decade of the electric car.” – Bloomberg 2016

Clean energy transportation technologies aren't coming…they're already here.

Electric Vehicle Supply Equipment Defined

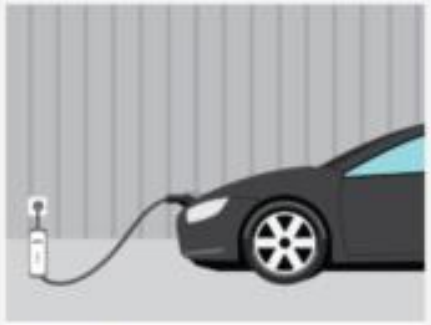
Clear definitions of the scope, purposes and definition of EVSE charging equipment is critical to developing appropriate support mechanisms and assessing policy implications of EVSE deployment

- Connects EV to distribution grid to provide charging services
- Prevents circuit overloading
- Provides safe connection before power flows
- Enables variable charging intensity to manage battery degradation
- Enables payment collection and other value-added services
- Enables collection of EV charging related data

Source: NREL, USAID

Electric Vehicle Supply Equipment Defined (cont.)

The size of EVSE charging equipment will have impacts on charging time expectations as well as distribution system infrastructure needed to support safe charging

Level 1	Level 2	DC Fast Charge
		
VOLTAGE: 120V 1-Phase AC **AMPS:** 12-16 Amps **CHARGING LOAD:** 1.4-1.9 kW **CHARGING TIME:** 3-5 Miles per Hour	**VOLTAGE:** 208V or 240 V 1-Phase AC **AMPS:** 12-80 Amps (Typ. 32 Amps) **CHARGING LOAD:** 2.5-19.2 kW (Typ. 6.6 kW) **CHARGING TIME:** 12-60 Miles per Hour	**VOLTAGE:** 208V or 480V 3-Phase AC **AMPS:** >100 Amps **CHARGING LOAD:** 50-350 kW **CHARGING TIME:** 60-80 Miles in 20 Minutes

- Level I and Level II charging stations are most commonly deployed for **residential (i.e. single family, muti family applications) and mixed-use commercial applications** (i.e. workplace)
- DC Fast charging stations are most commonly deployed in **high traffic corridors** to incent faster and more frequent charging
- **Utility economics** play a huge role in the profitability projections of DC fast charging applications (i.e. what is a demand charge?)

EVSE Deployment Objectives and Motivations

Climate change and economic development goals are prime reasons cited by state, local and federal/national governments for the deployment of EVSE

- **Increased energy security/reduced fossil fuel imports**: Shifts away from imported transport fuels (oil, gasoline, diesel, etc.) and increased reliance on domestic electricity for transport.
- **Local and urban air-quality improvements**: Zero direct exhaust emissions from EVs and reduction of conventional fuel vehicles reduce local pollutant emissions (NOx, SOx, VOCs, and particulates).
- **International climate and environment commitments**: Greenhouse gas reductions targeted in nationally determined contributions
- **Ensured reliable transportation**: Supporting reliable transportation for people and goods for economic development.
- **Economic Development**: Supporting multiple private sector opportunities, including EV manufacturing, sales, maintenance, and other services; also supports private-sector opportunities for charging and related services

