Introduction

Oregon has positioned itself as a leader in adopting electric vehicles (EV) to reduce dependence on fossil fuels and the resulting greenhouse gas emissions. So far, the biggest limitation for motorists considering EVs has been the absence of a reliable network of charging facilities to increase the range of these vehicles. Another barrier has been confusion surrounding the nature of EV charging and the steps needed to acquire EV charging capability in a home, business or public location.

In response to these challenges, Oregon has already taken several steps to ease the transition to EVs and make electric vehicles convenient and affordable. The state of Oregon has negotiated with several auto manufacturers to introduce new EVs in Oregon, and the Oregon Department of Transportation has developed competitive price agreements for EV charging equipment to ensure that equipment installed in different locations and by different electric utility companies will provide a common charging experience for all EV users. The state has also applied to the U.S. Department of Energy's Clean Cities program to cover up to half the cost of deploying initial EV charging stations.

This manual is intended to be an easy-to-follow guide to help any public or private entity install Electric Vehicle Supply Equipment, or EVSE. We hope this guide will be a useful reference in accelerating the deployment of EV charging infrastructure throughout Oregon. An on-line version of this manual is also available at: location@url

What is an Electric Vehicle?

Insert photo of electric vehicle

An electric vehicle (EV) is a vehicle that uses an electric motor for propulsion and is powered by a battery located on-board the vehicle. Section ___________ of this manual describes the kinds of EVs on the market today, as well as upcoming technologies in the world of EVs.

EV batteries are fully rechargeable, although the time it takes to recharge an EV depends both on the type of vehicle and the type of power supply equipment used. Below is a brief description of the power supply equipment used with today's EVs.

Electric Vehicle Supply Equipment and Wiring

Insert photo or graphic of car plugged into EVSE

There are three main components to Electric Vehicle Charging Infrastructure: electric vehicle supply equipment (EVSE), premises wiring, and electrical service and electrical panel capacity:

1) **The Electric Vehicle Supply Equipment (EVSE).** This consists of a supply device, power cord, and connector.

Insert photos or graphics of all three components

- **Supply Device**: This device is the main component of the electric vehicle charging station. Typically it supplies electrical power, provides shock protection, and may also contain information systems for measuring the amount of energy delivered while an EV is charging. For Level 1 and 2 charging (see below), the actual charger is located on-board the EV.
- **Power cord**: This is a cable that carries electrical current and communication signals from the supply device to the connector. For Level 1 and 2 charging, this cord conducts alternating current from the EVSE to the on-board charger.
- **Connector:** This is a plug on the power cord that connects the EVSE to charging sockets on the EV. In the fall of 2009 the Society of Automotive Engineers is expected to approve the SAE J1772 "SAE Electrical Vehicle Conductive Charge Coupler" as the national standard for EVSE connectors which will be used in virtually all electric vehicles in the U.S.

2) **Premises wiring.** This is the wiring that runs from the electric panel to the EVSE.

3) **Electrical service and electric panel capacity to charge an EV.** Electrical service includes the utility lines and electric meter, both of which are owned and controlled

by the local electric utility. Installation of EVSE may require new or upgraded electrical service. A local electrical contractor can determine if the existing service can support the additional load of EVSE and coordinate with the local utility if an upgrade is needed.

INSERT "EV Charge Residential Install" Drawing

Accessing Statewide Purchasing Agreement for EVSE

In order to promote the use of EVs and ensure a uniform charging experience the Oregon Department of Transportation (ODOT) has entered into a purchasing agreement with a reputable EVSE vendor. You can purchase EVSE equipment under this purchasing agreement; doing so will ensure that you receive high quality equipment that is standardized across the state of Oregon and available at a reasonable price.

In order to take advantage of thus purchasing agreement, you will need to fill out an EVSE Authorized Purchaser Participation Agreement. Forms are available at the ODOT website at location@url.

Electric Vehicle Charging Levels

EV charging can be performed at three different voltage and current levels. Each level has advantages and disadvantages and the EVSE installation requirements will differ depending upon the desired charging level.

Level 1 Charging

Level 1 Charging is done with a standard outlet and voltage level that is present in all homes and businesses. Using this level of charging rarely requires an upgrade to an existing electrical service. This level of charging can take between 8-14 hours to fully charge an EV and for this reason Level 1 charging may not be the preferred method of charging for most circumstances.

