Oregon Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

Preparing Corridors for Long-Range EVs (Challenging Market Conditions)

A Case Study for the "Accelerating Alternative Fuel Vehicle and Infrastructure Deployment with Innovative Finance Mechanisms Workshop"

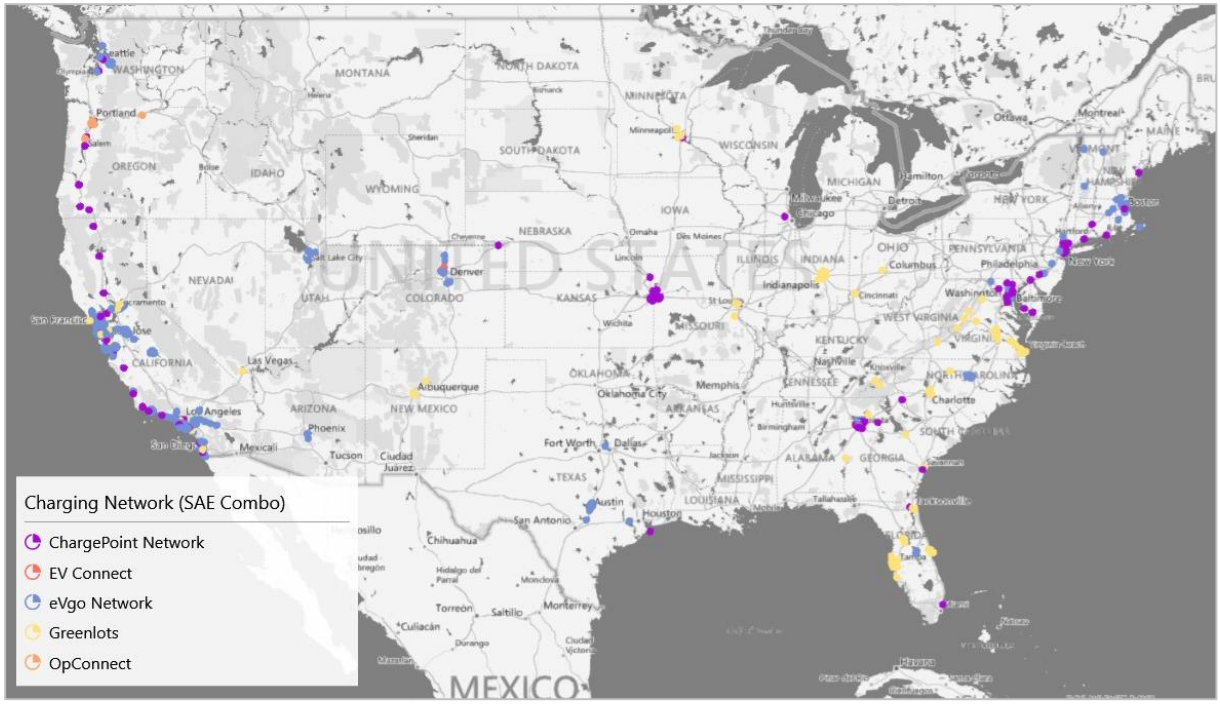
Northeast states have joined together to build a robust fast charging network in anticipation of long-range, low cost plug-in electric vehicles (EVs) hitting the road soon. The states want to make it possible for their residents to travel from Maine to Washington, DC relying only on publicly available fast charging.

Electric Vehicle Market

Automakers are beginning to offer vehicles with much longer electric ranges, which is increasing the need for an expansive fast charging infrastructure. By the end of 2016, General Motors will begin to sell the 200-mile, all-electric Chevy Bolt for about $30,000, after federal vehicle incentives. With the arrival of a long-range, affordable EV, drivers will be more dependent on a robust, widespread fast charging network.

