

May 3rd, 2015

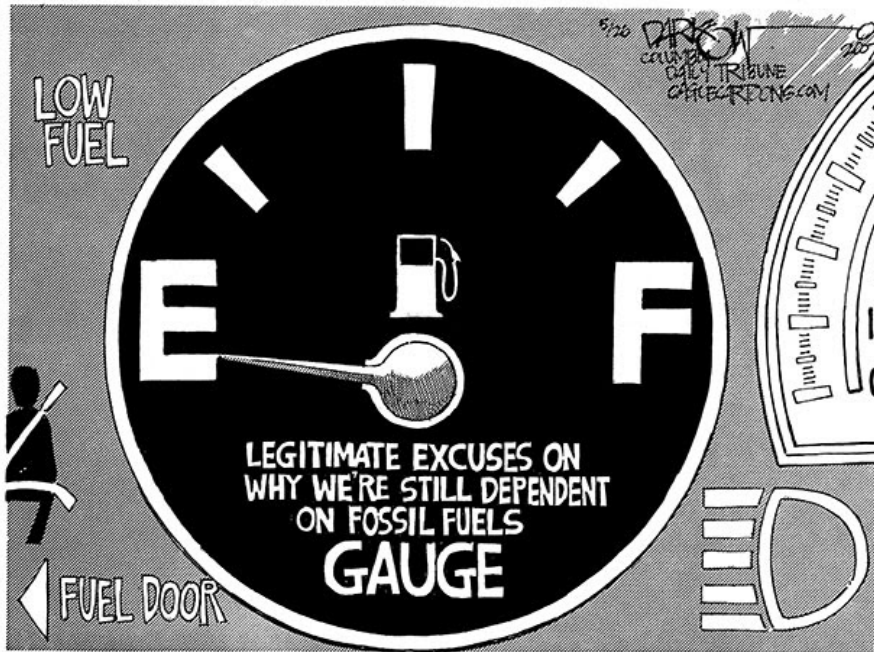
Electric Vehicle Support: Why it Matters

By Jay Donnaway, CEM
Sumner School District

Who Cares? Apparently *EVERY*body.

Whether an
impatient Lefty,

Or a knee-jerk
Conservative,



Who's this guy and why does he care so much about EVs?

- Certified Energy Manager, grew up in the oil patch, witnessed a lot of death and destruction.
- Passionate Car Guy, rebuilder since high school.
- For a torque addict, EVs offer the most. Period.
- For a tree hugger, EVs are the best option in personal transportation, and also for mass transit.
- EVs offer both cost savings and economic growth
- You can have your wheels, and smoke 'em too!

With Special Thanks to JJ McCoy, Tonia Buell, Peter Moulton, Andrea Pratt, and many others statewide for sharing their slides, research, and ears.

Glorified Golf Carts?