Level 1 Charging specifications:

- 120-volt ac single-phase nominal electric supply
- 12 to 16 amp maximum continuous current with 15 amps minimum branch circuit protection

Level 2 Charging

Level 2 charging is faster and more convenient than Level 1 charging and is expected to be the primary option for home, public, and fleet charging stations. This level of charging may require an upgrade to existing electrical service and will require a permanently wired and fixed charging station location. Level 2 charging can fully recharge an electrical vehicle in 3 to 6 hours.

Insert photo of chosen vendor's EVSE

Level 2 Charging Specifications:

- 240-volt ac single-phase nominal electric supply
- 32 -70 amp maximum continuous current with 40 amps minimum branch circuit protection
- Safety features: grounding, ground fault protection, no-load make/break interlock, cable/connector safety breakaway

EVSE available for purchase under the statewide procurement and purchase agreement are compatible with both Level 1 and 2 charging.

Level 3 Charging

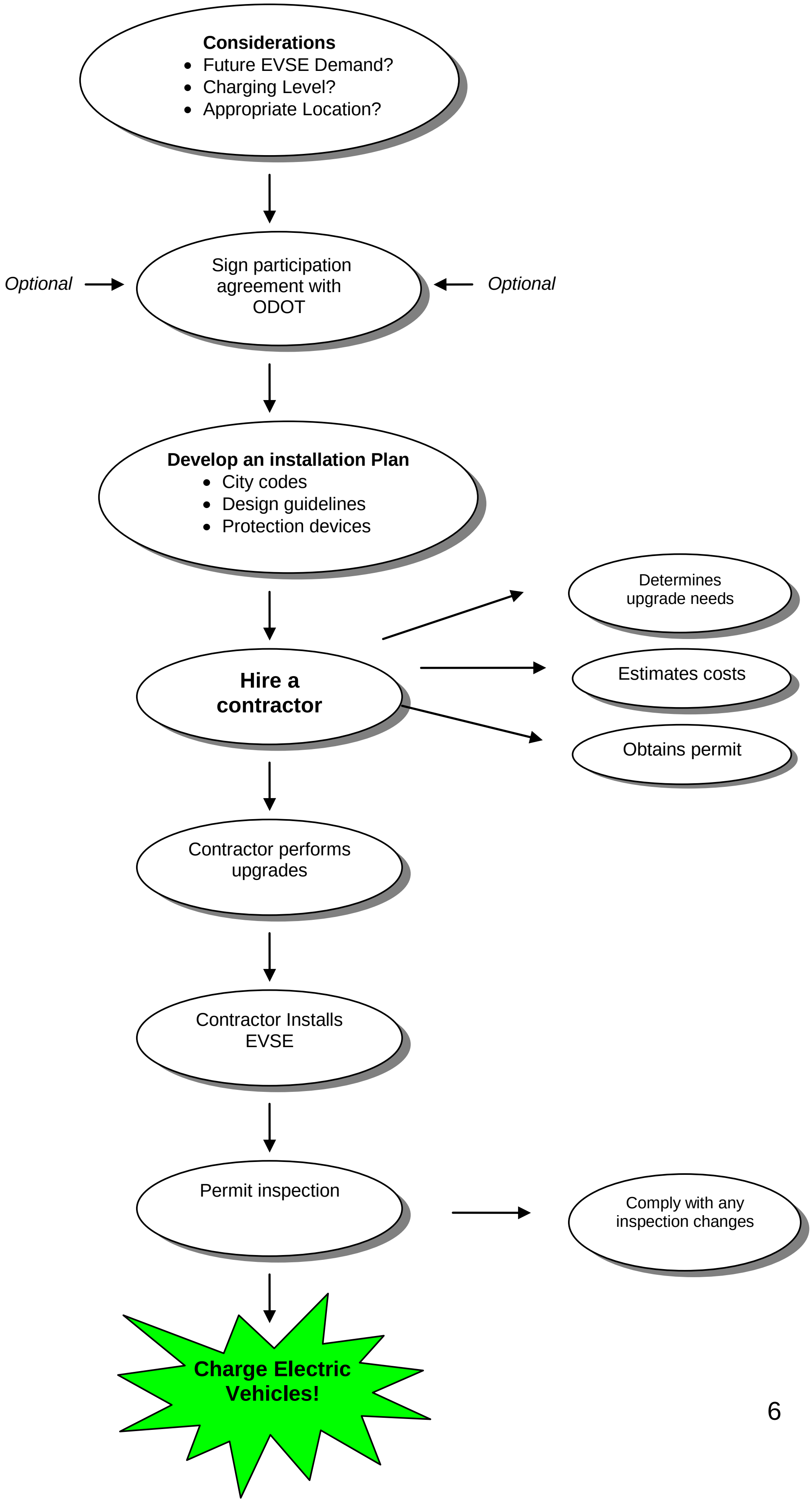
Level 3 Charging, also known as fast charging, involves high-powered technology that can fully charge a vehicle in 20 to 30 minutes. The amount of power required for Level 3 charging is beyond the capacity of most utility transformers. For this reason, along with the expectation that most EV charging will take place overnight when Level 2 charging would be sufficient, Level 3 charging will usually not be the preferred charging method. However in some situations such as large fleets of vehicles Level 3 charging may be appropriate. See section______for a discussion of fleets and Level 3 charging. A standard for level 3 charging systems is in development.