The Chevy Bolt and nearly all other American- and European-manufactured vehicles, along with Hyundai, have adopted the SAE Combo standard. Many Asian automakers are using the CHAdeMO standard which uses a different type of plug and Tesla has their own Supercharger plug as well. As of January 2016, there were about 1,000 CHAdeMO locations in the United States and 400 SAE Combo fast charging locations open to the public. Large swaths of the country are inaccessible to drivers relying on this quick charging technology. In particular, traveling along major arteries in the northeast is not possible when only relying on existing infrastructure (see Figure 1 below).

FIGURE 1: MUCH OF THE UNITED STATES IS INACCESSIBLE TO EV DRIVERS RELYING ON (SAE COMBO) FAST CHARGING



Source: Atlas Public Policy Analysis of data from U.S. Department of Energy Alternative Fuel Data Center as of January 4, 2016

Northeast Fast Charging Network

Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, and Maryland all have policies in place to promote EV deployment. To meet their environmental and energy security objectives, the governors of these states have committed the resources of three key agencies—transportation, environment, and energy—to support the building of the Northeast Fast Charging Network. The purpose of the network is to enable residents to travel along major interstates and alleviate concerns drivers may have with traveling long distances in their EV.

The states estimate that current and near-term market conditions will necessitate installing **2 charging stations 50 miles apart (12 total sites), totaling 24 new stations** for a total upfront cost of **$1.9 million**. In addition, the states estimate that operating costs will range from **$152 thousand to $191 thousand** annually, including the cost of delivering electricity to vehicles. The states estimate that the network will average about **1,200 charging sessions per month, growing 5% annually**. Finally, the states assume that drivers will be willing to pay $0.50 per kilowatt-hour of energy delivered.

The states have solicited key private sector partners to partially fund the network buildout. Automakers, including General Motors, Ford, BMW, and Volkswagen recognized the value of the stations and have agreed to subsidize the upfront cost of the equipment by **$10,000 per station**. In addition, the states demonstrated the value of providing charging services as an amenity the customers of station hosts. As a result, charging host sites have agreed to share with the network owner-operator 5% of the additional sales revenue the host is estimated to receive from offering charging services.

The Challenge

The states want the network to be a sustainable endeavor for the project's owner-operator. Despite additional financial contributions from third parties, the owner-operator of the charging network cannot achieve profitability and can be expected to lose about **$1 million over 10 years**.

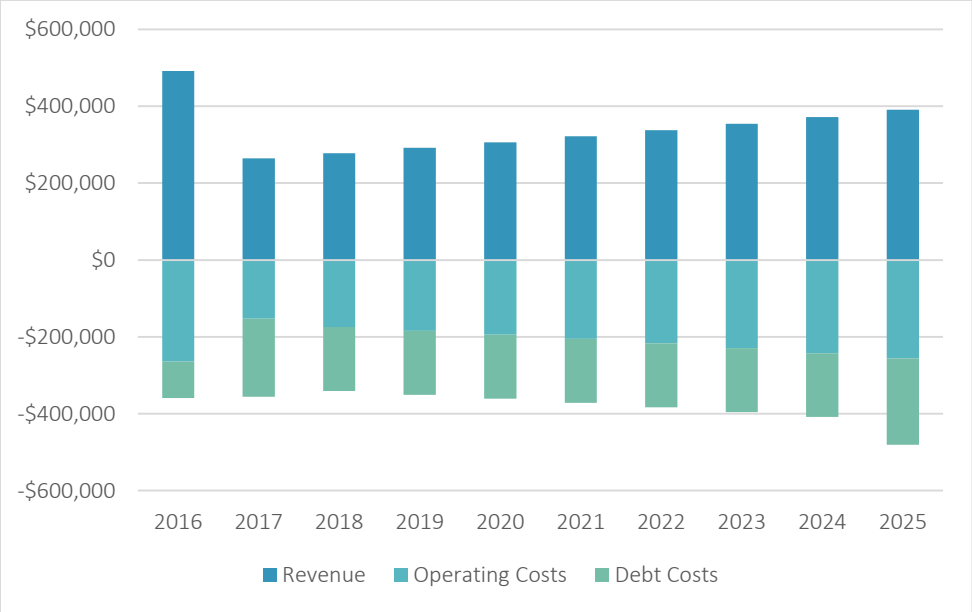
Recognizing the importance of EVs to the states' meeting their environmental and energy security objectives, they are willing to make public investments in the network so long as they adequately leverage private contributions. The state wishes to use its contributions to lower the risk for the private sector with the objective of encouraging additional private investments in infrastructure, as the EV market grows.

