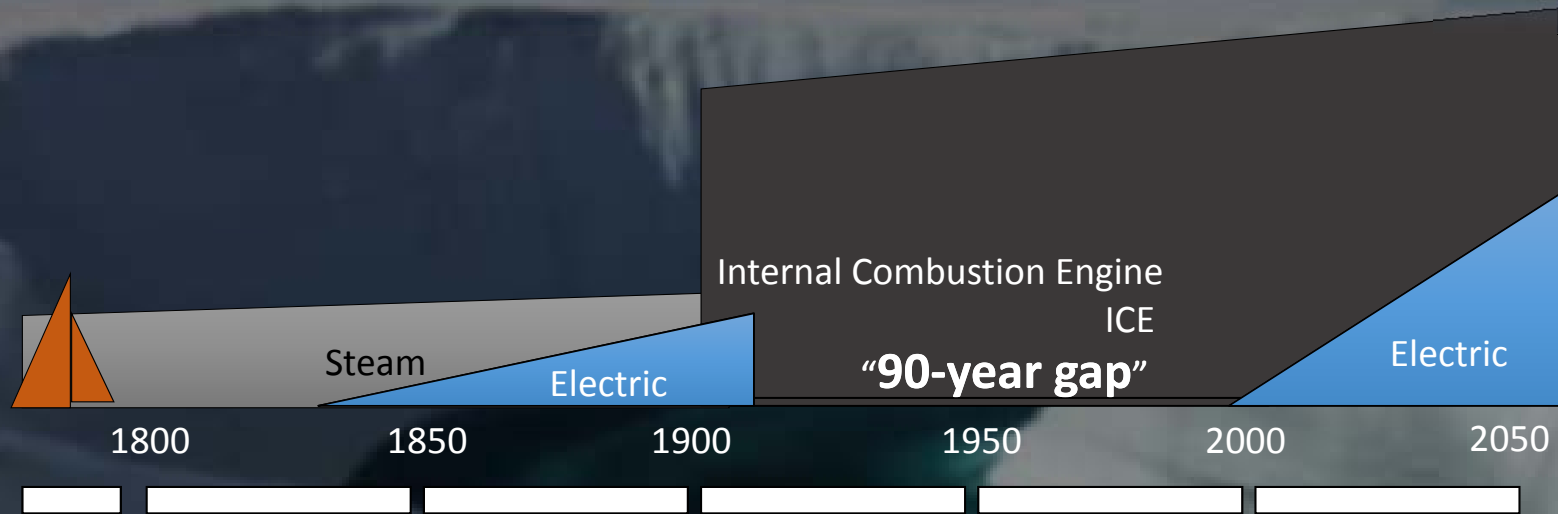


- History of electric
- Types of systems
- Propulsion basics
- Electronics basics



Guemes Island ferry planned- Crosscut.com

The ICE is melting...



- Jacobi, Russia: 14 passenger –E-boat- 3 mph
- Popularization of E- launches
- E-boat English Channel crossing 8 hrs, both ways
- 8 charging stations on Thames
- ELCO Electric Launch Company
- ELCO stops electric pleasure boats

Electric promises lower impact to self and others:

- No CO warning sticker
- No bilge buzzer
- No plume of diesel smoke in the marina
- Clean engine compartment and topsides
- Charging happens at your slip and under-way
- Great control- no stalling at low speeds
- Simpler to use and maintain
- Quiet- low vibration
- Odorless
- Renewable energy





Integrated outboards

- Simple to use
- Light weight- portable
- Cost competitive with gasoline
- dinghies thru 2 ton boats
- Range is expandable
- Small size = easy to charge

Non-integrated outboards:

- More customized installation
- More customizable range and power
- Charge options more limited by size
- For applications where weight not an issue.
- Larger boats
- Variable efficiency
- Requires engineering and installation
- Range can be upgraded later.



inboard all-electric

- Up to 60 miles range
- Control, environmental and sensorial benefits compared to ICE.
- Charge options limited by size
- Competitive purchase cost
- Greater weight -balance trim
- User-friendly controls
- Can be upgraded: more batteries, generator or solar.