Insert photo of Level 3 Charging station

The Installation Process

Installing EVSE for a fleet of vehicles or in a public or commercial location is not difficult, but there are important steps to follow and details to consider. Following is a flowchart showing the process of installing an EVSE in a public, commercial, or fleet location.

Figure 1: EVSE Installation in Commercial, Public, or Fleet Locations



Designing an Installation Plan

Before installing EVSE in a public location or commercial fleet it is important to coordinate the design of the installation with an electrical contractor and the site manager. The design should consider:

- Code requirements
- Electrical capacity
- Estimated demand for EVSE
- Location and local siting requirements

Insert "EV Charge Commercial Install" Drawing

Oregon Electrical Code Requirements

Installation and placement of EVSE is regulated by the National Electric Code (NEC) as adopted by the Oregon Electrical Specialty Code (OESC). NEC Article 625 addresses requirements for Electric Vehicle Supply Equipment. If the EVSE is purchased under the ODOT purchase agreement the property owner can be confident that the EVSE equipment meets all NEC and OESC requirements.

Only a licensed electrician or electrical contractor should install EVSE in a public or fleet location. An electrician can acquire the necessary permit, perform the installation and obtain an inspection. Hiring an electrical contractor will help streamline the process while ensuring that the installation adheres to all relevant electrical and building codes. See Appendix 1 for a helpful resource on finding an Oregon licensed electrical contractor.

Permits and Inspections

Oregon Revised Statute 479.550 requires that you acquire a permit before installing EVSE. You will also be required to have an inspection by the local jurisdiction prior to energizing the EVSE to ensure it is safely installed.

Inspections are limited to examining the feeder for compliance with the following OESC provisions:

a) Overcurrent protection, per articles 225 and 240;
b) Physical protection of conductors, per article 300;
c) Separation and sizing of the grounding and neutral conductors, per article 250.20; and
d) Provisions for locking out the breaker for maintenance, per chapter 4.

You may also choose to install a grounding electrode system for supplemental lightning protection, but this is not required by the OESC.

Ventilation

Electric vehicles that use lead-acid batteries may require ventilation when charging to prevent the build-up of hydrogen emitted from the charging battery. When deciding upon the type of EV to purchase and the location for EVSE, you should consider possible ventilation needs. If ventilation is required, EVSE chargers must be linked up to a mechanical ventilation system as described in NEC article 625. An electrical contractor will help ensure you have proper ventilation for the number and type of vehicles that will be charging at a given location.

In all charging locations, EVSE should clearly state if the EVSE is appropriate for vehicles requiring ventilation.

Insert photo or graphic of an EVSE that is linked up with a ventilation system.

Electrical Capacity Considerations

Installing EVSE in fleet or public locations may require upgraded electrical service including new feeder lines, panels, and possibly even new transformers. Several factors determine the need for electrical service upgrades, including:

- Number and type of charging units;
- Pre-existing electrical capacity; and
- Load management considerations

Insert photo of large bank of EVSE in fleet or public location

Number and Type of Charging Units: The number of EVSE and the level of charging will drastically impact electrical service demands, particularly in fleet locations with large numbers of EVSE charging stations. Due to the high electrical demands of Level 3 charging and the slow charging times of Level 1 charging, Level 2 will likely be the preferred level of charging for both public and most fleet locations.

