EV Charging

Modify the 2021 International Energy Conservation Code as follows:

Add new definition to R202 as follows:

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a building electrical service, EVSE, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded and equipment grounding conductors, and the EV connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses installed specifically for the purpose of transferring energy between the premises wiring and the EV.

EV-CAPABLE SPACE. A dedicated parking space which is provided with electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for each EV parking space, and the installation of raceways, both underground and surface mounted, to support the EVSE.

EV-READY SPACE. A designated parking space which is provided with one 40-ampere, 208/240-volt dedicated branch circuit for future dedicated Level 2 *EVSE* servicing EVs. The circuit shall terminate in a suitable termination point such as a receptacle, junction box, or an *EVSE*, and be located in close proximity to the proposed location of the EV parking spaces. The circuit shall have no other outlets. The service panel shall include an over-current protective device and provide sufficient capacity and space to accommodate the circuit and over-current protective device and be located in close proximity to the proposed location of the EV parking spaces.

Add new text as follows:

R401.4 Plug-in electric vehicle charging.
Where parking is provided, new construction shall provide EVSE-installed spaces and facilitate future installation and use of EVSE through the provision of *EV-Ready Spaces* and *EV-Capable Spaces* provided in compliance with Sections R401.4.1 through R401.4.4 (IRC N1101.15.1 through IRC N1101.15.3). Where more than one parking facility is provided on a site, electric vehicle ready parking spaces shall be calculated separately for each parking facility. The service panel or subpanel circuit directory shall identify the spaces reserved to support EV charging as “EV-Capable” or “EV-Ready”. The raceway location for *EV-Capable Spaces* shall be permanently and visibly marked as “EV-Capable”.
Exception: This section does not apply to parking spaces used exclusively for trucks or delivery vehicles.

R401.4.1 Electric vehicle service equipment (EVSE) ready circuit.
Each *EV-Ready Space* shall be provided with a minimum 40-ampere branch circuit to accommodate a future dedicated Level-2 EVSE. The service panel shall provide sufficient capacity and space to accommodate the circuit and over-current protective device. A permanent and visible label stating “EV-READY” shall be posted in a conspicuous place at both the service panel and the circuit termination point.

R401.4.2One- to two-family dwellings and townhouses..

For each dwelling unit, provide at least one *EV-Ready Space*. The branch circuit shall be identified as “EV-Ready” in the service panel or subpanel directory, and the termination location shall be marked as “EV-Ready.”

Exception: *EV-Ready Spaces* are not required where no parking spaces are provided.

R401.4.3 Multifamily dwellings (three or more units).
EVSE-Installed, EV-Ready Spaces and EV-Capable Spaces shall be provided in accordance with Table R401.4.3. EV-Ready Spaces that terminate with an installed Level 2 EVSE shall count as spaces under the EV-Ready Space requirements Where the calculation of percent served results in a fractional parking space, it shall round up to the next whole number.

Exception: Where the number of *EV-Ready Spaces* exceeds the required minimum in Table R401.4.3, the additional *EV Ready Spaces* shall be used for compliance with the minimum *EV-Capable Spaces* requirement.

Table R401.4.3 EVSE Installed, EV-Ready and EV-Capable Space Requirements for New Multifamily Buildings

Total Number of Parking Spaces	Minimum Number of Spaces with EVSE Installed[a]	Minimum Number of EV-Ready Spaces	Minimum Number of *EV-Capable Spaces*
1	1	1	-
2 – 10	1	2	-
11 – 15	1	2	1
16 – 19	1	2	2
21 – 25	2	3	2
26+	5% of total parking spaces	10% of total parking spaces	10% of total parking spaces

(a). Spaces that terminate with a Level 2 EVSE are considered *EV-Ready Spaces* and count towards the minimum number of *EV-Ready Spaces*.