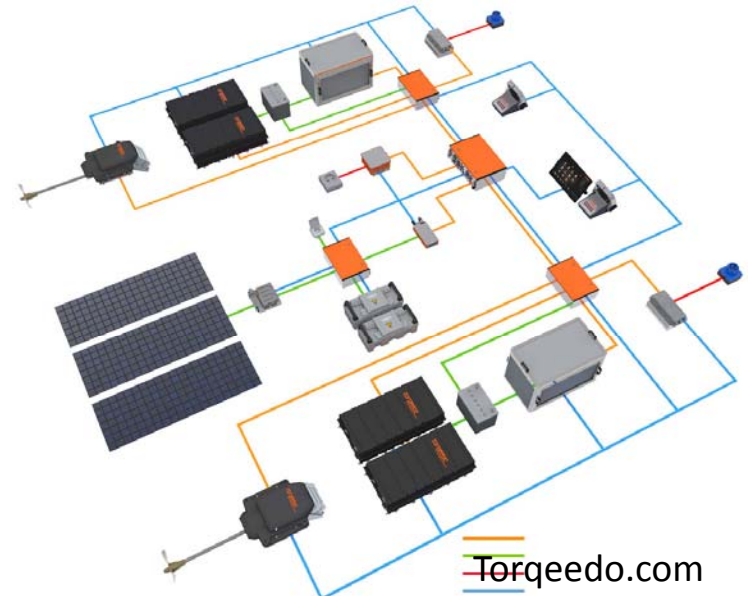
Torqeedo.com



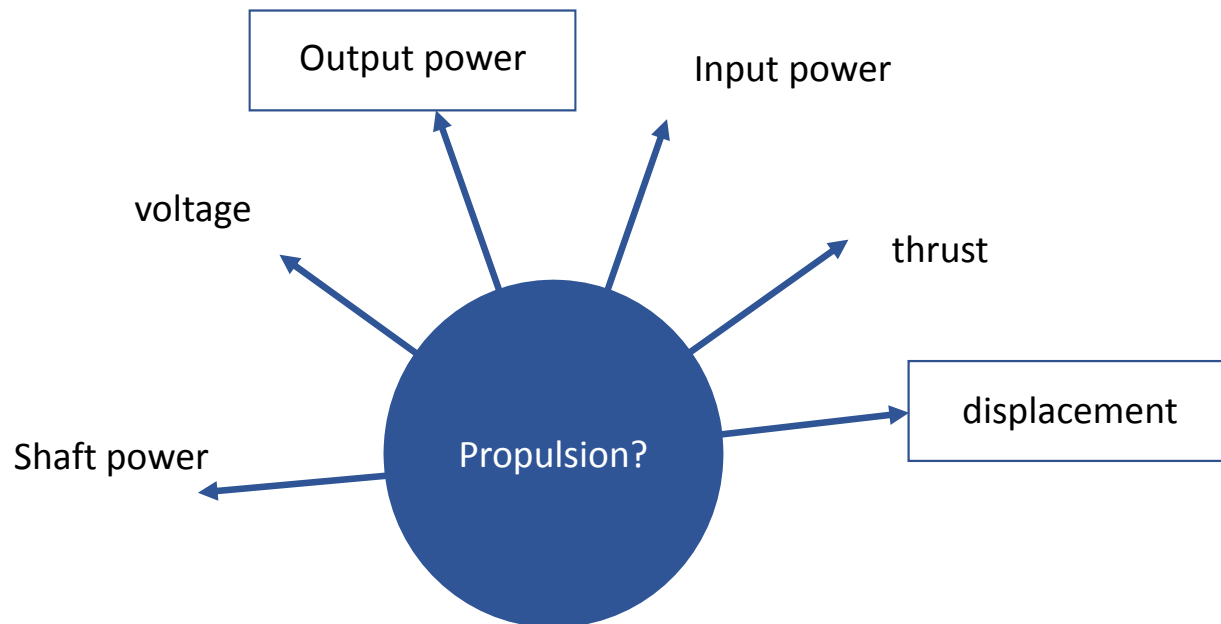
Elco.com

Inboard gas-electric hybrid

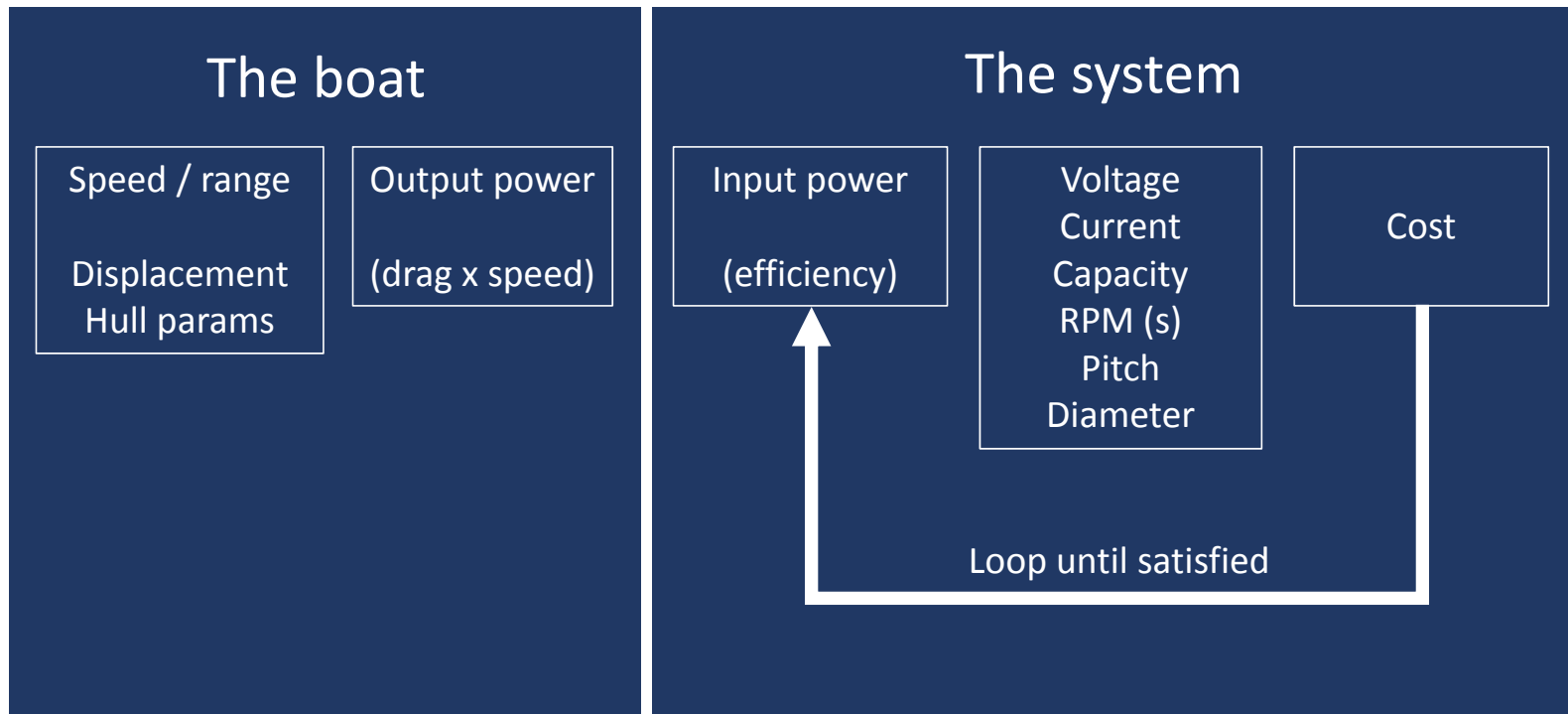
- Extended cruising.
- Don't mind extra \$ for a dual system.
- Power and range similar to ICE.
- Loses some environmental and operating cost benefits of EP
- Weight +- depending.