When deciding upon the number of EVSE to install, both public and fleet sites should estimate future increases in EV use. Public fleet managers should include consideration of alterative fuel mandates when estimating future EV demand.

Pre-existing Electrical Capacity: When considering where to install EVSE equipment for a fleet or public access, it is important to work closely with an electrical contractor who can assess current electrical capacity and the electrical demands of the EVSE.

Some locations may have existing electrical capacity for one or two EVSE stations, but installing several EVSE units may require upgraded electrical service. The electrical contractor can help determine possible upgrade needs and ensure that all electrical upgrades are done safely, within electrical code guidelines, and according to permit and inspection protocol. If upgrading electrical capacity or increasing a building's electrical load it is the building owner's responsibility to alert the utility company.

Load Management Considerations: Management of charging times can help control both demand on electrical service and the cost of recharging EVs.

Public and commercial fleet managers should consider timing the charging of their fleet vehicles to correspond with times of low electricity demand. If time-of-use rates are available then fleet managers could use these rates both to lessen the burden on the electric grid and lower the cost of recharging fleet vehicles. See section______ for an explanation of time-of-use rates.

Public EVSE stations should have an adequate number of chargers to meet charging needs during times of peak demand. If a location is expected to experience a high volume of use, then additional electrical capacity should be considered so that charging capacity does not diminish when several EVs are charging simultaneously. Most public charging will occur during the day when demand for electricity is relatively high.

Signs and Visibility

National Electric Codes require that all EVSE sites be identified by signs stating "For Use with Electric Vehicles." Signs may also indicate when parking spaces are for EV-charging only.

Insert photo of "EV Parking Only" sign

ODOT has developed a standing "Electric Vehicle Parking Only" sign but they are currently working through trademark issues that may require a new design. Several variations of the sign are currently under consideration.

Specific Considerations for Public Locations

Metering and billing Entities that provide public access to charging stations will need to decide if and how they will charge users of the EVSE. Some options include:

- The EVSE owner may choose to provide charging for free to encourage EV owners to come to their business location and to show their support of a greener transportation system.
- Employers with EVSE may charge their employees a premium for an electrified parking spot or provide them for free as an employee benefit.

Insert photo of EVSE point-of-sale machine (if this exists)

Currently, collecting payment for electricity at public charging stations is problematic because the transaction costs far outweigh the small cost of the electricity used. Also, only utilities can sell electricity in Oregon. Until there are significant numbers of EVs on the road the cost at any public station will be minimal because most of the charging will take place at home and at work. In time, standards and business models for charging users of public EVSE will likely emerge.

Accessibility Requirements: EVSE in public locations need to comply with the federal Americans with Disabilities Act and Chapter 11 of the Oregon Structural Specialty code (OSSC). Some aspects of EVSE installation to consider include disabled parking access, special curbing and the height of the EVSE equipment.

Though no current state guidelines exist, general recommendations are that there be at least one ADA accessible EVSE for every 25 EVSE charging spaces.

Insert "EV Charge Disabilities Act Compliant" drawing

Guidelines for Physical Layout of Public EVSE

To help motorists recognize and become comfortable with public EVSE stations, the state of Oregon is encouraging uniformity and standards in design of public EVSE. It is important that the public recognize and develop confidence with EVSE stations across the state. This will raise EV awareness and provide a common user charging experience regardless of location.

It's important to follow local zoning codes when installing public EVSE stations. For example, some cities may require a certain amount of landscape buffering or setbacks from sidewalks. Following is a list of suggested recommendations for EVSE placement, keeping in mind that local zoning requirements may impact your final EVSE setup.

a. Sidewalk Placement of EVSE: If EVSE is installed on a sidewalk adjoining a roadway the EVSE should be placed within the "furnishing zone" of the sidewalk,

Insert photo of EVSE sidewalk placement

similarly to parking meters, sign poles, and traffic signals. For a 9 foot sidewalk the "furnishing zone" is 36 inches from the edge of the curb; width of the furnishing zone will vary depending upon sidewalk width.

