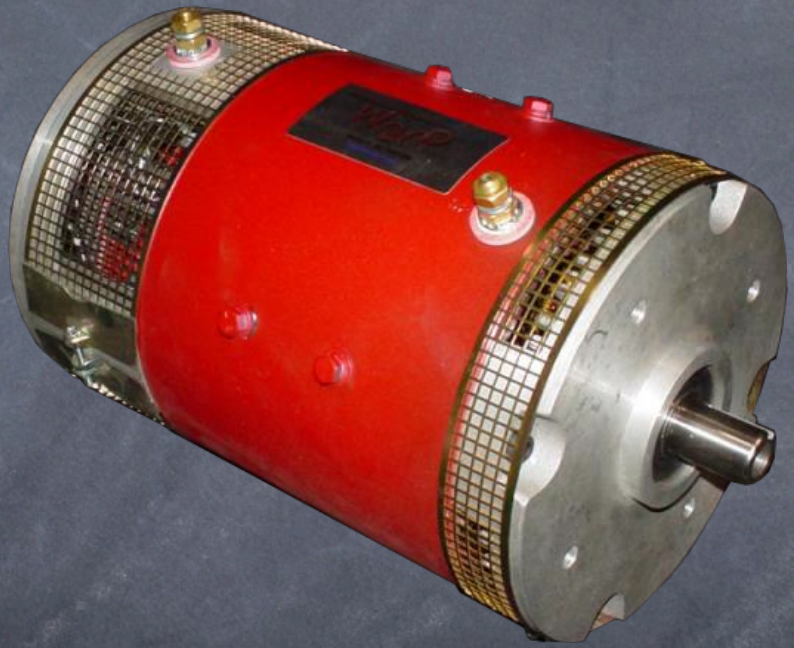
DC Motors

aka "KillaCycle and Beyond"



Ian Hooper
Zero Emission Vehicles Australia
April 2008

Introducing the world's quickest electric vehicle:


CHECKER AUTO PARTS
SCHUCKS AUTO SUPPLY
KRAGEN AUTO PARTS
PPG
AUTOMOTIVE FINISHES

KillaCycle Info

- Designed and built by Bill Dube in the US
- Dual Advanced DC L91 series DC motors and 990 A123Systems lithium batteries
- 7.82 second quarter mile
- 0-100km/h in just under 1 second
- http://www.killacycle.com

Things I'll Talk About:

- My series-DC powered MX5 project
- Overview of motor types
- Advantages and disadvantages of Series DC
- A little bit of tech stuff
- The future for EV motors
- (I'll upload these slides to the AEVA forum so you don't need to take notes!)

My Background

- Mechatronic Engineer (Curtin)
- Proprietor of Zero Emission Vehicles Australia, plus working as a contract software engineer to help pay the bills!
- ZEVA was started in 2007 with the primary goal of making it easier for Australians to build electric vehicles.
- My current project is an MX5 conversion

The MX5 Conversion

The MX5 Conversion

- Goal is to be the quickest electric car in the southern hemisphere!
- Intended for use in motorsport (e.g tarmac rally, autokhanas)
- Large lithium battery pack and DC motor for high performance

- NetGain Warp 11 motor, 192V Series DC
- Around 200hp peak and over 500 Nm of torque

Why Electric Motors are Better than Petrol Engines

(from a technical perspective)

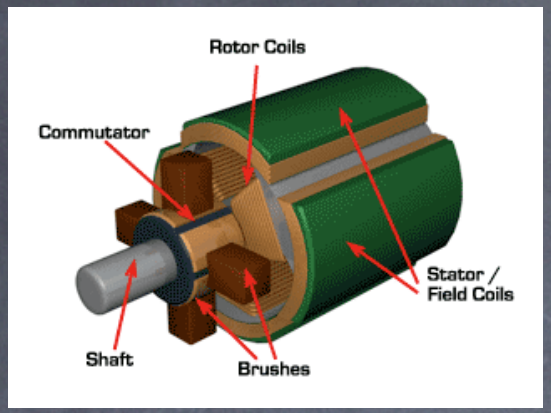
- Efficiency: around 90% instead of 25%!
- Simplicity: Just one moving part means low maintenance, high reliability and low cost
- Low noise: Almost silent in operation

