Understanding Cost Dynamics for Electric Vehicle Charging Stations in India

June 2020

Changing Landscape in Automobile segment in India

India is expected to emerge as the world's third-largest passenger-vehicle market by 2021.It took India around seven years to increase annual production to four million vehicles from three million. However, the next milestone—five million—is expected in less than five years. Hitting that mark will depend on today's rapid economic development continuing, with a projected annual GDP growth rate of 7 percent through 2020,ongoing urbanization, a burgeoning consuming class, and supportive regulations and policies. With this growth in mind, we set out to build a perspective on the trends shaping the Indian market, the value proposition for the automobile industry in India, and imperatives for winning in the market.

Currently, the automotive sector contributes more than 7 percent to India's GDP. The Automotive Mission Plan 2016–26 sets an aspiration to increase the contribution to 12 percent. A number of economic trends could help in meeting this target. Rapid urbanization means the country will have over 500 million people living in cities by 2030—1.5 times the current US population. Rising incomes will also play a role, as roughly 60 million households could enter the consuming class (defined as households with incomes greater than USD 8,000 per annum) by 2025. At the same time, more people will join the workforce. Participation could reach 67 percent in 2020, as more women and youth enter the job market, raising the demand for mobility. Some of them would leap straight into four-wheeler segment, and others will graduate from two- to four-wheelers. Over 44 percent of the consuming-class households will be in 49 growth clusters—for example, Delhi is expected to have the same GDP per capita at purchasing power parity as the entire country of Russia in 2025.Cities like Delhi are a sweet spot for car manufacturers to target. In the future, these macroeconomic and demographic trends could shift pockets of growth in passenger-vehicle market. Mini cars and hatchback cars have been the mainstay for the automobile industry in India, with share around 50 percent and growth of 6 to 10 % between financial year 2014 and 2019. These segments will continue to maintain a dominant position, but the majority of growth is expected to come from new segments such as compact SUVs, sedans, and luxury vehicles.

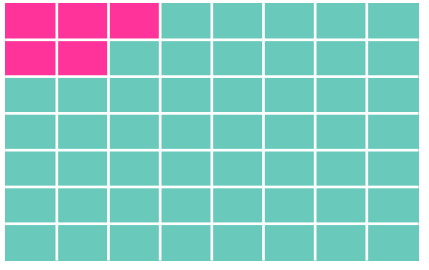
> **"FAME2 is expected to incentivize electrification of the public-transport fleet of buses and taxis, as well as facilitate demand for all types of alternative fuel."**

The development of India as a manufacturing hub:

The World Economic Forum ranks India 30th on the global manufacturing index, which assesses the manufacturing capabilities of more than 100 countries. The government's "Make in India" initiative has played an important role in elevating country's position. In the past three to four years, India improved on nine out of ten parameters for ease of doing business. Although there is still a long way to go before India becomes a leader in the manufacturing arena, companies in the automotive sector are embracing this opportunity to leverage India as a hub for low-cost, high-quality products. After creating a strong value proposition in mini cars, India is gaining global recognition in the compact sedan and SUV category.

Exhibit 1: Expected Penetration of Battery Electric Vehicle (BEV) in India Across Vehicle Segments by 2030 in Percentage

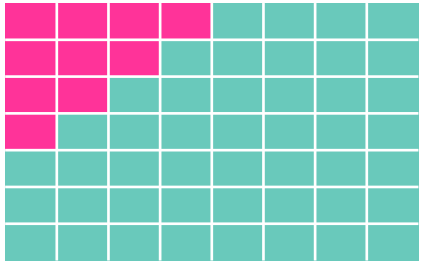
0-5%



of

- **Medium and heavy commercial vehicles**
- **Light commercial vehicles over 3.5 tons**
- **Construction equipment**

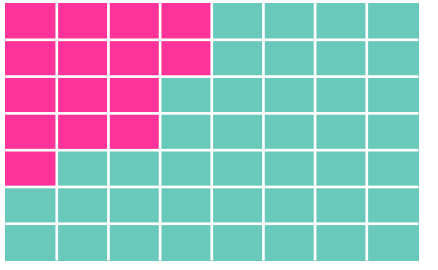
5-15%



of

- **Executive sedans**
- **Full size utility vehicle**

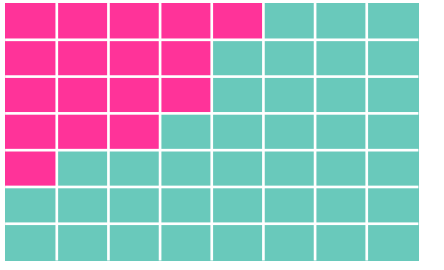
15-25%



of

- **Light commercial vehicles under 3.5 tons**
- **Motorcycles over 125 cc**
- **Midsize cars**
- **Compact utility vehicles**
- **Passenger Vans**

