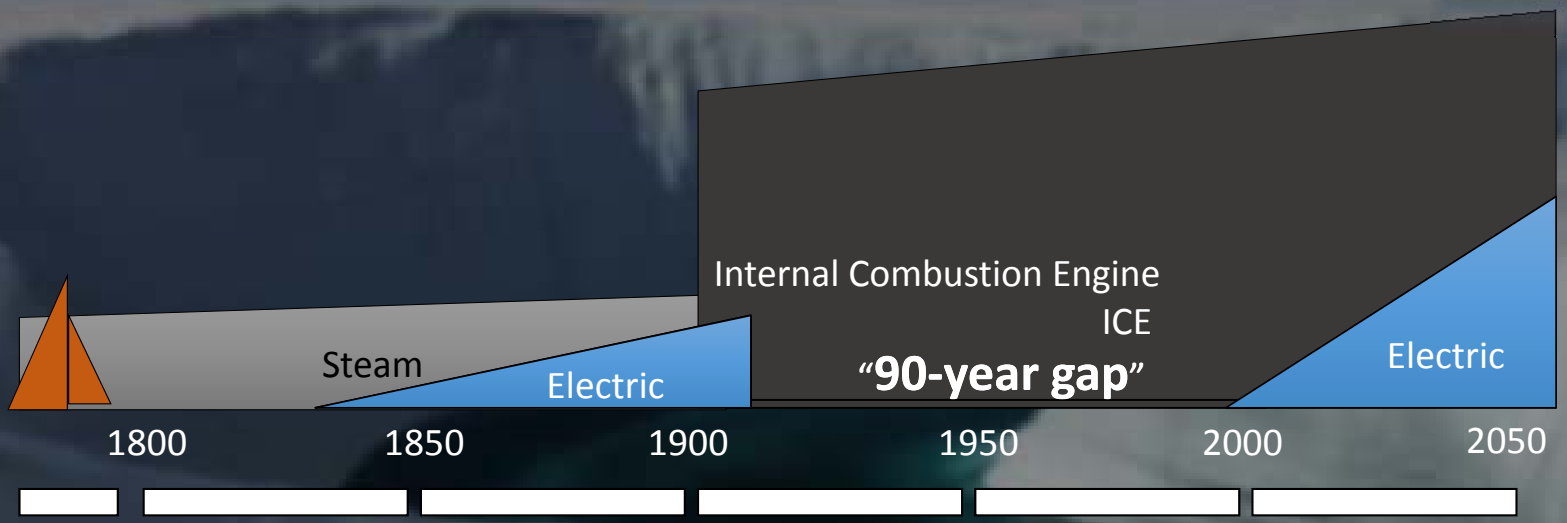
- History of electric
- Types of systems
- Propulsion basics
- Electronics basics