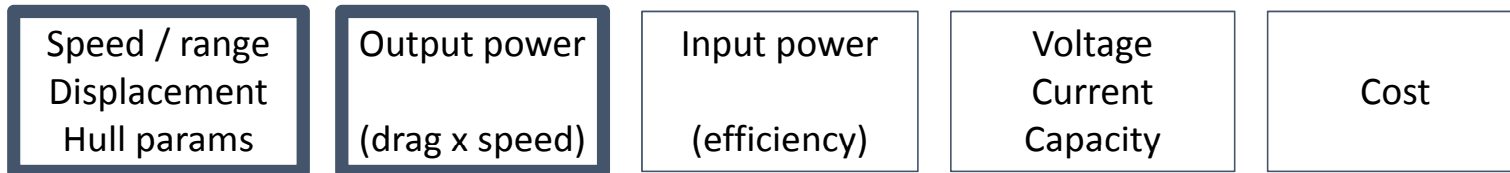
How to make sense of E propulsion?



How to make sense of propulsion?

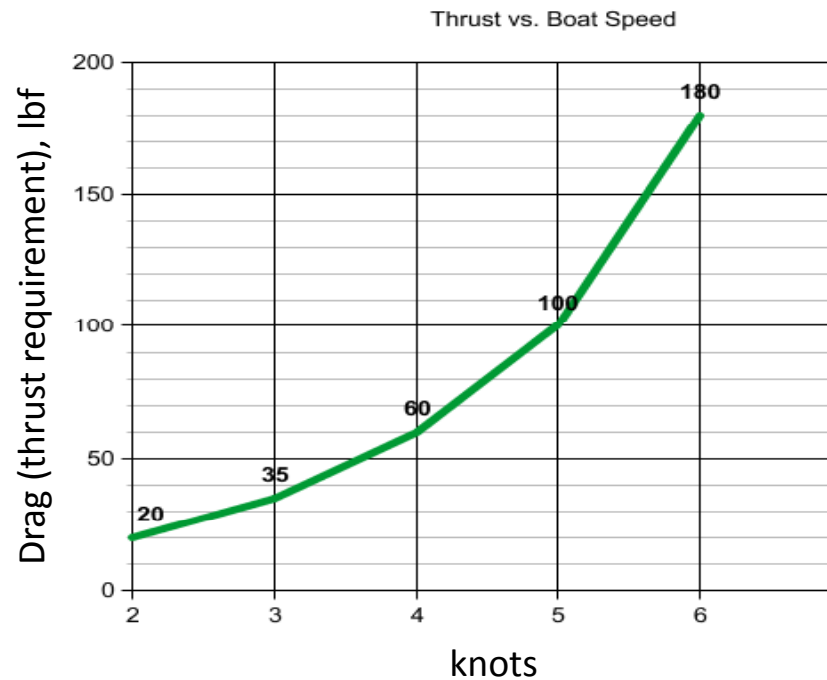


Thrust at speed...

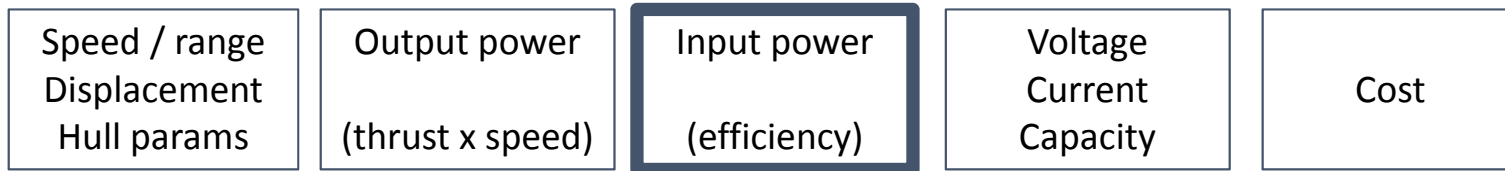


- **Catalina 30,** Data thanks to James Lambden, www.electricboatdesign.com

$$\begin{aligned} &\text{POWER required} \\ &= \\ &\text{Drag (thrust) x speed} \end{aligned}$$