25-35%



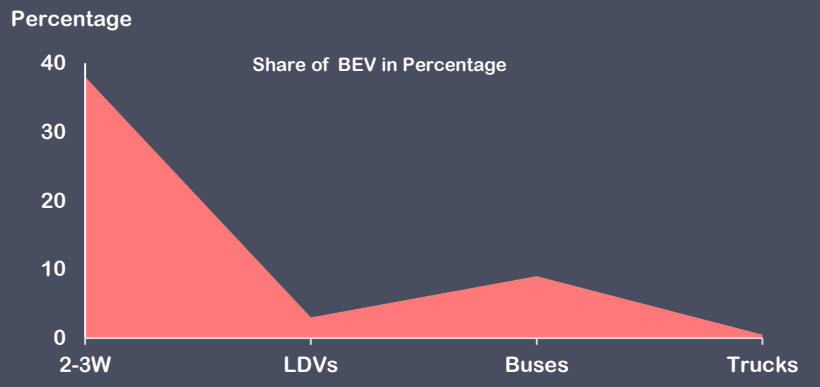
of

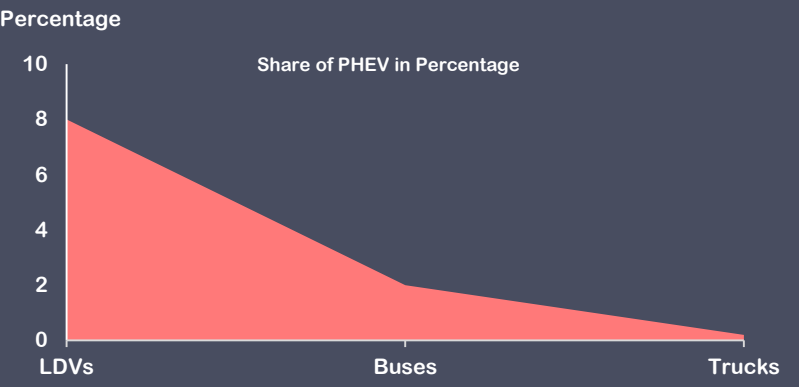
- **Motorcycles over 125 cc**
- **Scooters and mopeds**
- **Three wheelers**
- **Premium and luxury cars & Buses**
- **Light commercial passenger vehicles**

Source : Mckinsey , eninrac research

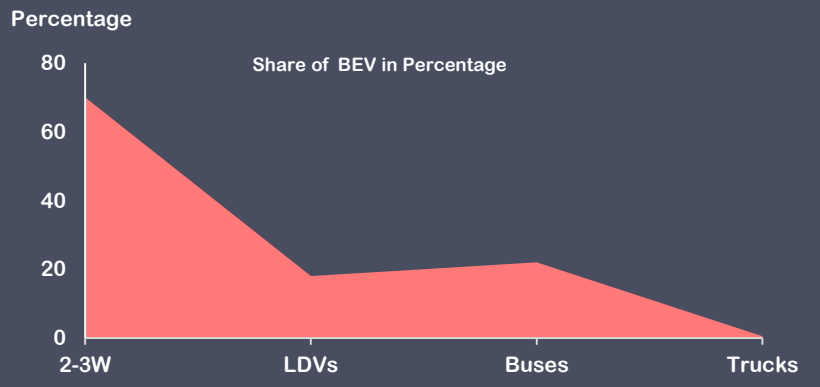
Exhibit 2
Electric Vehicle Market Share by Type and Scenario by 2030