Why Electric Motors are Better than Petrol Engines

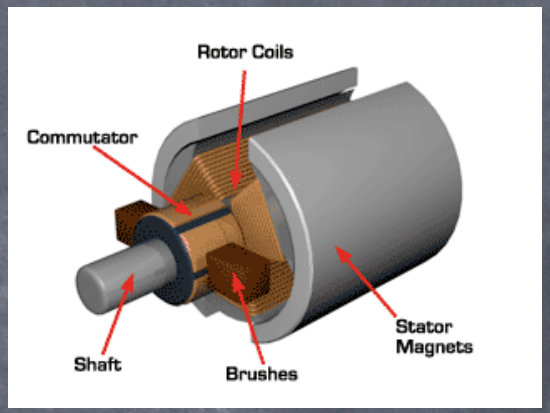
(from a human perspective)

- Zero emission
  (No air pollutants or greenhouse gasses generated)
- Economic security
  (No dependence on foreign oil)
- Running costs
  (Electrons are far cheaper than petrol)

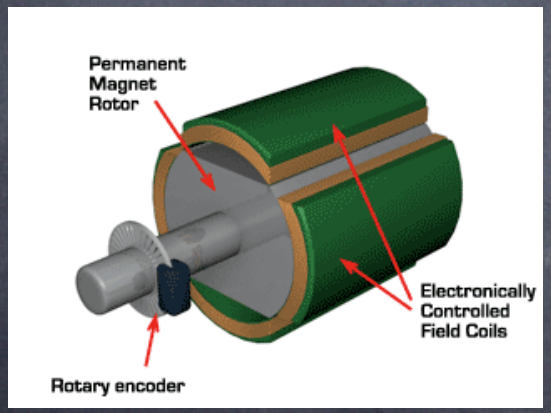
Types of Electric Motor



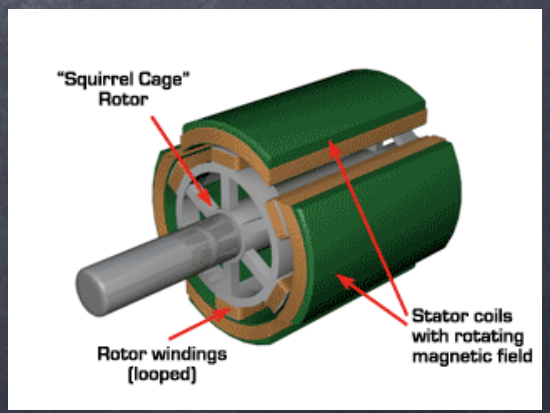
- Series/Shunt/Sepex DC



- Permanent magnet DC

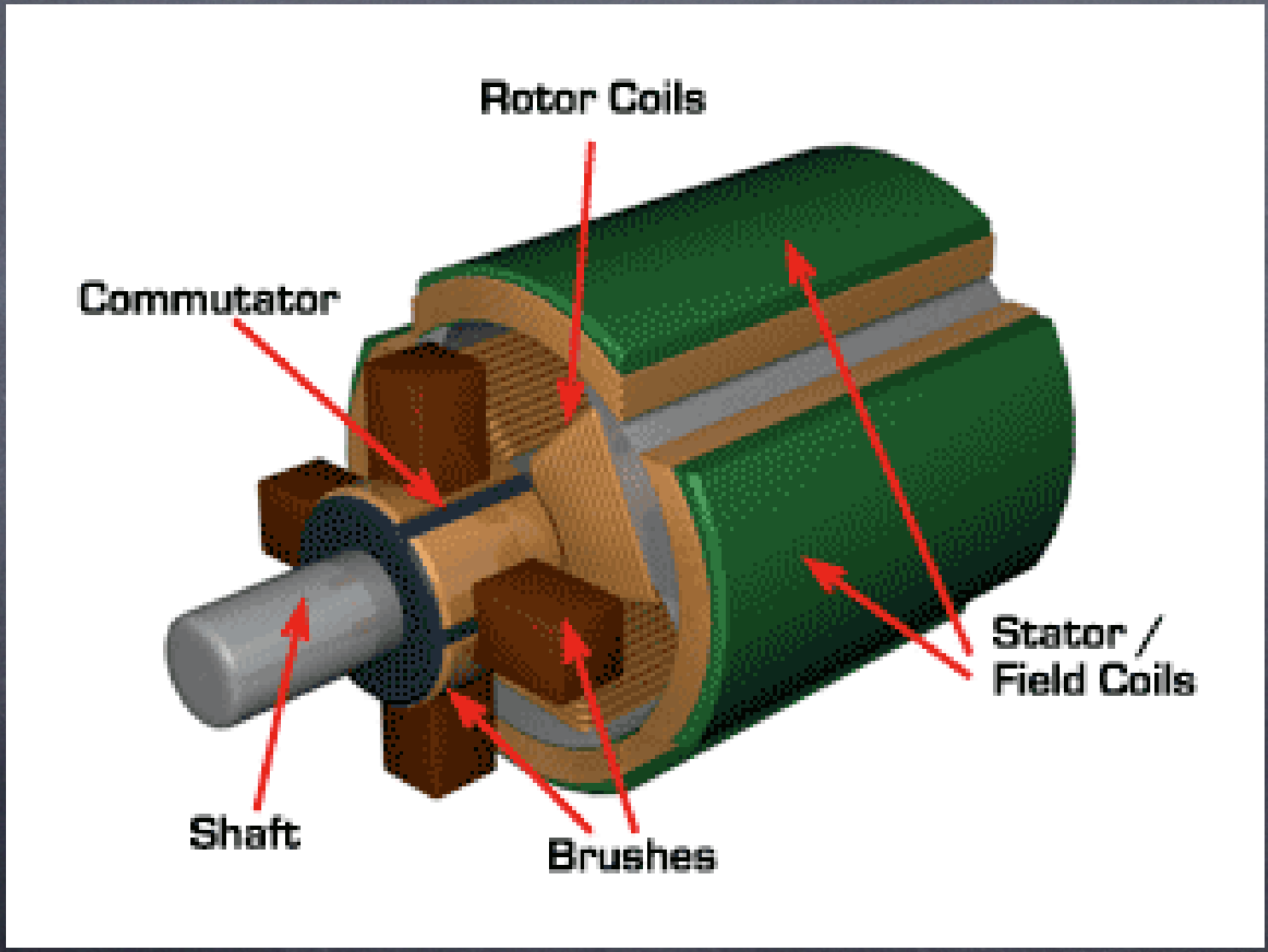


- Brushless DC



- AC Induction

Series DC: A closer look



Why Series DC?

- Tried and trued technology
- Abundant: many good makes and models
- Robust and long lasting
- Torque curve suited for traction applications
- Great power density (around 2hp per kg)
- Best bang for your buck (around $20 per hp)