Guemes Island ferry planned- Crosscut.com

The ICE is melting…



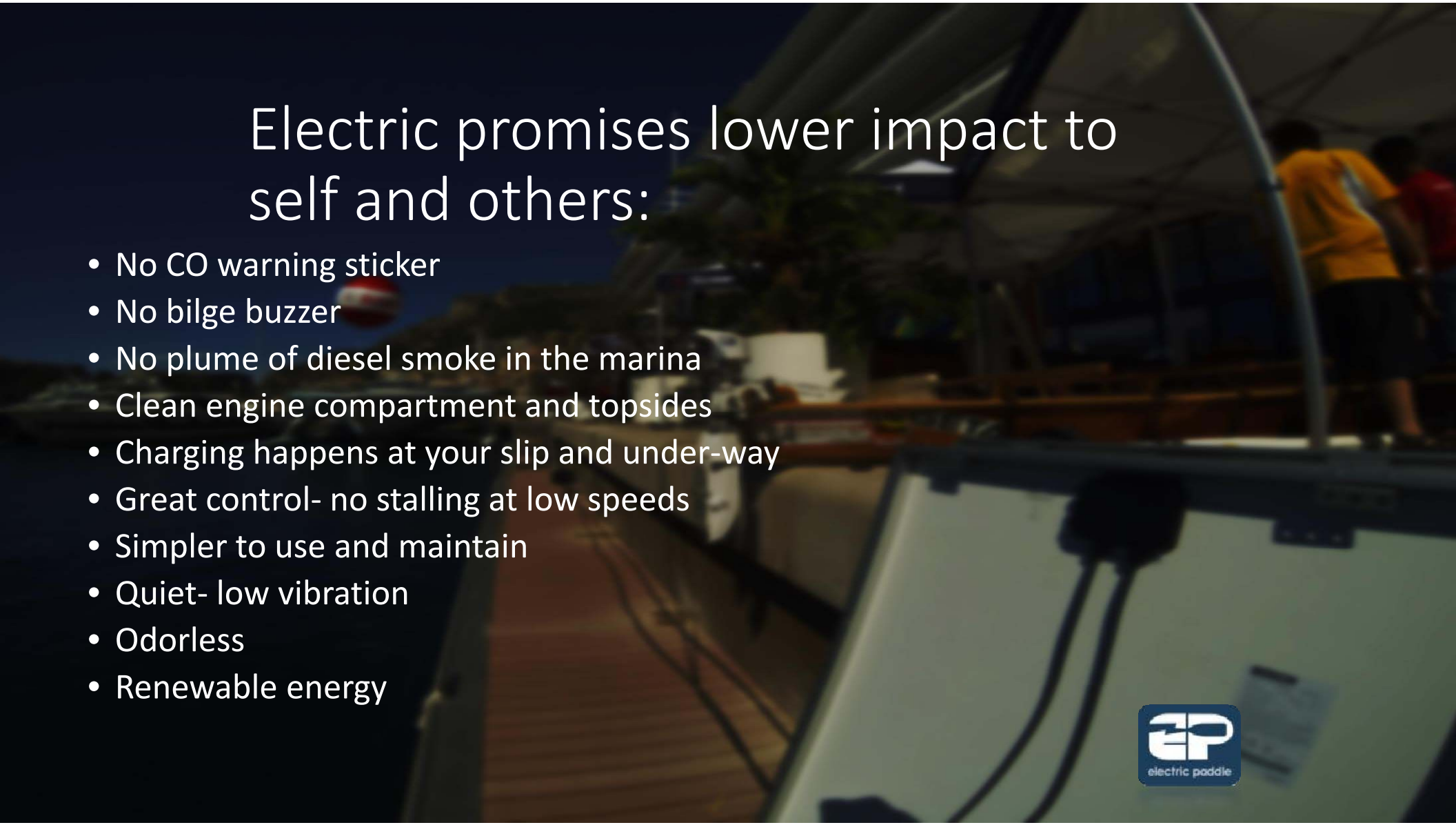
- ELCO stops electric pleasure boats
- ELCO Electric Launch Company
- 8 charging stations on Thames
- E-boat English Channel crossing 8 hrs, both ways
- Popularization of E- launches
- Jacobi, Russia: 14 passenger –E-boat- 3 mph

Photo: Tad Pfeffer/Extreme Ice Survey

Data from Wikipedia and Elco website

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

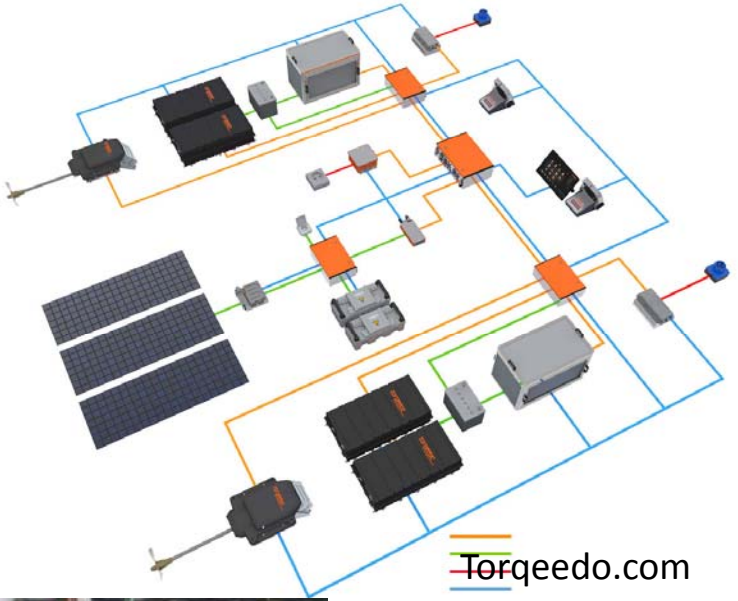
- Up to 60 miles range
- Control, environmental and sensorial benefits compared to ICE.
- Charge options limited by size
- Competitive purchase cost
- Greater weight -balance trim
- User-friendly controls
- Can be upgraded: more batteries, generator or solar.