To minimize vehicle contact the EVSE should be placed farther from the curb towards the end of the furnishing zone. This will avoid foot traffic while shielding the EVSE from the street and from any damage that could occur as a vehicle parks. When placing the EVSE within the furnishing zone ensure that the sidewalk remains accessible according to ADA and OSSC Chapter 11 rules.

b. Cords and Walkways: EVSE cables should not cross walkways or vehicle access areas.

c. Hazardous Locations: EVSE should not be placed near hazardous materials; if this is unavoidable, check with the electrical contractor to ensure placement meets articles 500-516 of the NEC.

d. Protective Barriers: We recommended that EVSE be protected by bollards, curbs or other barriers to prevent accidental damage to the EVSE.

Bollards or other appropriate protective devices should be placed with at least 36 inches of clearance between the EVSE and the barrier so the EVSE can still be accessed when a vehicle is parked near the barrier. Bollards and other protective devices should be placed so they allow a direct connection with the EVSE. The preferred standard design incorporates two bollards off-set from the center of the EVSE station (see photo).

Bollards and protective barriers should conform to the standards in Sections 815-820.90 of the Oregon Standard Specifications for Construction.

Insert photo of EVSE space with protective barriers (preferably two bollards, slightly off-center)

In a situation where EVSE is placed in a sidewalk furnishing zone and protective barriers such as bollards are not feasible, the curb can be considered an adequate protective device.

e. Outdoor EVSE: Where an EVSE is placed in an outdoor location, consider providing an overhang to protect it from the elements and alleviate customer concern over the risk of electric shock in inclement weather. EVSE obtained through the ODOT statewide procurement and purchase agreement is designed to operate safely even in wet areas, but providing a protective overhang may increase public acceptance.

EVSE placed in indoor locations, such as covered parking structures, do not require an overhang.

Insert photo of EVSE with desired overhang design.

f. Lighting In public areas, proper lighting of the EVSE station is important to ensure security and prevent vandalism or misuse. However, lighting should be designed to minimize distraction to traffic, disturbance to surrounding buildings and excessive light pollution. We recommended using motion-sensor lights.

Insert photo or graphic of EVSE with desired lighting scheme.

Specific Considerations for Fleet Locations

EV Fleets and Level 3 Charging

Before deciding on the appropriate level of charging for a fleet of vehicles, you will need to consider the needs of the fleet and potential recharging schedules. If you have a large fleet of EVs that will need frequent recharging on overlapping schedules, it may be appropriate to install Level 3 charging stations. However, with the extra expense of installing Level 3 charging, you should be certain that the use of Level 3 charging is justified.

If you are considering Level 3 charging, you should talk to an electrical contractor as soon as possible to determine if the amount of electricity required for Level 3 charging is feasible in the fleet location.

Expected Costs

Installation Costs

It is difficult to estimate costs for the installation of EVSE since cost depends on specific circumstances such as pre-existing electrical capacity, distance from the electrical panel to the desired EVSE location, the amount of construction that needs to be done to accommodate the EVSE, and number of chargers in an installation. The estimated average cost for an installation of a single EVSE in a public or fleet location is $10,000. This is a very rough estimate, as individual circumstances will vary, particularly in retrofit situations where extensive concrete cutting, trenching, conduit and panel upgrades may be required.

See Appendix 2, ‘Other Resources,’ for a link to an estimated installation cost break-down from the U. S. Department of Energy’s Vehicle Technology program.

Estimated Charging Costs

The cost to recharge an EV will vary depending upon the type of EV and the electricity rate. Electricity rates vary by utility company; in 2008 the average cost of electricity to a commercial consumer in the state of Oregon was around 8 cents per kilowatt-hour (kWh). The number of miles per kWh varies by EV but many average around 4 miles per kWh. With these numbers, cost would be approximately 2 cents per mile. In comparison, a gas vehicle that gets 20 miles per gallon and pays $3.00 for a gallon of gas pays 15 cents a mile. This is just an estimate; the exact cost could be more or less depending upon your utility rate and the range of the EV per charge.

Time-of-Use Rates

Some utility companies may offer different utility rates depending upon the time of use, with lower rates offered during times of low electricity demand. If time-of-use rates are offered fleets could save money by charging EVs during times of low demand, such as overnight.

