

Building an Electric Car



A Little History

- The early 1900s
- EVs held the land-speed record, and had greater range than Gasoline cars
- Gasoline was cheap (1/cent litre), electricity was expensive (20 cents/kWh)
- The Model-T was powered by Gasoline
- 100 years of development
- Gasoline cars are an accident of history

My EV

- 1991 Daihatsu Charade
- 10-50 kW electric motor
- 12 lead acid deep cycle batteries (144V, 75AH)
- 50 km range, out accelerates original car
- conversion cost \$14,000 (\$6,000 - \$25,000)
- 300-400 hours work (mechanical dummy)
- It really works!

EVs compared

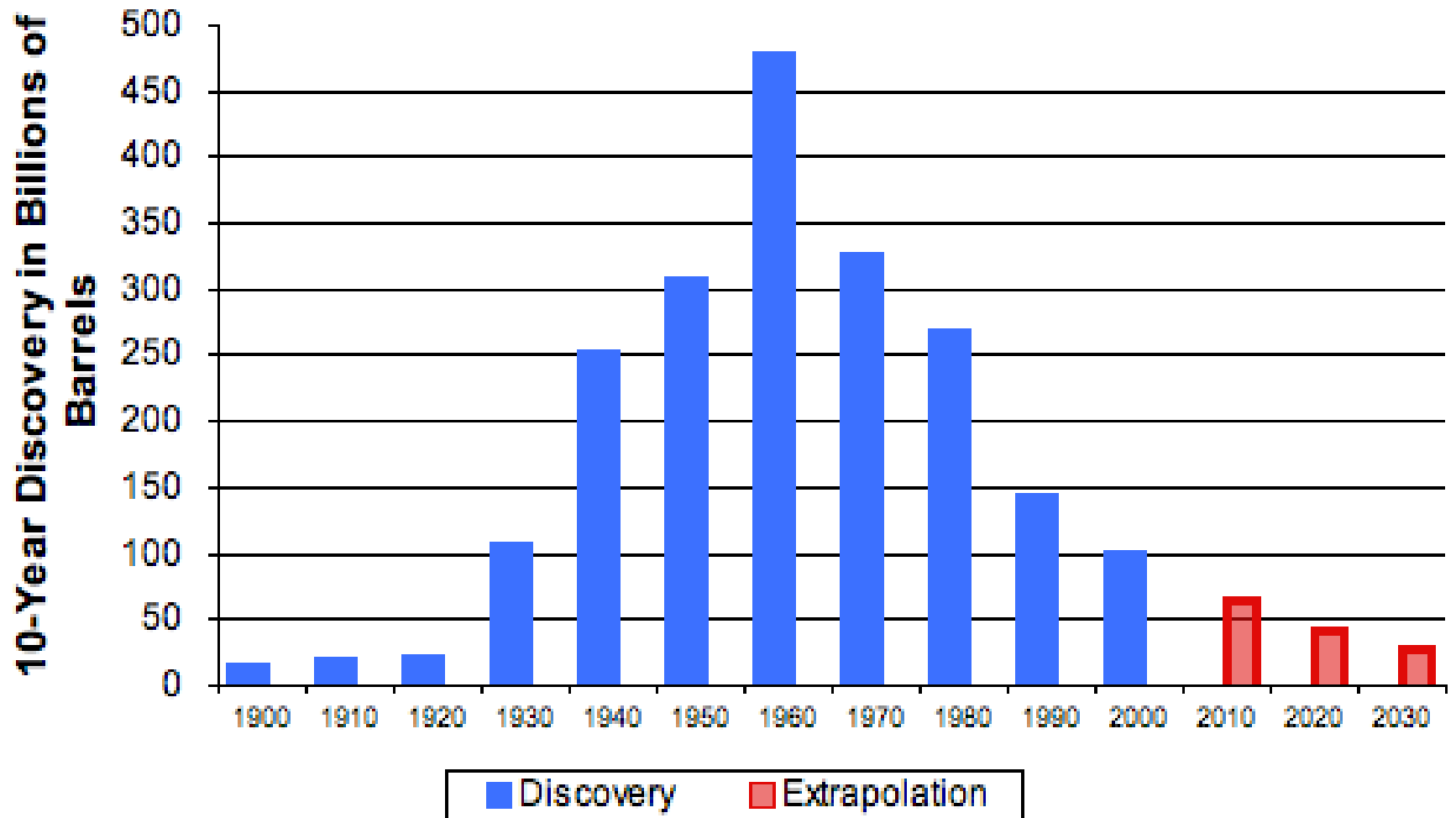
- 1 moving part
- low maintenance
- 90% efficient
- heavy
- 50-150km range
- clean
- renewable fuel
- 1000 moving parts
- regular maintenance
- 15% efficient
- light
- 400km range
- dirty
- non-renewable