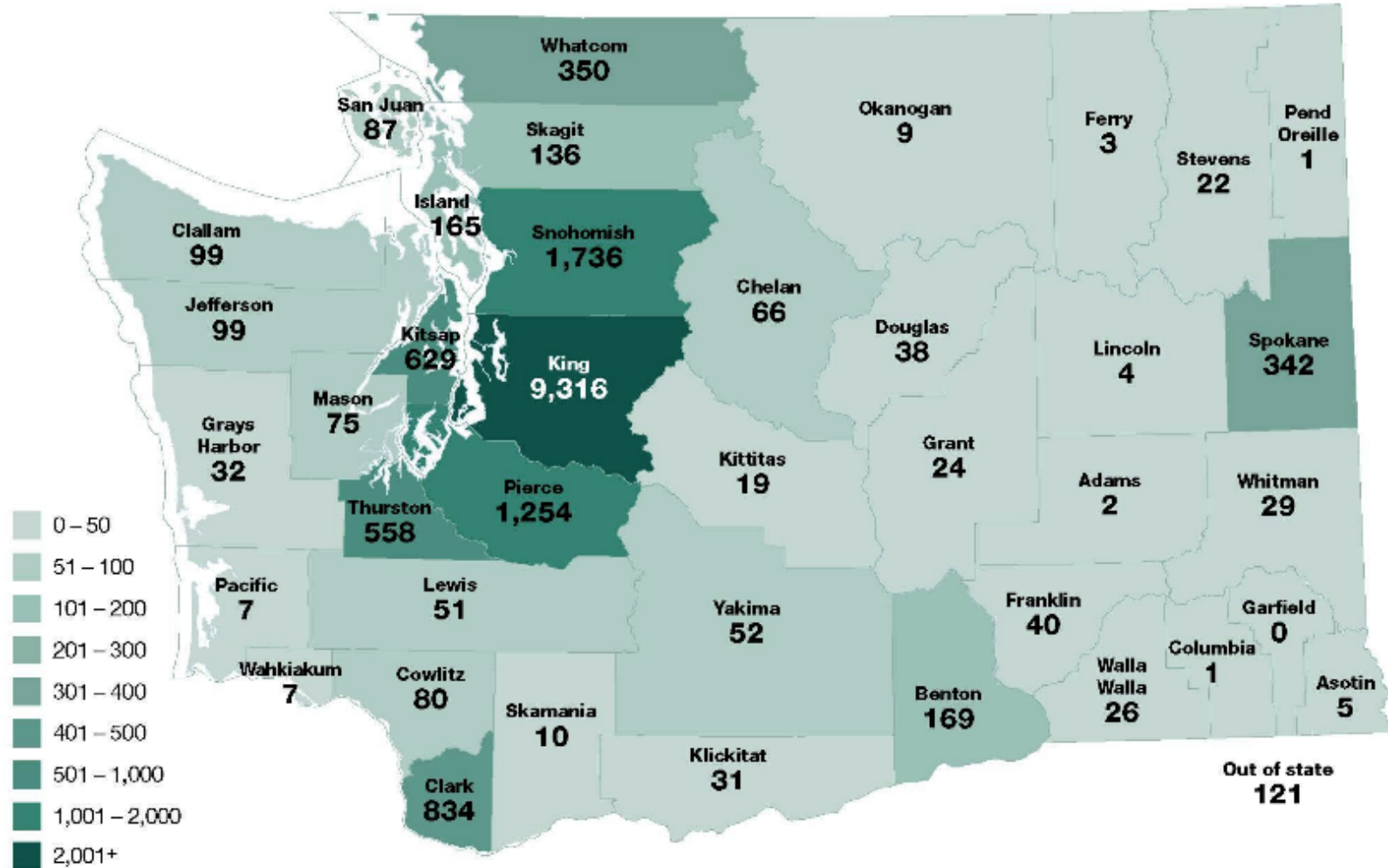


First away from EVery red light (without sounding like a jerk). Tighter cornering due to a lower center of gravity, and it just gets better due to the flat torque curve from a 13,000 rpm motor.

Links to performance EV videos <https://www.youtube.com/watch?v=KrNXB1Ck8GU>

16,529 Plug In Electric Vehicles Registered in Washington

As of December 31, 2015



Map includes Electric Vehicles (EVs) produced by major automakers since about 2011. It does not include cars that were converted to EVs by their owners, neighborhood EVs or EV models from the 1990's that are still registered in Washington, or motorcycles. WSDOT created this map based on data provided by the Washington State Department of Licensing.

PLUG-IN CAR BASICS

- ▶ Battery Electric Vehicles (BEVs)
- ▶ Plug-in Hybrid Electric Vehicles (PHEVs)

Level 1 Charging

$120V \times 12A = 1.4 \text{ kW}$ charge rate
Provides 3-4 miles range per hour of charging.
Free. Standard wall plug.



Level 2 Charging

$240V \times 30A = 6.6 \text{ kW}$ charge rate
Provides 20 miles of range per hour of charging.
\$1000 - \$4000 installed. Dryer plug.



Level 3 DC Fast Charging

$500V \times 100 A = 50 \text{ kW}$ charge rate
Can provide 65 miles of range in 30 minutes.
Dueling standards. **\$90,000+ installed.**



There are Frequently Mythologized Questions

- Green Or Not? Battery, "Long Tailpipe", Materials, Transportation, Imbedded Energy
- Patriotic Or Not?
- Convenient Or Not? (Recharging and Range)
- Expensive Or Not? (Purchase vs Operating Cost)
- Fun to drive Or Not? (Riding a Rocket or a Slug?)
- Growing Market or Not? (Dealer and Consumer Issues)
- Tax Credits and Depreciation vs Leasing
- Do Evs lead to other questionable activities?

A Question of Greenness

- Battery Materials Must Be Mined and Transported Great Distances
- Electricity is not always produced in a green manner, what if you have a 'coal-fired EV'?
- You still need a gas or diesel car for long trips, so how are 'more cars' a good thing?
- Shouldn't we be focusing on, Density, Transit and RideSharing?
- A new car's embodied energy is 76 000 kWh – so if you get one every 10 years, that's an average energy cost of 21 kWh per day. Driving an EV 50 miles uses about 12.5 kWh.
- Carbon Fiber and Aluminum= energy-intensive?



REDUCED GHG EMISSIONS

- GHG is a function of miles traveled and miles per gallon
- MPG is a function of vehicle economy and driver behavior

