INTRODUCTION

ELECTRIC VEHICLES

TRAVIS RITCHIE, TONY GIAMBRO



MAINE ELECTRIC VEHICLE ASSOCIATION



PARIS AUTOBARN



THE CENTER FOR AN ECOLOGY BASED ECONOMY

INTRODUCTIONS



TRAVIS RITCHIE

- OFFICE MANGER/EDUCATION
 OUTREACH COORDINATOR WITH
 PARIS AUTOBARN LLC
- OVER 10 YEARS EXPERIENCE IN AUTOMOTIVE REPAIR
- EV OWNER



TONY GIAMBRO

- OWNER/CHIEF SUSTAINABILITY
 OFFICER AT PARIS AUTOBARN LLC
- OVER 10 YEARS IN AUTOMOTIVE REPAIR

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• EV OWNER

OVERVIEW OF ELECTRIC VEHICLES BASIC GUIDE FOR EVERYONE



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- BASICS
- HYBRID VS EV
- CARS: TECHNOLOGY
- CARS: AVAILABLE MODELS
- CHARGING
- ENVIRONMENTAL ASPECTS
- ECONOMIC ASPECTS
- QUESTIONS



BASICS

- ELECTRIC VEHICLE= EV
- SIMILAR DRIVING EXPERIENCE, DIFFERENT FUELING EXPERIENCE
- PLUG IN AT HOME
- PLUG IN AT CHARGING STATIONS
- SAFE TO CHARGE
- SAFE TO DRIVE
- FEWER COMPONENTS
- MINIMAL MAINTENANCE
- INSTANT TORQUE
- MODERN TECHNOLOGY
- EXTENDED RANGES IN NEWER MODELS





COMPARISON: EV VS HYBRID

SIMPLIFIED HYBRID DRIVETRAIN

PRIUS





SIMPLIFIED EV DRIVETRAIN

LEAF

107-hp / 207 lb-ft traction motor



24.0 kW-hr Li-ion battery



BATTERY

- LITHIUM -ION TECHNOLOGY
- PROTECTED METAL CASING
- LONG LIFE SPAN (10+ YEAR WARRANTIES)
- INSTALLED UNDER FLOOR FOR LOW AND CENTERED WEIGHT DISTRIBUTION









CHARGE CONNECTORS



CHARGING LEVELS



Level 1 chargers use standard 120V electrical outlets. 120V circuits are also used by most home electronics. Level 2 chargers use 240V electrical circuits. 240V circuits are also used by electric dryers & electric stovetops. Level 3 direct current fast chargers use ultra high-power 480V circuits at public charging stations.

4-7 miles per hour

10-25 miles per hour

60-90 miles per 1/2 hr

1.4 kW power delivery 3.7 - 7.7 kW power delivery Up to 50 kW power delivery

CHARGERS



CHARGERS



WHERE TO PLUG IN

PLUGSHARE.COM OR DOWNLOAD THE APP!



CARS

2017

ELECTRIC VEHICLES: 15 MODELS (BMW, CHEVROLET, FORD, FIAT, HONDA, HYUNDAI, KIA, MERCEDES, MITSUBISHI, NISSAN, SMART, TESLA, VW

PLUG IN HYBRIDS: 20 MODELS (BMW, CHEVROLET, FORD, FIAT, HONDA, HYUNDAI, KIA, MERCEDES, MITSUBISHI, NISSAN, SMART, TESLA, TOYOTA, VW)

PLUS EV MOTORCYCLES, POWER SPORTS EQUIPMENT AND OF COURSE, STANDARD HYBRIDS!



We drive electric. You can too.

RANGE

2017 MODEL RANGE IN MILES

MITSUBISHI MIEV: 62 SMART EV: 68 LEAF: 107 500E: 87 MERCEDES B250E: 87 HONDA CLARITY: 89 KIA SOUL: 93 BMW 13: 114 **FOCUS EV: 115** HYUNDAI IONIQ: 124 VW EGOLF: 125 BOLT: 238 MODEL X: 237-295 MODEL 3: 220-310 MODEL S: 210-335



DRIVETRAIN



MOTOR ASSEMBLY



ON BOARD SYSTEMS

- SIMILAR INTERIOR EXPERIENCE AS TRADITIONAL CARS (POWER WINDOWS, AC, GAUGES, NAVIGATION, ETC)
- HEATER: EITHER HEAT PUMP OR RESISTIVE
- COLD WEATHER OPTIONS: HEATED SEATS & STEERING WHEEL
- "FUEL" GAUGE AND RANGE



WINTER DRIVING

- AS GOOD OR BETTER HANDLING
 AS TRADITIONAL VEHICLES
- CAN WARM UP IN GARAGE
 WITHOUT RISK OF DEATH
- REMOTELY WARM/COOL VEHICLE
- RANGE REDUCTION: 10-40%
 DEPENDING ON MODEL &
 WEATHER
- HEATER REDUCES RANGE



