



Introduction

Personal

- Environmental engineer and owner of a Nissan Leaf EV for 6 months
- Active family of 4, two young kids
- Have had an active interest in EVs for several years

EVs/PHEVs

- EV = electric vehicle, battery only
 - Sometimes known as a BEV (battery EV)
- PHEV = plug-in hybrid electric vehicle
 - More limited range, but typical daily driving patter = can drive on electricity majority of the time

Commuting Mode Hierarchy

Where does an EV fit in?

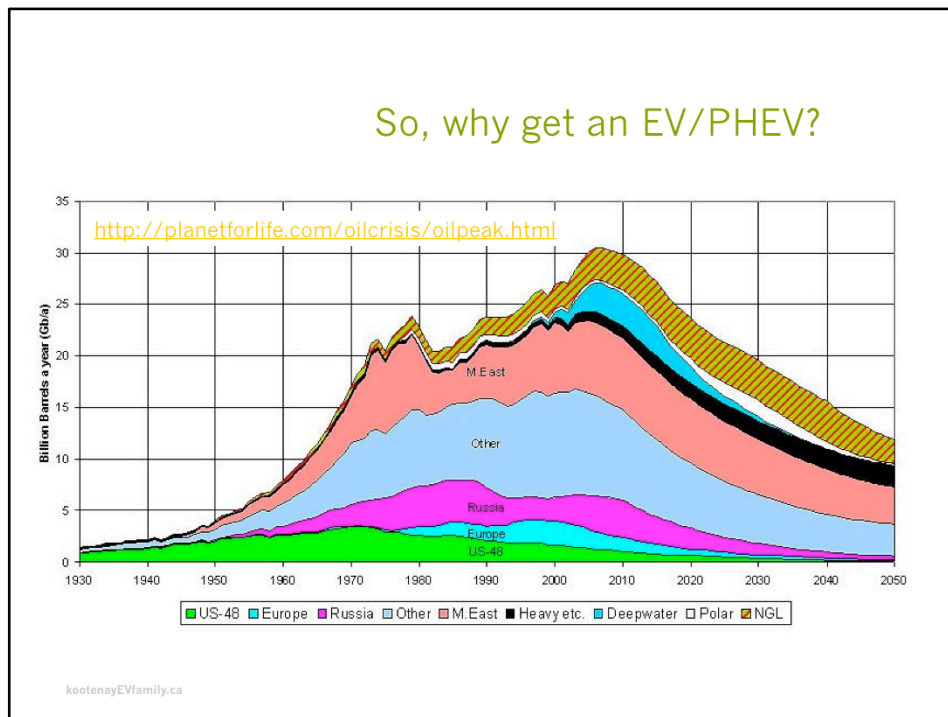
- Biking, e-biking, walking
- Taking the bus
- Car pooling in an EV/PHEV
- Single occupant in EV/PHEV
- Car pooling in hybrid/small car
- Single occupant hybrid/small car
- Typical cars



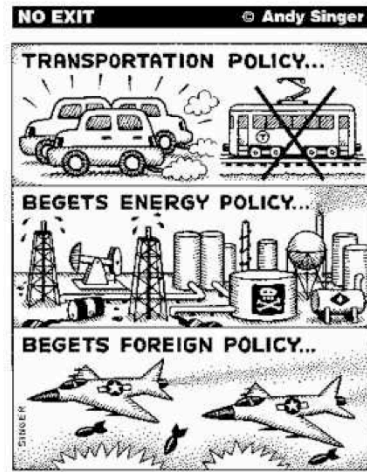
kootenayEVfamily.ca

Biggest choice you can make is to live close to where you work or go to school. EVs are a big improvement over typical cars and even hybrids, but ultimately our society needs to better embrace alternative transportation to personal vehicles.

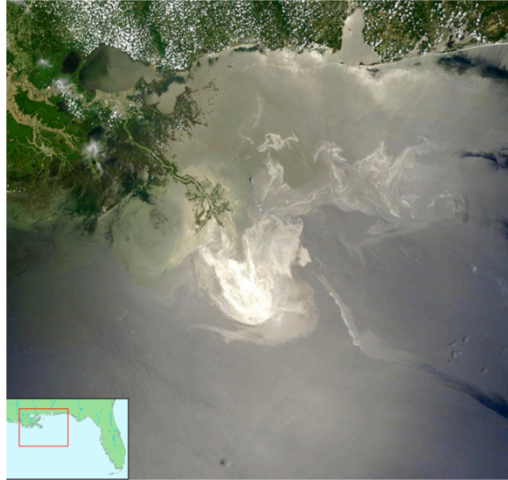
So, why get an EV/PHEV?



