

4. EV CHARGING IN SINGLE FAMILY RESIDENCES

Residential EV users are fortunate in that suppliers of EVs and EVSE provide substantial assistance in setting up charging infrastructure. PG&E also provides assistance to those who have questions about the adequacy of their current electrical service. In addition, electrical contractors should be familiar with technical and permitting issues. This chapter provides an overview of the necessary steps in the installation process.

As mentioned in earlier sections, charging facilities must comply with all local, state, and national codes and regulations, regardless of the type of installation, and all work requires a permit and should be handled by appropriately licensed contractors. Contractors should make sure to check with the local planning department before starting work. It is important to note that PG&E will not energize a new meter without a properly signed building inspection.

This chapter is presented as a step-by-step process that should be followed to ensure proper EVSE installation. This chapter also includes information specific to multi-family residences.

A. Step 1: Determine the Charging and Battery Types

Before any equipment purchases and electrical services changes are made, the homeowner should determine the type and model of EVSE the EV manufacturer provides or specifies, and that equipment's electrical requirements. As discussed in Chapter 2, conductive and inductive charging equipment require different connectors and are installed in a different manner. The EV dealership will also know if the vehicle's battery requires ventilation during charging.

B. Step 2: EV Utility Rates and Meter Options

Before installing the EVSE, contact PG&E for more information about its special EV rate schedules (see Chapter 2E *PG&E EV Rates*). It is the homeowner's responsibility to sign up for rate schedule E9 with PG&E. For the homeowner to take advantage of PG&E's E9B rate schedule, the residence must be able to separately meter EV charging. As mentioned earlier, some municipalities do not allow separate meters to be installed in a residence. Homeowners are advised to check with their city's building inspection department.

C. Step 3: Determine the Home's Electrical Capacity

The installation contractor can tell the homeowner if the home has adequate electrical capacity for EV charging. Many people will want to use Level 2 EVSE due to the quicker charging times, but many older homes may not have sufficient electrical capacity. In those instances, they must add a new electrical service panel to handle the 240 volt, 40 amp Level 2 charging circuit needed for Level 2 charging. A quick survey by an electrical contractor can determine if a service panel upgrade—generally the most costly step in installing charging facilities—is necessary.

D. Step 4: Determine EVSE Placement

The following factors should be considered when determining where to place EVSE:

1. Safety Issues in Enclosed Garages

Enclosed garages offer convenience, safety and security. Most single family residences will employ this option. Some of the factors to consider when planning an EVSE installation in an enclosed garage include:

- The EV charger should be placed where the cable will stretch the shortest distance, where the user can easily reach the charger handle, and where it does not block entry or exit. Therefore, check the location of the charging port on the EV before planning the EVSE location.
- Avoid having the cords and cables cross areas with heavy foot traffic.
- If practical, use cable management to prevent accidents.
- As mentioned in Chapter 3, EVSE must not be installed near explosive material; flammable vapors, liquids and gases; combustible dust or fibers; and materials that ignite spontaneously on contact with air. See NEC Articles 500 to 516 for more information.

2. Extending Electrical Service

If a detached garage does not have electrical service, the installer should help the homeowner decide where to place the wiring for the EVSE: overhead, which is less expensive but visually less attractive option; or underground which can be more expensive but is also more attractive.

3. Outdoor Charging

Charging equipment is weatherproof and can be placed outdoors, but it should be protected from damage. It is also recommended that EVSE be installed in a secure location to protect against vandalism. In addition, EV buyers should check the EV manufacturer's recommended operating and charging temperature range for the battery pack and site the EVSE accordingly. This applies to both indoor and outdoor locations.

E. Step 5: Drawing Up the Installation Plans

After determining the electrical equipment needs and the optimal location of the EVSE, the next step involves drawing up precise plans for the branch circuit and EVSE installation. Part of this step involves checking that the planned installation complies with the code requirements as summarized in Chapter 3. Most importantly, local building code officials should be contacted regarding special requirements and documentation needed to obtain the permit and pass the building inspection. Then, the EV buyer should select a currently licensed electrical contractor.

The contractor will help draw up any installation plans to be submitted as part of the permit applications. For a residential permit, most jurisdictions require a drawing that shows:

- The electrical panel schedule
- The wiring of the new branch-circuit, including the meter, charger, and all receptacles
- If ventilation is required, the location of the vent fan, its specifications, and air inlet and air flow in cubic feet per minute
- The location of the EVSE in the garage and any potential hazards

The installation plan should be detailed enough for the local code official to determine that the installation meets code requirements, is safe, and meets all federal, state, and local requirements. Drawings should be complete but not overly detailed.