R401.4.4 Identification.
Construction documents shall indicate the raceway termination point and proposed location of future EV spaces and EV chargers. Construction documents shall also provide information about the amperage of future EVSE, raceway methods, wiring schematics, and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformers, have sufficient capacity to simultaneously charge all EVs at all required EV spaces at the full rated amperage of the EVSE.

Add new definition to C202 as follows:

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a building electrical service, EVSE, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded and equipment grounding conductors, and the EV connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses installed specifically for the purpose of transferring energy between the premises wiring and the EV.

EV-CAPABLE SPACE. A dedicated parking space which is provided with electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for each EV parking space, and the installation of raceways, both underground and surface mounted, to support the EVSE.

EV-READY SPACE. A designated parking space which is provided with one 40-ampere, 208/240-volt dedicated branch circuit for future dedicated Level 2 *EVSE* servicing EVs. The circuit shall terminate in a

suitable termination point such as a receptacle, junction box, or an *EVSE*, and be located in close proximity to the proposed location of the EV parking spaces. The circuit shall have no other outlets. The service panel shall include an over-current protective device and provide sufficient capacity and space to accommodate the circuit and over-current protective device and be located in close proximity to the proposed location of the EV parking spaces.

Add new text as follows:

C401.4.1Electric Vehicle ready parking.
Where parking is provided, new construction shall provide EVSE installed spaces and facilitate future installation and use of *EVSE* through the provision of *EV-Ready Spaces* and *EV-Capable Spaces* provided in compliance with Sections C401.4.1 through C401.4.3, Where more than one parking facility is provided on a site, *EV-Ready Spaces* and *EV-Capable Spaces* shall be calculated separately for each parking facility.
C401.4.1New commercial and multifamily buildings.

EVSE Installed spaces, *EV-Ready Spaces* and *EV-Capable Spaces* shall be provided in accordance with Table C401.4.1 for commercial buildings and Table C401.4.2 for multifamily buildings. Where the calculation of percent served results in a fractional parking space, it shall be shall rounded up to the next whole number. The service panel or subpanel circuit directory shall identify the spaces reserved to support EV charging as “EV-Capable” or “EV-Ready.” The raceway location shall be permanently and visibly marked as “EV-Capable.”

Exception: Where the number of *EV-Ready Spaces* exceeds the required minimum, the additional *EV Ready Spaces* shall be used for compliance with the minimum *EV-Capable Spaces* requirement.

Table C401.4.1 EVSE Installed, EV-Ready Space and EV-Capable Space Requirements for New Commercial Buildings

Total Number of Parking Spaces	Minimum number of Spaces with EVSE Installed[a.]	Minimum Number of EV-Ready Spaces	Minimum Number of EV-Capable Spaces
1	1	1	-
2 – 10	1	2	-
11 – 15	1	2	1
16 – 19	1	2	2
21 – 25	2	3	2
26+	5% of total parking spaces	10% of total parking spaces	10% of total parking spaces

(a). Spaces that terminate with a Level 2 EVSE are considered *EV-Ready Spaces* and count towards the minimum number of *EV-Ready Spaces*.

Table C401.4.2 EVSE Installed, EV-Ready Space and EV-Capable Space Requirements for New Multifamily Buildings

Total Number of Parking Spaces	Minimum number of Spaces with EVSE Installed[a.]	Minimum Number of EV-Ready Spaces	Minimum Number of EV-Capable Spaces
1	1	1	-

Total Number of Parking Spaces	Minimum number of Spaces with EVSE Installed[a]	Minimum Number of EV-Ready Spaces	Minimum Number of EV-Capable Spaces
2 – 10	1	2	-
11 – 15	1	2	1
16 – 19	1	2	2
21 – 25	2	3	2
26+	5% of total parking spaces	10% of total parking spaces	10% of total parking spaces

(a). Spaces that terminate with a Level 2 EVSE are considered *EV-Ready Spaces* and count towards the minimum number of *EV-Ready Spaces*.