The following slides show a few negative images associated with conventional cars. Peak oil is the concept that despite the large amount of oil remaining in the ground, it is getting harder to produce and we will reach a peak in oil production – most estimates put us at or near the peak now (or even as early as 2005, depending on how you define 'peak'). The end result of this is that society will have to adapt to less availability of petroleum fuel, which affects much more than just driving your car, since the industrial food system uses 10 calories of energy for every 1 calorie it produces!



Foreign Wars to Secure Oil Supply
<http://www.lysistrataproject.org/oilandwar.htm>



Deepwater Horizon Oil Spill

http://en.wikipedia.org/wiki/Deepwater_Horizon_oil_spill



Canadian Oilsands

<http://www.ctvnews.ca/canada/oilsands-plant-spills-waste-water-into-river-1.1212729>

EVs because...



- Driving quality is better than hybrids or conventional cars
 - Quicker acceleration, very smooth, and quiet
- Convenient 'fueling' (plug in at home)
- Less maintenance
- Potentially democratic fuel source and decentralized
- EVs are inherently more energy efficient
- Electricity can get cleaner, oil is only going to get 'dirtier' and harder to extract

kootenayEVfamily.ca

The positives for driving an EV

- Quicker because electric motors provide all of their torque right away
- Smoother because there is no transmission lurching around
- Quiet – there aren't any explosions happening under the hood of your car; only a handful of moving parts instead of thousands!
- Less maintenance because there are less moving parts and no regular fluids to change (aside from brake fluid)

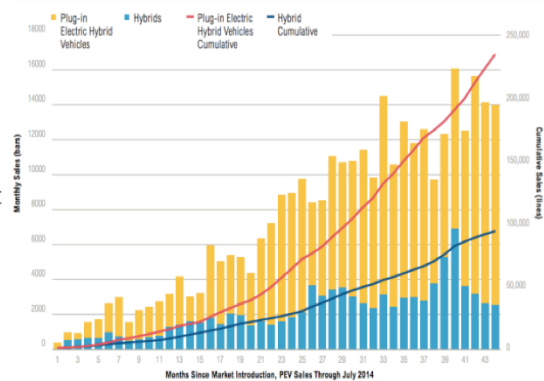
How well are EVs selling?



■ EV/PHEV vs Hybrids

- As of Sep 2014, approx. 600,000 worldwide (<http://cleantechnica.com/2014/10/23/sales-of-plug-in-cars-exceed-600000-worldwide/>)
- Existing worldwide fleet estimated at ~750 million, with ~80 million produced every year

Figure 3.4 | The Uptake of Electric Vehicles Has Been Faster than the Uptake of Hybrid Vehicles



<http://evobsession.com/electric-car-sales-growing-much-faster-hybrid-sales-chart/>

kootenayEVfamily.ca

Graph I believe is supposed to be for both BEV and PHEV

EVs and PHEVs Available



10

EVs

- BMW i3
- Ford Fusion
- Kia Soul
- Mitsubishi i-MiEV
- Nissan Leaf
- Tesla Model S and Model X (2015)
- Volkswagen E-Golf (US only right now, late 2014)

PHEVs

- BMW i3 Rx
- Chevrolet Volt
- Ford C-Max Energi and Fusion Energi
- Mitsubishi Outlander (late 2015)
- Via Motors Silverado Truck and Express Van (fleet only)
- Volvo XC90 (2015)

Other vehicles that are being electrified



■ Electric bus (city and school)



kootenayEVfamily.ca

■ Small utility vehicles



School bus under development in Quebec, range ~80km, on a trial route this fall, expected availability is 2015. Saves 8,000L diesel annually and expected \$15,000 annual in operating cost. <http://www.lechodelaval.ca/actualites/societe/185937/le-premier-autobus-scolaire-electrique-a-lessai-a-laval>

City bus by BYD has done numerous trials and is now selling commercially, range >200km, recharge in 3-6hr

Canev is a Vancouver Island company, around 20 years, converts Ford Rangers and also builds these two vehicles

How far can EVs go?