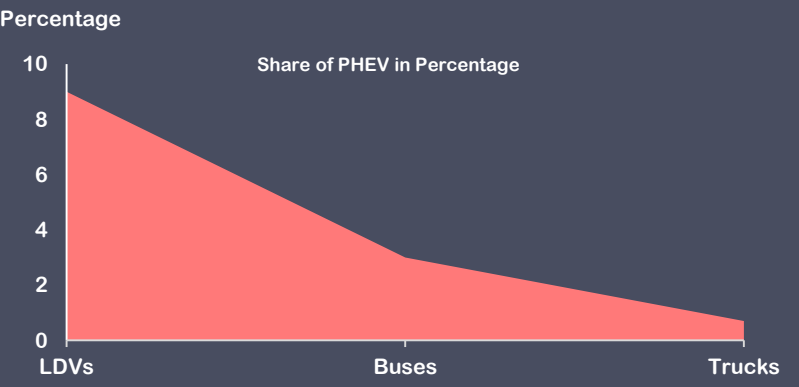
New Policy Scenario





Successful Implementation of EV@2030 Targets – Aggressive Scenario



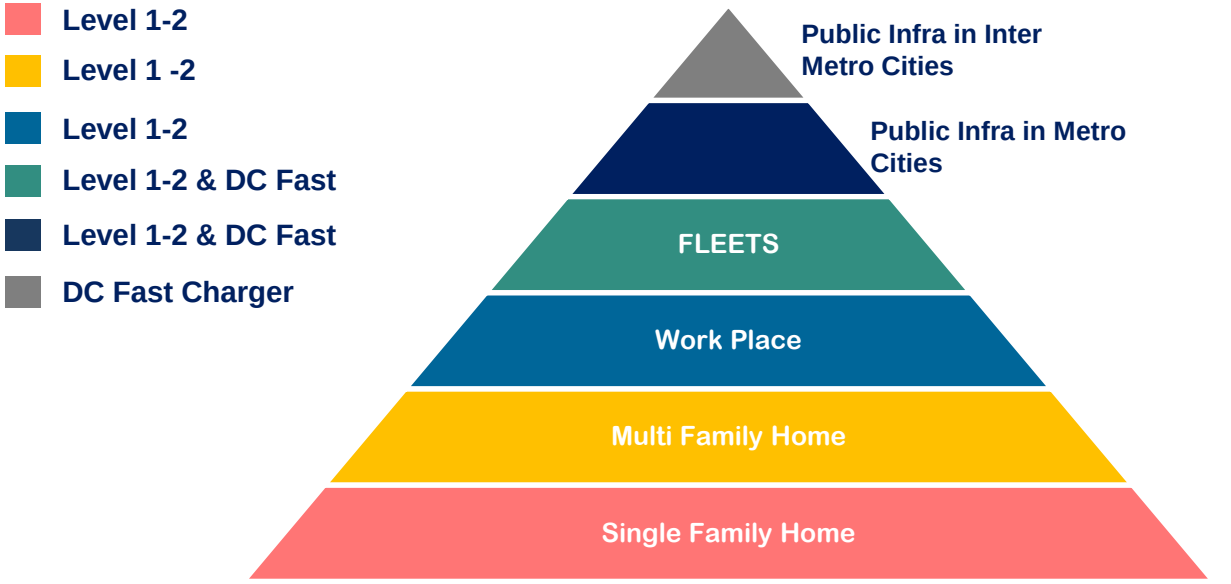


Source : IEA , eninrac research

Cost dynamics in EV Charging Infra

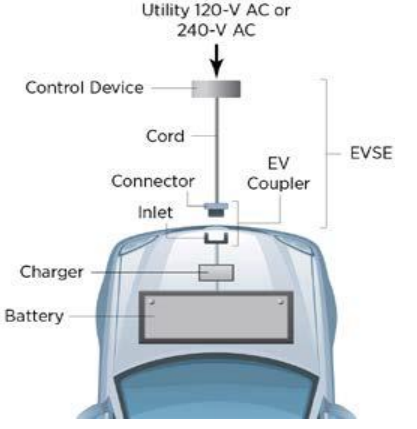
This section is designed to help employers, business owners, and fleet operators understand the costs associated with installing, operating, and maintaining electric vehicle supply equipment (EVSE), also known as electric vehicle “charging stations.” It provides an overview of the equipment and processes needed to install EVSE and offers representative examples of cost ranges. The information presented is based on data collected from various studies around the country, as well as input from EVSE owners, manufacturers, installers, and utilities. Many plug-in electric vehicle (PEV) drivers charge their vehicles at home using residential charging located at single family homes or multi-family complexes such as apartments and condominiums. This section however, focuses on the costs of non-residential stations such as public access, workplace, and fleet stations shown in the middle and top of the pyramid in Exhibit 3. Increasing the number of EVSE available in these nonresidential locations can help expand the electric driving range for PEVs, as well as enable PEV ownership for drivers without access to home charging. Public access charging stations are available for use by the general public or patrons/visitors to businesses, institutions, and municipalities. Workplace charging stations are intended for the use of employees or guests of a particular organization. Fleet stations are primarily used by business, government, or other fleet vehicles and are located at commercial, government, or other non-residential parking locations.

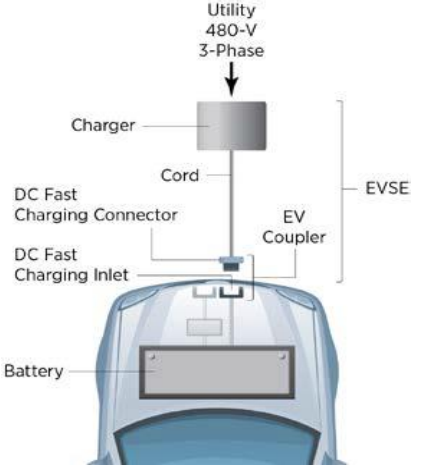
Exhibit 3: Typical Requirement of Chargers as per Spread of Place & Fleet in a Particular City



Source: eninrac research & channel checks

Exhibit 4: AC Level 1 and 2 charging schematic. and DC fast charging schematic.





Source: eninrac research & NREL

AC Level 1 & Level 2 Charging Schematic

DC Fast Charging Schematic

Charging Infrastructure (EVSE) Overview

EVSE consists of all the equipment needed to deliver electrical energy from an electricity source to a PEV battery. The EVSE communicates with the PEV to ensure that the plug is securely connected to the vehicle receptacle before supplying a safe flow of electricity. There are three primary types of EVSE. Two types—AC Level 1 and AC Level 2—provide alternating current (AC) to the vehicle, which the vehicle's onboard charging equipment converts to the direct current (DC) needed to charge the batteries. Note that for AC Level 1 and 2 the charger built directly into the car is charging the battery. The third type—DC fast charging—provides DC electricity directly to the vehicle's battery. The charger is located off-board the vehicle, in the DC fast charger (DCFC).

