USER GUIDE: CALSTART Workplace Charging Calculator

CALSTART's intent in developing this Workplace Charging Calculator is to provide employers and employees a simple and useful planning tool that can help them make informed decisions about electric vehicle workplace charging. Like its partner tool, the Best Practices for Workplace Charging (available at: http://evworkplace.org/wp-content/uploads/2013/10/Best-Practices-for-Workplace-Charging-CALSTART.pdf), this calculator was developed to promote adoption of Plug-in Electric Vehicles and specifically focuses on solutions for charging infrastructure at the workplace.

This calculator is a great tool to visually show if workplace charging can be a success for you, whether you are an employer interested in installing EV chargers or an employee desiring to use a plug-in electric vehicle to commute to / from work.

If you wish to explore further, we recommend trying the following calculators to decide if electric vehicles are right for you:

Fuel Economy
http://www.fueleconomy.gov/
The official U.S. government source for fuel economy information.

Pacific Gas & Electric / Plug-in Electric Vehicle Calculator
http://www.pge.com/cgi-bin/pevcalculator/PEV
Provides an illustration of potential costs and savings associated with a plug-in electric vehicle based on manufacturer's specifications.

Sacramento Municipal Utility District / Electric Vehicle Calculator
http://c03.apogee.net/contentplayer/?utilityid=smud&coursetype=misc&id=18862
To help you decide which electric vehicle is right for you.

South Coast Air Quality Management District / Clean Air Vehicle Calculator
http://cleancarchoices.org/#
It compares driving a 2012 or 2013 clean vehicle model to an average gasoline-powered vehicle (using the EPA's Annual Fuel Economy Trends Report average).

Southern California Edison / Electric Vehicle Rate Assistant
https://www.sce.com/wps/portal/home/residential/electric-cars/rates-charging-options/EV-Rate-Assistant/!ut/p/b0/04_Sj9CPykssy0xPLMnMz0vMAfGjzOK9PF0cDd1NjDwtnB3NDBwtAh3NTL0DjZwtjPQLsh0VAXM9RqE!/
Use this quick and easy tool to understand the right rate plan for you and learn how to save on your electricity bill when charging an electric vehicle.

University of Santa Barbara – Institute for Energy Efficiency / Clean Car Calculator
http://iee.ucsb.edu/CleanCarCalculator/#.UwUHjIWhZQg
Find out if buying a high-efficiency vehicle can save you money by answering a few simple questions.

This user guide is laid out quite simply – it provides an explanation of all the fields in the calculator, guiding you on which ones you can enter data into, and where to find guidance information for fields where you are not yet sure of your own data. At each stage, we also share with you the assumptions built into the calculator's function.

1. Assumptions

- We included a 90% efficiency correction to account for losses during charging.

- We assumed that only 80% of the advertised battery capacity of PHEV and EV models is being used for driving. The remaining 20% are used as a buffer to preserve battery life.

- The calculator has 3 different charging infrastructure costs scenarios:
    - Hardware Only,
    - Hardware + Low Installation Cost,
    - Hardware + High Installation Cost.

We assumed the following prices for the initial charging infrastructure costs.

	Hardware Only	Hardware + Low Installation Price	Hardware + High Installation Price
Level 1 (120V, 12A)	$100	$200	$500
Level 2 (240V, 16A)	$500	$1,500	$5,000
Level 2 (240V, 30A)	$2,000	$4,000	$7,000
Level 2 (240V, 40A)	$4,000	$7,000	$10,000

2. User Inputs

- **Gasoline fuel price**

The default value is the weekly California midgrade gasoline price from the U.S. Energy Information Administration (EIA) weekly gasoline and diesel fuel update.[1] We recommend you visit the Energy Information Agency web site for the latest fuel prices. For your information, the table below presents an example of midgrade gasoline fuel prices from the EIA as of April 2014:

U.S. Midgrade Gasoline Fuel Prices	$ / gallon
U.S.	3.834
East Coast	3.825
New England	3.834
Central Atlantic	3.822
Lower Atlantic	3.825
Midwest	3.777
Gulf Coast	3.637
Rocky Mountain	3.567
West Coast	4.150
West Coast less California	3.846
California	**4.272**