Torqeedo.com

Elco.com

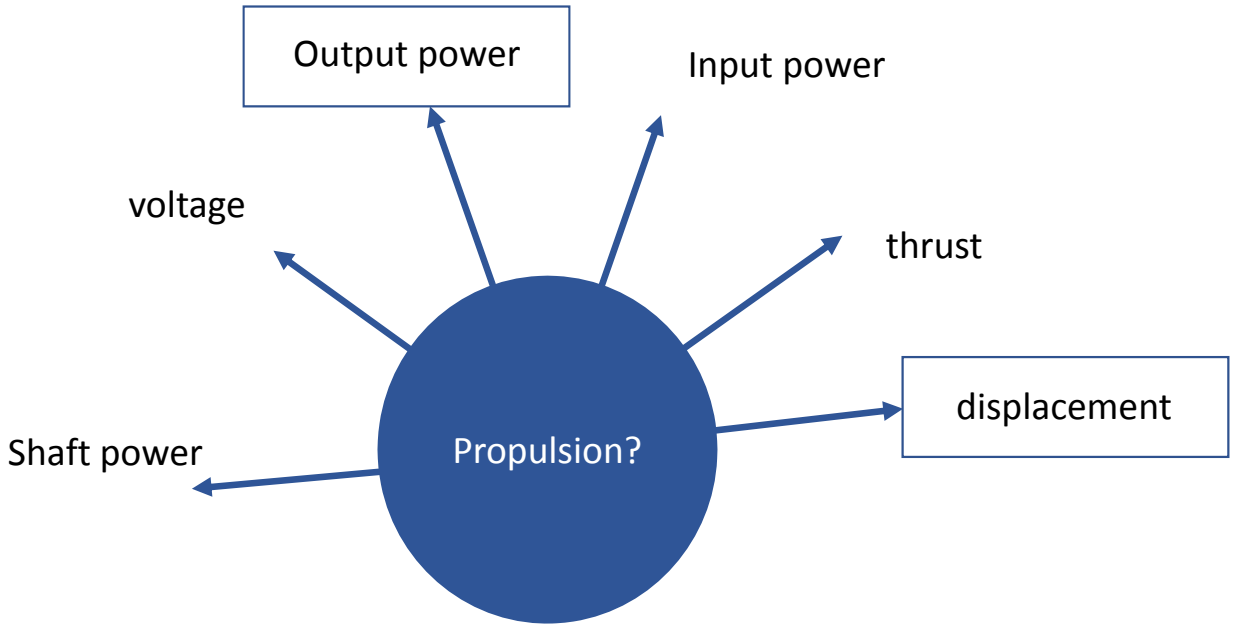
Inboard gas-electric hybrid

- Extended cruising.
- Don’t mind extra $ for a dual system.