Controlling use of EVSE for different times of day will be more difficult at public EVSE locations, but entities that are paying for public access should be aware of the potential impact that time-of-use rates will have upon the cost of EV charging for their EVSE location.

Check with your local utility provider to see if they offer time-of-use rates before deciding upon a charging plan for your EV. If your utility offers time-of-use rates you will need to have a special time-of-use meter installed. Some vehicles may come with the option of setting a delay for charging similar to the delayed start of a washing machine, dryer or dishwasher. If this feature is not available, property owners may also have an external timer installed in the electric panel that will control when the EVSE can charge the vehicles. If you are considering using time-of-use rates and want to have a timer installed, consult with your electrical contractor before EVSE installation begins.

State and Federal Tax Credits for Electric Vehicles

There are various state and federal tax credits for consumers installing EVSE or purchasing one or more electric vehicles.

Oregon State Tax Credits

1) Oregon Business Energy Tax Credit: Transportation.

The Oregon Business Energy Tax Credit is available to businesses to help pay for projects that reduce miles driven or promote alternative fuels and more sustainable vehicles. The purchase of EVs and installation of EVSE are eligible for this credit. The tax credit is equal to 35 percent of eligible project costs and can be taken over five years at the rate of 10 percent in the first and second years and 5 percent each year thereafter. Projects with eligible costs less than $20,000 would take the entire tax credit in one year.

Federal Tax Credits for Purchasing an Electric Vehicle

1) Energy Improvement and Extension Act of 2008

New Electric Vehicles: Currently, there is a federal tax credit for new plug-in electric vehicles, ranging from $2,500 to $7,500 for cars and trucks, and from $10, 000 to $15,000 for larger commercial vehicles. For each make and model of EV this tax-credit will begin to phase out after 200,000 EVs have been sold. See the adjacent table for phase-out periods and amounts. This tax credit applies to vehicles acquired after December 31, 2009, and expires December 31, 2014.

Vehicle Size (lbs)	Maximum credit	Phase-out level	50 percent credit Qtrs 1 & 2 post phase -out	25 percent credit Qtrs 3 & 4 post phase-out
< 10,000	$7,500	200,000 sold	$3,750	$1,875
10,000-14,000	$10,000	200,000 sold	$5,000	$2,500
14, 000-26,000	$12, 500	200,000 sold	$6,250	$3,125
> 26, 000	$15, 000	200,000 sold	$7,500	$3,750

Electric Vehicle Conversions: Through December 31, 2011, qualified plug-in electric vehicle conversions are also eligible for a tax credit of 10 percent of the conversion cost up to $4,000.

Low-Speed Electric Vehicles: A second tax credit of up to 10 percent of the cost of qualified low-speed electric vehicles, electric motorcycles, and three-wheeled electric vehicles, not to exceed $2,500, is available through December 31, 2011.

2) Alternative Fuel Infrastructure Tax Credit

The federal government is offering a tax credit for the cost of installing alternative fueling equipment, including electric vehicle charging stations. Individual consumers may receive a tax credit of up to $2,000 for equipment that was placed into service after December 31, 2008.

For large commercial or public installations the credit amount is equal to 50 percent of the installation costs, not to exceed $50,000, for all equipment placed into service on or after January 1, 2009. There is a 30 percent credit amount, not to exceed $30,000, for equipment placed into service before January 1, 2009.

The Alternative Fuel Infrastructure Tax Credit expires December 31, 2010 for electric vehicle supply equipment. Form 8911(PDF 247 KB) provides additional information and must be used to claim the tax credit.

Electric Vehicles Today

NEV (neighborhood EV) or LSV (low-speed EV)

Most of the EVs currently on the road are known as NEVs or LSVs that have a maximum speed of 25 mph in Oregon. These vehicles are not crash tested or safety certified and in Oregon many are registered with the Driver and Motor Vehicles as motorcycles. An example includes the GEM car:

Insert photo of GEM Car

PHEV (Plug-in Hybrid Vehicle)

Another type of EV is the plug–in hybrid. This vehicle includes the standard hybrid gasoline/electric engine but is augmented with additional battery cells and a charging mechanism. Example includes Toyota's plug-in Prius, scheduled for release in the US in 2010:

Insert photo of Toyota Plug-in Prius

Some hybrids can also be converted to a PHEV with a conversion kit that adds an additional battery pack.