Source: U.S. Energy Information Administration (EIA)

[1] http://www.eia.gov/petroleum/gasdiesel/

- **Energy cost**

The default value is the California average commercial or residential retail price of electricity to ultimate customers.[2] We recommend you visit the Energy Information Agency web site for the latest electricity prices. For your information, the table below presents the average commercial and residential retail electricity prices from the EIA as of November 2013:

Average Retail Price of Electricity to Ultimate Customers (¢ / kWh)	Commercial	Residential
U.S.	10.12	12.09
Massachusetts	14.23	16.05
New York	13.65	18.48
Ohio	9.35	11.88
Missouri	7.84	9.80
Florida	9.67	11.51
Kentucky	8.77	9.60
Texas	7.90	11.68
Colorado	9.96	11.65
California	**14.67**	**16.80**
Hawaii	34.61	37.24

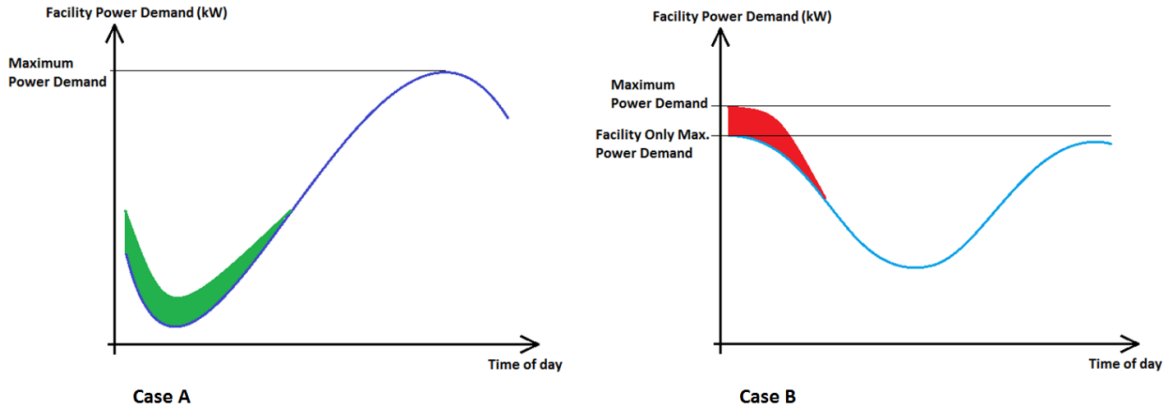
Source: U.S. Energy Information Administration (EIA)

- **Demand charges**

Demand charges have been a surprise to some users, and in some few cases have been quite substantial. The rate structures that apply to commercial and industrial customers usually include a monthly demand charge based on the highest amount of power drawn by the facility. In the simplest case, the demand charge is based on the peak demand in a given month, usually averaged over a 15-minute period, no matter what time of day it occurs.[3]

The user has the possibility to include in the calculation the demand charges from electric vehicle charging. When they are included, we assume a "worst-case scenario" where the power demand from the electric vehicles is added to the maximum power demand of the fleet facility.

For example, in case A below, electric vehicle charging occurs at night when the facility's power demand is low. Although, charging increases the facility power demand at night, it does not increase the maximum power demand for the day, and thus does not increase the demand charges. On the other hand, in case B below, the facility sees its maximum power demand at night. Charging electric vehicles at this time increases the maximum power demand for the day, and thus increases the demand charges as well.



[2] http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a

[3] From G. Masters, *Renewable and Efficient Electric Power Systems,* ISBN 0-471-28060-7, John Wiley & Sons, Inc., 2004

From a scroll-down menu, the user can choose between 5 different demand charges prices, ranging from $5/kW and $25/kW. You do not need to build demand charges into your business case if you do some smart planning in advance of deployment to know how much energy the facility uses where you will be recharging your vehicles, and can avoid going over your peak demand.

