Electric Aircraft Range and Endurance from Battery Energy

Range and endurance of a battery-electric aircraft or fixed-wing drone from battery mass and specific energy, total mass, L/D and powertrain efficiency.

Method: Range of battery-electric aircraft (electric Breguet relation)

Input parameters

Unit system: SI

Parameter	Value	Unit
Battery mass	200.00	kg
Battery specific energy (pack)	200.00	Wh/kg
Total aircraft mass	700.00	kg
Lift-to-drag ratio in cruise	15.000	
Battery-to-thrust efficiency (motor, controller, propeller)	72.000	%
Usable energy fraction (after reserve)	80.000	%
Cruise speed	162.00	km/h

Calculated results

Parameter	Value	Unit
Range	181.24	km
Endurance at the cruise speed	1.1188	h
Battery power in cruise	28.603	kW
Battery mass fraction	28.571	%
Battery energy	40.000	kWh

Notes for this case

• Electric Breguet equation R = e* (m_b/m) η (L/D)/g × usable fraction: unlike fuel, the battery mass does not fall in flight, so there is no logarithm. Climb and reserves reduce the usable range.

Formula and method

$$R = \frac{e^{*} m_b}{m g}\,\eta_{tot}\,\frac{L}{D}\,f_u, \quad P_{batt} = \frac{m g V}{(L/D)\,\eta_{tot}}, \quad E = \frac{R}{V}$$

Variables

m_b	Battery mass	kg
e^{*}	Battery specific energy (pack)	J/kg
m	Total aircraft mass	kg
L/D	Lift-to-drag ratio in cruise	-
η_{tot}	Battery-to-thrust efficiency (motor, controller, propeller)	-
f_u	Usable energy fraction (after reserve)	-
V	Cruise speed	m/s
R	Range	m
E	Endurance at the cruise speed	s
P_{batt}	Battery power in cruise	W
m_b/m	Battery mass fraction	-
E_b	Battery energy	J

Method and standards

Energy balance for battery-powered flight.

Assumptions and limits

- Steady cruise at constant L/D and efficiency.

References

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Report details

Report reference	FCC-QFTS-D3H8 (the same inputs always give the same reference)
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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/mechanical/aerospace/electric-aircraft-range

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Reopens the calculator with the inputs of this report.