C401.4.2Identification.
Construction documents shall indicate the raceway termination point and proposed location of future EV spaces and EV chargers. Construction documents shall also provide information about the amperage of future EVSE, raceway methods, wiring schematics, and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformers, have sufficient capacity to simultaneously charge all EVs at all required EV spaces at the full rated amperage of the EVSE.

Modify the 2021 International Residential Code as follows

Add new definition as follows:

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a building electrical service, EVSE, a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded and equipment grounding conductors, and the EV connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses installed specifically for the purpose of transferring energy between the premises wiring and the EV.

EV-CAPABLE SPACE. A dedicated parking space which is provided with electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for each EV parking space, and the installation of raceways, both underground and surface mounted, to support the EVSE.

EV-READY SPACE. A designated parking space which is provided with one 40-ampere, 208/240-volt dedicated branch circuit for future dedicated Level 2 EVSE servicing EVs. The circuit shall terminate in a suitable termination point such as a receptacle, junction box, or an EVSE, and be located in close proximity to the proposed location of the EV parking spaces. The circuit shall have no other outlets. The service panel shall include an over-current protective device and provide sufficient capacity and space to accommodate the circuit and over-current protective device and be located in close proximity to the proposed location of the EV parking spaces.

Add new text as follows:

N1101.15 Plug-in electric vehicle charging.
Where parking is provided, new construction shall provide EVSE-installed spaces and facilitate future installation and use of EVSE through the provision of EV-Ready Spaces and EV-Capable Spaces provided in compliance with Sections R401.4.1 through R401.4.4 (IRC N1101.15.1 through IRC N1101.15.3). Where more than one parking facility is provided on a site, electric vehicle ready parking

spaces shall be calculated separately for each parking facility. The service panel or subpanel circuit directory shall identify the spaces reserved to support EV charging as “EV-Capable” or “EV-Ready”. The raceway location for EV-Capable Spaces shall be permanently and visibly marked as “EV-Capable”. Exception: This section does not apply to parking spaces used exclusively for trucks or delivery vehicles.

N1101.15.1 Electric vehicle service equipment (EVSE) ready circuit. .
Each EV-Ready Space shall be provided with a minimum 40-ampere branch circuit to accommodate a future dedicated Level-2 EVSE. The service panel shall provide sufficient capacity and space to accommodate the circuit and over-current protective device. A permanent and visible label stating “EV-READY” shall be posted in a conspicuous place at both the service panel and the circuit termination point.

N1101.15.2 One- to two-family dwellings and townhouses.

For each dwelling unit, provide at least one EV-Ready Space. The branch circuit shall be identified as “EV-Ready” in the service panel or subpanel directory, and the termination location shall be marked as “EV-Ready.”

Exception: EV-Ready Spaces are not required where no parking spaces are provided.

N1101.15.3 Identification.
Construction documents shall indicate the raceway termination point and proposed location of future EV spaces and EV chargers. Construction documents shall also provide information about the amperage of future EVSE, raceway methods, wiring schematics, and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformers, have sufficient capacity to simultaneously charge all EVs at all required EV spaces at the full rated amperage of the EVSE.

Reason:

Numerous studies show that sales of electric vehicles (EVs) have grown consistently over recent years in the U.S. Edison Electric Institute (EEI) estimates one million EVs on the road in 2018 and forecasts a total of 18.7 million EVs on the road by 2030. Based on this forecast, EEI projects the need for an additional 9.6 million EV charging stations by 2030. It is imperative that the EV charging infrastructure keeps pace with sales of EVs to to enhance overall EV growth, and to ensure that lack of access to EV charging stations is minimized as a critical barrier to EV adoption.

EVs provide substantial benefits to the consumer and society. EVs are less expensive to operate than conventional gas vehicles, have lower maintenance costs, and have the convenience of fueling (charging) at home or work. EVs likewise reduce GHG emissions. EV market growth combined with a cleaner grid will support goals of reduced GHG emissions established across the U.S. and others by federal agencies, as well as many states and local governments. According to the U.S. Environmental Protection Agency (EPA), the transportation sector (cars, trucks, trains, ships, airplanes, and other vehicles) accounts for 29% of total U.S. GHG emissions. Globally, road travel accounts for 75% of transportation emissions. Studies conducted in California show that costs associated with installing EV charging infrastructure can be substantially more expensive for retrofit scenarios compared to new construction.

