The Rogue Valley Green Car Guide

How to Evaluate, Select and Purchase/Lease a Low-Emissions Vehicle

2018 Edition

By Bruce Borgerson

"We have met the enemy and he is us."

Pogo comic strip

Opening Caveat

Nothing in this document should be construed as expressing an endorsement of, or preference for, motorized transportation as opposed to other forms of personal transportation. Human powered transport – whether pedestrian or bicycle – should have first priority in forming public policy. Second priority goes to public mass transit, although significant "greening" of vehicles is required here as well. This document simply recognizes that personal vehicular transportation will continue in the Rogue Valley, and it is therefore imperative that we greatly reduce its negative impact on the global climate.

Preface to First Edition

This booklet started out as the "Ashland Green Car Guide." It was initially limited to my home city because Ashland is unique in that it is the only community in Southern Oregon contracting with the Bonneville Power Administration (BPA) for electric power. BPA's power generation – overwhelmingly hydroelectric – is significantly greener than that serving Southern Oregon as a whole, which is principally supplied by Pacific Power. That tilts the balance more in favor of plug-in vehicles in Ashland when compared to other places in the Rogue Valley.

My principal source of comparison between plug-in and fossil fuel vehicles is fueleconomy.gov. It lets you compute upstream greenhouse gas (GHG) emissions for any plug-in vehicle by entering a zip code; the resulting figures reflect the GHG emissions of the electricity grid used for charging. But it cautions that the results shown are "for your region." It turns out the regions are quite wide, and seem to correspond roughly to those shown in this map from the Union of Concerned Scientists. In other words, when looking up the upstream greenhouse gas emissions for a particular vehicle, I found no differences anywhere on the West Coast, from Tacoma to Los Angeles, including checks for Grants Pass, Medford and Ashland. However, when I checked upstream emissions from the electricity grids in Denver, Minneapolis and Wheeling, West Virginia, the GHG numbers were much higher – double for Denver!

So I decided to expand the scope of this guide to the entire Rogue Valley. I surmise that plug-in cars could be significantly greener when charged in Ashland, but quantifying any precise differential would be complicated and subject to variability. However, the relative rankings of specific plug-in vehicles – when compared to each other and to fossil fuel vehicles – should be valid throughout the Rogue Valley, even if there are hidden variations in the precise upstream emissions from electricity generation.

The grid is greening. Cars are stalled.

This booklet is for Rogue Valley residents who are concerned about climate change. If you're simply looking to save a lot of money, this may not help much – at least not in the short run. (Better prospects over the long run.) And if you're looking for driving thrills…well, maybe a bit. Electricity delivers torque! But you might find similar thrills at less expense while remaining under fossil fuel power.

So with green cars, the driving force is climate change. We crossed a critical threshold in 2016. At some point during that year, according to the (Obama Administration's) Energy Information Administration, transportation surpassed electricity generation as the prime contributor to greenhouse gas (GHG) emissions in the USA. [1] Bringing it all back home, personal vehicles – cars and light trucks – are now responsible for more than half of direct, primary GHG emissions in the average American household. [2]

This change in "worst offenders" is largely because the electricity grid is getting greener. Not fast enough, but we are making gains nationwide. We are now at an awkward plateau because much of the recent progress in the electricity sector is due to the changeover from coal (horrendous) to natural gas (just plain bad). So we still have a long way to go if you look at the national situation. Nevertheless, hydroelectric remains a reliable resource regionally, with solar and wind adding to the GHG-free mix.

Consequently, despite the Neanderthal attitudes now dominant in our nation's capital, the grid will likely continue to make "green gains" based on changing economics and enlightened state and local actions, including Ashland's promising 10 x 20 initiative.

At the same time, the personal transportation sector has flat-lined due to "fracking"- low fuel prices. [3] While average vehicle fuel economy has improved, more drivers are choosing to purchase larger and more powerful vehicles. Progress has stalled when we look at total emissions from privately owned vehicles. Too many Americans are making questionable choices at car dealerships, either because they are not informed or they just don't care about the future of the planet.