- Numerous factors that impact range:
 - Battery size!
 - Elevation changes
 - Speed
 - Outside temperature (i.e. HVAC use)

Elevation effects on efficiency

	Distance (km)	Efficiency (km/kWh)	Energy Used (kWh)
Trail to Rossland	10	2.6	3.85
Rossland to Trail	10	-	-1
Trail to Rossland (round)	20	7.0	2.85
Similar distance on flat ground	20	8	2.5

Range (km)	Typ. PHEV	Typ. EV	Model S
Minor hills, -10C	25 - 50	90 - 120	350
Minor hills, +20C	30 - 60	120 - 150	425
Flat, max range	40 - 80	140 - 180	500

kootenayEVfamily.ca

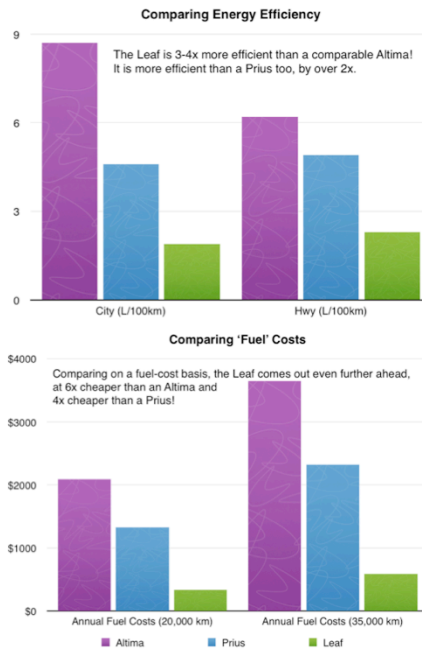
Typical EV has a battery size of 20 – 30 kWh (the next generation will have 50% more capacity, coming out in around 2017ish)
 Typical PHEV 8 – 12 kWh
 Model S 85 kWh

Efficiency

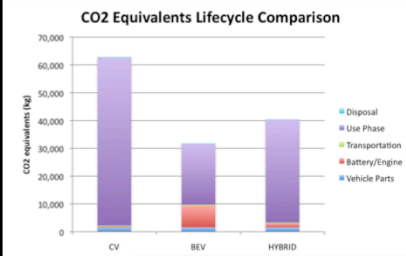
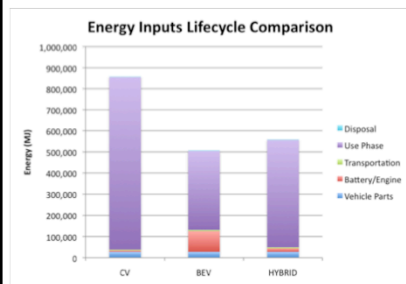


13

kootenayEVfamily.ca



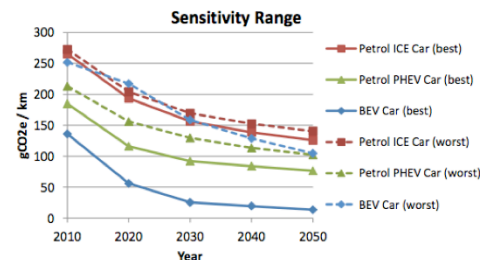
Lifecycle Analysis



"Lifecycle Analysis Comparison of a Battery Electric Vehicle and a Conventional Gasoline Vehicle", Aguirre et al for CARB, June 2012

kootenayEVfamily.ca

- Manufacturing battery currently consumes the most energy and emits most emissions
 - Expected to improve dramatically
- The CO2 noted for energy use is based on a mix:
 - Left graph, California mix, 7% coal, 14% nuclear, 42% natural gas, 25% renewable
 - Right graph, UK mix (not noted in study; however, www.carbonbrief.org notes UK mix as 66% fossil fuel, 21% nuclear, 12% renewables for 2013)



"Life-Cycle Assessment for Hybrid and Electric Vehicles", Hill for LowCVP Annual Conference, July 2013

<http://www.ncardo-aea.com/cms/assets/Documents/for-Insight-pages/Transport/08-LowCVP-conference.pdf>

Lifecycle analysis are notoriously hard to conduct, but the two quoted above are quite thorough and generally agree with each other in the conclusions. A BEV/PHEV operated on electricity is the best you can do. (Aside from walking, biking!)