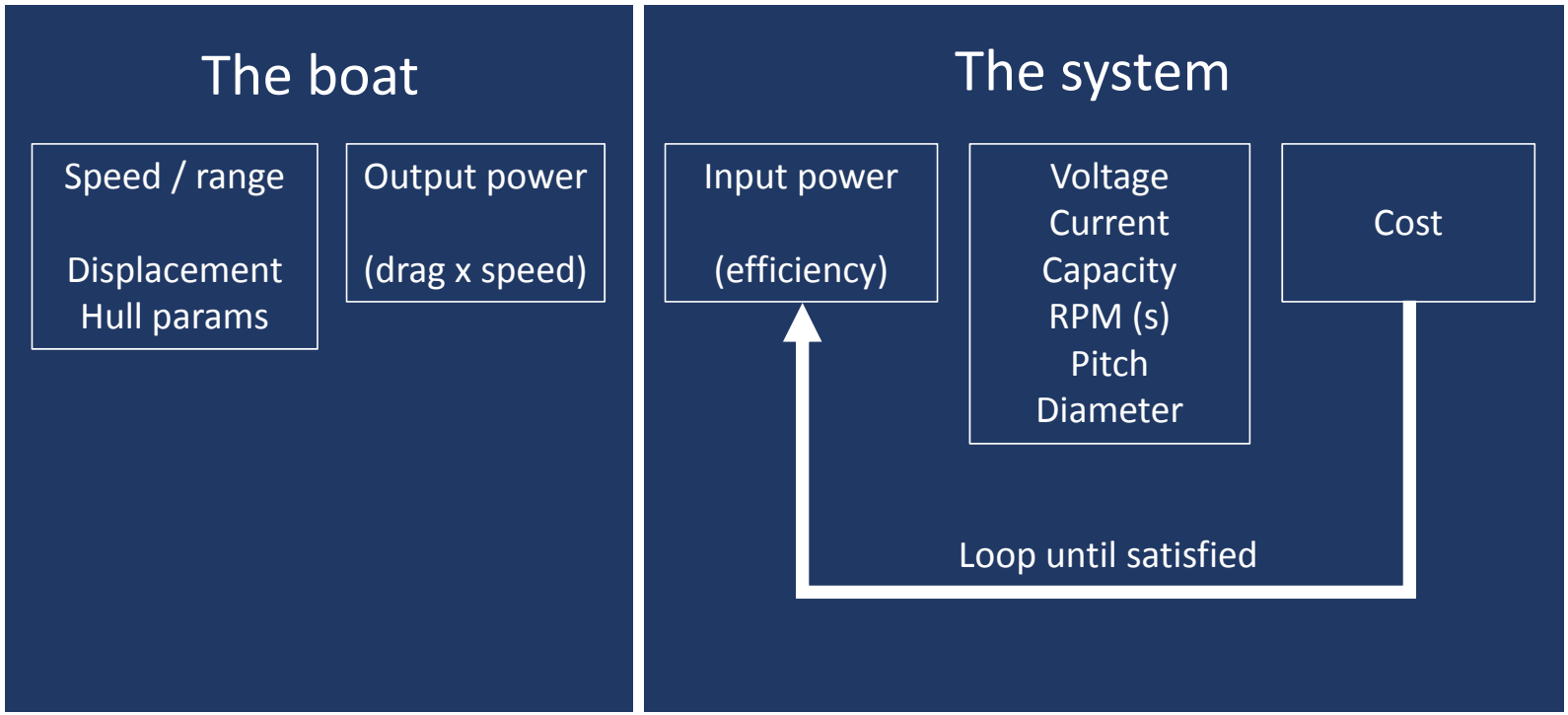


- Power and range similar to ICE.
- Looses some environmental and operating cost benefits of EP
- Weight +- depending.

How to make sense of E propulsion?



How to make sense of propulsion?



Thrust at speed…

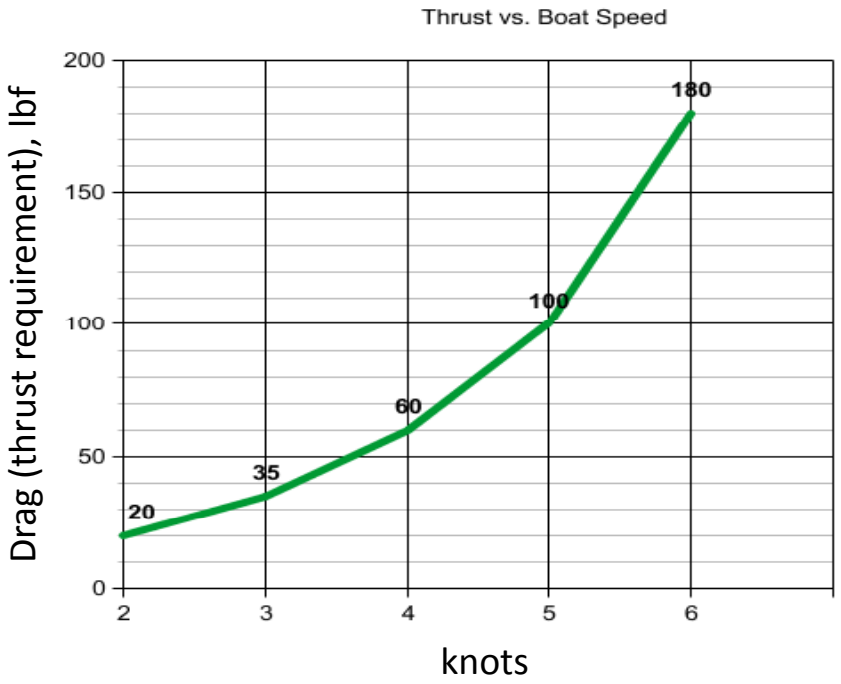
Speed / range Displacement Hull params	Output power (drag x speed)	Input power (efficiency)	Voltage Current Capacity	Cost