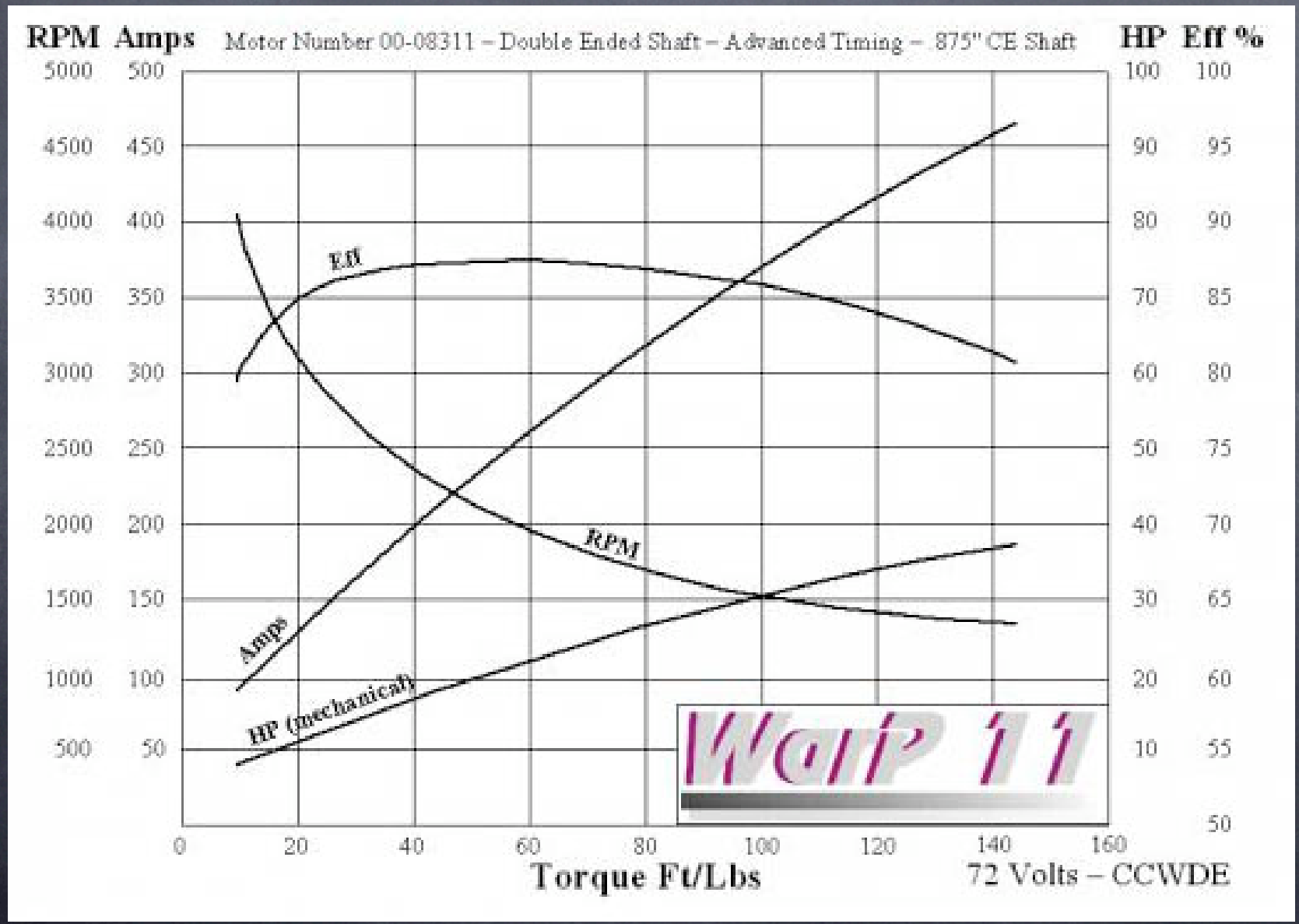
Disadvantages

- Not the most efficient type of electric motor
  - Usually 90% max vs 95% for AC induction