ECONOMICS

- AVERAGE COST PER KWH = 15 CENTS
- 2013 NISSAN LEAF "FILL UP" = \$3.60 OR 4.5 CENTS PER MILE
- 2017 CHEVROLET BOLT "FILL UP = \$9 OR 3.7 CENTS PER MILE
- 2017 TESLA MODEL S 100D "FILL UP" = \$15 OR 4.5 CENTS PER MILE
- 2017 HONDA CIVIC "FILL UP" = \$33.48 OR 8 CENTS PER MILE



ENVIRONMENTAL IMPACTS: MANUFACTURING

- ALL CARS ARE MADE WITH ROUGHLY
 THE SAME MATERIALS EXCEPT
 BATTERY
- BATTERIES MADE FROM SAME
 MATERIALS AS CELL PHONE & LAPTOP
 BATTERIES (ALL LITHIUM ION)
- BATTERIES & COMPONENTS HAVE SOME RARE EARTH MINERALS – SAME MINERALS NEEDED FOR OTHER TECH



ENVIRONMENTAL IMPACTS: CHARGING



A 2013 Nissan LEAF (24 kWh) charged in 66101 produces about as much global warming pollution as a gasoline vehicle getting 53 miles per gallon.

f 🖸 🔂 🖂



(1)

GRAMS OF CO₂e

GRAMS

OF CO2e



AVERAGE EMISSIONS IN 66101

That's like driving a car that gets

Conventional cars run on gasoline and tend to be dirtier and more expensive

Plug-in hybrids use both gasoline and electricity and can be recharged from an



(i) GRAMS OF CO₂e

44 miles per gallon.

24

ENVIRONMENTAL IMPACTS: CHARGING

Electric Vehicle Global Warming Pollution Ratings and Gasoline Vehicle Emissions Equivalents by Region



Note: The MPG (miles per gallon) value listed for each region is the combined city/highway fuel economy rating of a gasoline vehicle that would have global warming emissions equivalent to driving an EV. Regional global warming emissions ratings are based on 2012 power plant data in the EPA's eGRID 2015 database (the most recent version). Comparisons include gasoline and electricity fuel production emissions. The 68 MPG U.S. average is a sales-weighted average based on where EVs were sold in 2014.

SOURCE: EPA 2015C.

© Union of Concerned Scientists

ENVIRONMENTAL IMPACTS: CHARGING



ENVIRONMENTAL IMPACTS: DRIVING

- NO LOCAL TAILPIPE EMISSIONS
- NO LEAKING OIL, TRANSMISSION FLUID, POWER STEERING FLUID, COOLANT
- NO NOISE POLLUTION

The energy used to produce one gallon of gas would propel a Tesla Model S for 20 miles – US Department of Energy

ADDRESSING MISINFORMATION: LITHIUM

• LITHIUM

- NOT RARE EARTH MINERAL
- OBTAINED FROM BRINE & SALT WATER DEPOSITS
- CAN BE RECYCLED

ADDRESSING MISINFORMATION: COBALT

- COBALT
 - USED IN ELECTRODES OF LITHIUM ION BATTERIES
 - EXTREMELY RESISTANT TO CORROSION, OXIDATION AND WEAR
 - ESSENTIAL NUTRIENT TO SOME ANIMALS
 - CAN BE RECYCLED
 - USED IN GAS ENGINE TURBINES (POWER PRODUCTION, JET AIRCRAFT)
 - USED FOR DENTAL AND MEDICAL PROSTHETICS (REDUCED WEAR)
 - USED IN PLATINUM JEWELRY
 - USED IN STRONG MAGNETS
 - USED IN PRODUCTION OF CERAMICS AND GLASSWEAR FOR THOUSANDS OF YEARS
 - USED IN PRODUCTION OF PAINTS AND VARNISHES
 - USED TO FILTER SULFUR COMPOUNDS OUT OF PETROLEUM DURING REFINEMENT

If everyone who could use an EV had one today, we would save 350 million barrels of oil a year.



Visit ucsusa.org/cleancars to see how you can be part of the solution.