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

POWER required

=

Drag (thrust) x speed

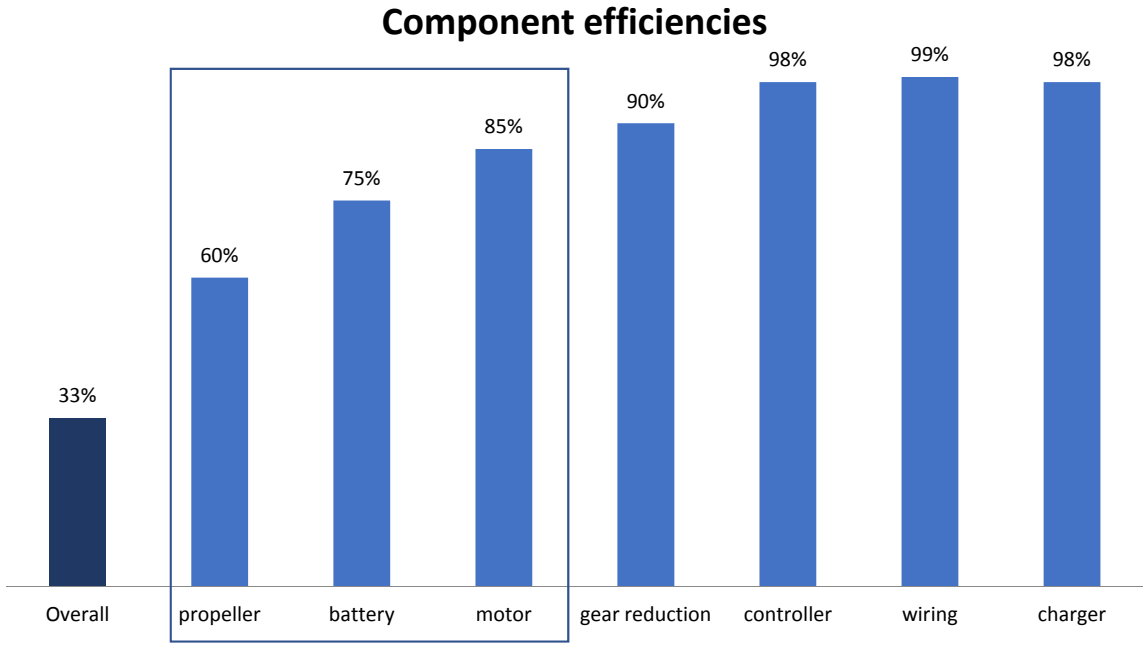


Definitions and system types

Speed / range Displacement Hull params	Output power (thrust x speed)	**Input power** **(efficiency)**	Voltage Current Capacity	Cost