The states must identify the scope of public interventions needed to make the charging project a profitable investment for the private sector in the near term, including upfront subsidies, low interest financing, and policies that will encourage greater use of the network.

Discussion Questions

- Who are the key benefactors of the project and how can a public-private finance program encourage them to participate?
- What deployment barriers can a public-private finance program address?
- What other public programs, incentives, or policies may be needed in order to make the project financially feasible?
- What are the key challenges of using a public-private finance program for a corridor project?

Exhibit 1: Discounted Cash Flow Analysis



Project	
Total Capital Investment	$1,872,600
Total Net Present Value	$(1,006,384)
Total Internal Rate of Return (IRR)	N/A
Discounted Payback (Years)	N/A
Owner-Operator	
Total Capital Investment (Equity)	$749,040
Total Net Present Value	$(1,376,393)
Total Internal Rate of Return (IRR)	N/A
Discounted Payback (Years)	N/A
Private Sector Partner(s)	
Total Capital Investment	$-
Total Other Contributions	$466,408
Total Net Present Value	$382,241
Total Internal Rate of Return (IRR)	80.6%
Discounted Payback (Years)	3.0
Other Non-Partner Private Sector	
Total Capital Investment (Loans)	$1,123,560

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenue	$366,000	$132,300	$138,915	$145,863	$153,160	$160,816	$168,858	$177,301	$186,165	$195,475
Operating Costs	-$191,396	-$82,805	-$100,496	-$106,540	-$112,959	-$119,773	-$127,014	-$134,707	-$142,880	-$151,570
Debt Costs	-$113,011	-$202,668	-$166,629	-$166,588	-$166,545	-$166,501	-$166,453	-$166,404	-$166,352	-$195,618
Total	$61,593	-$153,172	-$128,210	-$127,265	-$126,344	-$125,458	-$124,609	-$123,809	-$123,067	-$151,713

Exhibit 2: Potential Stakeholder Benefits and Roles

Stakeholder	Benefits from Public EV Charging Network	Roles in Public EV Charging Network	Example (with link)
Private Sector			
Automaker	Increased EV sales	Subsidize upfront cost of charging network installation	BMW and Nissan are (Sort Of) Taking On Tesla Motors' Superchargers (The Motley Fool)
Electric Utility	Increased electricity demand; increased utilization of grid assets	• Subsidize upfront cost of charging network installation • Operate charging network • Subsidize operating cost of network	PG&E submits a revised plan to build up to 7,500 EV chargers (GreenTech Media); Green Mountain Power brings high-speed car chargers to Rutland (Digital VPR)
Charging Service Provider	Increased business opportunity as an operator of charging networks	Operate charging network, including handling equipment maintenance.	BMW and EVgo expand ChargeNow program with 500 ccs DC fast chargers (Charged EVs); BMW, Volkswagen join with ChargePoint to build EV fast-charging stations (Business Insider)
Site Host	Additional consumer sales at host site	Share portion of perceived additional revenue with network owner-operator. Subsidize siting costs.	Why small businesses are installing electric vehicle charging stations (Huffington Post)
Private Finance Institution	Provides investment opportunity, diversification	Offer loans, leases, loan guarantees, lines of credit, bonds, equity investment, etc.	
Non-Profit Organizations			
Clean Cities Coalition	Part of organizational goal of reducing petroleum dependence	• Facilitate partnerships • Facilitate funding acquisition	Fast-charging station for electric cars now exists in Blacksburg (Roanoke Times)
Non-Profit Organization	Part of organizational goal to enhance energy security or protect the environment	• Conduct research • Share best practices • Conduct consumer education	Public support, innovative business models could boost EV charging (Center for Climate and Energy Solutions)
Public Sector			

