Building an EV

TOPIC #2

What kind of motor should I use?

http://www.evalbum.com

http://www.diyelectriccar.com

Topics

- **What is the best car to convert?**
- ***What kind of motor should I use?***
- ***What kind of batteries do I use?***
- **What are controllers?**
- **Where can I buy the parts?**
- **Are there any books on how to do a conversion?**
- **How far can I go on a charge?**
- **How fast will it go?**
- **How much will it cost?**
- **How to make battery cables?**
- **How do I charge the batteries?**
- **How to add power brakes and power steering?**
- **How to add safety?**
- **How to add air conditioning?**
- **How about solar panels?**
- **Is there anyway to make it recharge itself while driving?**
- **How about adding a generator?**
- **How about EV kits?**

What kind of motor should I use?

- The most commonly used motors in EV conversions are series wound DC motors. Most new parts suppliers carry the Advanced DC or Warp lines of motors. There are also quite a few folks using older General Electric, Baldor, and Prestolite motors. Many older conversions were based on surplus starter/generators.

What kind of motor should I use?

- There are a few decent surplus motors available from time to time. Forklift and elevator motors are usually much to heavy to use, while golf cart motors are too small. Recently, AC drive motors have become available, and it is likely that more conversions will be using them.
- AC motor selection differs from DC motor selection because AC motors MUST be matched to a controller. In fact, most AC motors for EVs come with a controller. These controllers often (but not always) include a built-in charger and DC-DC converter.

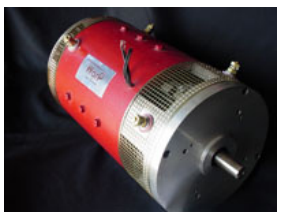
What kind of motor should I use?

DC MOTORs

- Advanced DC **($1,700.00)**

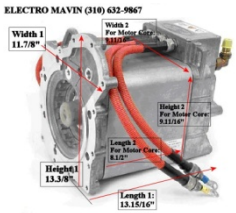
- D&D Motor **($1,429.95)**

- Warp DC **($1,675.00)**



AC MOTORs

- Siemnens AC **($2,000.00)**



- Solectria AC **($2,595.00)**

- AC Propulsion **($?K)**

What kind of motor should I use?

DC MOTOR

- Advantages of a brushed DC motor
  - low initial cost,
  - high reliability
  - simple control of motor speed.
- Disadvantages
  - some maintenance (80-100K Miles)
  - low life-span for high intensity uses.
  - regen would have you doing maintenance every 3,000 miles.
- Maintenance
  - involves periodically replacing the brushes and springs which carry the electric current, as well as cleaning or replacing the commutator. This is commonly done at 80K to 100K miles.

AC MOTOR

- Advantages of an AC motor
  - Long life
  - high power
  - High reliability
- Disadvantages
  - High initial cost
  - Requires mated controller
- Maintenance
  - None
    - AC motors do not use brushes or commutators.

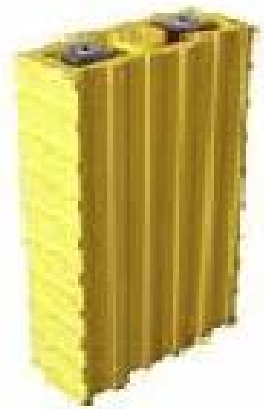
What kind of batteries do I use?

- Battery Analysis

AC	-VS-	DC
		
Controller and Motor: ACP $20K		Zilla and ADC Motor: $3700
Batteries: 28 Sealed Optima 55 Ah		18 Trojan T-875 flooded 180ah
System Voltage: 336 Volts		144 Volts
Battery Capacity :		
efficiency : **250 wh/mile (average for EVs)**		**250 wh/mile (average for EVs)**
energy required : **250x40miles = 10kWh**		**250x40miles = 10kWh**
Ah rating : **10kWh/336V = 29.76 Ah**		**10kWh/144V = 69.44 Ah**
Battery rating needed : **29.76 X 1.8 = 53.57 Ah**		**69.44 X 1.8 = 125 Ah**

What kind of batteries do I use?

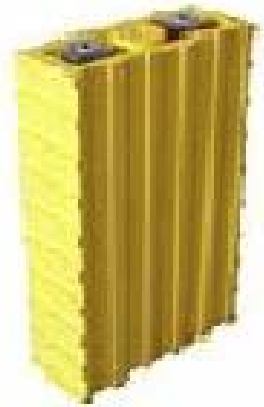
- Battery Analysis VS Lithium!
  - AC LEAD -VS- Lithium



  - **Battery Capacity :**
    - efficiency : **250 wh/mile (average for EVs)**
    - energy required : **250x40miles = 10kWh**
    - Ah rating : **10kWh/336V = 29.76 Ah**
    - Battery rating : **29.76 X 1.8 = 53.57 Ah** — **29.76 X 1.05 = 31.24 Ah TS-LFP60AHA $108.00**
    - Battery Weight : **28 x 44.5 lbs = 1,246 lbs** — **(336/3.2=105) x 3.5 lbs = 367.5 lbs 70.1% lighter**
    - Battery Cost : **28 x $179.99 = $ 5,040** — **105 x $108.00 = $11.340**

What kind of batteries do I use?