Above all, the EV owner and contractor should follow the instructions provided by the EV and EVSE manufacturers to ensure safe and proper equipment operation.

F. Step 6: Obtaining Permits, Performing the Installation, and Conducting a Site Inspection

When the installation plan is drawn up, the EV owner then applies for the permit, which varies in price by task and jurisdiction. The contractor can begin installation when the permit is issued. When the installation is complete, the owner should arrange for an inspection with the local building inspector, and then make any required changes. Figure 4 on the following page illustrates a typical residential EV infrastructure site plan using a separate meter for the EVSE.

G. Other Issues Pertaining to Single Family Residences

In addition to following the process outlined above, the homeowner should be aware of other issues that can affect their EVSE installation:

1. Insurance

According to insurance companies contacted, EVSE in a single-family residence does not require a rider to the existing insurance policy or separate coverage. EV owners should check insurance requirements with their insurance agent.

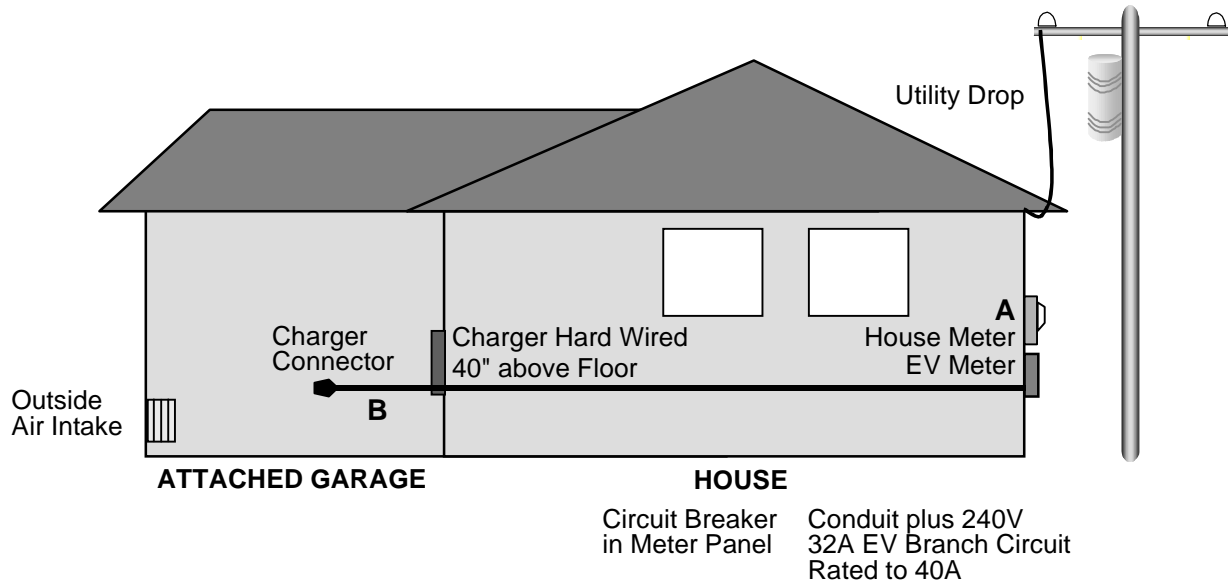
2. Costs

In general, the cost of an EVSE installation ranges from \$500 to \$1,500 if an electrical panel upgrade is not required. If a panel upgrade is needed, the installation cost will be approximately \$2,500. These costs do not include the EVSE itself. Some EV manufacturers include EVSE equipment in their vehicle lease price. As mentioned earlier, check with the EV dealer first before starting with the installation planning.

The following factors will influence the total installation cost:

- The particular EVSE selected
- Whether the garage is attached or detached
- Electrical service panel upgrade requirements
- The use of trenching vs. use of existing conduit or raceway
- The electrical panel location relative to the EVSE
- Type of construction (slab or crawlspace)
- Ease of installing new wiring

Figure 5: Sample Residential EV Infrastructure Plan



A

Electrical Panel Schedule

1	2	3	4
240V 30A Garage Dryer	240V 40A EV Meter	120V 15A House Lighting	120V 15A Bedroom Receptacles
5	6	7	8
120V 15A Dining Room Living Room Receptacles	120V 15A Kitchen Receptacles	Available	Available

- B**
- Electrical Vehicle Supply Equipment**
- Level 2 Conductive or Inductive Charger 240V, 32A, All Components and Cables New
 - Connector Interlock Includes Automatic De-energizer for Vehicle, Cable and Connector
 - Circuit Breaker in Meter Panel
 - Charger Installed 40 Inches Above Floor

For reference only, the following table lists some sample costs for specific components. Actual costs will vary and all costs may not apply to all installations.