But it's no use pointing fingers. That doesn't get us anywhere. If we want to bend the line down on transportation GHG emissions, we all must choose vehicles that produce lower emissions. A lot lower. If we're not part of the solution, we're part of the problem. Maybe not as much of a problem as some other folks, but that's no excuse. We're all on this warming planet together.

A Great Place to Plug In: Ashland's Greener Grid

Most of us don't stop to think about it. We pull up to the gas pump, ask the friendly attendant (perhaps after some delay) to fill the tank with regular, the tank is filled and (perhaps after more delay) the attendant finally gives you your receipt and you drive away.

There, now you've done it. For every gallon of gas you just put in the tank, you've committed to dumping another 8.8 kilograms (19.2 pounds) of greenhouse gas emissions into the atmosphere. And every dollar you just spent at the pump will help to finance, at multiple levels, the global fossil fuels industry. There has to be a better way.

In Ashland, fortunately, there is. Ashland is among a dozen or so municipalities in the Pacific Northwest that have contracted to receive electricity from the Bonneville Power Administration (BPA), the government-owned agency created to market electricity generated by the hydroelectric dams spanning rivers in the region. In more recent decades, the BPA portfolio has expanded to include increasing amounts of solar and wind generation capacity. As a result, the overall generation profile of BPA is about 95% free of GHG emissions. (Roughly ten percent of the BPA total is from nuclear, which although free of direct carbon emissions does have its down sides.) [4] Granted, the power generation that Ashlanders pay for may not match the power actually coming out of the wall: BPA's own capacity can be "polluted" by other providers sharing the common northwest power grid. (How this works is complicated and varies according to several factors.) However, even if we simply align it with the Oregon average, Ashland's grid is still among the cleanest in the nation in terms of low GHG emissions. [5]

Very clean, but not perfect. So if you do opt for a plug-in vehicle, you will have to factor in the small estimated amount of "upstream" GHG emissions involved in charging your battery. Nevertheless, you will be far, far ahead of the game – mile for mile – when compared to any car of comparable size that is directly powered by fossil fuels.

You could go the final step. If you are among the dozens of Ashland residents who have their own rooftop solar capacity at home, you can have the ultimate with a new electric vehicle (EV): absolute zero emissions motorized transportation! (Well, except for the manufacturing penalty as noted later.)

From MPG (Miles per Gallon) to GPM (Grams per Mile)

What is a "green car?" In the broadest terms, it's a personal motor vehicle that operates with minimal impact on the environment. Most notably, the vehicle itself produces little or no emissions of either toxic or greenhouse gases.

The "no" part is easy to define. That means zero. There is no consumption of fossil fuels by the vehicle itself. However, as just noted, absolute zero GHG emission is possible only with a 100% renewable electricity source.

The "little" part is subjective. Vehicle types are not a certain guide. True, all vehicles that fall into the electric vehicle (EV) and plug-in hybrid (PHEV) categories will at least potentially qualify as "green." (With some PHEVs it will depend on the electric/gasoline mix.) But not all hybrids fall into that category, as some large hybrid vehicles – luxury sedans, pickups and SUVs – are worse emitters than the best conventionally powered cars.

The key metric here is not the vehicle type or even – strictly speaking – fuel efficiency. Rather, it is the amount of GHG emissions per distance traveled, here expressed as weight in grams per mile.

The emissions-per-mile metric is closely related to miles-per-gallon (mpg), but there are discrepancies because different fuels will produce different amounts of greenhouse gases. Diesel fuel, for example, produces about 15% more greenhouse gases per mile than gasoline. [6] (Unless you rig the tests.) As we will notice later, there are no diesels qualifying as green cars under my strict definition.