E overall = Eprop x Ebattery x Emotor x Egear x Ewiring x Echarging

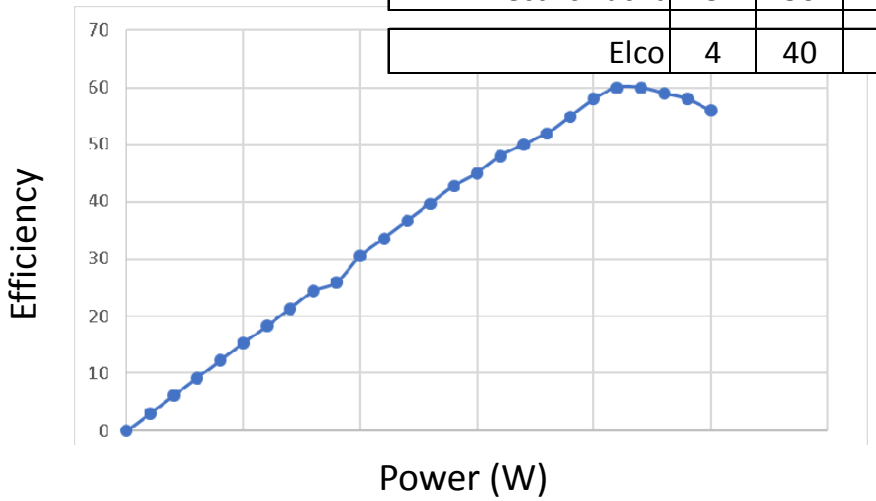
Typical gasoline or diesel conversion



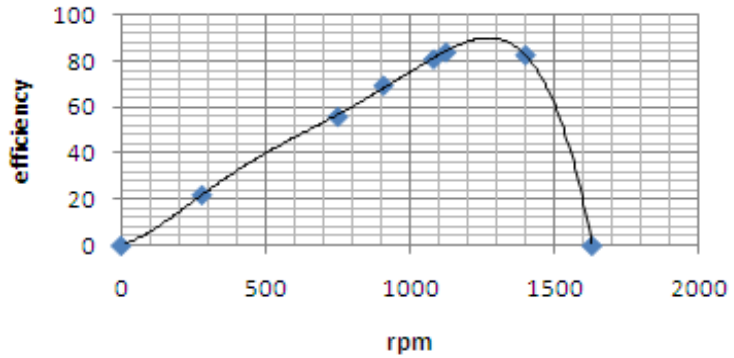
Sizing vs efficiency

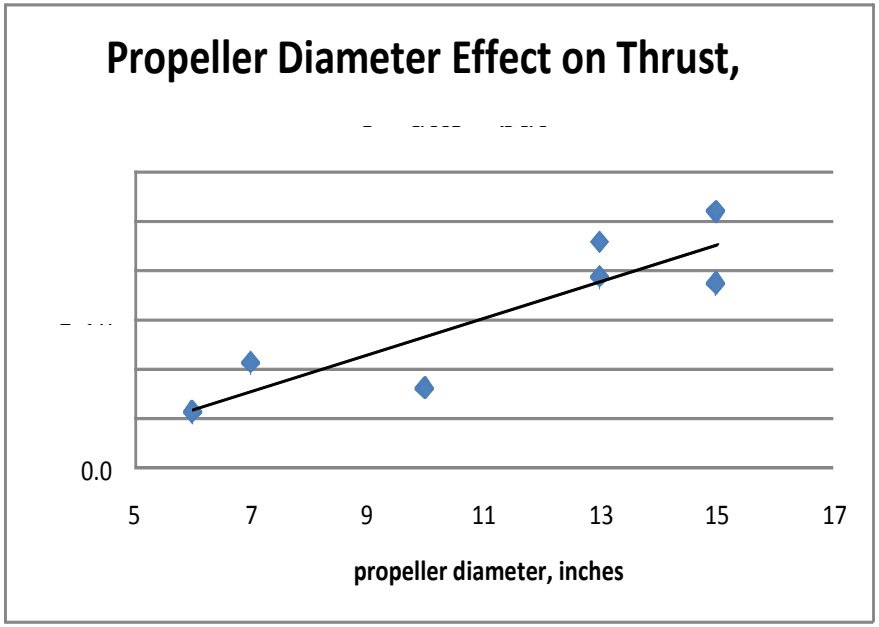
Speed / range Displacement Hull params	Output power (drag x speed)	**Input power** **(efficiency)**	Voltage Current Capacity	Cost