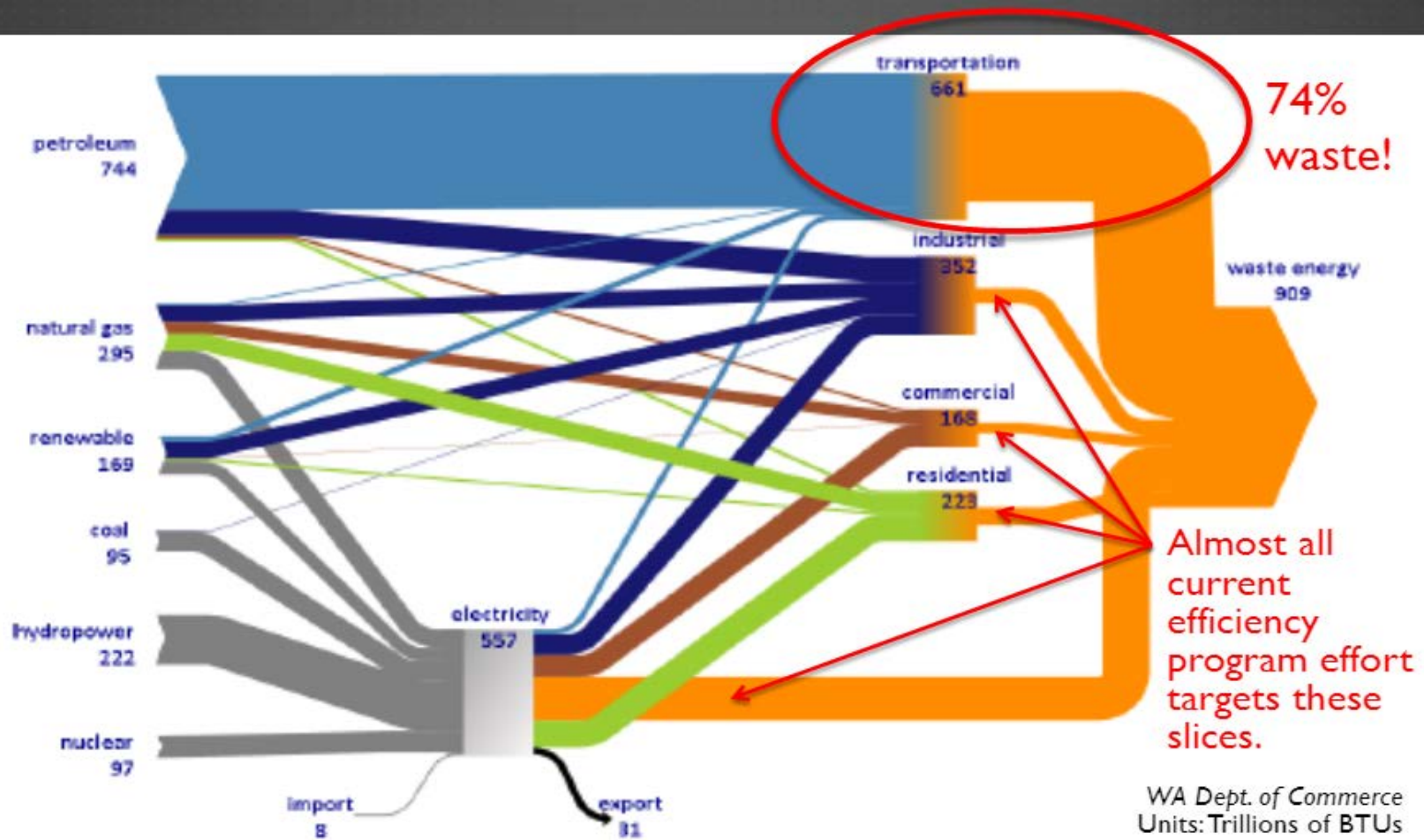
Actual fleet data assuming 5,422 miles per year:

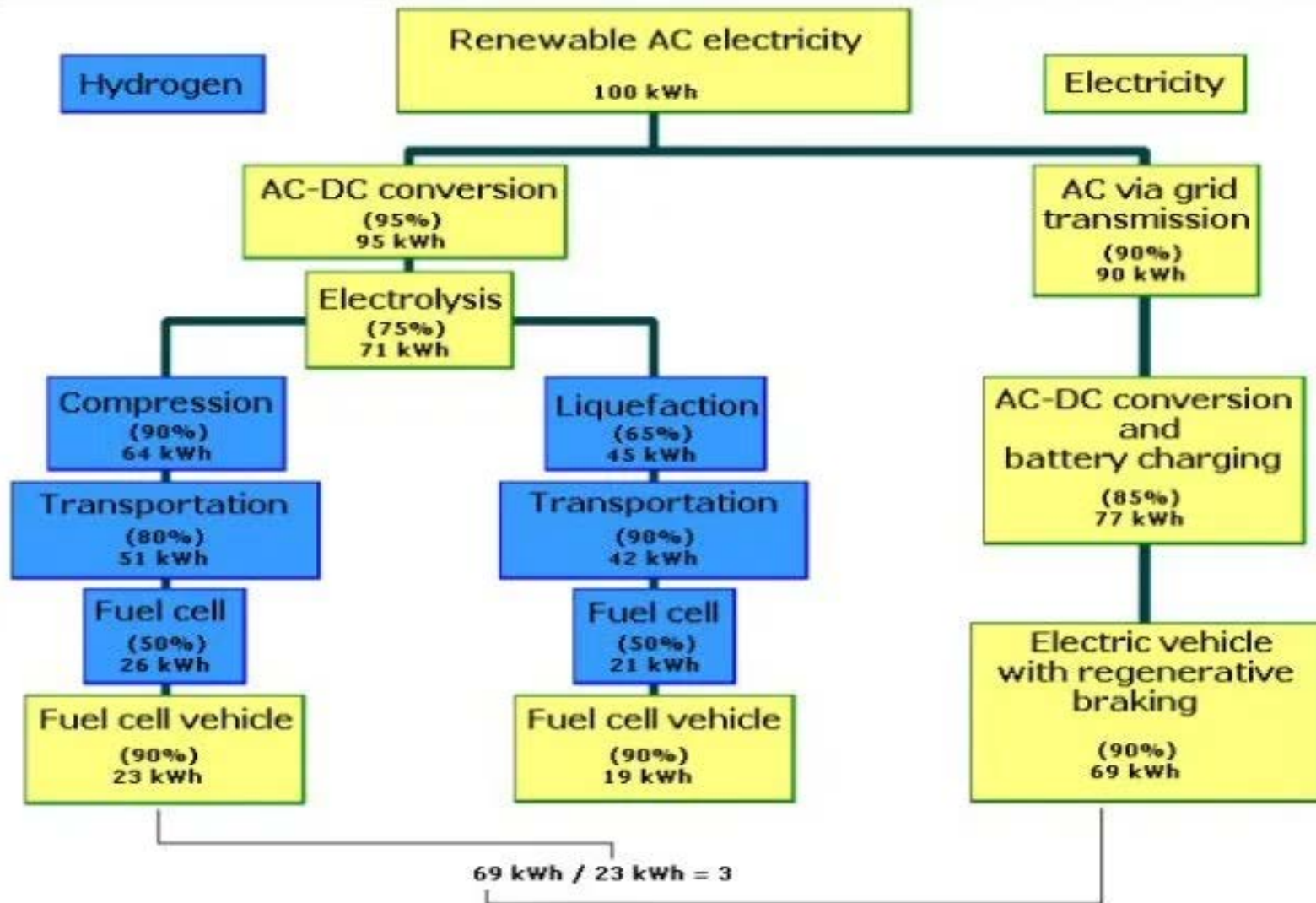
Make/Model	Type	Avg MPG	tCO ₂ *
Ford Escape	SUV	17.7	3.46
Toyota Prius	Hybrid Sedan	41.1	1.49
Ford CMAX	Hybrid Sedan	26.8	2.29
Nissan Leaf	BEV Sedan	0.46 kWh/mi	0.03

**Based on CARB LCFS CI values and Seattle City Light 2012 retail power emissions factor*

Replacing hybrids or SUVs with BEVs = 98-99% GHG reduction /vehicle

EVs PRESENT THE LARGEST POTENTIAL EFFICIENCY GAIN IN OUR ENERGY SYSTEM





Electric is 3x more efficient than Hydrogen!!!

A Question of Patriotism?



My Truck Burns the
Gas Your Prius
Saves.