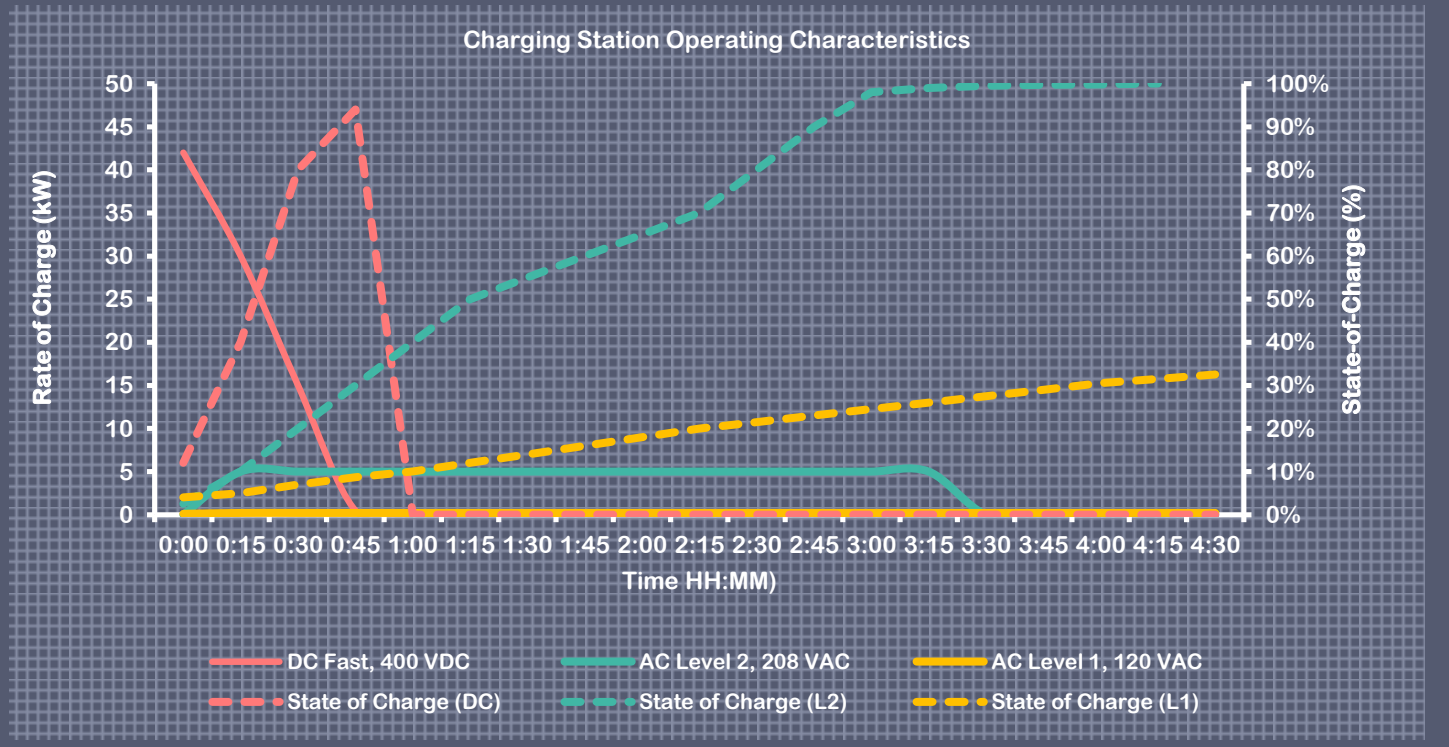
Table 1 Description of charging level supply power and charging times*

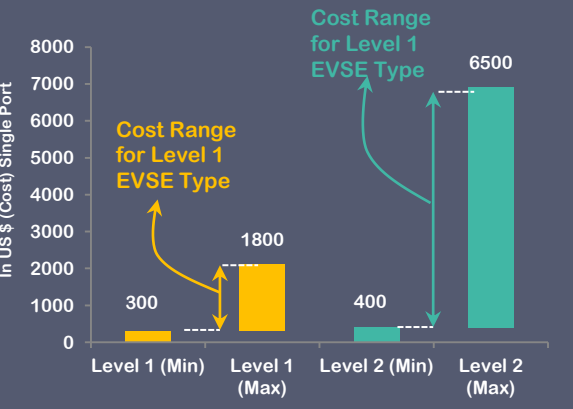
Charging Level	Vehicle Range Added per Charging Time & Power	Supply Power
AC Level 1	4 mi/hour @ 1.4 kW	120 VAC/20A (12A-16A Continuous)
	6 mi/hour @ 1.9 kW	
AC Level 2	10 mi/hour @ 3.4 kW	208/240VAC/20-100A (18A-18A Continuous)
	20 mi/hour @ 6.6 kW	
	60 mi/hour @ 19.2 kW	
DC Fast Charging	10 mi/hour @ 3.4 kW	208/480VAC 3-phase (input current proportional to output power; ~20-400A AC)
	20 mi/hour @ 6.6 kW	
	60 mi/hour @ 19.2 kW	

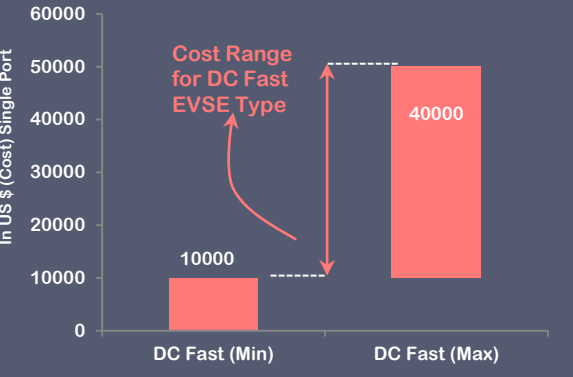
*Note: The power coming from the EVSE depends on the voltage from the electrical service and the EVSE amperage rating.