Peak Oil

- The term “Non-renewable” has become a cliché
- It means this: one day it is going to stop
- Before then it will get scarce and very expensive
- If we really depend on that resource, it is going to really really hurt.
- Australia 1 Mb/day, world 85 Mb/day, 31 Bb/yr
- growth Growth GROWTH

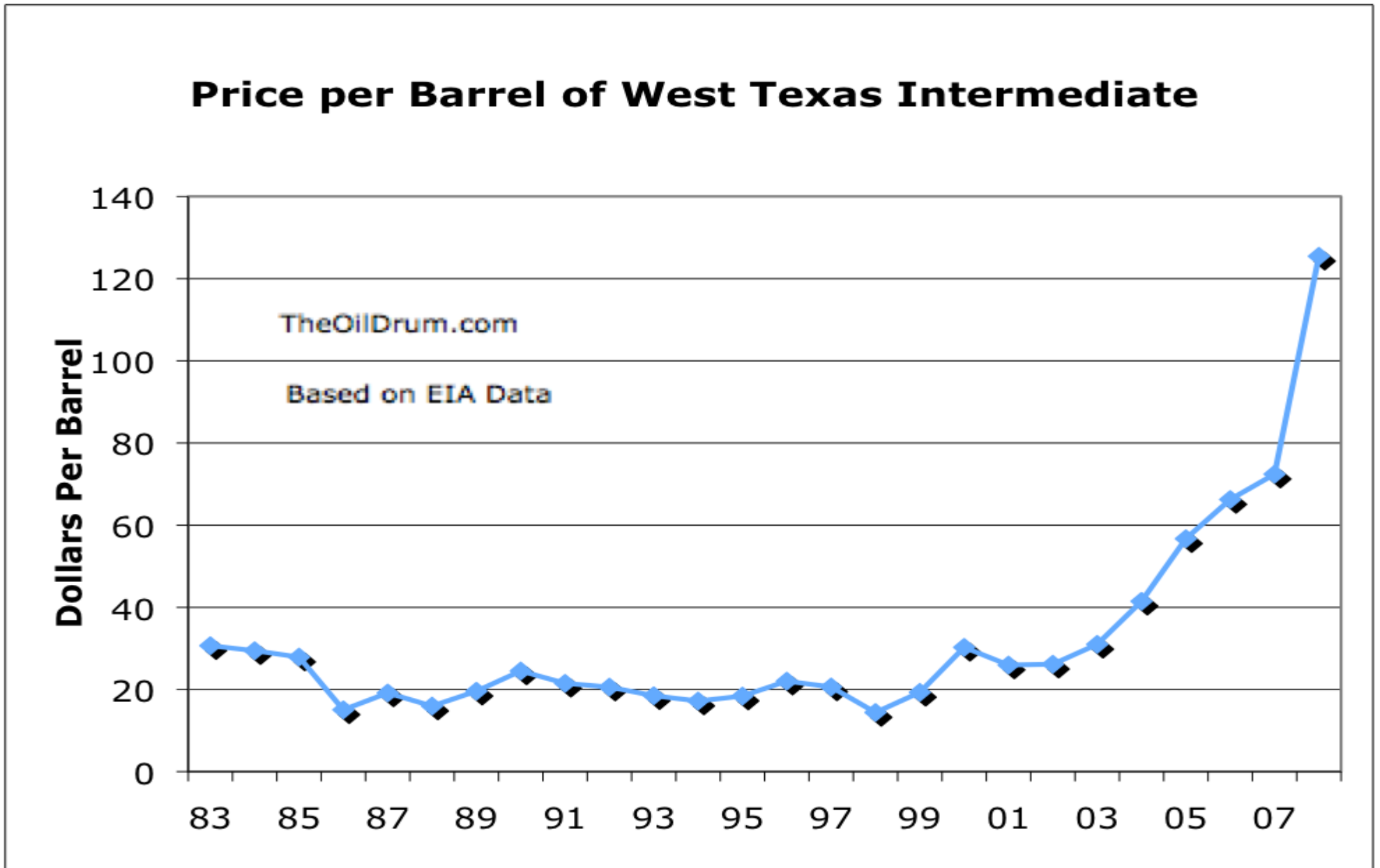
Peak Oil

Oil discoveries have been declining since 1964



Note: World oil discovery over 10-year periods, by Association for the Study of Peak Oil and Gas.

Peak Oil



Best Thing About EVs

The Fuel is made **right here** in South Australia (in fact on my roof)

Parts for a Conversion

- Electric Motor (\$1,900)
- Batteries (\$5,400)
- Speed Controller (\$2,100)
- Charger (\$1,000)
- Adapter Plate & Coupling (\$1,500)
- Vacuum pump, metal stock, welding cable
- Not counted (Donor car, tyres, brakes, tools)

Challenges

- Low skill level with cars
- Welding
- Electrical engineering
- EVs
- Great community, just like open source
- Web resources
- Everyone is fascinated (mechanics, friends) and helpful

Adaptor Plate



Build Battery Racks



Under the Bonnet



Under The Bonnet



Charging



De-Misting



De-Misting



Batteries

- Most EVs to date have used lead-acid batteries
- Reliable, well understood, low-moderate cost, robust to charging errors.
- But heavy and poor cycle life
- Many EV conversions in progress are now using Lithium batteries
- Light and high cycle life
- higher capital cost (but better life-cycle cost), special care when charging

Debugging an EV

- Testing batteries, 12V @ 250A (3.6kW) kettle!
- Lots of torque, needed a new clutch
- Height, new rear springs
- Short to chassis – broken brush clip spring

Testing Batteries



Broken Brush Clip



Technical

- Acceleration: $144V$ at $330A = 47kW$