: DESTROYING
the environment...
One battery at a time



**DRILL
BABY
DRILL
.COM**

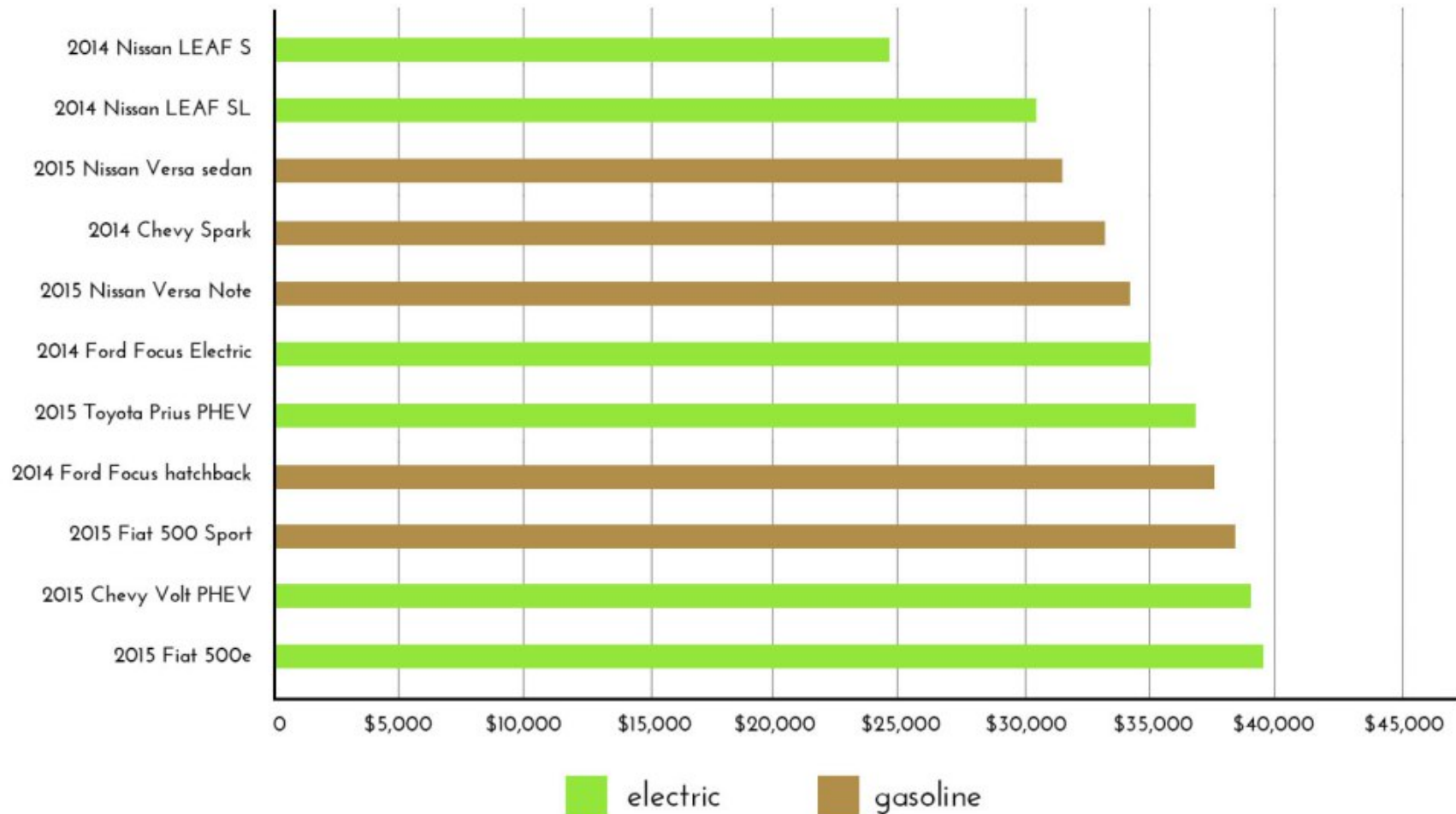


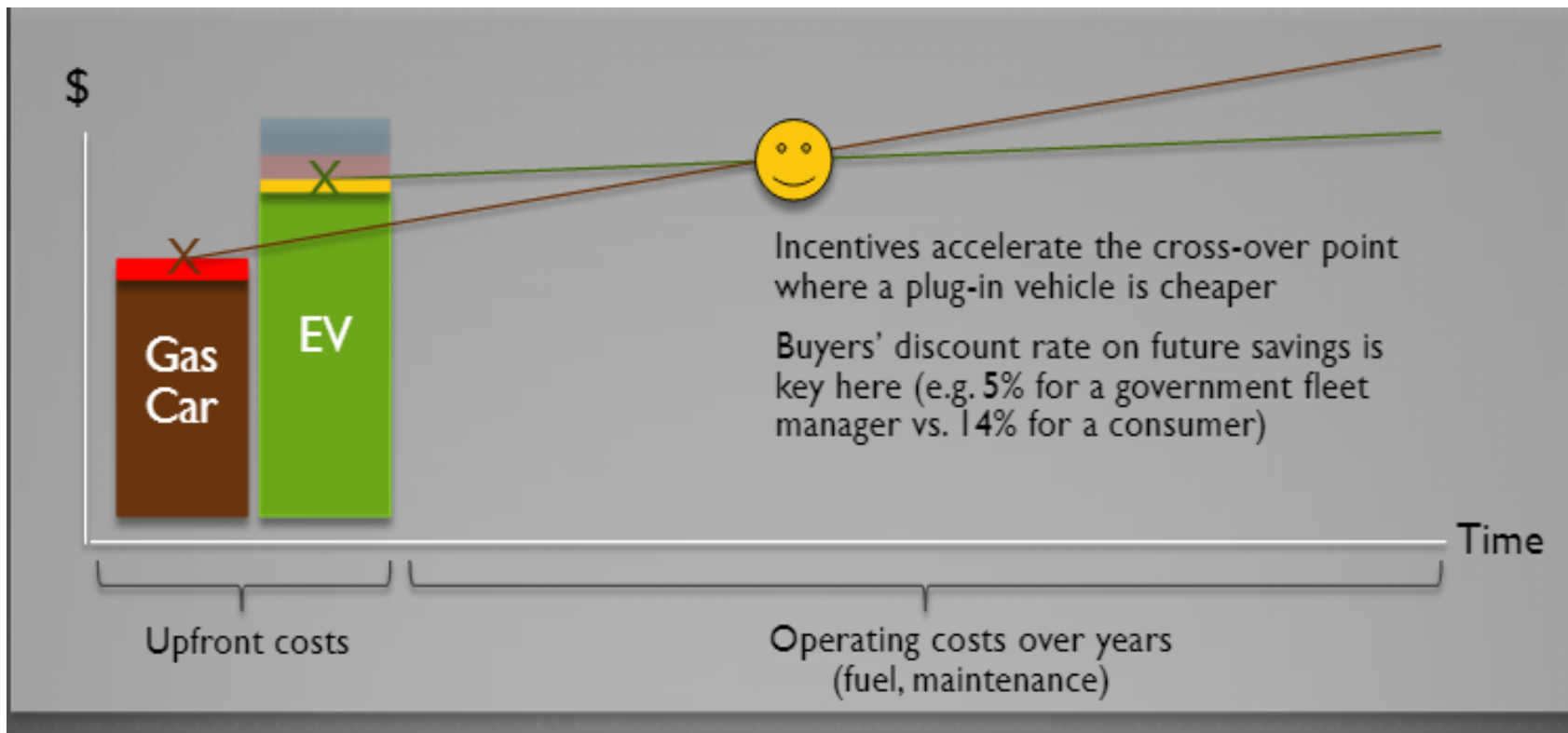
Silent but
NOT Deadly



A Question of Cost

Five-Year Cost of Ownership for Selected Electric Vehicles and Gasoline Cars





Upfront cost for gas car (left):
Operating costs:

Purchase price + **sales tax**
Fuel costs of 8-20 cents / mile + oil changes, etc.

Upfront cost for EV (right):

Purchase price after **federal income tax** and **state sales tax incentives** + **charging station purchase and installation**

Operating costs:

Fuel cost of 3 cents / mile and almost no maintenance.
Battery replacement in 7+ years is a major expense.

Costlier to Buy, Cheaper to Drive

Dollar Cost of Driving 15,000 Miles

Location	Electric Car	50 MPG Hybrid Car	30 MPG Gasoline Car
Phoenix	\$491	\$816	\$1,360
San Francisco	647	936	1,560
Boulder	490	801	1,335
Miami	487	792	1,320
Boston	613	804	1,340
Detroit	529	828	1,380
Nashville	397	756	1,260
Houston	500	777	1,295
Seattle	345	897	1,495
Washington, DC	593	840	1,400

REDUCED OPERATING COSTS

$$\text{TCO} = \text{Acquisition} + \text{Life Fuel} + \text{Life Maint.} - \text{Salvage}$$

Type	Description	Life	Acq.	Fuel	Maint.	Salvage	TCO
Gas	Ford Focus	10 yrs	\$21,284	\$8,000	\$11,790	\$6,811	\$34,263
Hybrid	Toyota Prius	10 yrs	\$28,773	\$4,000	\$6,890	\$9,207	\$30,456
EV	Nissan Leaf	10 yrs	\$32,466	\$1,872	\$6,030	\$10,389	\$29,979