Source: eninrac research, Company, NREL

Exhibit 5: Charging Station Operating Characteristics for Typical Configurations Cost Ranges for EVSE Types (Global Benchmarks)



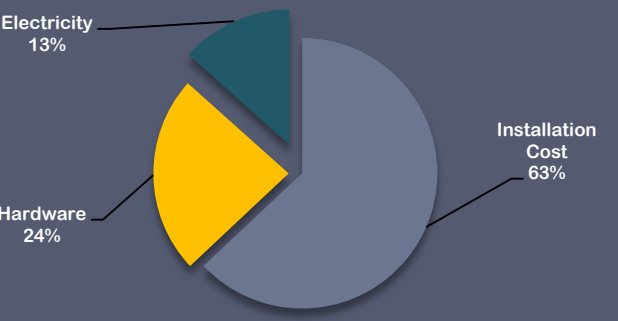




Source: eninrac research & Companies

The majority of expenses for fixed charging stations are spent in the first year during the installation. For commercial or public charging, Level 2 charging stations are currently the most ubiquitous. This cost analysis is based on Level 2 charging. Hardware for the charging station can cost up to $7500. There are many less expensive models in the $2000-$3000 range but commercial grade charging station requires more than the ability to weather the outdoors. For large parking facilities, the management of the stations is important. Electrical supplies typically cost $210-$510, but can be up to $1000 if a new breaker is required. Permitting costs depend on the city and is usually $50-$200. The distance from the central source of power plays into a few factors of the total cost. For the set of charging stations closest to the central source of power, wiring and conduit costs are $30-$50. Costs for trenching and boring costs can range from $500 to $2000 depending on the surface, soil, and underground makeup. Installation labor costs $1490-$3690.

Exhibit 6: Share of Cost Components for EV Charging Station (Level 2)



Source: eninrac research & Companies

EVSE Unit Cost Factors

EVSE units are available from many different manufacturers with a variety of designs and features. Features range from a simple unit that turns on and off to units that collect data, communicate to users, and provide a billing option for the owner of the charging station. The type and quantity of EVSE chosen for a site will depend on the intended users, site specific conditions, data management, and business case for the station. When purchasing an EVSE unit, an owner may choose to also purchase an extended warranty to cover potential repairs beyond the standard unit warranty period.

EVSE Unit Cost Drivers

EVSE unit costs are affected by the charging level, number of ports, communications system, data analysis, and other features.

1. Charging Level & Amperage Rating

All PEVs have a cord-set that plugs into a Level 1 outlet (110-120V) and connects to the vehicle's charging port with a connector . Providing Level 1 charging is the most inexpensive charging option. It can range from offering an outlet for a PEV driver to plug in a Level 1 cord-set to offering an EVSE with a connector. Level 2 units are the midrange cost option and DCFC is the highest cost tier. The EVSE charging power depends on the voltage from the electrical service and the EVSE unit amperage rating. Level 1 EVSE are rated from 12-16A continuous, Level 2 EVSE are commonly rated from 16-48A continuous, and DCFC typically have a maximum of 60-200A. An increase in charging power also increases the cost of the unit due to the higher manufacturing cost to accommodate the higher amperage

2. Charging Ports

Single port EVSE units provide access for only one vehicle to charge at a time. Multiple port EVSE units (commonly 2, 3, or 4 ports) are available to allow multiple vehicles to charge simultaneously or sequentially.

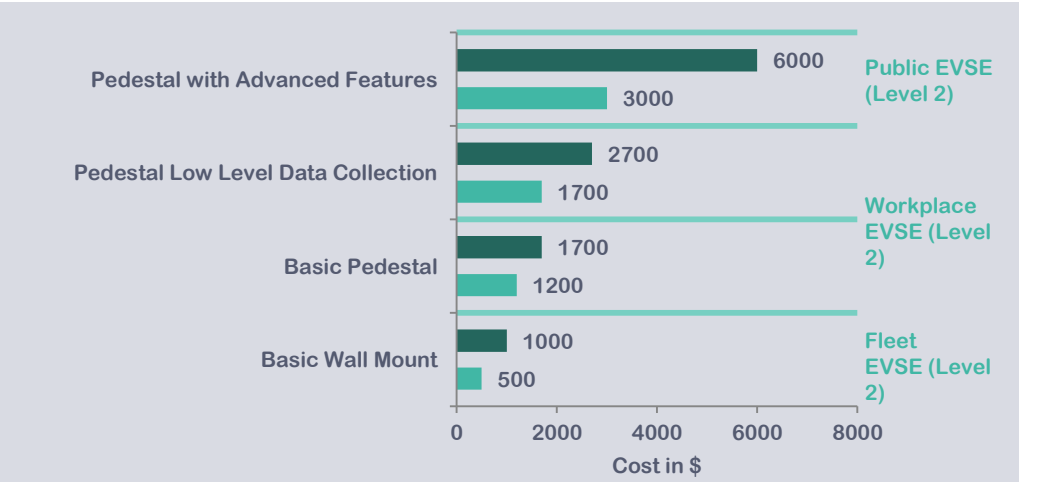
Exhibit 7 : Ballpark Cost Range of Level 2 EVSE as per Usage