- **PHEV / EV model**

The user can choose among 17 models of commercially available (as of early 2014) plug-in and battery electric vehicles (PHEV / EV):

Selected PHEV / EV Models	All-electric Range	Max. Charging Level	Battery Size
BMW i3	100 miles	7.4 kW	22.0 kWh
Cadillac ELR	35 miles	3.3 kW	16.5 kWh
Chevrolet Spark EV	82 miles	3.3 kW	20.0 kWh
Chevrolet Volt	38 miles	3.3 kW	16.5 kWh
Fiat 500e	87 miles	6.6 kW	24.0 kWh
Ford C-Max Energi Plug-in Hybrid	21 miles	3.3 kW	7.6 kWh
Ford Focus Electric	76 miles	6.6 kW	23.0 kWh
Ford Fusion Plug-in Hybrid	21 miles	3.3 kW	7.6 kWh
Honda Accord Plug-in Hybrid	13 miles	6.6 kW	6.7 kWh
Honda Fit EV	82 miles	6.6 kW	20.0 kWh
Mitsubishi iMIEV	62 miles	3.3 kW	16.0 kWh
Nissan LEAF	75 miles	3.3 kW	24.0 kWh
Porsche Panamera S E-Hybrid	22 miles	3.6 kW	9.4 kWh
Smart fortwo Electric Drive	68 miles	3.3 kW	17.6 kWh
Tesla Model S	265 miles	10.0 kW	85.0 kWh
Toyota Prius Plug-in	11 miles	3.3 kW	4.4 kWh
Toyota RAV4 EV	103 miles	10.0 kW	41.8 kWh

- **Commute distance to work**

This is the number of miles a particular employee normally drives to get to work (in miles).

- **PHEV / EV charging level**

This is the charging rate a particular employee will recharge his/her vehicle at the workplace. Below are the 4 different charging levels available in this calculator:

Charging Level	Maximum Charging Power
Level 1 (120V, 12A)	1.44 kW
Level 2 (240V, 16A)	3.84 kW
Level 2 (240V, 30A)	7.20 kW
Level 2 (240V, 40A)	9.60 kW

Please note that the calculator compares the maximum charging level of the selected vehicle and the maximum charging power and selects whichever is lower for the calculations.

- **Combined MPG of car to be replaced**

This is the combined fuel economy (city and highway) of the vehicle that the employee is looking at replacing by a plug-in electric vehicle.

- **Years to recover the initial charging infrastructure cost**

The user can choose to charge each employee using workplace charging to recover his initial charging infrastructure cost within the chosen number of years.

3. Outputs

- **Time to reach full charge**

This is the estimated time it will take to reach a full charge, given the estimated state of charge when the employee arrives at work.

- **Initial charging infrastructure cost**

This is the total cost to the employer to purchase and install the number of EV chargers necessary to charge the employee(s) plug-in electric vehicle(s).

- **Operating cost**

This is the monthly and yearly costs (including energy and demand charges) that the employer will incur to provide workplace charging for the employee(s) plug-in electric vehicle(s).

- **Monthly charge to recover half/all operating costs**

This is amount the employer needs to charge monthly to each employee using workplace charging to recover half or all of the monthly costs (including energy and demand charges) that the employer will incur to provide workplace charging for the employee(s) plug-in electric vehicle(s).

For information purposes, we provide the fuel economy of a conventional vehicle that would spend the same amount in fuel cost as the monthly charge.

- **Monthly charge to achieve the desired payback**

This is amount the employer needs to charge monthly to each employee using workplace charging to recover his initial charging infrastructure cost within the chosen number of years.

- **Yearly saving for employee if employer doesn't charge for workplace charging**

This is the yearly amount an employee will save in fuel cost by driving a plug-in electric vehicle to work and using workplace charging at no cost.

- **Yearly saving for employee if employer charges the same or twice the price the employees pays at home for electricity**

This is the yearly amount an employee will save in fuel cost by driving a plug-in electric vehicle to work and using workplace charging at the same or twice the price the employee pays at home for electricity.