- AMERICAN ELECTRONS
- HTTPS://IMAGES-NA.SSL-IMAGES-AMAZON.COM/IMAGES/I/51J05U0%2BKFL._SL1000_.JPGGOLD BOLT
 - HTTPS://HIPS.HEARSTAPPS.COM/AMV-PROD-CAD-ASSETS.S3.AMAZONAWS.COM/IMAGES/16Q1/665058/2017-CHEVROLET-BOLT-EV-PHOTOS-AND-INFO-NEWS-CAR-AND-DRIVER-PHOTO-665149-S-ORIGINAL.JPG

KIA SOUL

- HTTP://WWW.MYKIASOULEV.COM/WP-CONTENT/UPLOADS/2015/03/KIA-SOUL-EV-CHARGING-STREETSIDE.JPG,
- TWO LEAFS: TRAVIS RITCHIE
- PRIUS DRIVETRAIN
 - HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2011/06/TOYOTA-PRIUS-POWERTRAIN.JPG,
- VOLT DRIVETRAIN

HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2011/06/CHEVROLET-VOLT-POWERTRAIN.JPG

RESOURCES LEAF DRIVETRAIN

- HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2011/06/NISSAN-LEAF-POWERTRAIN.JPG,LEAF BATTERY
 - HTTP://CLEANTECHNICA.COM/FILES/2014/07/LEAF-BATTERY.JPG
- CHARGING LEVELS
 - HTTPS://WWW.PLUGLESSPOWER.COM/WP-CONTENT/UPLOADS/2016/12/L123-DIAGRAMS-1.JPG
- LEAF CHARGE

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- HTTPS://WWW.NISSANUSA.COM/CONTENT/DAM/NISSAN/VEHICLES/2017/LEAF/CHARGING-RANGE/CHARGING-PAGE/CHARGING-BASICS/2017-NISSAN-LEAF-CHARGING-STATION.JPG
- BOLTCHARGE
- HTTP://GMAUTHORITY.COM/BLOG/2016/11/2017-CHEVROLET-BOLT-EV-FACES-AN-UPHILL-BATTLE-WITH-CHARGING-TIMES/
- EGOLF CHARGE

HTTP://WWW.VWVORTEX.COM/WP-CONTENT/UPLOADS/2014/07/VOLKSWAGEN-E-GOLF-009-960X581.JPG

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- TESLA CHARGE
 - HTTP://INSIDEEVS.COM/WP-CONTENT/UPLOADS/2014/01/MODEL-S.JPG
- LEAF CHARGE PORT
 - HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2016/02/2016-NISSAN-LEAF-EV-PLUG-IN-PORT.JPG
- BOLT CHARGE PORT
 - HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2017/04/2017-CHEVROLET-BOLT-EV-PREMIER-CHARGE-PORT.JPG
- TESLA CHARGE PORT
 - HTTP://WWW.IRISHEVOWNERS.COM/WP-CONTENT/UPLOADS/2014/03/DSC00736.JPG
- PLUG COMPARISON
 - HTTP://WWW.CASHBACKCARS.CO.NZ/USERFILES/IMAGE/ELECTRIC-PLUGS.JPG
 - LEVEL 1 CHARGER
 - HTTP://WWW.PLUGINCARS.COM/SITES/DEFAULT/FILES/EVSE-G2H-UG-BRIGHT-620_0.JPG

• LEVEL 2 CHARGER

HTTP://ECX.IMAGES-AMAZON.COM/IMAGES/I/41JIQWHMV6L.01_SL500_.JPG

• LEVEL 3 CHARGER

HTTP://MULTIFILES.PRESSHERALD.COM/UPLOADS/SITES/2/2016/09/1073325_278582-PETERPHOTO.JPG

• PLUGSHARE

HTTPS://WWW.PLUGSHARE.COM/

• PLUG IN AMERICA

HTTPS://PLUGINAMERICA.ORG/WP-CONTENT/UPLOADS/2016/04/7B1163ACC8-B1AE-4691-BFBF-6B4AC9DFE3D87D_PLUG_IN_AMERICA_COLOR.JPG

• UNION OF CONCERNED SCIENTISTS INFOGRAPHIC

HTTP://WWW.UCSUSA.ORG/CLEAN-VEHICLES/ELECTRIC-VEHICLES/BEV-PHEV-RANGE-ELECTRIC-CAR#.WBNAFRDRYFY

LEAF POWERTRAIN

HTTPS://QPH.EC.QUORACDN.NET/MAIN-QIMG-02171D8DD7C5E731522FA5A105FD1D2F

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- LEAF POWERTRAIN 2
 - HTTP://WWW.FUTUREAUTOREVIEW.COM/WP-CONTENT/UPLOADS/2016/03/2017-NISSAN-LEAF-POWERTRAIN.JPG
- TESLA INTERIOR
 - HTTPS://SECURITYLEDGER.COM/WP-CONTENT/UPLOADS/2014/08/2012-TESLA-MODEL-S-INTERIOR.JPG
- SNOWY PLUG IN
 - HTTP://ARCHIVE.BOSTON.COM/CARS/NEWSANDREVIEWS/OVERDRIVE/ASSETS_C/2011/01/ 2012-TOYOTA-PRIUS-PLUG-IN-SNOW-THUMB-607X455-31491.JPG
- COST OF FUELING
 - HTTP://WWW.UCSUSA.ORG
- TESLA FACTORY
 - HTTP://WWW.4TROXOI.GR/SITES/DEFAULT/FILES/IMAGES/ARTICLES/IMAGES/2017/05/TESLA _FACTORY10.JPG