Vehicle greenhouse gas emissions listed on the EPA site and used in my rankings here are calculated using GREET Model 1.8 (U.S. Department of Energy, Argonne National Laboratory) and includes the three major greenhouse gases emitted by motor vehicles: CO2, nitrous oxide, and methane.

For the purposes of "apples to apples" comparison of different vehicle types, all GHG emissions given here also include upstream emissions. For EVs and the electric component of PHEVs, that includes emissions created during electric power generation. (These are estimated for each vehicle on the fueleconomy.gov site; figures given here from the Ashland ZIP code but valid throughout the area.) That is why no "zero emissions" vehicles are listed, as I'm assuming few will be charged from personal solar installations. For gasoline, the upstream component covers emissions from exploration, extraction, refining and transportation of the gasoline, adding about 20% to tailpipe emissions.[7]

So, What Qualifies as a Green Vehicle?

Ultimately it's a judgement call. For the purposes of this document, I'm going to draw the line at 333 grams (about ¾ pound) per mile of combined tailpipe and upstream GHG emissions. It's admittedly arbitrary but there's some logic to it. First, that figure is derived from the current average for light

vehicles in America, which I calculate as around 500 grams per mile. (This is based on the tailpipe average of 411 grams plus about 20% from upstream emissions.)[8] Lop a full third off that figure and you get 333 grams per mile, which I consider as the maximum tolerable for personal transportation of up to five people and a reasonable amount of luggage. Anything significantly above that number, to my mind, is unconscionable when acquiring a new (or newer used) car as it constitutes a small but measureable – and completely unnecessary – threat to our survival as a species.

The second reason is that you can still buy five vehicles locally (two from BMW, one each from Nissan, Subaru and Toyota) – all close to our 333 upper limit – that offer all-wheel drive (AWD). Note that the only EV currently offering AWD is the pricey Tesla Model X, at nearly double the cost of a BMW PHEV. All-wheel drive is a capability that comes with a built-in climate penalty; compared to two-wheel drive equivalents, AWD cars require more fuel and thus generate more GHGs. Unless you are an avid skier or commute to Klamath Falls during the winter, you probably don't need AWD.

To get oriented with this concept, let's look at three comparisons that might prove enlightening. A 2017 Subaru Forester SUV emits 381 grams of greenhouse gases per mile, which is a notable engineering achievement for a spacious SUV with AWD. Nevertheless, that's 14% over what we should consider the highest permissible amount for a green car, and about four times the upstream emissions of a roughly comparable EV. However, it's not so bad that, if you just bought one, you must get rid of it right away. As will be explained later, the "manufacturing penalty" could be too high for acting now.

On the other hand, let's say you now drive a 2007 Toyota Camry V-6. That car is responsible for 463 grams per mile, which is 40% over our maximum allowance. It's time to consider alternatives. And should your vehicle be a 2007 Ford Explorer V-8 with four-wheel drive, you are spewing out 711 grams/per mile, which is nearly *nine times* the upstream emissions of the top-rated Hyundai Ioniq and BMW i3 EVs. Yikes.

To find the GHG emissions for your car, go to www.fueleconomy.gov and select Power Search under Find and Compare Cars. Enter the year, make and market class. (This is enough to give you a very short list.) Click "Search" then find your car by scrolling down the list. Click on exact car model (engine and transmission) name. Select the "Energy and Environment" tab. Under "Greenhouse Gas Emissions - Show" select "Tailpipe and Upstream." Add the two numbers and you have the total for your car.

Best: Electric Vehicle (EV)

An electric vehicle uses no fossil fuels at any time for powering the wheels. It is as green as the grid to which it is connected for charging. And in Ashland, that is very green indeed.

When charging from the local grid, how much better is an EV in comparison to a typical gasoline-driven vehicle? Somewhere between four and nine times better, and that's with upstream emissions factored in for both. [9] The variation depends on the age, size and type of the comparison vehicles and exactly how the upstream impact is calculated. (The Explorer to Ioniq/i3 comparison above is an extreme.)