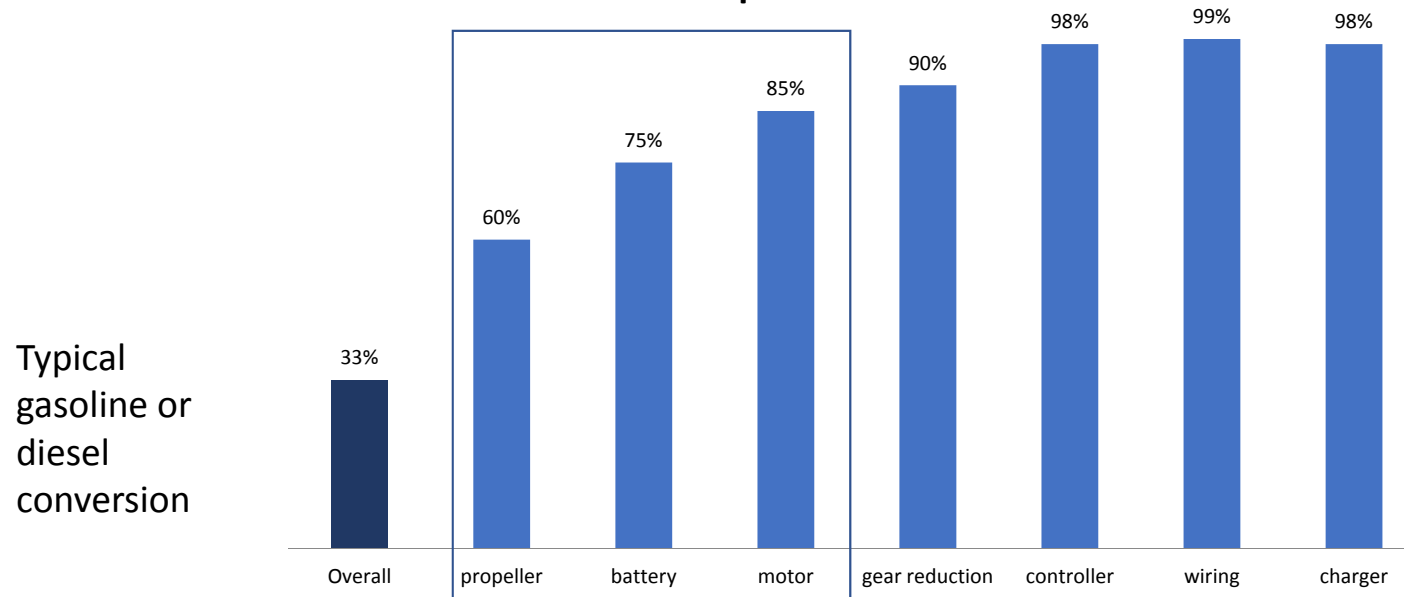


Definitions and system types



$$E_{\text{overall}} = E_{\text{prop}} \times E_{\text{battery}} \times E_{\text{motor}} \times E_{\text{gear}} \times E_{\text{wiring}} \times E_{\text{charging}}$$