Stakeholder	Benefits from Public EV Charging Network	Roles in Public EV Charging Network	Example (with link)
State Department of Transportation	Environmental regulation compliance (e.g., CMAQ and state GHG targets), policy priorities	Plan and finance EV corridors	The West Coast Electric Highway (Energy Central)
State Energy/Environmental Office	Environmental regulation compliance, policy priorities	Coordinate EV deployment strategy and ensure state meets long-term environmental goals	DEEP extending rebates to purchase electric cars (CT Post)
State Clean Energy/Green Bank	Environmental regulation compliance, policy priorities	Provide loans and loan guarantees for projects	$2 million financing program to boost electric vehicle charging stations (Sacramento Bee)
Metropolitan Planning Organization	Environmental regulation compliance, policy priorities	Integrate EV charging network into transportation planning	28 new electric car charging stations to begin construction in Jacksonville area next month (Jacksonville.com)
Regional, Multi-State Coalition, or Megaregion	Environmental regulation compliance, policy priorities	Electricity transmission planning	Western governors push for long-term transmission planning, infrastructure for electric vehicles (Western Governors' Association)
City Sustainability Office	Environmental regulation compliance, policy priorities	Goal setting, public awareness	New electric car charger installed in downtown Front Royal (Your4State)

Exhibit 3: Public Policy Toolbox

Type of Policy	Description	Effects on Charging Network	Scale of Impact
Fuel and Vehicle Policies			
Low carbon fuel standard	Market-based regulation on fuel providers to meet slowly-lowering average carbon intensity of fuel supply.	Lowers operating costs by reducing cost of electricity.	Low
California ZEV Program	Market-based regulation on automakers requiring slowly increasing penetration of ZEVs in vehicle fleet.	Greater charging demand by increasing vehicle deployment.	Medium
Vehicle Subsidies			
Sales tax exemption	EVs are exempt from some or all sales tax upon purchase.	Greater charging demand by increasing vehicle deployment.	High
Tax credits	Income tax credit for vehicle purchasers.		High
Purchase rebate	Rebate issued to vehicle owner at time of vehicle purchase.		High
Other			
Carpool lane access	Access to high-occupancy vehicle lanes for single occupancy EVs. Provides greatest incentive in highly congested cities.	Greater charging demand by increasing vehicle deployment.	Medium
Preferred parking	Provides desirable parking spots to EVs.		Low
Public ad campaign for EVs	Raise awareness for EVs through advertisements and educational activities.		Medium
Charging installation incentive	Subsidy or tax credit for individual or business to install charging equipment.	Lowers upfront cost of equipment installation.	High