Charging

15

Type of Charging	Level 1	Level 2	Level 3 (Quick Charge)
Range gained per hr	5 – 8 km	20 – 40 km (20 – 90 km)	90 – 120 km (200 – 270 km)
Electrical	120V, 15 – 20A	240V, 15 – 80A	>400V, >100A
Where	Almost anywhere!	Home, commercial, public spaces	Public (in BC)
Useful for...	Overnight charge for commute, opportunity charge	Long commutes, errands into adjacent town, intra-regional travel (with patience)	Intraregional travel for today's cars; inter-regional (e.g. to Vancouver) for future

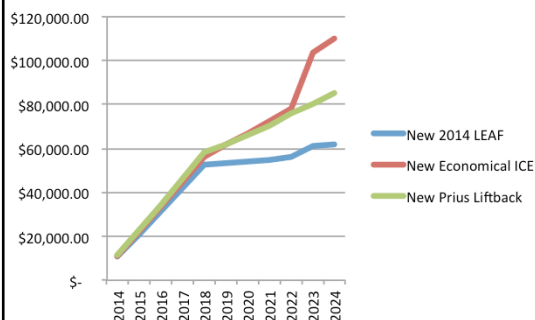


Model S range is in italics

Level 1 and 2 use the same plug, called a J1772 connector

Level 3 is in a bit of a standards war right now with CCS and CHAdeMO, though new charging stations are coming with both. Then there is the Tesla Supercharger.

Personal Costs and Savings



My projections based on my yearly driving of 35,000 km

kootenayEVfamily.ca

Actual Costs for first 6 months:

- One time, \$1800 for Level 2 charger in my carport (not needed if commute < 60km)
- \$195 for electricity (\$32.5/month)
- Fuel savings, \$1920 (\$320/month)
- Regular maintenance avoidance savings, \$200 (two oil changes)
- Car payment, \$660/month for 'S', \$820/month for 'SL'

I didn't include the Volt b/c the cost savings vary dramatically for all PHEVs based on your regular driving day and the all-electric range; more in-depth analysis than I can present today

Because of my commute length, I save money from day 1 by driving a Leaf over either a hybrid or a conventional car

This includes schedule maintenance, fuel costs, assumes financing **comparably equipped** cars for 5 years, battery replacement on both the hybrid and the Leaf, and a new conventional car after 300,000km

Deciding between EV or PHEV



17

Consider an EV if...

- You commute between 10 – 40km and have no plug at work (up to 80km if you do)
- Your living situation already requires two vehicles
- Or, if you want only one vehicle, the idea of renting for road-trips is fine (or join the car co-op!)

Consider a PHEV if...

- You would prefer to remain a single-car family and occasionally take road trips
- Your commute fits entirely (or close to it) within the electric-only range
 - This maximizes the financial return

kootenayEVfamily.ca

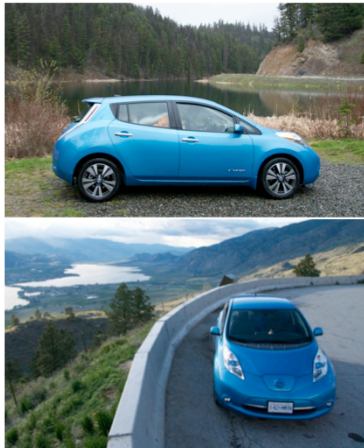
One-way distances

Road trips with an EV



18

- I drove from Vancouver to Nelson



kootenayEVfamily.ca

- Short road trips possible now, Nelson to New Denver, to Kaslo, to Nelson



- Future regional trips with a few key chargers in other towns
 - Nelson to Kelowna currently, about 24 hours
 - Nelson to Kelowna with upgraded infrastructure, about 7.5 hours
 - Compared with gas car now, about 5.5 hours

Vancouver to Nelson: the Leaf is not suited for this type of trip unless you have lots of patience! As we get more/better charging infrastructure, this will change. I will create a post detailing the journey for the blog.

Questions?

kootenayEVfamily.ca
Electric vehicle tidbits
and adventures in the
Kootenays

Andrew Chewter
achewter@gmail.com
**Electric Vehicle
Enthusiast**



kootenayEVfamily.ca