RESOURCES LEAF CHARGE EMISSIONS

HTTP://WWW.UCSUSA.ORG/CLEAN-VEHICLES/ELECTRIC-VEHICLES/EV-EMISSIONS-TOOL#Z/04240/2013/NISSAN/LEAF%20(24%20KWH)

• CHARGE MPG

HTTP://WWW.UCSUSA.ORG/SITES/DEFAULT/FILES/IMAGES/2015/11/VEHICLES-M-EMISSIONS-MAP-WITH-NOTES.JPG

• TESLA CAMPER

 HTTPS://WWW.AUDIWORLD.COM/FORUMS/ATTACHMENTS/Q5-SQ5-MKI-8R-DISCUSSION-129/64964D1490407077-NEEDED-BEST-TRANSMISSION-COOLER-Q5-PULLING-CAMPER-TESLA-AS22-FB.JPG

• LITHIUM MINE

HTTP://LH3.GOOGLEUSERCONTENT.COM/-5XYCB_8SBW/VIM-K2Z0E-I/AAAAAABIEI/6J1VPKPCYCK/LITHIUM-MINE-ATACAMA-5%25255B6%25255D.JPG? IMGMAX=800

• LAST PAGE: IF EVERYONE HAD AN EV THAT COULD USE ONE UNION OF CONCERNED SCIENTISTS INFOGRAPHIC


We are here on behalf of these three organizations

(GO OVER THE THREE DIFFERENT ORGANIZATIONS)



Introductions:

Let me be clear, we don't sell electric vehicles at our shop. Yet. We don't really work on them either because they don't break down. Essentially, by being electric vehicle advocates we are attempting to put ourselves out of business!



- This presentation is meant for a general audience that is interested in electric vehicles. There are a lot of questions that can be asked that are not covered in this presentation but we are trying to answer some of the basic questions about electric vehicles.
- Just as the picture states, American electric vehicles are fueled with electrons produced in America, often within the same state. Using electricity as a fuel means more domestic jobs and keeps money closer to home.



- Here is a brief run down of some of the topics we will cover today. There's a lot of information to deliver in a relatively short period of time. In our travels we have gotten used to hearing the same few questions asked again and again, so we focused these topics around those specific questions.
- This picture shows the new Chevrolet Bolt that came out this year. It's a very nice all electric car.

BASICS

- ELECTRIC VEHICLE= EV
- SIMILAR DRIVING EXPERIENCE, DIFFERENT FUELING EXPERIENCE
- PLUG IN AT HOME
- PLUG IN AT CHARGING STATIONS
- SAFE TO CHARGE
- SAFE TO DRIVE
- FEWER COMPONENTS
- MINIMAL MAINTENANCE
- INSTANT TORQUE
- MODERN TECHNOLOGY
- EXTENDED RANGES IN NEWER MODELS



- So, to start off, electric vehicles are just that. They are vehicles that use only electricity as a fuel. An electric vehicle does not care where the fuel comes from, so the electricity can be generated from any source.
- There are numerous benefits to an electric vehicle, with only a few specific drawbacks: charge time and range – both of these "issues" are actually not that invasive with a little preparation, but due to the demand for longer range vehicles, every manufacturer is aiming at providing long range vehicles
- EV's offer a similar experience to the drivers, all without the need for gas or oil, or many other components common on traditional internal combustion vehicles.
- One of the greatest experiences with EV's is the instant torque. If you've ever gone to pass someone, or anticipate a large hill with a vehicle with an automatic transmission you would be familiar with a downshift, where you step on the gas, after a brief pause it shifts to a lower gear, revs up and then eventually speeds up. There is no lag in an EV.

COMPARISON: EV VS HYBRID

SIMPLIFIED HYBRID DRIVETRAIN



- When we talk about Electric Vehicles what we are specifically talking about is battery electric vehicles with no other source of fuel. There are many 'hybrid' vehicles however, and a new word the auto makers are using is 'electrified' but as of right now that means a lot of different things. Hybrids take EV technology and blend it with traditional internal combustion engines. Standard hybrid vehicles like the Prius operate only as a traditional vehicle and its gas motor recharges the batteries when needed, where as a Plug-In Hybrid allows the driver to select between electric only and full hybrid. They also can recharge the batteries independent of running the gasoline motor. meaning they can drive the vehicle as if they were battery only. However, the addition of an internal combustion engine means hybrids and ev's are VERY different machines in a lot of ways. Light hybrid vs plug in hybrid vs EV.
- Here are two ultra simplified drivetrain schematics. Both of these vehicles have internal combustion engines that still require a lot of equipment that you dont see here, things like spark plugs, oil, belts, exhaust, computer controllers and numerous other parts. But even with this simplified diagram you can begin to see some of the complexities of blending together electric and gasoline engines. Notice the size of the batteries and the amount of components.