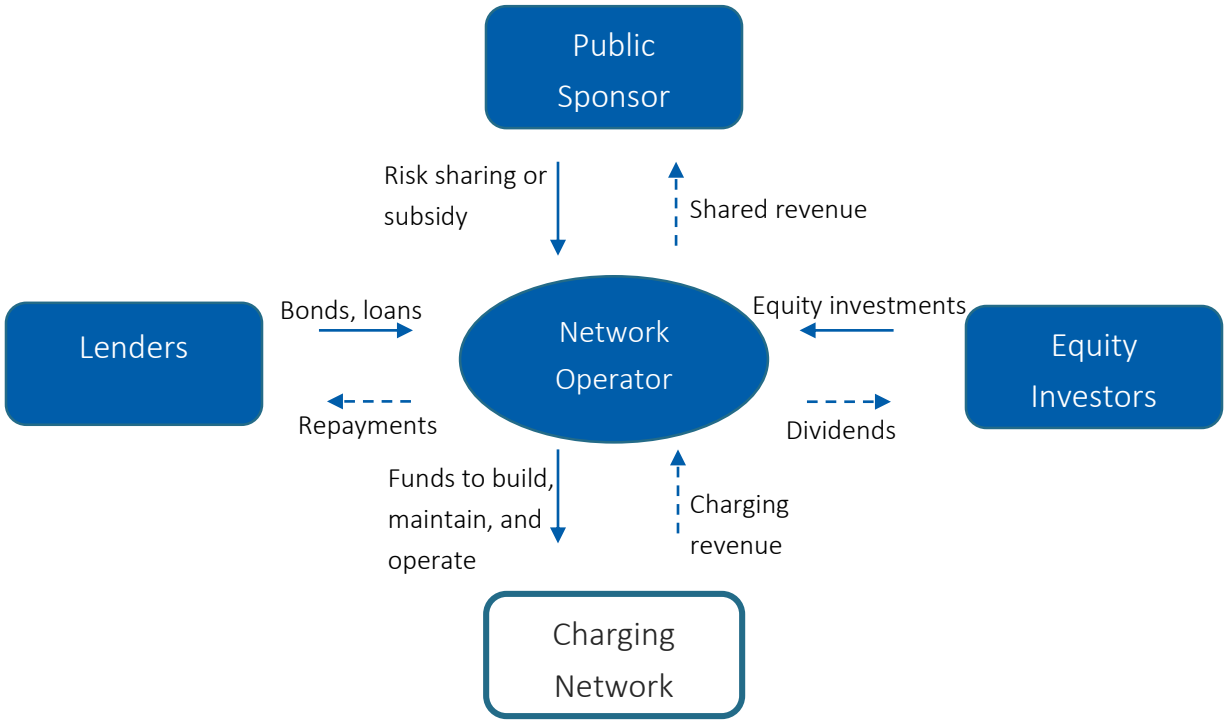
Exhibit 4: Public-Private Financing Toolbox

"Public-private partnerships (P3s) are contractual agreements formed between a public agency and a private sector entity that allow for greater private sector participation in the delivery and financing of transportation projects. […] There are many different P3 structures, and the degree to which the private sector assumes responsibility - including financial risk - differs from one application to another."
– Federal Highway Administration Office of Innovative Program Delivery

The following table provides a list of public and private sector funding sources. A well-constructed P3 leverages private sector funds using public sector sources, such that each participant achieves an appropriate balance between risk and return.

Financing Mechanism	Partner Applicability	Funding Type	Uses	Potential Sources
Funding Sources That Do *Not* Need to Be Repaid				
Grants	Public	Transfer	Subsidize both the upfront project cost and ongoing operations	Federal or state programs (e.g., CMAQ), foundations
Taxes and Fees	Public	Transfer		Registrations fees, motor fuel tax, tolls, special assessment districts, emissions proceeds (e.g., RGGI)
Ratepayer Funds	Public / Private	Transfer		Utility system benefits charges
Donations	Private	Transfer		Foundations, private sector partners
Budget Appropriations	Public	Transfer		Federal, state, local budgets
Funding Sources That Need to Be Repaid				
Bonds	Public / Private	Debt	Provide capital for upfront project cost	Federal or state government (general obligation or revenue bonds), transportation authorities, secondary markets (securities) such as Private Activity Bonds (PABs)
Loans	Public / Private	Debt		Infrastructure / green banks, federal (TIFIA) or state loan programs (Section 129), banks, foundation investments, mission driven investments, pension funds, private investors
Lines of Credit	Public / Private	Debt		Infrastructure / green banks, federal (TIFIA) or state programs, banks, private investors
Other				
Ownership / Equity Position	Private	Equity	Provide capital for upfront project cost	Equity investors, private equity, corporate investors
Leases	Public / Private	Variable		State infrastructure / green banks, federal or state programs, banks, private investors, corporate investors
Loan Guarantees / Credit Enhancements	Public / Private	Variable	Subsidize the upfront project cost	State infrastructure / green banks, federal (TIFIA) or state programs, Section 129 loans

Simple P3 Financing Structure



Adapted from Figure 5-1 Simple P3 Financing Structure, *Establishing A Public-Private Partnership Program: A Primer*, November 2012, accessible at https://www.fhwa.dot.gov/ipd/pdfs/p3/p3_establishing_a_p3_program_112312.pdf.