- Cruises at 58 km/hr using $37A$ ($5.3kW$)
- I average 15 km/day, uses $3kWh$ at the wall to charge (60 cents)
- “Economy” is 200 Wh/km
- Curb weight $1060kg$ up from $820kg$ (GVM 1240). Payload is 2 adults or 1 adult plus 2 kids
- $12V$ system charged from DC-DC converter

Driving an EV

- Power and Torque reverse of petrol engine
- Maximum torque at stall, so quick off the line
- Then power drops off as speed increases
- Quiet but not silent. Weird at traffic lights
- Charging more convenient than petrol station
- Start in 2nd, change to 3rd at 40 km/hr
- Really notice stink, waste and expense of petrol cars

Registration

- Around 5 registered EVs in S.A.
- Information Bulletin 74
- Full road worthiness inspection (painful)
- Demisting, braking system, weight, weight distribution, 12V system, wiring standards
- Ventilation and sealing of batteries
- Depends on Inspector on the day

Running Costs

- Very cheap per km (4 cents), 10% of petrol car
- Very little maintenance
- Dominated by cost of batteries, lead acid need replacing every few years.
- Roughly the same as a petrol vehicle in 2004
- Improving as we understand more about battery care
- Improving with better batteries
- Batteries 95% recyclable (try that with petrol)

Business Opportunities

- I can build an EV for one third the cost of a Prius and my EV uses no petrol.
- What could a real business (like Holden) do?
- Based on the simplicity EVs should cost 50% of a petrol car
- “EV conversion business” like LPG: \$6,000 conversions
- Batteries, electronics, mass production, export
- \$10B could convert 2M cars

EV Resources

- Australian Electric Vehicle Association (AEVA)
- Electric Vehicle Discussion list (EVDL)
- Lots of great conversion blogs
electric-echo.com
kiwiev.com