Level 1 EVSE Unit (Single Port) Cost Range ($300 – 1800)

Main L1 EVSE Cost Factors
- Mounting
- ✓ Cord-set that can plug into a 120V outlet (low cost)
- ✓ Wall mounted unit
- ✓ Pedestal unit (higher cost)
- Advanced Features

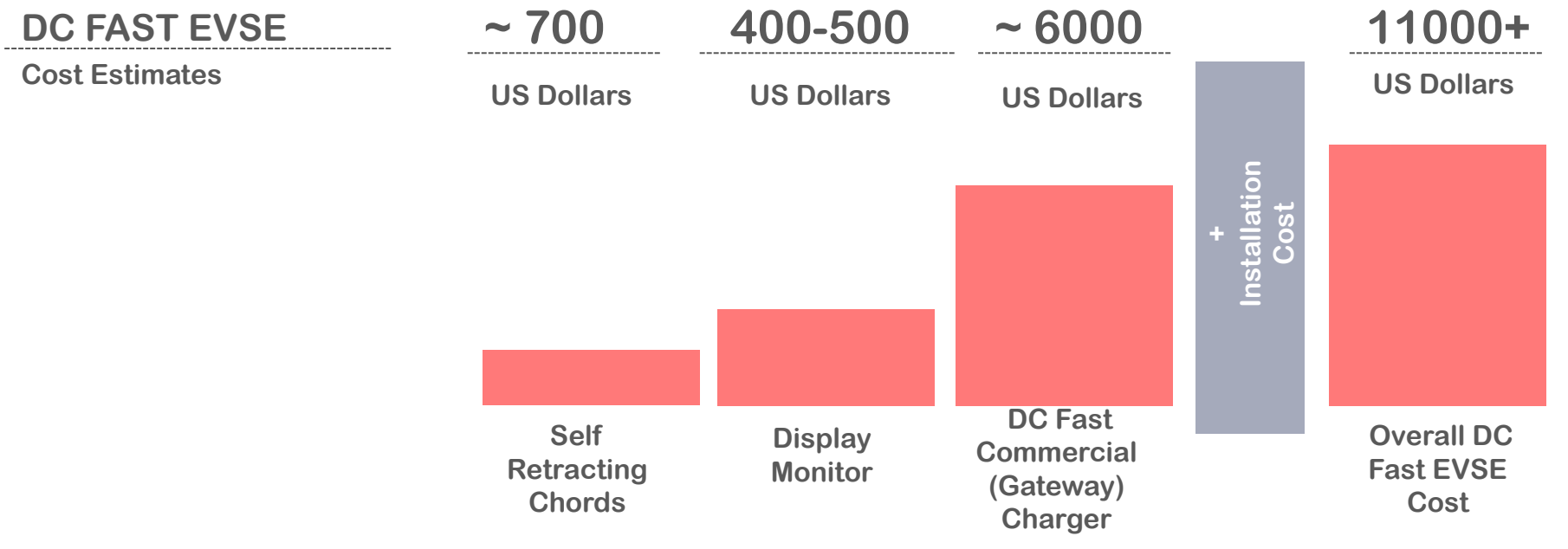
Level 2 EVSE Unit (Single Port) Cost Range ($400 – 6500)

Main L2 EVSE Cost Factors
- Mounting (Wall /Pedestal)
- Communication Capabilities
- Advanced Features



Source: eninrac research & Companies

Exhibit 8: Equipment Cost Break-up for DC Fast Chargers (Based on Channel Checks)



*** The cost break-up is shown for Charge Point CT 4000 Family CT 4021 Bollard Dual Level DC Fast Commercial Gateway Charger EVSE**

Source: eninrac research , Charge Point & Companies

3. Type of Mounting System

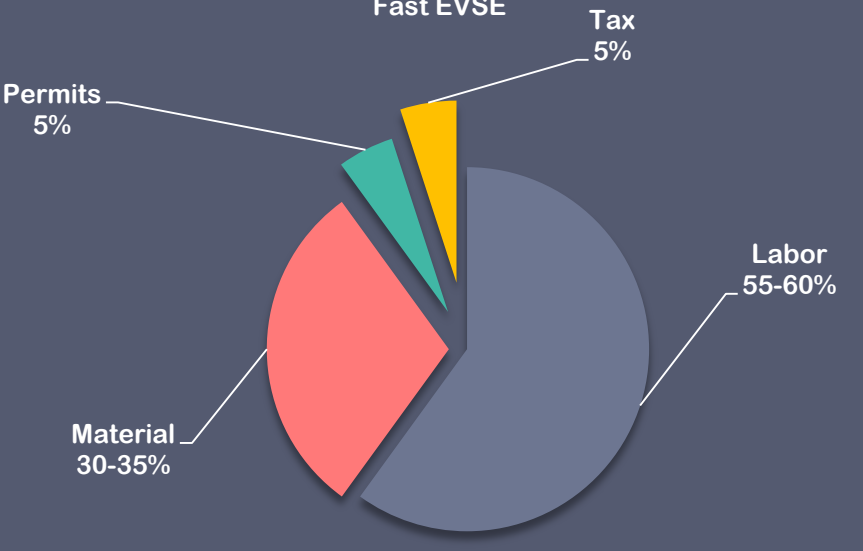
Units are typically available as either wall mounted or pedestal mounted. A pedestal mounted unit costs about $500-$700 more than a wall mounted one due to the material and manufacturing cost of the pedestal. There is also an additional construction cost for installing a pedestal mounted unit (e.g., pouring a concrete pad at the base). Typically, site owners choose a wall mounted unit if the parking spots to be used for charging are close to a wall, since the unit and installation cost less than
a pedestal mount.