- Some maintenance required
  - Commutator brushes wear out eventually
- Not suited to regenerative braking

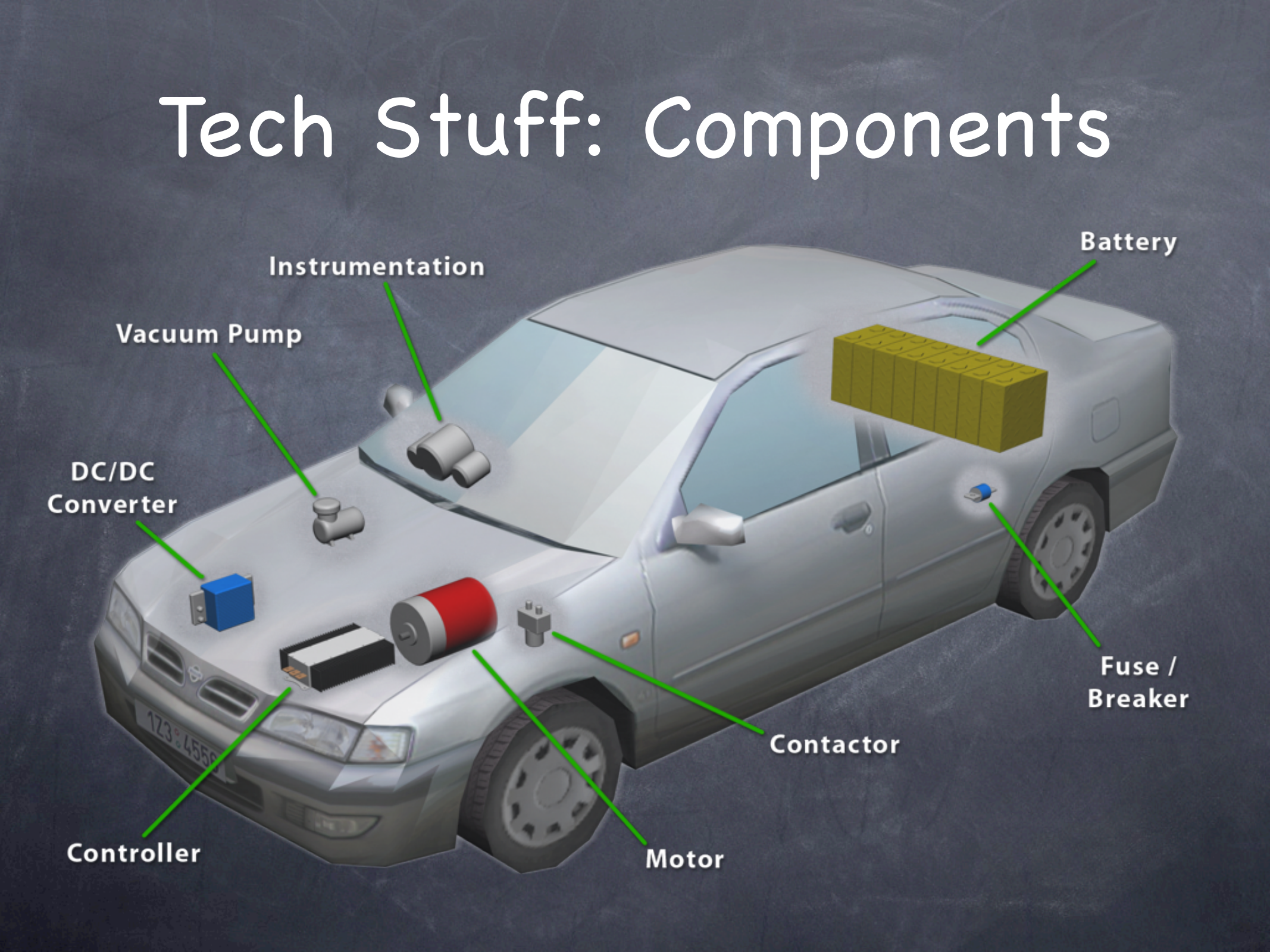
Regenerative braking?