EV*	<i>Nissan Leaf</i>	<i>10 yrs</i>	<i>\$21,649</i>	<i>\$1,872</i>	<i>\$6,030</i>	<i>\$10,389</i>	<i>\$19,162</i>

*Incentives included: Washington State sales tax exemption & Nissan Corporate \$8000 fleet discount

Fleet operating cost for 150 passenger sedans:

ICE Sedans:	\$5,139,419
BEV Sedans:	<u>\$2,874,300</u>
Savings	\$2,265,119

A Question of Convenience?

Model	Base price after tax credit	Electric range (miles)	Total range (miles)	MPGe (electric)	Top speed	Hours to charge, 120V	Hours to charge, 240V
Mitsubishi MiEV	\$21,625	62	62	112	80	23	7
Nissan Leaf	\$27,700	73	73	99	93	20	7
Honda Fit Electric	\$29,125	76	76	116	92	15	3
Toyota Prius Plug-In	\$29,500	12	540	95	112	3	2
Chevy Volt	\$31,645	35	379	93	100	10	4
Ford Focus Electric	\$32,495	76	76	105	84	20	4
Tesla Model S 40 kWh	\$49,900	125*	125*	108	110	?	~5
Tesla Model S 60 kWh	\$59,900	187*	187*	89*	120	?	~7.5
Tesla Model S 85 kWh	\$69,900	265	265	89	125	?	~10

LESSONS FROM THE HYBRID ROLL-OUT OF THE 2000s

Several published papers using regression analysis on state- and province-level (Canada) hybrid car adoption rates tell us that:

- ▶ Gasoline price / fuel savings is the largest and most consistent driver of alt vehicle adoption.
- ▶ Purchase price incentives (federal, state, local) play a significant role. These can take the form of rebates, income tax credits, sales tax exemptions.
- ▶ HOV lane access for zero emission vehicles may help. Data somewhat equivocal.
- ▶ Demographic factors (income, environmental concern, energy security concerns) also matter.