Installation Costs

Potential EVSE hosts are encouraged to have an electrical contractor complete a site evaluation when budgeting for a specific EVSE installation. An initial site evaluation should include determining the electrical capacity of the site, the location of distribution or service lines, the required electrical capacity for the type and quantity of EVSE units, and the best location for the EVSE unit(s). The best location for the units will take into consideration minimizing the installation costs and other local level accessibility requirements.

During the installation process, a contractor will procure the EVSE unit(s), install a new or upgraded electrical service or connect the EVSE to an existing electrical service that will accommodate the EVSE load, install the EVSE equipment, and restripe parking spaces as necessary to fulfill the ADA parking requirements. The local electric utility may need to be involved if the necessary electrical supply upgrades to the facility are considerable (e.g., higher capacity supply wires, transformers, etc.)

Exhibit 9: Installation Cost Brea-down for Commercial DC Fast EVSE



Source: eninrac research & Companies

Installation Cost Drivers

A simple installation will be at the lower end of the cost range while a more complex installation will move toward the middle or higher end. An installation becomes more complex when it requires one or more of the following:

- Trenching or boring a long distance to lay electrical supply conduit from the transformer to the electrical panel or from the electrical panel to the charging location;
- Modifying or upgrading the electrical panel to create dedicated circuits for each EVSE unit if none are already available
- Upgrading the electrical service to provide sufficient electrical capacity for the site;
- Locating EVSE on parking levels above or below the level with electrical service; and/or
- Meeting ADA accessibility requirements such as ensuring the parking spaces are level.

Installation Cost Ranges

Installation costs are highly variable and are difficult to compare from one site to another. The installation cost ranges and averages described in Exhibit 10 are based on past installations and provide a ballpark idea of how much future installations may cost. These installation costs do not include the cost of the EVSE unit.

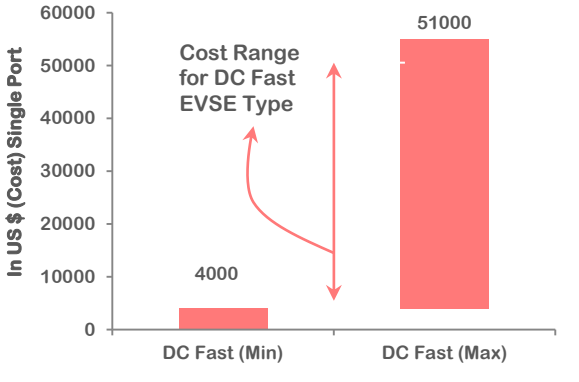
Exhibit 10 Ballpark Installation Cost for Level 1, Level 2 & DC Fast Chargers inclusive of all Ranges

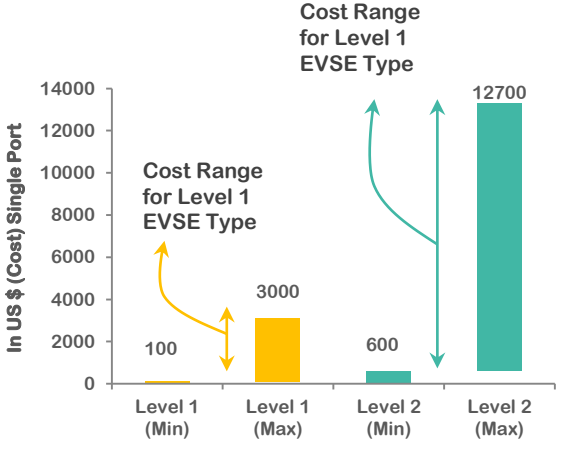
Level 1 EVSE Unit (Single Port) Cost Range ($100 – 3000)

Level 2 EVSE Unit (Single Port) Cost Range ($600 – 12700)

Main L1 EVSE Cost Factors
- Location
- Trenching of Boring to connect EVSE to electrical service

Main L2 EVSE Cost Factors
- Mounting (Wall /Pedestal)
- Location
- Trenching/Boring
- Communication Capabilities
- Advanced Features





Source: eninrac research & Companies

DCFC Installation

There is also a wide variation in cost for installing DCFC. The lower installation costs ($8,500-$20,000) were generally for sites that were able to use existing electrical service. For example the distribution of DCFC Costs in WCEH is depicted in the Exhibit 11