The two universal limitations on electric cars are range and charging times. Both are largely dependent on battery size. A larger battery will give the car greater range, but it will take more time to charge given the same charging system. More expensive EVs, most notably the Teslas, can be fully charged quite rapidly, but both the cars and the chargers are more costly. Less costly EVs generally have shorter range and longer charging times – though notable improvements have been realized on both fronts in recent years as battery technology continues to make rapid gains.

A third limitation depends on your housing. If you live in an apartment complex or in other housing where the car cannot be parked in your own garage or in a driveway near the house, then you may have some difficulties with charging your EV or PHEV at home. We hope that future housing options will take this into account, and that some existing apartments will be retrofitted by enlightened landlords. In the meantime, you still have options with hybrids and very low emission standard vehicles.

In listings below, EVs are listed and ranked according to GHG emissions (all upstream of course) as calculated by the EPA specifically for the Ashland ZIP code. This allows for a fair comparison to other types of vehicles.

Better: Plug-in Hybrid Electric Vehicle (PHEV)

Most plug-in hybrid electric vehicles are almost identical to their now-familiar hybrid gas-electric counterparts. The difference is that they are equipped with larger batteries and a plug socket for external charging. The car runs on the battery until it is nearly exhausted at which point the gasoline engine kicks in to operate the car as a typical hybrid. (Chevy's Volt is technically unique in its drivetrain specifics, but from the owner's viewpoint it is functionally the same as the others.)

The PHEV lets you reduce vehicle emissions to zero while driving locally but eliminates range anxiety if you want to leave town. You can charge up at home, drive around town or – if range allows – around the valley as you please as a zero emissions EV. When you run out of battery juice, the engine kicks in and you keep on cruising, but using gasoline. Fuel economy while running on gasoline ranges widely, from excellent to poor (lower fifties to middle twenties) which means a few larger PHEVs (mostly SUVs) will not qualify as green vehicles under our criteria when driven under gasoline power predominantly.

To determine the critical GHG emissions equivalent per mile figure, the EPA assumes a PHEV will be driven 55% of the miles locally using electricity and 45% of the miles on the highway under gasoline power. Obviously this is a fluid number as it would drop with more miles under electric power and rise with more highway miles on gasoline. Nevertheless, in nearly all cases the GHG emissions will fall between pure EVs and standard hybrids. Again, the numbers listed below include upstream emissions for both the electric and gasoline components.

Very Good: Standard Hybrid

Hybrid cars have been with us since 2000, and they have made a solid contribution to … well, keeping things from getting even worse even faster. Hybrid propulsion is highly efficient because it recaptures otherwise wasted energy when the vehicle slows and stops. (This is why hybrids excel in stop-and-go

urban driving but are closer to conventional compacts in highway mileage.) However, ultimately all energy for propulsion must come from fossil fuels as there is no option for plugging into a "green grid."

We should note here that hybrids have been a valuable proving ground for EVs because they share the same basic battery technology. When hybrids were first introduced, there was some concern that the expensive batteries might have to be replaced in as little as five years. This has not been the case; battery life has largely exceeded expectations. My brother has a 13-year-old Prius still going strong on the original battery.

Again, only those hybrids with combined GHG emissions under 333 grams/mile will be listed below.

Not as Bad: Low-emissions Internal Combustion Engine (LE-ICE)

When it comes to internal combustion engines, size matters. In fact, as an alternative or supplement to fuel taxes, several European countries tax new vehicles according to engine size. That's because, all other factors being equal, a smaller engine will burn less fuel and produce lower GHG emissions.