Highest & Lowest Percentage of Registrations Coming from EVs: Jan-Nov 2013					
Rank	State	EV Market Share	Rank	State	EV Market Share
1	Washington	1.6%	42	Oklahoma	0.1%
2	Hawaii	1.6%	43	Alabama	0.1%
3	California	1.4%	44	Louisiana	0.0%
4	Georgia	1.1%	45	Wyoming	0.0%
5	Oregon	1.1%	46	Kentucky	0.0%
6	District Of Columbia	0.6%	47	West Virginia	0.0%
7	Utah	0.4%	48	Arkansas	0.0%
8	Colorado	0.4%	49	North Dakota	0.0%
9	Tennessee	0.3%	50	South Dakota	0.0%
10	Illinois	0.3%	51	Mississippi	0.0%

Source: Polk, Edmunds.com

Plug-In Car 20,000 Mile Operations Report for the Moore & McCoy Household

Nissan Leaf acquired in October 2012; Chevy Volt acquired in December 2012



	Nissan Leaf	Chevrolet Volt	Household Total
<u>Miles Driven</u>	9,650	9,938	19,588
Electric Miles	9,650	8,005	17,655
Gas Miles	-	1,933	1,933
% Electric	100%	81%	90%
Gallons of Gasoline Used	-	58	58
MPG	∞	171	337
Fuel Cost @ \$4.00 / gal (Premium required for Volt)	\$0	\$232	\$232
kWH Used	3,016	2,502	5,517
Fuel Cost @ \$0.1071 / kWH (City Light 2nd Tier Residential Rate)	\$323	\$268	\$591
Total Fuel Cost (Gas + Electric)	\$323	\$500	\$823
Fuel economy of prior cars (MPG) ¹	20	21	
Previous Fuel Use for Same Mileage, Gallons	483	473	956
Gallon Reduction by Switching to Plug-Ins	483	415	898
% Reduction in Gasoline Use	100%	88%	94%
Cost of Fueling Prior Cars (Regular Gas @ \$3.72/ gal)	\$1,795	\$1,760	\$3,555
Reduction in Fuel Cost Due to Plug-Ins	\$1,472	\$1,260	\$2,732
% Reduction in Fuel Cost	82%	72%	77%
# of Times Stranded with No Power	0	0	0
\$s Spent Shopping While Charging (IKEA, Burlington Outlet Mall, etc.)	More than we care to admit.		

¹ A 2005 Volvo S40 and a 2005 Acura TL

Auto Industry Approach to EVs



Profit-Maximizing Strategies

Volume

Basic profits by selling enough cars to cover both fixed and variable costs

Versioning reduces costs by increasing volume. This makes profits come earlier for volume cars, and reduces the costs of halo, conquest, and compliance programs.

Halo

Improving brand perception and driving store traffic

Conquest

Acquiring new customers that used to shop other brands

Compliance

Earning credits or rights to sell higher-profit cars



Current EV Offerings
Under \$35k



200 + miles for
\$35k, coming
2017-2018
Bolt vs Model 3



BMW i3 has WA content, 81
or 114 miles, \$42k, REX option



Tesla Model S- \$70 to \$120K, could still
be worth 2x the price of an average
police cruiser....

Worth Extra Consideration in Washington

Advanced Li-Ion Batteries

The 23 kWh Li-ion battery pack delivers up to 40-mile, zero-emission battery range.

Gas/Electric Generator

The economical 4.3L V6 GEN V combustion engine is used only when needed to generate electricity to automatically charge the batteries on the go.

VIA's Motor Controller

The 350 volt architecture provides the power density and economy required for a wide variety of trucks.

Payload and Towing

The VTRUX Extended Cab has a curb weight of 6,500 lbs and a fullsize bed, delivering a 1,000 lb payload capacity.

Power Export

Onboard 120 & 240 volt outlets
14.4 kw at 50 amps

VIA's 190 kW Peak (415 Nm) Electric Drive Motor

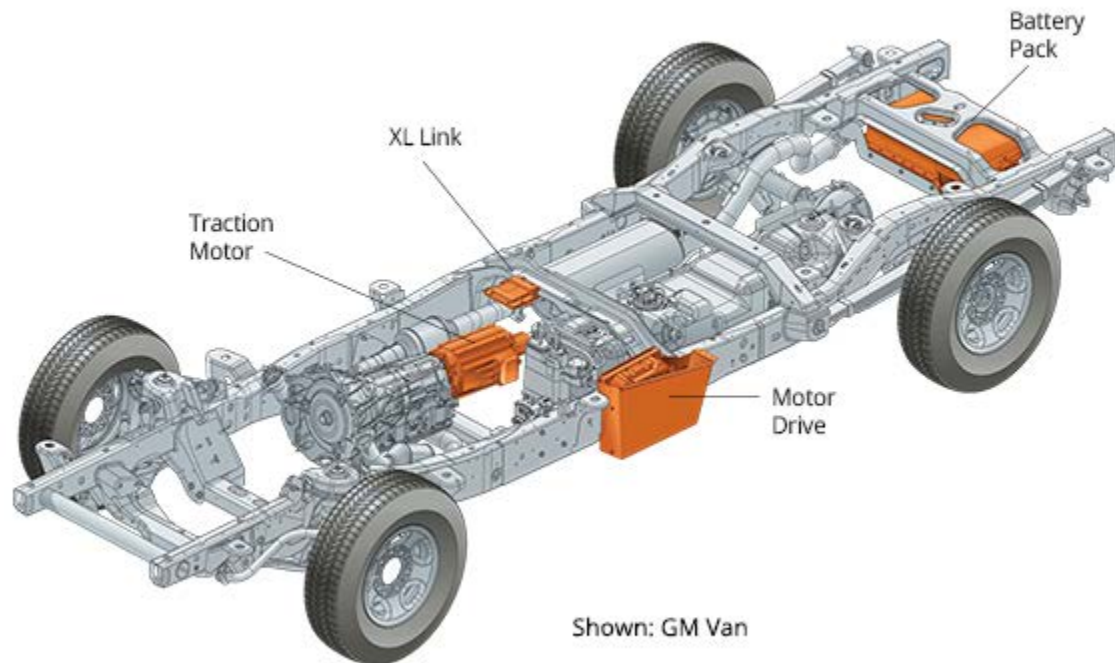
VIA's VR190 delivers 415 Nm in an extremely small, light package.