Component efficiencies



Sizing VS efficiency

Speed / range
Displacement
Hull params

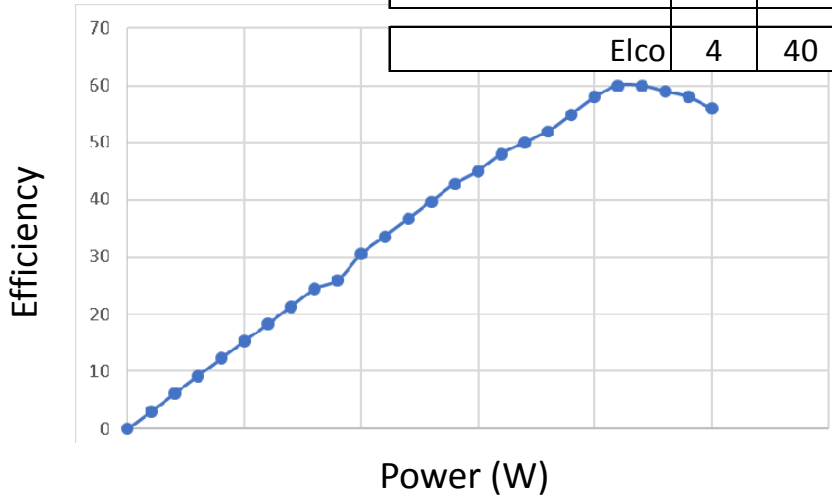
Output power
(drag x speed)

**Input power
(efficiency)**

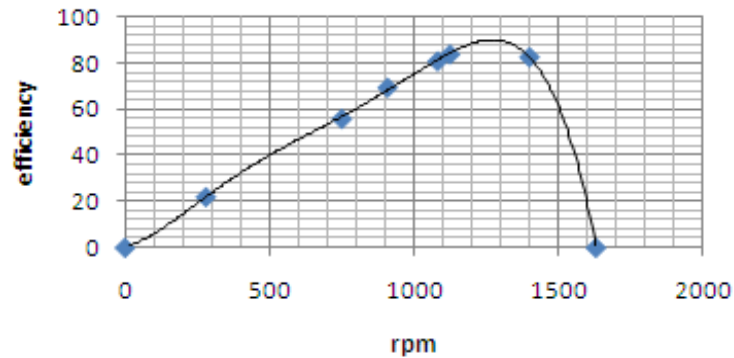
Voltage
Current
Capacity

Cost

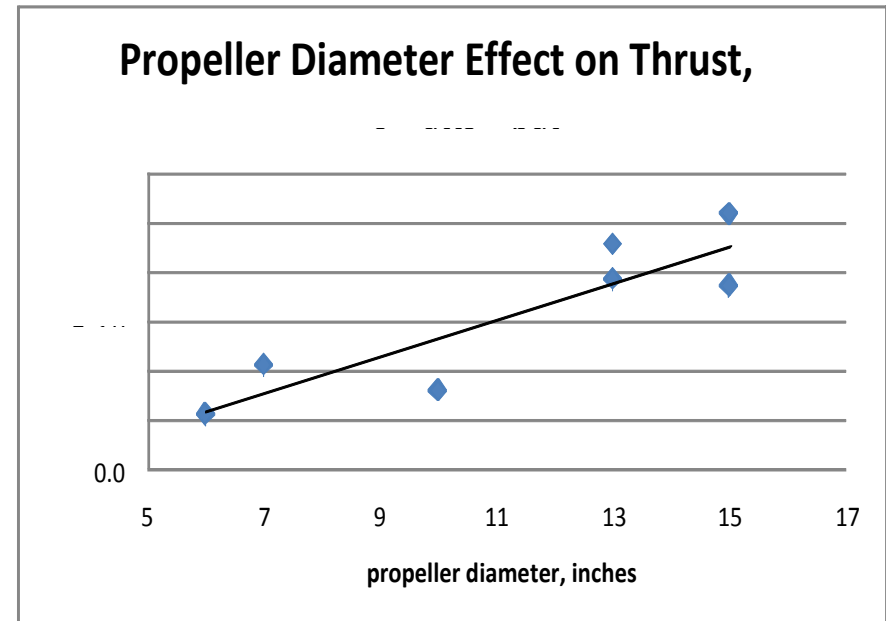
	watts input		tons													
			0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6		
EP Carry		0.25	●													
Torqueedo	0.5	66		● ● ...												
Oceanvolt	3.5	8.5		● ● ...												
Electric Yacht	5	30		● ● ...												
Elco	4	40		● ● ...												