COMPARISON: EV VS HYBRID		
	SIMPLIFIED EV DRIVETRAIN	
	LEAF	
	107-hp / 207 lb-ft traction motor	
	24.0 kW-hr Li-ion battery	7

- This is the same style ultra simplified schematic for the most common electric vehicle on the road, the Nissan Leaf. Like the previous pictures, there are other components not pictured, but the equipment you see here does the same job that the previous two did with one component.
- Electric vehicles are truly a return to simplicity, mechanically speaking.



- This is what an EV battery looks like. The battery is the heart of an EV, where as in an ICE vehicle, the engine is usually considered the 'heart'. This one has a little bit of the top cut away to take a peak at the internals. In almost every EV the batteries are stored beneath the floor. By putting all this weight down low, centered in the vehicle, it aids in traction and handling. Many EV's have a near perfect front/rear weight distribution which helps a lot in winter traction.
- Lithium Ion technology is the best battery we have in our place in history. That's why it's used in every single one of your phones and laptops. Lithium Ion batteries can be recharged at any time, they do not have to be drained all the way down. They don't vent harmful gases and their power to weight ratio is very high.
- A common question is "how long do the batteries last for" and the answer depends on a lot of factors, but EV batteries are some of the highest quality lithium ion batteries you can find. Most manufacturers offer 7-10 year warranties on their batteries. In almost every case, the battery doesn't "go bad" rather it slowly loses the ability to hold as high of a charge. There are some Tesla Model S's that have over 200,000 miles and lost less than 20% of their range. The Model 3 is expected to go over 500,000 miles before losing that much.



- These are what a few of the most popular models look like charging. The plugs are weatherproof, so it's fine to charge outside like the two on the right.
- However, the biggest advantage that most people don't think about with EV's is the ability to charge your car at home overnight like the two on the left. Except when I go on a long trip, I don't even have to think about finding a place to charge. I just go.



These are the different charging ports of a Tesla, Leaf and Bolt. These are the 3 different competing styles of connector.

INDUCTIVE CHARGING TOO

CHARGE CONNECTORS				
Slow (AC)	Fast (DC)	Combo (slow AC and fast DC)	Tesla	
Type 1 ("J1772") (Japan / US)	CHAdeMO (Japan / US)	Type 1 CCS (Japan / US)	Tesla Supercharger (Japan/US)	
INTERNATIONAL STANDARD	JAPANESE DC	EUROPEAN STANDARD	TESLA STANDARD	
LEVEL 1 (120 V) LEVEL 2 (240 V)	LEVEL 3 (DC)	LEVEL 1 (120 V) LEVEL 2 (240 V) LEVEL 3 (DC)	LEVEL 1 (120 V) LEVEL 2 (240 V) LEVEL 4 (DC)	

These are what the different charging connectors look like. The one on the left is the one you will find on any manufactured electric vehicle that isn't a Tesla. The one on the right is what you will see on a Tesla.

These differences are due to the same reasons why an iphone has a different charge port than an android phone – each company thinks theirs is better.



One of the first questions people ask us is "how long does it take to charge". That is a very fair question and the answer isn't so fair: it depends.

These are the most popular types of chargers. The first is a level 1 charger that plugs into a standard household outlet

And here are the famed Tesla chargers. The one on the left is a "destination charger" and the one on the right is the super charger.

(Explain charge times etc)

Note: chargers in canada. Colder climate. Governor wants to install chargers to bring more tourists.

- Electric vehicles are the future, whether we are ready or not.
- This list shows the number of electric vehicles available in 2017, as well as the number of plug in hybrids. We factored in plug-in-hybrids just to show how quickly manufacturers are implementing electric vehicle technology. This list does not even cover your standard, nonplug in hybrids like the Prius!

Mention: EV motorcycles & powersports equipment

Now to talk about the biggest question, range. How far can an EV go on a charge?

Range anxiety is when you worry if you can make it to your destination without refueling. Americans have grown used to the 300 mile range of the average gasoline vehicle.

Everywhere I go there is always someone who says "Electric vehicles don't get enough range! I drive a hundred miles to work and tow a boat everywhere". To them I say "that is an alternative lifestyle. EV's will suit the vast majority of American lifestyles.

No, an EV doesn't suite everyone. Yet.