BEV (Battery Electric Vehicle)) or EV (Electric Vehicle)

Almost every major car manufacturer has announced plans to introduce all-electric vehicles in the next couple of years. Examples include:

Smart Electric Vehicle This is an electric version of the existing Smart Car, which continues to grow in popularity in the United States. Electric Smart Cars will be available to select customers in the U.S. in June 2010, with greater availability by 2011.

Insert photo of Smart EV

Insert photo of Mitsubishi MIEV.

The Mitsubishi Innovative Electric Vehicle (MIEV). This car is currently in production in Japan and should be available worldwide in 2010.

Nissan EV-02. This car should be released in Oregon for fleet use in 2010, with planned expansion to the consumer market in 2012. The Nissan EV-02 is capable of highway speeds and should have a 100 mile battery range.

Insert Photo of Nissan EV-02

Highway Speed Commercial Electric Vehicles

There are already many commercial electric vehicles in use in a variety of different commercial and governmental settings, such as:

Insert photo of Alke ATX E

The Alke ATX E Series of commercial vehicles. Built in Italy, these vehicles have load capacity up to 2200 pounds and towing capacity up to 6600 pounds.

Smith Edison Minibus. This is available in three different body styles and two different lengths.

Insert photo of Smith Edison Minibus

Insert photo of Smith Newton

Smith Newton A 12-ton truck with a 7.4 ton payload, it also has a range of over 150 miles and a maximum speed of 50 mph.

The Future of Electric Vehicles

Many new and exciting technologies are currently being developed in the world of electric vehicles. Below is a list of cars that will be available in the near future, along with brief highlights of some of the EV technology being developed. See Appendix 2 for a link to an updated list of new EVs and EV technology

Future EVs

Insert photo of Phoenix Motorcar SUT

Phoenix Motorcars SUT. This is a four passenger sport utility truck that can go highway speed and travel over 100 miles on a single charge.

Think Ox vehicle. This is a small four-door sedan with a 124 mile range that is rechargeable either with a normal household outlet, Level 2 charging, or rapid-charging technology.

Insert photo of Think Ox

Future Commercial Vehicles

Insert photo of Nemo HD 2

Nemo Must HD 2. This commercial vehicle with rear cargo capacity of 300 pounds can be fitted with drop-down sides; it has a 115 mile range at a speed of 25 mph.

Future EV Technology

Smart Grid Technology and Vehicle to Grid Charging

Many new and exciting technologies are being developed to increase the convenience and affordability of EVs. Some developments that should be available in the near future include Smart Charging and Vehicle to Grid (V2G) charging.

Smart Charging

In very basic terms, "Smart Charging" refers to a variety of technologies that allow the EV to interact with the electrical grid beyond the simple charging of EV batteries, communicating with the grid in real time and charging exactly when the grid needs it to. Although still being developed, Smart Charging could simplify Time-of-Use charging, help consumers avoid charging vehicles during peak demand, and allow for point-of-sale charging at public EVSE locations.

Vehicle to Grid (V2G) and Vehicle to Building (V2B)

Both V2G and V2B charging would allow two-way energy flow between the EV and the power grid or building. This would allow the EV to act as an energy storage system and provide power either to the electrical grid in the case of V2G charging or directly to a building's energy management system with V2B charging.

Smart Grid

The use of Smart Charging and V2G technologies is contingent upon the upgrade of the nation's electric grid to what is being called a new "Smart Grid" that would allow communication between the electric grid and home appliances such as EVs. This technology could potentially expand the economic and environmental benefits of EVs by allowing the consumer to save money and by decreasing utility companies' reliance upon more polluting energy sources when demand for electricity is high. Smart Grid and V2G and V2B technologies are still being developed and many questions, such as who will control the flow of electricity, are still being debated. Once implemented, V2G or V2B capabilities on a Smart Grid could significantly increase the convenience and affordability of EVs.

In the meantime, using EVs today is a smart choice for many people, and Oregonians are, once again, leading the way to a smarter, more sustainable future for everyone.

See the following appendices for resources, contractor information, and more.