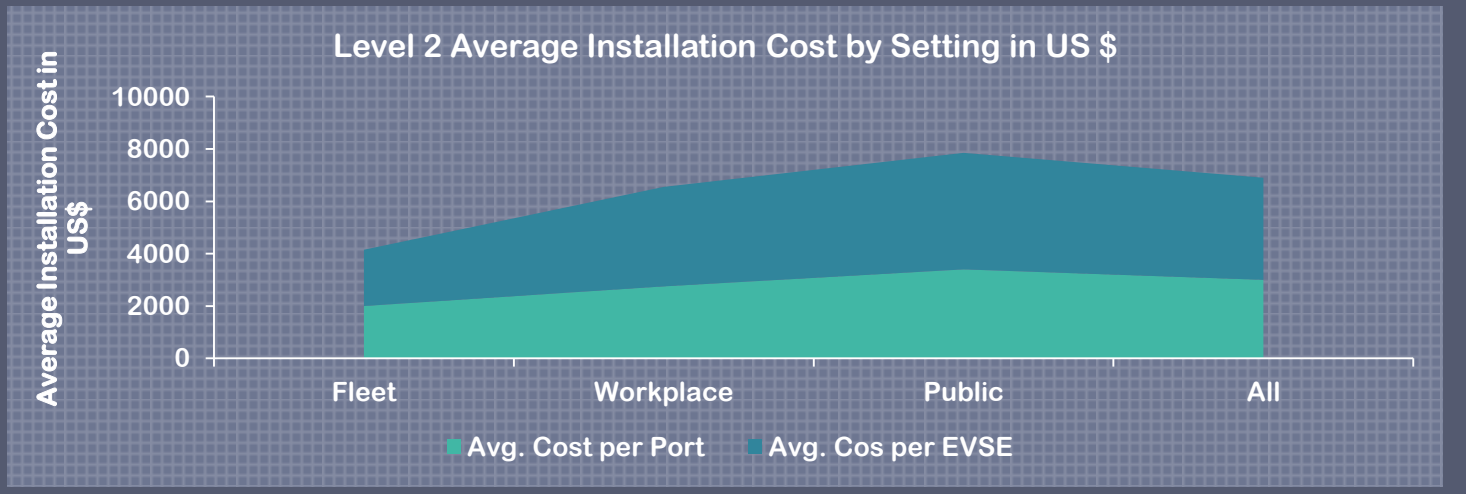


Exhibit 11 Average Cost of Installation for Level 2 Chargers as per Setting in US$

Source: eninrac research & Companies

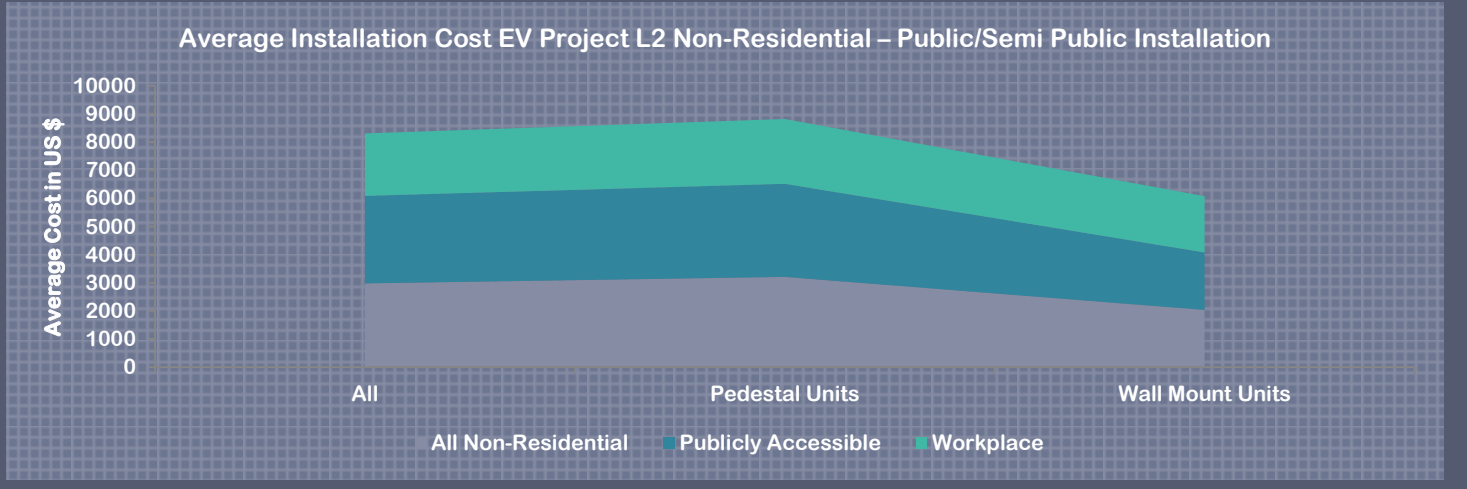


Exhibit 12 Average Cost of Installation for Level 2 Chargers for Public /Semi-Public Installations

Source: eninrac research & Companies

> The life of a man consists not in seeing visions and in dreaming dreams, but in active charity and in willing service
>
> **- Henry Wadsworth Longfellow**

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