This is what the drivetrain of an electric vehicle looks like. This is the basic layout for nearly all EV's. Some have the motor in the back, and some Teslas even have one motor in the front, one in the rear to provide all-wheel drive

So this is a closeup of just the drivetrain "stack". This takes up the space that is normally occupied by an engine assembly and transmission.

Explain: DC/DC converter instead of alternator Onboard charger Inverter Motor

NO transmission!

ON BOARD SYSTEMS

- SIMILAR INTERIOR EXPERIENCE AS TRADITIONAL CARS (POWER WINDOWS, AC, GAUGES, NAVIGATION, ETC)
- HEATER: EITHER HEAT PUMP OR RESISTIVE
- COLD WEATHER OPTIONS: HEATED SEATS & STEERING WHEEL
- "FUEL" GAUGE AND RANGE

WINTER DRIVING

- AS GOOD OR BETTER HANDLING AS TRADITIONAL VEHICLES
- CAN WARM UP IN GARAGE WITHOUT RISK OF DEATH
- REMOTELY WARM/COOL VEHICLE
- RANGE REDUCTION: 10-40% DEPENDING ON MODEL & WEATHER
- HEATER REDUCES RANGE

ECONOMICS

- AVERAGE COST PER KWH = 15 CENTS
- 2013 NISSAN LEAF "FILL UP" = \$3.60 OR 4.5 CENTS PER MILE
- 2017 CHEVROLET BOLT "FILL UP = \$9 OR 3.7 CENTS PER MILE
- 2017 TESLA MODEL S 100D "FILL UP" = \$15 OR 4.5 CENTS PER MILE
- 2017 HONDA CIVIC "FILL UP" = \$33.48 OR 8 CENTS PER MILE

Civic: 37avg mpg, 12.4 gal tank, \$2.70 avg nationwide cost of a gallon of gas. 458.8 miles range.

ENVIRONMENTAL IMPACTS: MANUFACTURING

- ALL CARS ARE MADE WITH ROUGHLY THE SAME MATERIALS EXCEPT BATTERY
- BATTERIES MADE FROM SAME MATERIALS AS CELL PHONE & LAPTOP BATTERIES (ALL LITHIUM ION)
- BATTERIES & COMPONENTS HAVE SOME RARE EARTH MINERALS – SAME MINERALS NEEDED FOR OTHER TECH

ENVIRONMENTAL IMPACTS: CHARGING				
A 2013 Nissan LEAF (24 kWh) charged in 04240 produces about as much global warming pollution as a gasoline vehicle getting 118 miles per gallon.	A 2013 Nissan LEAF (24 kWh) charged in 66101 produces about as much global warming pollution as a gasoline vehicle getting 53 miles per gallon.			
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BATERY ELECTRIC Battery electric vehicles run on electricity and are some the detament and electricity and are some the detament electricity and are some the detament and electricity and are some the detament per MLE	BATTERY ELECTRIC Battery electric vehicles on on electricity and are some the clearest and chequest as to drive. PER MILE			
	24			

These stats only factor in the source of electricity, but don't factor in the energy used

Long story short: EV's, while not perfect, are truly better than gas vehicles

This chart shows the average CO2 emissions of vehicles, factoring in their entire life span, including manufacturing.

- And if you are truly concerned about having a minimal impact on the environment, nothing goes better together than solar power and electric vehicles.
- Fred runs a small solar installation company and he powers his eGolf and a Leaf from his solar tracker that he installed himself. This isn't his tracker, but he did install it.

- Everyone focuses on carbon dioxide emissions and stuff, but often overlooked are some of the most locally damaging pollutants that vehicle emit. All you have to do is drive a car through a deep puddle and that puddle will have the teltale rainbow color that petroleum residues leave behind.
- EV's don't have oil to leak. They don't have gallons of coolant that is under high pressure.
- How many people have gone out to walk their dog or go for a run & take in gulps of exhaust fumes? If you happen to live near a steep hill, how often do you enjoy the rotten egg smell of a worn out catalytic converter? These little improvements on local ecology are more important than I think people give them credit for.
- Of course electric vehicles are quiet. Some people find this as the most offensive fact about EV's. Now, I'm a gearhead and have been in love with fast cars for nearly my entire life. I even have a piston tattoo on my leg. I still appreciate a good sounding classic, but lets not pretend that almost all of the cars on the road today sound good! But still people say "I've just got to hear that engine"
- I think back to when the gas car began to beat the horse as the most popular form of transportation. I imagine some old holdouts saying "You know, cars are ok, but man I've just got to smell that manure"

There are a lot of people who have never given the environment a thought that are trying to smear the electric vehicle as causing more harm to the environment than good. The interesting thing about ev's is that they are just better machines. They are simpler, more reliable and you don't have to be an environmentalist to enjoy owning one. But it helps.