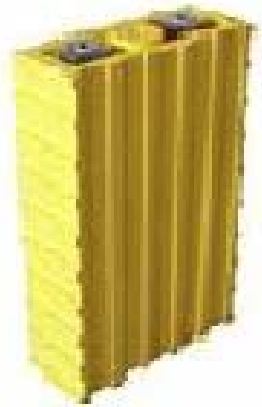
- Battery Analysis backwards for Lithium!
  - AC LEAD -VS- Lithium



- **Battery Capacity :**
  - efficiency : **250 wh/mile (average for EVs)**
  - energy required : **250x40miles = 10kWh** — **250 x 76.8miles = 19.2kWh**
  - Ah rating : **10kWh/336V = 29.76 Ah** — **19.2kWh / 336V = 57.14 Ah**
  - Battery rating : **29.76 X 1.8 = 53.57 Ah** — **57.14 X 1.05 = 60Ah TS-LFP60AHA $108.00**
  - Battery Weight : **28 x 44.5 lbs = 1,246 lbs** — **(336/3.2=105) x 3.5 lbs = 367.5 lbs 70.1% lighter**
  - Battery Cost : **28 x $179.99 = $ 5,040** — **105 x $108.00 = $11.340**

What kind of batteries do I use?

- Battery Analysis VS Lithium!
  - DC LEAD -VS- Lithium

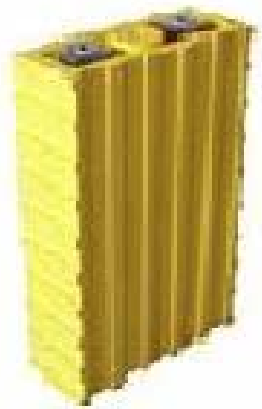


  - **Battery Capacity :**
    - efficiency : **250 wh/mile (average for EVs)**
    - energy required : **250x40miles = 10kWh**
    - Ah rating : **10kWh/144V = 69.44 Ah**
    - Battery rating : **69.44 X 1.8 = 125 Ah**
    - Battery Weight : **18 x 63 lbs = 1,134 lbs**
    - Battery Cost : **18 x $157 = $2826**

69.44 X 1.05 = 72.9 Ah TS-LFP90AHA $149.00
(144V/3.2V=45) x 6.6 lbs = 297 lbs 73.9% lighter
45 x $149.00 = $6,705.00

What kind of batteries do I use?

- Battery Analysis backwards for Lithium!
  - DC LEAD -VS- Lithium



- **Battery Capacity :**
  - efficiency : **250 wh/mile (average for EVs)**
  - energy required : **250x40miles = 10kWh** — **250x 49.37miles = 12.34kWh**
  - Ah rating : **10kWh/144V = 69.44 Ah** — **12.34kWh / 144V = 85.71 Ah**
  - Battery rating : **69.44 X 1.8 = 125 Ah** — **85.71 X 1.05 = 90 Ah TS-LFP90AHA $149.00**
  - Battery Weight : **18 x 63 lbs = 1,134 lbs** — **(144V/3.2V=45) x 6.6 lbs = 297 lbs 73.9% lighter**
  - Battery Cost : **18 x $157 = $2826** — **45 x $149.00 = $6,705.00**

What kind of batteries do I use?

- Flooded Lead Acid, it’s cheap, it’s available, it doesn’t require anything special. Requires watering. High capacity, lower power.

Sealed Lead Acid

- AGM (Absorbed Glass Mat) – High Power and maintenance free. Requires BMS and special charger.
- GEL – Low Power, long life. Requires BMS and special charger. Best for modest power high voltage systems.

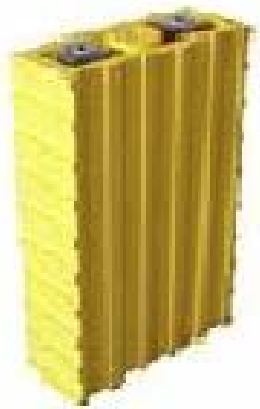
Nickel Based Batteries

- Nickel Cadmium – Extremely high up front cost, but over their 30+ year lifetime will be cheaper. Limited availability and a nightmare to dispose of at the end of their life due to heavy toxic cadmium.
- Nickel Metal Hydride –

Chevron Says No! Don’t perform well in heat.

Lithium! The Holy Grail?

- It is coming and soon!
- So many types of lithium batterie there will be little if any patent issues.
- Lithium Cobalt – catches fire if punctured.
- Lithium Iron Phosphate (LiPoFe) – Minimal fire danger.
  - Will require special charger and sophisticated BMS to monitor each cell.



Sources:

- http://www.evalbum.com/build.html
- http://www.diyelectriccar.com/forums/showthread.php?t=669