Propeller and motor matching

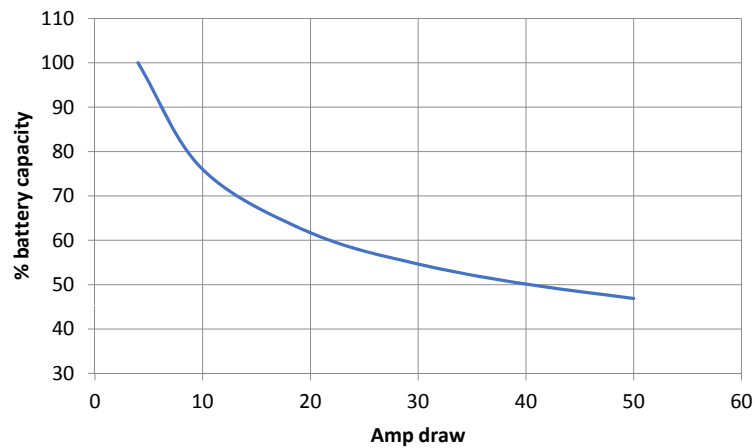


- All motors have their efficient RPM operation range.
- Larger diameters , higher pitch and slower rotation lower blade area.
- **Gearing matches motor to propeller.**

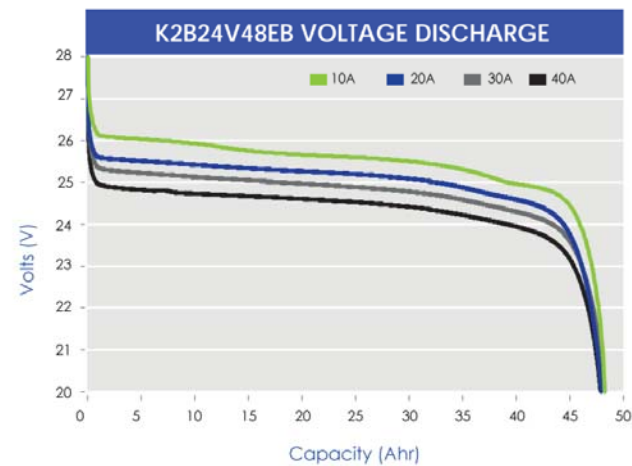


Batteries

100 Ah lead acid battery



50 Ah battery



- A lead acid 100 AH battery will lose 50% of its capacity at 40 amps draw. (when new).
- A 48Ah LiFePO4 will lose about 5-8 % at 40 amp draw.
- Choice of battery affects range, speed etc.

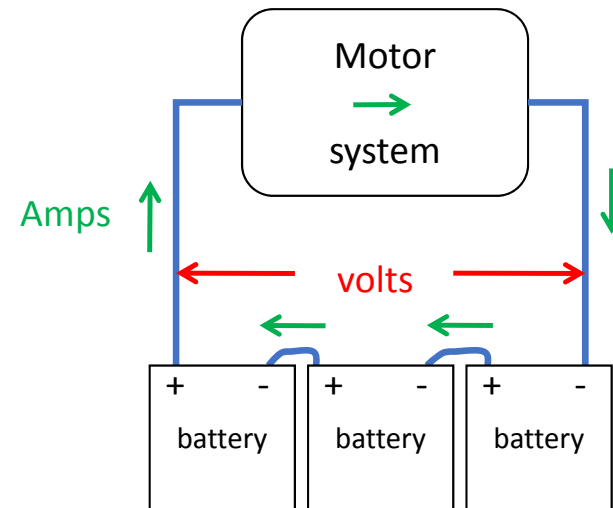
A Lead acid system can be upgraded to one of these in the future.