Case Study: EVs at Multi-Family Buildings

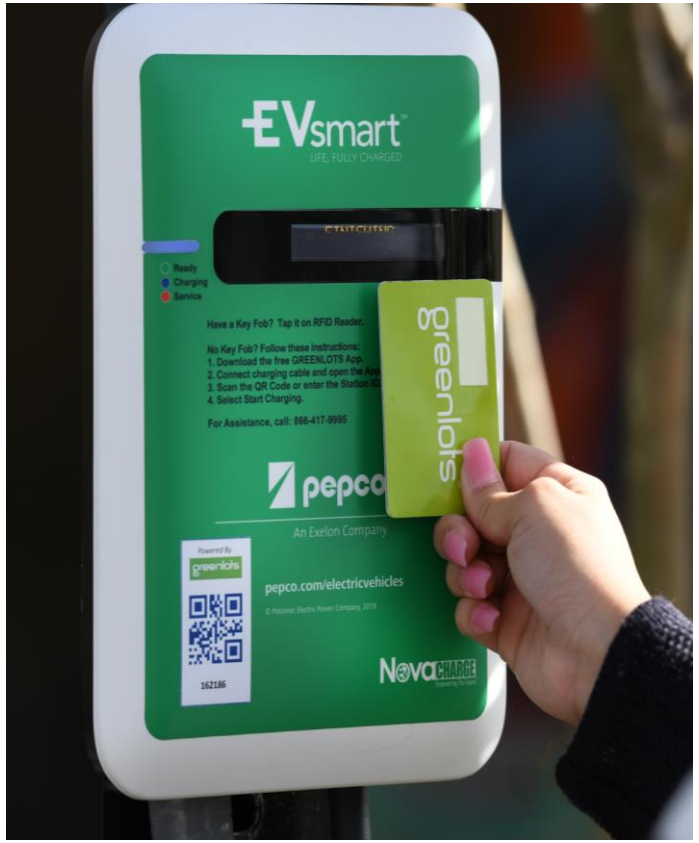
All across the US, an increasing number of residential property developers, building owners and property managers have begun to see the benefits of installing EV charging stations in their buildings

- **Tenant or resident retention or attraction:** The availability of charging infrastructure enables alternative commuting options within cities, thereby attracting and retaining tenants or residents who drive EVs
- **Alternate revenue streams**: Building owners and property managers can tap into alternative revenue streams from the advertisement of products and services on charging stations
- **Credits or points towards building certification programs:** Installation of charging stations would qualify new and existing buildings for additional credits or points from building environmental performance assessment or certification programs, such as LEED
- **Energy Management**: Energy management solutions can help increase visibility of the building's overall energy usage

EVSE Deployment Objectives and Motivations (cont.)

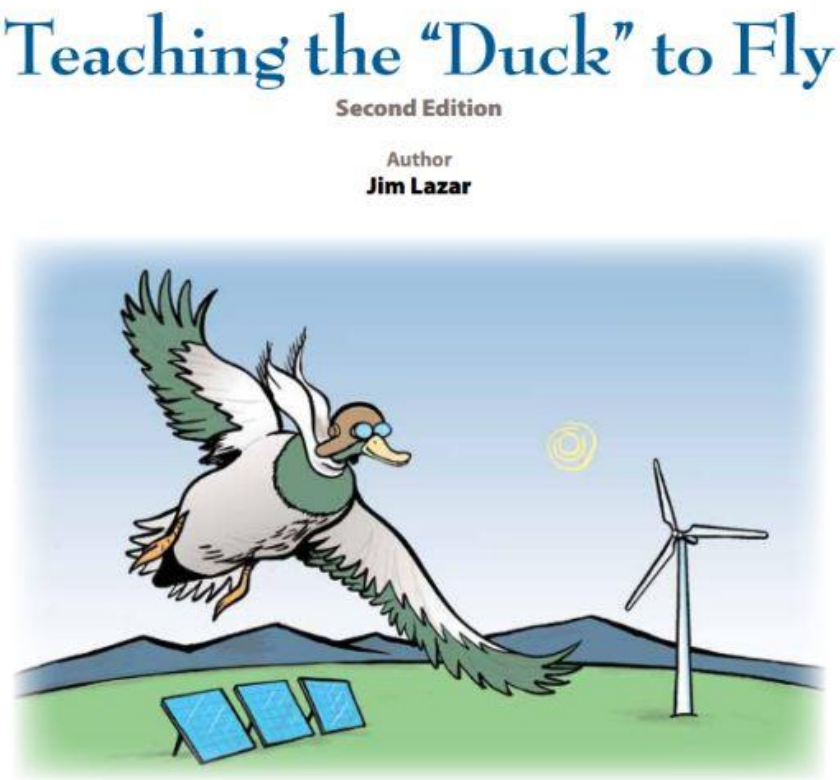
Utilities are equally motivated to deploy EVSE to support increased customer engagement, more equitable utility rate base economics and efficient grid management