	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	●												
Torqeedo	0.5	66		●	●	…	■	■	■	■	■	■	■	■	▨
Oceanvolt	3.5	8.5		●	●	…	■	■	■	■	■	■	■	■	▨
Electric Yacht	5	30		●	●	…	■	■	■	■	■	■	■	■	▨
Elco	4	40		●	●	…	■	■	■	■	■	■	■	■	▨



Propeller and motor matching



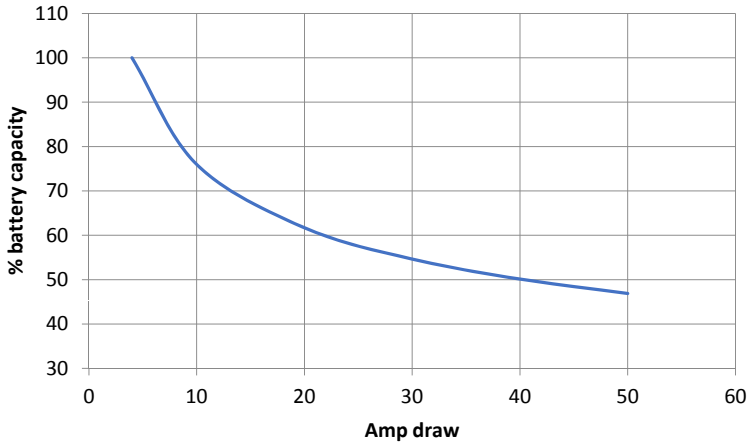


- All motors have their efficient RPM operation range.
- Larger diameters , higher pitch and slower rotation lower blade area.

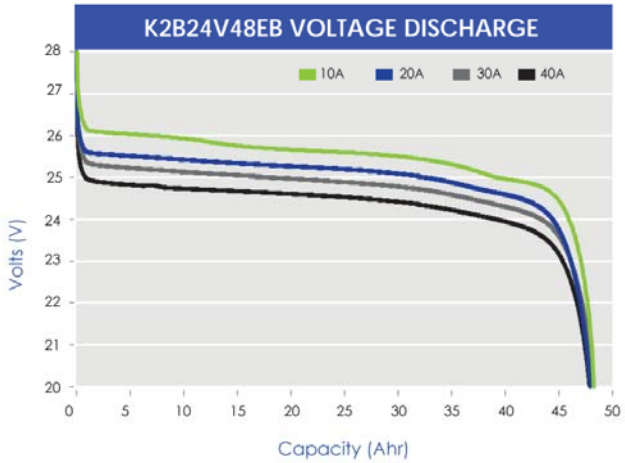
- **Gearing matches motor to propeller.**

Batteries

100 Ah lead acid battery



50 Ah battery

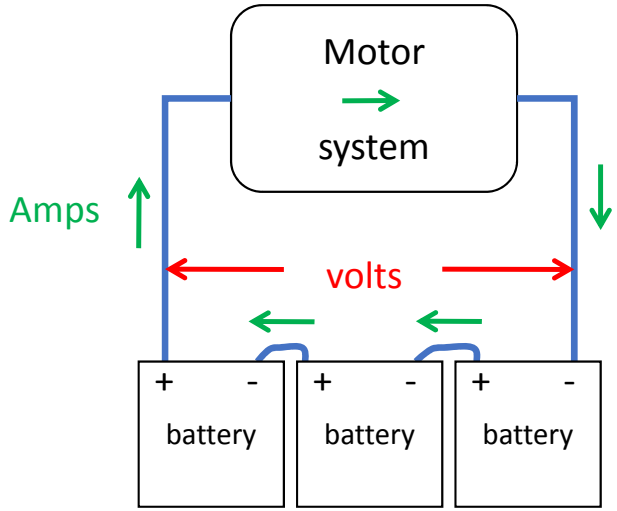


- A lead acid 100 AH battery will lose 50% of its capacity at 40 amps draw. (when new).
- A 48Ah LiFePO4 will lose about 5-8 % at 40 amp draw.
- Choice of battery affects range, speed etc.