Volts, Amps, Watts, Horsepower

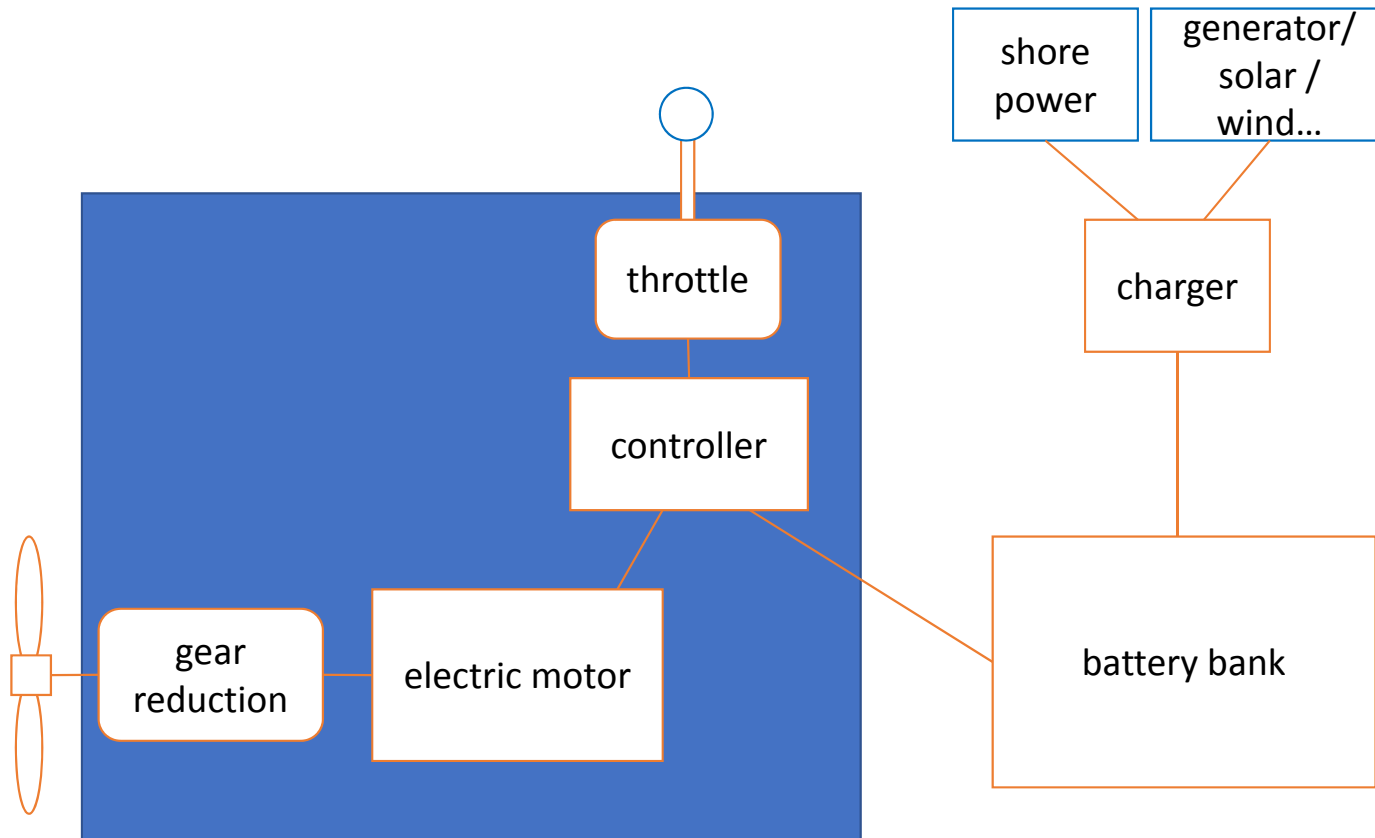
- Volts, V
- Amps, A
- Power = V x A, Watts, W
- Amp capacity = A x time, Amp hours, Ah
- Energy = V x A x time , Watt hours, Wh

1kW motor system

- Volts: 3 battery system = 12v x 3 = 36 Volts
- Amps: 0 to 28 Amps depending on throttle
- Power: 0 to 36 x 28 = 1000 Watts depending on throttle
- Amp capacity: Each battery (idealized) can provide 4 amps for 20 hours = 80 Ah
- Energy: Ah x Volts = 80 Ah x 36V = 2880Wh



Review



- Questions
- Comments
- Feedback