Appendix 1: Hiring a Licensed Electrical Contractor

The state of Oregon has resources available to help ensure that the contractor you hire to install EVSE will be licensed and reputable. Before hiring a contractor you should consult the Construction Contractors Board's office or website where you can find a licensed contractor, check a known contractor's license, or register a complaint about a contractor.

The Construction Contractors Board also features information on "Best Practices" when hiring a contractor, and can help you mediate any conflicts that may arise during or after your installation.

You can access the Construction Contractors Board online at

http://www.oregon.gov/CCB/index.shtml

In addition to the Construction Contractors Board, you can find referrals for qualified electrical contractors through the following organizations:

The National Electrical Contractors Association (NECA) at 503-233-5787
Or 541-736-1443

Independent Electrical Contractors of Oregon (IEC) at 503-598-7789

You can also learn more about permitting in Oregon at the "Permits Protect" website:

http://www.permitsprotect.info/

Appendix 2: Other Resources

Utility Companies in Oregon, by region:

- http://www.oregon.gov/ENERGY/Power.shtml

Cost-estimates for EVSE installations in residences and commercial facilities:

- U.S. Department of Energy Vehicle Technologies Program: *"Plug-in Hybrid Electric Vehicle Charging Infrastructure Review."* http://avt.inel.gov/pdf/phev/phevInfrastructureReport08.pdf

Updates on EVs entering the market

- Plug-In America's *"Plug-in Vehicle Tracker"* **http://www.pluginamerica.org/plug-in-vehicle-tracker.html**

Oregon Electric Vehicle Association: www.oeva.org

Appendix 3: Glossary of Acronyms

ADA: Americans with Disabilities Act

BEV: Battery Electric Vehicle (see also EV)

EV: Electric Vehicle

EVSE: Electric Vehicle Supply Equipment

KWh: Kilowatt-hour

LSV: Low-speed Electric Vehicle

NEV: Neighborhood Electric Vehicle

NEC: National Electric Code

ODOT: Oregon Department of Transportation

OESC: Oregon Electric Specialty Code

OSSC: Oregon Structural Specialty Code

Appendix 4: Glossary of Terms

Ampere (amp): A unit of measurement for current, or the amount of electricity flowing through a circuit.

Battery: A vessel made up of a number of battery cells which produce and store an electric charge. It can also be used to refer to an individual battery cell.

Battery Electric Vehicle (BEV) : An automotive-type vehicle for highway use, such as passenger automobiles, buses, trucks, and vans, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current. (EV definition from 2008 National Electric Code 625.2). *See also: Electric Vehicle*

Capacity: The total number of ampere hours (Ah) that can be withdrawn from a fully charged cell of battery for a specific set of operating conditions.

Charge: *(verb)* Conversion of electrical energy into chemical potential energy within a cell by the passage of a direct current. *(noun)* Couloumbs or ampere-hours of energy available in a cell or battery.

EV Connector: An off-board component that, by insertion into an inlet on the electric vehicle, establishes connection to the EV for the purpose of energy transfer and information exchange.

Coupler: The device connected to the electric vehicle supply equipment that transfers power to the electric vehicle for charging the energy storage system and permits the exchange of information between the EV and the EVSE. The coupler contains the primary coil of the take-apart transformer, an antenna for communications, a magnet for connection check, and provisions for locking the coupler in the vehicle to prevent tampering.

Electric Vehicle (EV): An automotive-type vehicle for highway use, such as passenger automobiles, buses, trucks, and vans, primarily powered by an electric motor that draws current from a rechargeable storage batter, fuel cell, photovoltaic array, or other source of electric current. *See also: Battery Electric Vehicle (EV definition from 2008 National Electric Code 625.2).*

Electric Vehicle Supply Equipment (EVSE): The conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle. *(EVSE definition from 2008 National Electric Code 625.2).*

Power Cord: The off-board cable that connects the EV plug with the EV power controller to provide power and communications for the vehicle during charge.

Range: The maximum distance that an electric vehicle can travel on a single battery charge over a specified driving cycle to the battery manufacturer's recommended maximum discharge level.

Time-of-Use rates: Discounted electricity rates established by utilities to encourage use of electricity during off-peak hours.

Volt: Basic unit of electrical potential. One volt is the force required to send one ampere of electrical current through a resistance of one ohm.