EV Battery Pack Sizing from Target Range

Gross pack energy for a target range from consumption, usable state-of-charge window and end-of-life capacity, and the cells in series and parallel to build it.

Method: Pack energy and configuration balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Target range at end of life	400.00	km
Consumption at the battery	170.00	Wh/km
Usable state-of-charge window	90.000	%
End-of-life capacity	80.000	%
Target nominal pack voltage	400.00	V
Cell nominal voltage	3.6500	V
Cell capacity	60.000	Ah
Cell mass	0.90000	kg
Pack-to-cell mass factor	1.4500	

Calculated results

Parameter	Value	Unit
Gross pack energy needed	94.444	kWh
Cells in series	110.00	
Cells in parallel	4.0000	
Pack energy as built	96.360	kWh
Total cells	440.00	
Pack mass	574.20	kg

Notes for this case

• Gross energy = range × consumption/(usable SOC window × end-of-life capacity); S = round(V_p/V_c), P = ⌈E_g/(S·V_c·C_c)⌉. The pack-to-cell mass factor covers modules, cooling, structure and electronics (about 1.3–1.6). Consumption should be the realistic (cold, highway) figure at the battery terminals.

Formula and method

$$E_g = \frac{Re}{w_{SOC} SOH_{EOL}}, \quad S = \operatorname{round} \frac{V_p}{V_c}, \quad P = \left\lceil \frac{E_g}{S V_c C_c} \right\rceil$$

Variables

R	Target range at end of life	m
e	Consumption at the battery	J/m
w_{SOC}	Usable state-of-charge window	-
SOH_{EOL}	End-of-life capacity	-
V_p	Target nominal pack voltage	V
V_c	Cell nominal voltage	V
C_c	Cell capacity	C
m_c	Cell mass	kg

k_p	Pack-to-cell mass factor	-
E_g	Gross pack energy needed	J
S	Cells in series	-
P	Cells in parallel	-
E_{pack}	Pack energy as built	J
N	Total cells	-
m_{pack}	Pack mass	kg

Method and standards

Pack sizing.

Assumptions and limits

- Nominal voltages; equal cells.

References

Pack energy and configuration balance

Report details

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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-pack-sizing-from-range

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.