EV Range Loss from Cabin Heating

Extra energy per kilometre and the range with cabin heating by resistive heater or heat pump, from heater power, average speed and driving consumption.

Method: Energy per distance balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Usable battery energy	60.000	kWh
Driving consumption without heating	160.00	Wh/km
Cabin heat demand	3.0000	kW
Heater COP (1 for resistive)	1.0000	
Average speed	35.000	km/h

Calculated results

Parameter	Value	Unit
Heating energy per km	85.714	Wh/km
Range without heating	375.00	km
Range with heating	244.19	km
Range loss	34.884	%

Notes for this case

• Heating energy per km = P_h/(COP·v̄): heating draws power per hour, so slow city driving loses the most range. A heat pump with COP 2–3 cuts the loss sharply above about −10 °C. Cold also raises battery resistance and driving consumption, which this calculator leaves in e_d.

Formula and method

$$e_h = \frac{P_h}{COP \cdot \bar{v}}, \quad R_h = \frac{E_u}{e_d + e_h}$$

Variables

E_u	Usable battery energy	J
e_d	Driving consumption without heating	J/m
P_h	Cabin heat demand	W
COP	Heater COP (1 for resistive)	-
$\bar{v}$	Average speed	m/s
e_h	Heating energy per km	J/m
R_0	Range without heating	m
R_h	Range with heating	m
$\Delta R/R_0$	Range loss	-

Method and standards

Heating energy.

Assumptions and limits

- Constant heat demand and speed.

References

Energy per distance balance

Report details

Report reference	FCC-CJMH-MNVP (the same inputs always give the same reference)
Generated	23 November 2026, 18:18 UTC
Calculator	EV Range Loss from Cabin Heating
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 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-cabin-heating-range-loss

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.