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

Volts, Amps, Watts, Horsepower

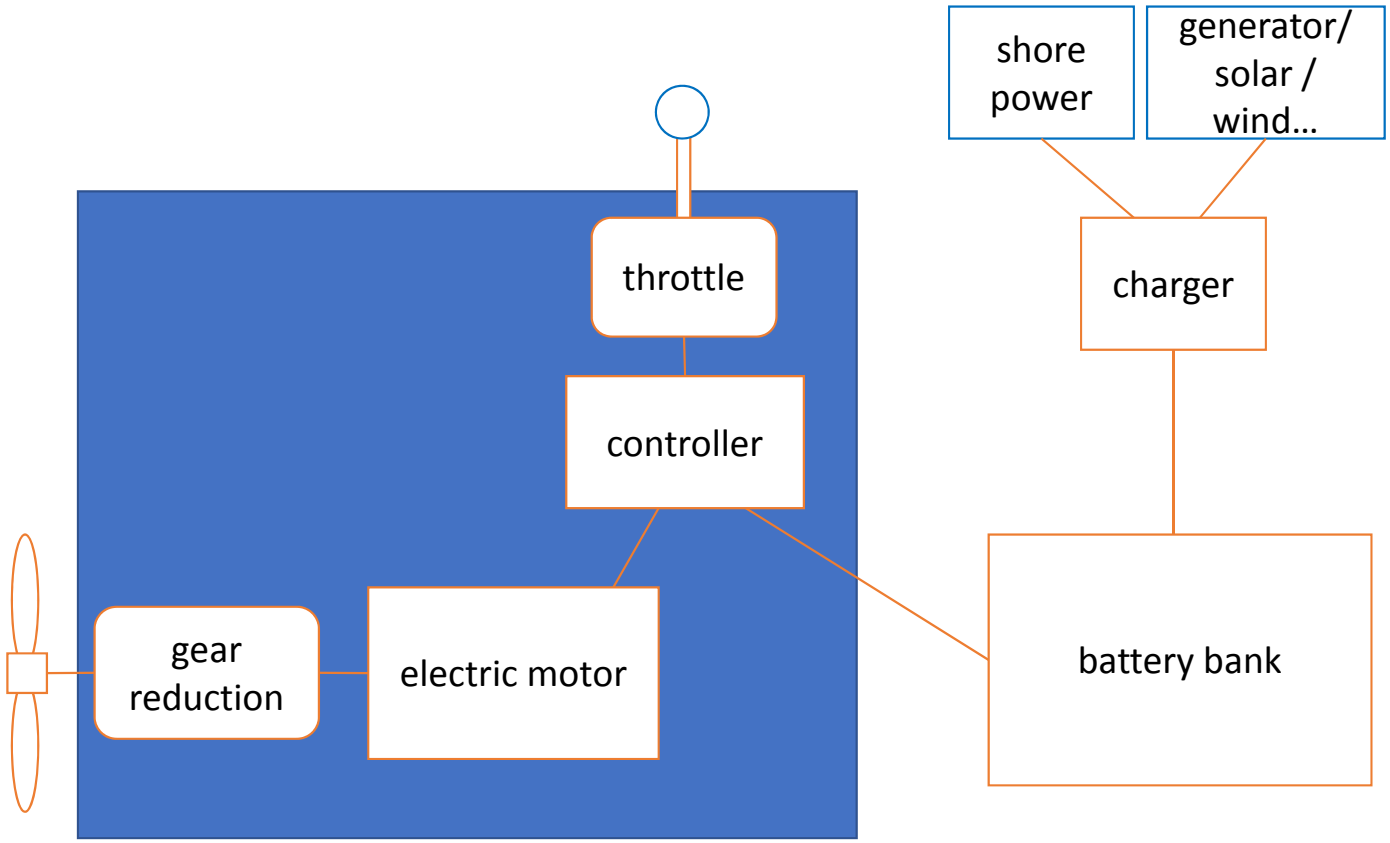
•Volts, V
•Amps, A
•Power = V x A, Watts, W
•Amp capacity = A x time, Amp hours, Ah
•Energy = V x A x time , Watt hours, Wh



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


shore power
generator/ solar / wind…
charger
throttle
controller
gear reduction
electric motor
battery bank

- Questions
- Comments
- Feedback