Many states and local governments have added EV provisions to their building codes, local ordinances and zoning requirements. This proposed code language for EV charging infrastructure builds upon language considered for the 2021 IECC, and includes additional requirements developed by both PNNL staff and ICC staff.

Cost Impact:
The code change proposal will increase the cost of construction.

The costs associated with installing EV charging infrastructure during new construction are substantially lower than during a retrofit. A cost-effectiveness study for the City and County of San Francisco conducted by Pacific Gas & Electric (PG&E) showed costs for installing Level 2 EV charging stations as a retrofit are several times more expensive than installing them during new construction.[1] Installing infrastructure during new construction avoids the retrofit costs of breaking and repairing walls, installing longer raceways, and using more expensive methods of upgrading service panels. A study conducted by DOE determined the installed costs of a single port ESVE unit ranges from $0-$3,000 for Level 1, $600-$12,700 for Level 2 and $4,000-$51,000 for DC fast charging. Various elements lead to the high variability of costs due to the type of unit, applications and cost factors to determine if a ESVE unit will be on the low or high end of the range.[2]

Table 1 compares the cost of installing Level 2 EV charging infrastructure during new construction and during a retrofit. Figure 7 shows the cost breakdown of the Level 2 EV charging infrastructure installation.

Table 1 Cost of EV Charging Infrastructure

	Per EV Parking Space with Electric Circuit		Total Incremental Cost of Building	
	New	Retrofit	New	Retrofit
Scenario A – 10 Parking Space Building, two EV Parking Spaces	$920	$3,710	$1,840	$7,420
Scenario B – 60 Parking Space Building, 12 EV Parking Spaces	$860	$2,370	$10,320	$28,440

Source: PG&E 2016

For one- and two-family dwellings, costs for Level 2 charging stations include the price and labor associated with the installation of one 40-ampere, 208/240-volt dedicated branch circuit and a circuit terminating in a receptacle, junction box, or EVSE. The average cost to install (exclusive of charger cost) a Level 2 EVSE in an existing home was $1,354 across 13 cities in the U.S. based on more than 25,000 installations. The average maximum installation cost across these 13 locations was approximately $4,000. The key factors affecting the cost of installing EVSE in an existing home included insufficient electrical panel capacity for a dedicated 40-ampere charging circuit, location of the electric panel relative to the garage, and permit costs, which averaged 8.6% of the installed cost. The capacity limitation was found to be more prevalent in less-affluent areas.[3] The proposed code would reduce the cost impact for a home-owner to make the switch to EV by requiring EVSE infrastructure to be included in new homes.

Table 2. Cost of EV Charging Infrastructure – Single Family

	New[a.]	Avg. Retrofit[b.]	Avg. Max. Retrofit[b.]
Single Family Home	$860-920	$1,354	$4,000

Notes: (a).Source PG&E 2016, (b) Source Francfort et al. 2015

1. http://evchargingpros.com/wp-content/uploads/2017/04/City-of-SF-EV-Infrastructure-Cost-Effectiveness-Report-2016.pdf

2. https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

3. Francfort, Jim, Brion Bennett, Richard Carlson, Thomas Garreston, LauraLee Gourley, Donald Karner, Mindy Kirkpatrick, Patti McGuire, Don Scoffield, Matthew Shirk, Shawn Salisbury, Stephen Schey, John Smart, Sera White, Jeffery Wishart.2015. 2015*Plug-in Electric Vehicle and Infrastructure Analysis.* Publication Number: INL/EXT-15-35708, Idaho National Laboratory, Idaho Falls, Idaho.

Bibliography:

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www.energycodes.gov/sites/default/files/2021-07/TechBrief_EV_Charging_July2021