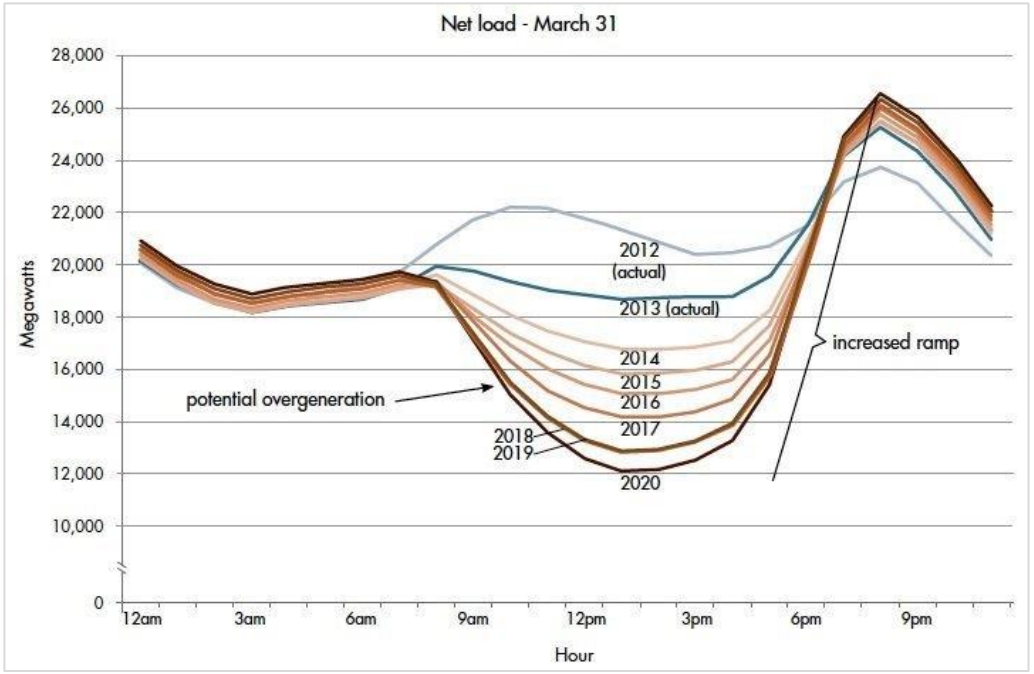
- **Create additional demand**: Increased EV deployment increases demand for electricity and charging infrastructure (EVSE) provides customers with access to this service.
- **Address seasonal surpluses of electricity**: In instances of surplus electricity from renewable energy, EV deployment provides domestic demand and revenue for power when demand for power export is low.
- **Increase access to utility capital, expertise, and resources**: EV deployment ensures utility involvement to lower distribution system, maintains reliability, minimizes grid impacts, and lowers infrastructure costs through coordination.
- **Improve understanding and control of vehicle charging**: Involvement allows access to data and operational strategies to control future load and renewable energy integration.
- **Flexible grid resources**: EV deployment increases opportunities to use EVSE to provide grid stability and balancing as EVs have long dwell times.



California Case Study: Teaching the duck to “fly”

The rapid growth in the deployment of renewable energy generation is leading to the realization of nonstandard operating conditions that require flexible resource capabilities to ensure green grid reliability