- First, as mentioned already, EV's are not more polluting than gas cars. We don't have time to go into the popular conspiracy theories that say otherwise. To be frank, the internal combustion vehicle has zero reason to attempt to claim environmental superiority. Absolutely none.
- Some of the most pervasive myths circle around lithium. Lithium is abundant in the universe, but like iron, it easily reacts with other minerals so it's not usually found in elemental form. It can be mined from ocean deposits like borax or baking soda are, but it's more economically viable when obtained through pumping brine from underground aquifers into large pools that dry in the sun. The mineral deposits are then separated and processed.
- Many lithium ion batteries are repurposed into storage for PV/Wind generation. But the batteries can be recycled as well. The lead acid batteries in regular vehicles are recycled at a 99% rate one of the greatest examples of good environmental regulation. All we need is a program similar to the lead acid program to increase the recycling capability of lithium ion batteries. But that requires citizens to be aware and to actually care about such things.

ADDRESSING MISINFORMATION: COBALT

COBALT

- USED IN ELECTRODES OF LITHIUM ION BATTERIES
- EXTREMELY RESISTANT TO CORROSION, OXIDATION AND WEAR
- ESSENTIAL NUTRIENT TO SOME ANIMALS
- CAN BE RECYCLED
- USED IN GAS ENGINE TURBINES (POWER PRODUCTION, JET AIRCRAFT)
- USED FOR DENTAL AND MEDICAL PROSTHETICS (REDUCED WEAR)
- USED IN PLATINUM JEWELRY
- USED IN STRONG MAGNETS
- USED IN PRODUCTION OF CERAMICS AND GLASSWEAR FOR THOUSANDS OF YEARS
- USED IN PRODUCTION OF PAINTS AND VARNISHES
- USED TO FILTER SULFUR COMPOUNDS OUT OF PETROLEUM DURING REFINEMENT

There are materials known as "conflict materials" in all of the consumer electronics that exist in society today. Currently there are people trying to pin this on EV owners, but there are a few problems. The same rare earth materials in all electronics exist in regular vehicles too. There are numerous computers in modern vehicles, each with components made with these materials. Companies like Tesla have pledged to use "conflict free" materials and source their materials from more expensive, but reputable countries. In fact, their business model is to source all of their battery materials from the US.

The newest material to be under the microscope is cobalt, but more specifically, the way cobalt is mined. A few years ago there were images from cobalt mines in the Democratic Republic of Congo showing child labor used to obtain cobalt for the production of cell phones. Unfortunately, that did not gain enough traction worldwide to effect the mining, so EV opponents simply replaced the word cell phone with electric vehicle, and shared the news as if it was a new story.

Thank you for coming out today

- AMERICAN ELECTRONS
- HTTPS://IMAGES-NA.SSL-IMAGES-AMAZON.COM/IMAGES/I/51J05U0%2BKFL._SL1000_.JPG
- GOLD BOLT

HTTPS://HIPS.HEARSTAPPS.COM/AMV-PROD-CAD-ASSETS.S3.AMAZONAWS.COM/IMAGES/16Q1/665058/2017-CHEVROLET-BOLT-EV-PHOTOS-AND-INFO-NEWS-CAR-AND-DRIVER-PHOTO-665149-S-ORIGINAL.JPG

• KIA SOUL

HTTP://WWW.MYKIASOULEV.COM/WP-CONTENT/UPLOADS/2015/03/KIA-SOUL-EV-CHARGING-STREETSIDE.JPG,

- TWO LEAFS: TRAVIS RITCHIE
- PRIUS DRIVETRAIN

HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2011/06/TOYOTA-PRIUS-POWERTRAIN.JPG,

VOLT DRIVETRAIN

HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2011/06/CHEVROLET-VOLT-POWERTRAIN.JPG

LEAF DRIVETRAIN

HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2011/06/NISSAN-LEAF-POWERTRAIN.JPG,

- LEAF BATTERY
- HTTP://CLEANTECHNICA.COM/FILES/2014/07/LEAF-BATTERY.JPG
- CHARGING LEVELS

HTTPS://WWW.PLUGLESSPOWER.COM/WP-CONTENT/UPLOADS/2016/12/L123-DIAGRAMS-1.JPG

• LEAF CHARGE

HTTPS://WWW.NISSANUSA.COM/CONTENT/DAM/NISSAN/VEHICLES/2017/LEAF/CHARGING-RANGE/CHARGING-PAGE/CHARGING-BASICS/2017-NISSAN-LEAF-CHARGING-STATION.JPG