ITEM	COST	ITEM	COST
<i>Permits</i>	\$45—\$110	<i>240 V outlet and 30 ft. wiring</i>	\$195 installed
<i>Circuit breaker panel boards</i>		<i>Drywall labor 6 ft x 8 ft</i>	\$225
- 100A	\$450—\$685 installed	<i>400 ft trenching</i>	\$225
- 225A	\$940—\$1,300 in- stalled	<i>Cut and patch concrete - 221 ft²</i>	\$525
- 60A subpanel	\$385 installed	<i>Ventilation</i>	\$275 + installa- tion
- 40 A circuit breaker	\$23—\$75 installed	<i>EVSE</i>	\$100—\$3,000

H. Single-Family Residence EVSE Installation Checklist

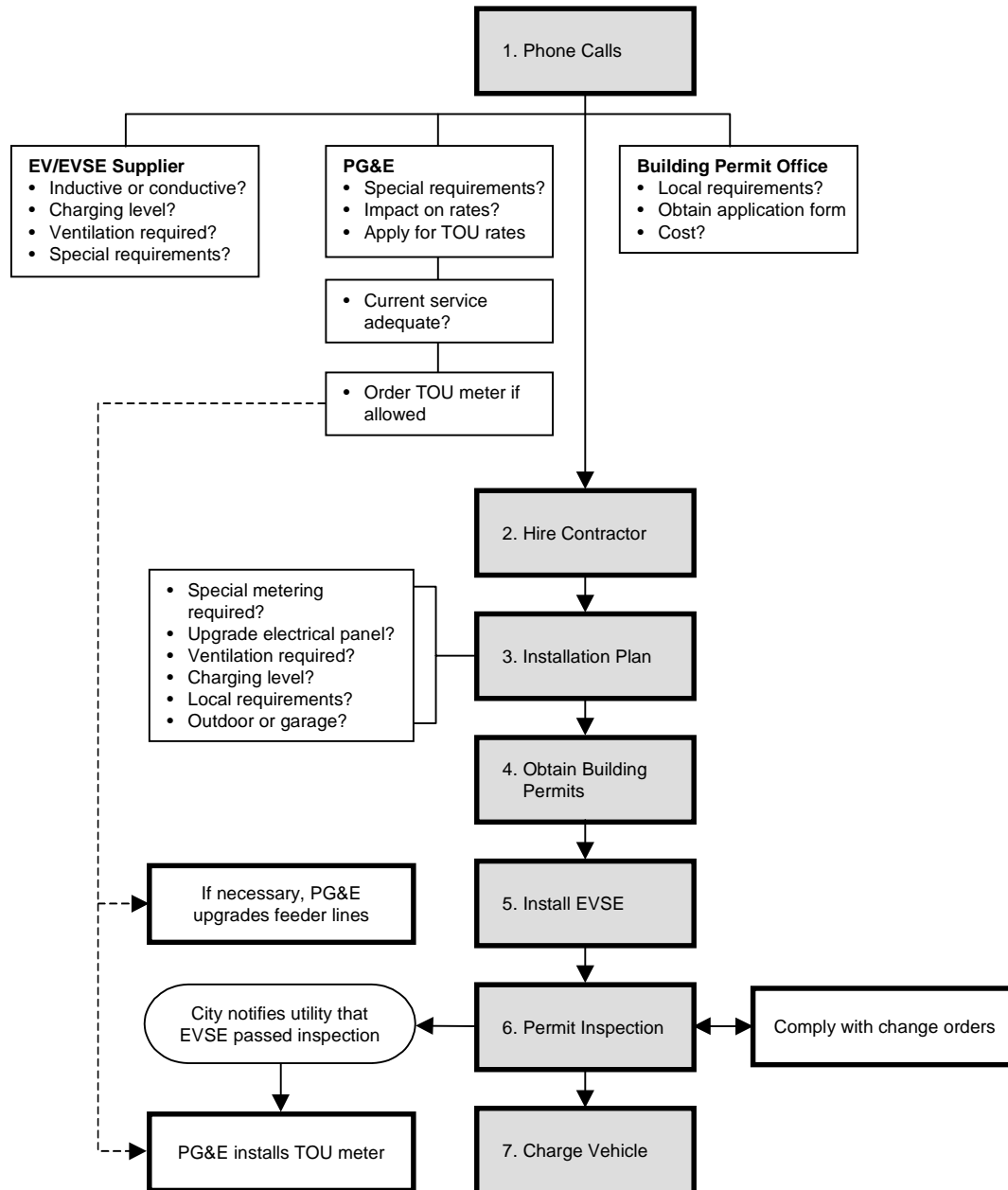
In summary, the following steps should be taken to successfully install EVSE in a single family residence:

1. Determine from EV dealer whether vehicle requires conductive or inductive EVSE
2. Determine from EV dealer whether the vehicle battery requires ventilation during charging
3. Check with PG&E about special time-of-use rates, metering, and electrical service requirements.
4. Check with local building inspection office about the use of dual meters
5. Decide whether to place the EVSE in the garage or outdoors
6. Determine whether the home’s electrical service is adequate for the charging needs
7. Determine whether the local jurisdiction, EV, or EVSE manufacturer has any special requirements
8. Select an electrical contractor and ensure that the contractor’s license for electrical work is current
9. Develop an installation plan, including drawings, panel schedule, lists of materials, and ventilation diagram if ventilation is required
10. Apply for a building permit. Do not begin installation until the permit is issued
11. Order necessary components and supplies
12. Install EVSE (and ventilation if required)
13. Notify building department that the installation is ready for inspection

14. Comply with inspector's change orders, if any are issued. The city will notify PG&E that the circuit is ready to be energized after it passes inspection

15. Charge and drive the EV.

The following flowchart illustrates the process.



I. Issues Related to Installations in Multifamily Residences

Many of the steps taken to complete an EVSE installation at a single-family residence will apply to multifamily residences. However, the following issues are specific to this customer segment and must be addressed before installation begins:

- The ownership of the electrical work and circuit from the meter to the charger, which a tenant cannot take when moving
- How the EVSE will be connected to existing circuits if a separate meter is not possible, along with arrangements for paying electricity bills
- The ownership of the EVSE
- Determining responsibility for any increased insurance costs related to the EVSE
- The location of the charger
- Determining payment arrangements for any mechanical, civil and electrical engineering work and landscaping required for the site

1. Ownership of EVSE

Ownership of EVSE becomes a potentially contentious issue in apartment buildings and condominiums. The EV buyer must settle the issue before any additional planning starts. How this is resolved will affect who pays for the installation, who is responsible for permits, metering issues, electricity payments, and whether or not the EV owner can keep the EVSE upon vacating the building. The following sections examine how these issues might be discussed and resolved for two different types of residences.

2. Apartments

In virtually all situations, the landlord must approve any EVSE installation. Tenants should discuss installation cost with the property owner or manager to see if the property owner will install the EVSE and make an appropriate rent adjustment to cover its cost. One possible arrangement is having the apartment owners pay for installation of the circuit, while EV owners could pay for the charging equipment and take it with them when they move. Also, some municipalities allow only one meter per unit plus one for common areas. This can negate the use of a dual meter setup.

3. Condominiums and Townhouses

Some of the issues are similar in condominiums. The EV owner in a condo or townhouse will probably need the homeowners' association approval to install the EVSE. The homeowner should discuss installation cost with the homeowners' association to see if the association, which may be eligible for a tax deduction, will install the EVSE and make an appropriate adjustment to association dues or fees to cover its cost.

4. Metering Arrangements

Depending on the municipality, the property owner/manager, or homeowners' association, must determine whether to:

- Run the service from the relevant residential unit
- Meter each EV parking space separately
- Run all chargers off one meter

5. Electrical Capacity

Since many multifamily dwellings are built up to the full capacity of their electrical service, building owners/operators must determine whether they have adequate electrical service for the number of planned EV charge stations. The owner/operator should also take any future EV charging needs into consideration. They may necessitate the upgrading of the feeder lines and transformers serving the site, which can delay the service. If upgrades to the transformers or the electrical panel on site are required, the party paying for the installation may incur significant expenses.

6. Insurance

Owners of multifamily residences, condos, and townhouses may need additional insurance to cover the cost of the EVSE and liability. Property damage insurance should cover EVSE and installation costs. Determining who pays for the coverage and the extent of coverage are issues for negotiation between the apartment owner and tenant, or between a condo/townhouse owner and the homeowners' association. A local insurance agent should be contacted for specific details.

7. Costs

As with any EVSE installation, the cost will depend on the type of EVSE, number of spaces required, and siting requirements. The following table lists. For reference only, the table in the next chapter lists some sample costs for specific components in typical EVSE installations at multifamily residences. Actual costs will vary and all costs may not apply to all installations.