Electric Vehicle Charging Time, Energy and Cost

Energy into the battery and from the grid, charging time and cost for an electric vehicle between two states of charge at a charger power.

Method: Energy balance of charging (definitions)

Input parameters

Unit system: SI

Parameter	Value	Unit
Battery capacity	40.000	kWh
Starting state of charge	20.000	%
Final state of charge	80.000	%
Charger power (drawn from the grid)	7.4000	kW
Charging efficiency	90.000	%
Tariff per kWh (your currency)	8.0000	

Calculated results

Parameter	Value	Unit
Energy into the battery	24.000	kWh
Energy from the grid	26.667	kWh
Charging time	3.6036	h
Charging cost	213.33	

Notes for this case

- Constant charger power. Fast chargers taper above about 80 % state of charge, so the last 20 % takes much longer than this estimate.

Formula and method

$$E_{grid} = \frac{E_b (SOC_2 - SOC_1)}{\eta_c}, \quad t = \frac{E_{grid}}{P_c}, \quad C = \frac{E_{grid}}{3.6 \times 10^6 \ \mathrm{J/kWh}}\, c$$

Variables

E_b	Battery capacity	J
SOC_1	Starting state of charge	-
SOC_2	Final state of charge	-
P_c	Charger power (drawn from the grid)	W
η_c	Charging efficiency	-
c	Tariff per kWh (your currency)	-
E_{bat}	Energy into the battery	J
E_{grid}	Energy from the grid	J
t	Charging time	s
C	Charging cost	-

Method and standards

Energy balance.

Assumptions and limits

- Constant power (no taper above about 80 %).
- P_c is the power drawn from the grid (AC input), so the losses are inside it; if the charger is rated by its DC output, divide by the

efficiency first.
- Tariff in your currency per kWh.

References
- Energy balance of charging (definitions)

Report details

Report reference	FCC-2X9K-3B2Y (the same inputs always give the same reference)
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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online
https://calc.firecad.com/automotive/electric-vehicles/ev-charging-time-cost

Open this case on calc.firecad.com →
Reopens the calculator with the inputs of this report.