BOLTCHARGE

HTTP://GMAUTHORITY.COM/BLOG/2016/11/2017-CHEVROLET-BOLT-EV-FACES-AN-UPHILL-BATTLE-WITH-CHARGING-TIMES/

• EGOLF CHARGE

HTTP://WWW.VWVORTEX.COM/WP-CONTENT/UPLOADS/2014/07/VOLKSWAGEN-E-GOLF-009-960X581.JPG

TESLA CHARGE

HTTP://INSIDEEVS.COM/WP-CONTENT/UPLOADS/2014/01/MODEL-S.JPG

LEAF CHARGE PORT

HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2016/02/2016-NISSAN-LEAF-EV-PLUG-IN-PORT.JPG

 BOLT CHARGE PORT HTTP://ST.MOTORTREND.COM/UPLOADS/SITES/5/2017/04/2017-CHEVROLET-BOLT-EV-PREMIER-CHARGE-PORT.JPG
TESLA CHARGE PORT

HTTP://WWW.IRISHEVOWNERS.COM/WP-CONTENT/UPLOADS/2014/03/DSC00736.JPG

PLUG COMPARISON

HTTP://WWW.CASHBACKCARS.CO.NZ/USERFILES/IMAGE/ELECTRIC-PLUGS.JPG

• LEVEL 1 CHARGER

HTTP://WWW.PLUGINCARS.COM/SITES/DEFAULT/FILES/EVSE-G2H-UG-BRIGHT-620_0.JPG

RESOURCES LEVEL 2 CHARGER HTTP://ECX.IMAGES-AMAZON.COM/IMAGES/I/41JIQWHMV6L.01 SL500 .JPG • LEVEL 3 CHARGER HTTP://MULTIFILES.PRESSHERALD.COM/UPLOADS/SITES/2/2016/09/1073325_278582-PETERPHOTO.JPG PLUGSHARE HTTPS://WWW.PLUGSHARE.COM/ PLUG IN AMERICA HTTPS://PLUGINAMERICA.ORG/WP-CONTENT/UPLOADS/2016/04/7B1163ACC8-B1AE-4691-BFBF-6B4AC9DFE3D87D_PLUG_IN_AMERICA_COLOR.JPG UNION OF CONCERNED SCIENTISTS INFOGRAPHIC HTTP://WWW.UCSUSA.ORG/CLEAN-VEHICLES/ELECTRIC-VEHICLES/BEV-PHEV-RANGE-ELECTRIC-CAR#.WBNAFRDRYFY LEAF POWERTRAIN HTTPS://QPH.EC.QUORACDN.NET/MAIN-QIMG-02171D8DD7C5E731522FA5A105FD1D2F

• LEAF POWERTRAIN 2

HTTP://WWW.FUTUREAUTOREVIEW.COM/WP-CONTENT/UPLOADS/2016/03/2017-NISSAN-LEAF-POWERTRAIN.JPG

TESLA INTERIOR

HTTPS://SECURITYLEDGER.COM/WP-CONTENT/UPLOADS/2014/08/2012-TESLA-MODEL-S-INTERIOR.JPG

SNOWY PLUG IN

HTTP://ARCHIVE.BOSTON.COM/CARS/NEWSANDREVIEWS/OVERDRIVE/ASSETS_C/2011/01/ 2012-TOYOTA-PRIUS-PLUG-IN-SNOW-THUMB-607X455-31491.JPG

COST OF FUELING

HTTP://WWW.UCSUSA.ORG

TESLA FACTORY

HTTP://WWW.4TROXOI.GR/SITES/DEFAULT/FILES/IMAGES/ARTICLES/IMAGES/2017/05/TESLA _FACTORY10.JPG

LEAF CHARGE EMISSIONS

HTTP://WWW.UCSUSA.ORG/CLEAN-VEHICLES/ELECTRIC-VEHICLES/EV-EMISSIONS-TOOL#Z/04240/2013/NISSAN/LEAF%20(24%20KWH)

CHARGE MPG

HTTP://WWW.UCSUSA.ORG/SITES/DEFAULT/FILES/IMAGES/2015/11/VEHICLES-M-EMISSIONS-MAP-WITH-NOTES.JPG

- TESLA CAMPER
- HTTPS://WWW.AUDIWORLD.COM/FORUMS/ATTACHMENTS/Q5-SQ5-MKI-8R-DISCUSSION-129/64964D1490407077-NEEDED-BEST-TRANSMISSION-COOLER-Q5-PULLING-CAMPER-TESLA-AS22-FB.JPG
- LITHIUM MINE

HTTP://LH3.GOOGLEUSERCONTENT.COM/-5XYCB_8SBW/VIM-K2Z0E-I/AAAAAAABIEI/6J1VPKPCYCK/LITHIUM-MINE-ATACAMA-5%25255B6%25255D.JPG? IMGMAX=800

LAST PAGE: IF EVERYONE HAD AN EV THAT COULD USE ONE

UNION OF CONCERNED SCIENTISTS INFOGRAPHIC