VIA's 115 kW Continuous Electric Generator

Nowhere to plug in? No problem. VIA's VR115 electric generator delivers enough power to recharge batteries quickly and efficiently while driving.

Powered by
VDRIVE

415 Nm
Electric Motor



Washington State is Special

Washington Tax Incentives



Sales/Use Tax Exemption

- **Alternative Fuel Vehicles**
- **Batteries & Charging Infrastructure**

B&O/Public Utility Tax Credit

- **Alternative Fuel Commercial Vehicles**

Leasehold Tax Exemption

- **Charging Infrastructure**



Legislative Update



Signed...

- **HB 2317:** Medium-speed and neighborhood EVs allowed on state highway segments with speed limits up to 30 mph
- **HB 2884:** B&O and utility tax credits for leased commercial alternative fuel vehicles (including electrification)
- **HB 2357:** Revolving loan/grant program for UST cleanup, includes renewable energy incentives (e.g. EV charging)

Awaiting signature...

- **HB 2778:** Sales/use tax exemption for EVs (MSRP \leq \$42,500, \$32,000 cap, all lease payments covered, expires at 7,500 vehicles or June 30, 2019, whichever comes first)



Budget Update



Transportation

- **WSDOT:** \$1 million in seed funding for EV Infrastructure Pilot Program
- **WSDOT:** \$500,000 to continue work on Road Usage Fee Pilot Program
- **DOL:** \$20,000 to implement leased commercial alternative fuel vehicle tax incentive change

Capital

- **PLIA:** \$10 million for UST revolving loan/grant cleanup program



What's this about a 100% alt-fueled state fleet?

“Extent Practicable” Rules

Mission: Define “practicability” and how state and local governments will be evaluated in efforts to operate publicly owned vessels, vehicles and construction equipment from electricity or biofuel, “to the extent practicable.” CNG and propane can be considered if electricity and biofuels not “reasonably available.”

State Agencies: June 1, 2015 (effective May 2013)

Local Governments: June 1, 2018

- Transit agencies with majority of active revenue fleet using CNG exempt
- Exemption for engine retrofits that void warranties
- Authority to exempt emergency response vehicles
- Highest level of biodiesel warranty when purchasing diesel vehicles



"Hey, Sisyphus, when you've got a minute I'd like to discuss this progress report with you."



Program Participation



- **All Jurisdictions Comply**
- **Annual Reporting**
 - Gas and diesel use >200,000 gallons/year
 - Cities (10), counties (18), transit (17), schools (16), PUDs (3), ports (2), RFD (1)
 - Fleet composition
 - Procurement plans
 - Obstacles and opportunities
- **Technical Assistance**
 - Alternative Fuels & Vehicles Technical Advisory Group



Program Compliance: Vehicles



Renewable Natural Gas (biomethane)

- Blends of 20% RNG or more, regardless of lifecycle cost

Electric & Hybrid Electric Vehicles

- Models that meet operational needs? Suitable for routine use?
- Compare lifecycle cost, including charging infrastructure, to vehicle you'd otherwise procure

Alternate Fuel Vehicles (natural gas and propane)

- Include engine conversions and changes to fueling infrastructure and maintenance facilities in lifecycle cost

Charging Infrastructure

- Encouraged for fleet parking and maintenance facilities, incorporate into new construction and major remodels





Department of Commerce

For more information:

Peter Moulton

Senior Energy Policy Specialist

(360) 725-3116

peter.moulton@commerce.wa.gov

electricdrive.wa.gov

www.commerce.wa.gov

facebook

twitter

The Future is Bright

- CARB and CAFÉ require more and more cars
- Offerings have to improve to stay competitive
- Conquest cars require rarity
- Demand triggers are better understood
- Customers and dealers are getting interested
- More range and lower prices are coming soon
- High volume, good marketing may be a while

The Future Is Bright