- Allows vehicles to recapture kinetic energy while braking, recharging the batteries
- 10-40% improvement in range, depending on driving conditions
- Unfortunately doesn't work well in series DC motors due to inductance in the coils causing commutator arcing
- Probably DC's biggest shortcoming

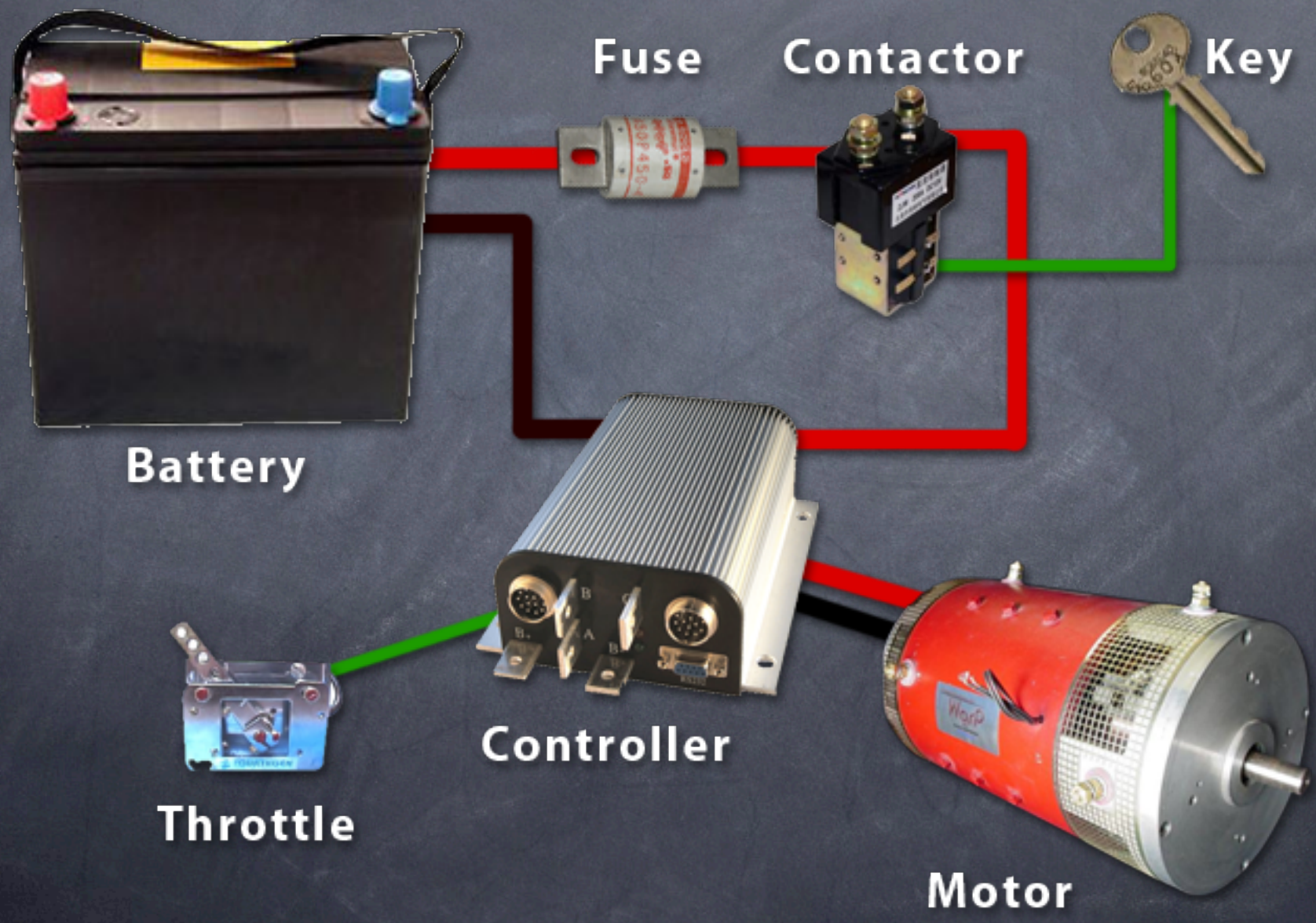
Tech Stuff: Dyno Graph



Tech Stuff: Components

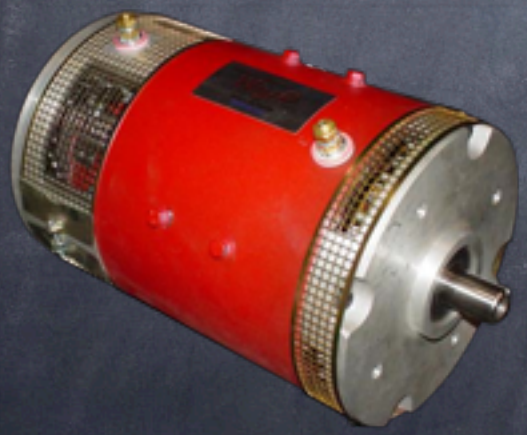


Tech Stuff: Circuit

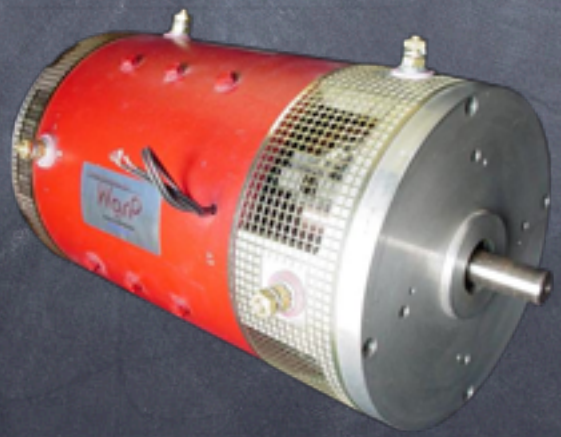


Gratuitous ZEVA Plug

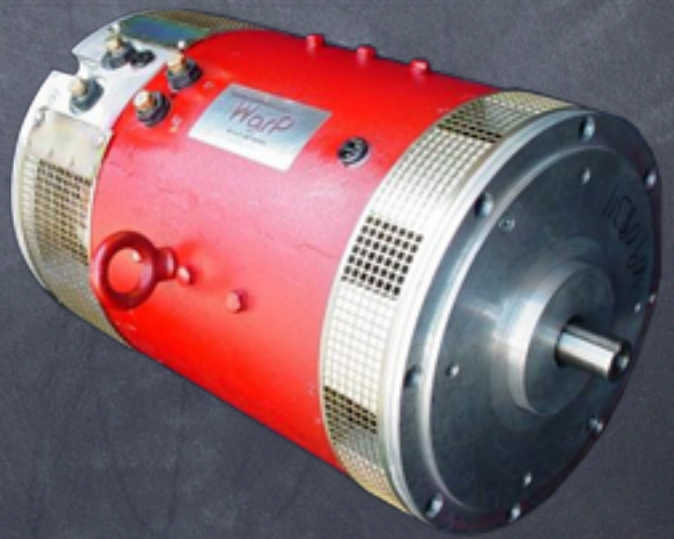
- Authorised distributor of NetGain EV motors
- NetGain are widely respected as having some of the best series DC motors on the market
- http://www.zeva.com.au for more info



Impulse 9
~100hp, up to 1200kg



Warp 9
~130hp, up to 1600kg



Warp 11
~200hp, up to 2000kg

The Future: AC Induction

- Series DC are about as good as they're going to get
- AC induction are more efficient, lower maintenance, and great for regen
- Main downside with AC is cost - currently they are *several times* more expensive (motor + controller) for equivalent power!
- No technical reason why they won't one day be on par with series DC for cost and power density... but I predict it's many years off yet

Any questions?