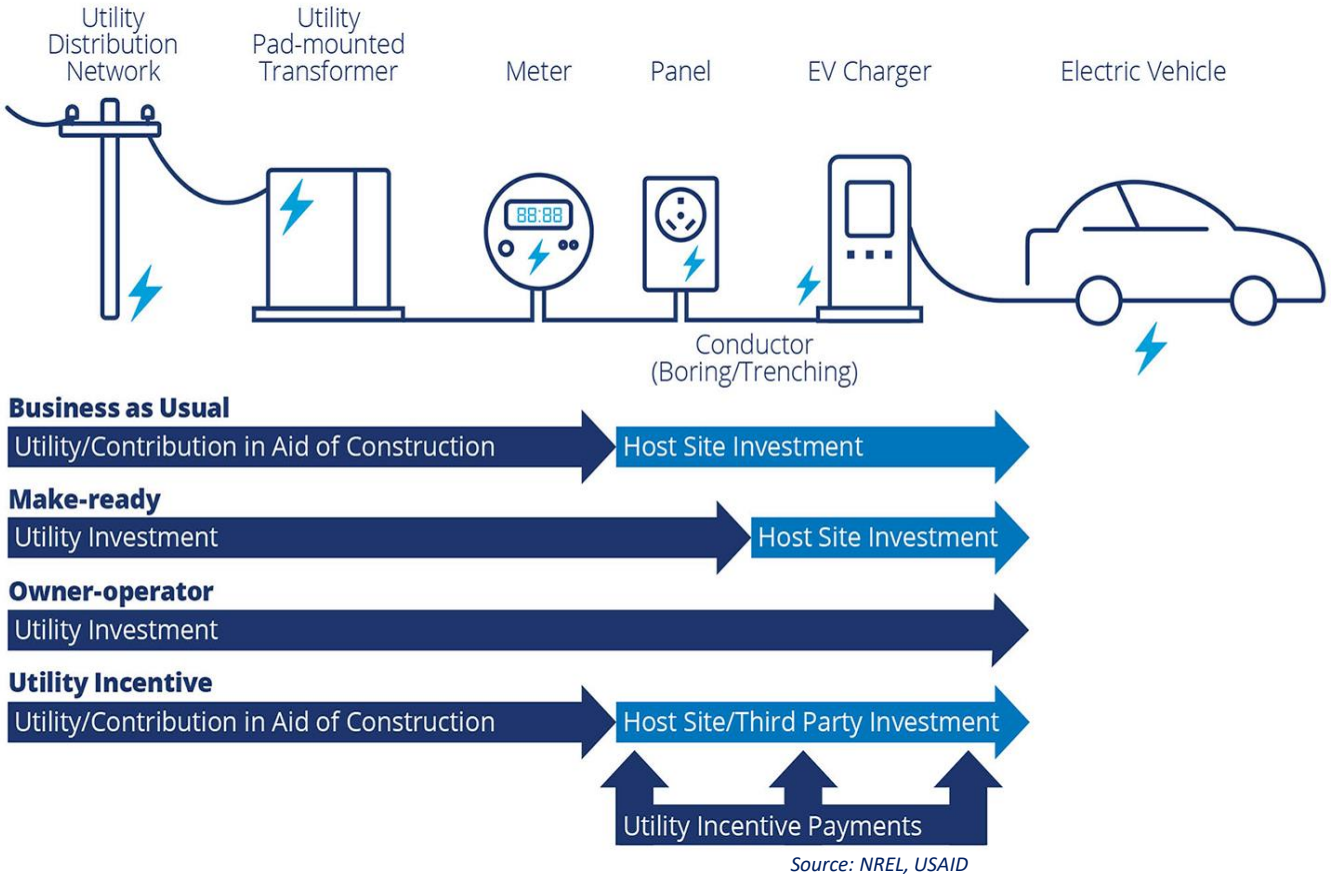




Source: California Independent System Operator

EVSE Business Models: Key Considerations

Charging station location, proximity to existing distribution utility infrastructure, and anticipated demand of EV drivership are some of the most significant consideration for the decision to deploy charging infrastructure – classic example of the “chicken and the egg” conundrum



Source: NREL, USAID

Considerations

- Each existing business model features **financial implications** for both utilities and 3rd party developers
- Certain business models are better positioned to address **non-financial considerations**
- **Technical composition of charging infrastructure** imposes limits/additional considerations on business model decisions

Policy Considerations

Due to the combination of the technical characteristics of EVSE and their physical location (i.e. behind the customer meter) in the utility power delivery value chain, EVSE deployment raises some important considerations for policy makers

Regulatory and policy considerations (non exhaustive)

- Flexibility of applications of various business models to support aggressive climate change mitigation focused goals (i.e. state renewable energy targets, Infrastructure Investment and Jobs Act, Inflation Reduction Act, etc.)
- Security and resiliency considerations for key public safety adjacent segments of the economy (i.e. firetrucks, ambulances, etc.)
- Role of natural gas infrastructure in the face of greater demands on the electric system due to rapid electrification of the transportation sector
- Equity implications of price support mechanisms for EVSE deployment in locations that feature low charging station utilization in the short run
- Allocation of costs and benefits of EVSE charging deployment where costs are more easily defined

Questions?

"With all good technologies, there comes a time when buying the alternative no longer makes sense. Think smartphones in the past decade, color TVs in the 1970s, or even gasoline cars in the early 20th century. Predicting the timing of these shifts is difficult, but when it happens, the whole world changes. It's looking like the 2020s will be the decade of the electric car." – Bloomberg 2016