According to the guidelines set above, as a rough rule of thumb a gasoline-powered car must achieve better than 32 mpg combined city and highway in order to keep greenhouse gas emissions below our limit of 333 grams per mile. Dozens of available models, both new and used, can qualify. These vehicles provide an option for individuals and families that want the reliability and safety features of a newer vehicle but either have problems with PHEV/EV charging or cannot afford the added cost of a hybrid. Because these cars are largely compacts and sub-compacts, most are relatively inexpensive. For example, thanks to an attractive rebate offer, in 2017 we purchased a new four-passenger sub-compact (323 grams/mile) with automatic transmission for only $10,500.

Sub-compacts are also an economical option as a second car for households that honestly do need one larger car for some uses. A bonus feature of a sub-compact is that you can fit into tight parking spaces on the residential streets near the Ashland Food CO-OP that other cars have to pass by.

Finding Your Best Choice: Single Vehicle Households

The American car consumer tends to ask, "What kind of car will fulfill all my needs all of the time?"

We have to stop asking that question. Instead we ask, "What's the lowest GHG emission vehicle I can afford that will meet most of my needs most of the time?"

Three main factors come into play here:

1. How many passengers will I need to accommodate on a regular basis?
2. How much stuff do I need to haul around on a regular basis – not just occasionally?
3. Do I (honestly) really need all-wheel drive (AWD)?

There are too many large AWD SUVs, each able to accommodate 7 or 8 persons, that are driving around our valley with only the driver on board and otherwise empty. Some of these drivers only use their full

capacity a few times a year. If you are a one car household, think differently. If you need to take more than three or four passengers, can you get somebody else to come along with their car? If you need to haul a bunch of stuff, can you rent a U-Haul? Re-think what you really need.

Two or More: The Optimum Household Mix

It can get tricky when you have a household with two, three or four drivers and more than one vehicle. What if a teenager is on the high school ski team? What if you regularly haul food or clothing for charitable work? Yes, perhaps one vehicle needs to be larger and have AWD. But you use that one only when needed. For all the other times, get something greener. If both vehicles are needed at the same time, use the greener one for the longer trip.

That's where we ended up in our household. We have an 11-year-old compact SUV that pumps out 485 grams per mile, but it stays in the driveway as much as possible. We expect it will only be driven about 1,000 miles in 2018. The other car, a PHEV (140 grams per mile), is first call otherwise and is used for all trips outside Ashland as it goes about 50 miles on electric and afterwards gets around 40 mpg on gas. Our goal is to reduce household gasoline consumption (both vehicles) below 120 gallons annually by 2020.

Your situation may differ, but the same rules apply. How can you drive the most miles using a vehicle with the lowest possible GHG emissions – and do so without imposing an excessive "manufacturing penalty?" It will take some research, some forethought and perhaps a significant financial investment. But it needs to be done, and we'll all be glad you did it.

Plug-in Considerations: Downsides and Upsides

The only significant down side to owning a plug-in vehicle is finding a place to plug it in when you're away from home. The shorter the range, the more often you have to plug it in. Because we have a PHEV, I haven't had to go much out of my way on long trips to find a juice source. On my last trip to Seattle I was pleased to find free charging at the Washington State rest area just north of Portland, and I brought along my own charger to juice up when I stopped overnight at my brother's house in Corvallis. But otherwise, alas, I resorted to gasoline.

My biggest gripe is that very few hotels now offer charging. That has to change. But you can manage longer trips if you're patient and resourceful. I know of Bolt and Tesla owners who've driven from Ashland to the Bay Area with only a leisurely lunch and/or coffee charging break (or two) along the way.

When you are at home, plugging in is quick and easy. It takes me literally no more than ten seconds, twenty for a plug-unplug cycle. That's no more time spent than going out of your way to get gas and (often) waiting several minutes for the attendant to finally get around to your turn.

There are side benefits to owning an electric car, some obvious, some less so.

1. Faster heat – Because the heater is electric, you don't have to wait for the engine to warm up.
2. Quiet! - The difference is noticeable and a blessing when listening to classical music.

3. Acceleration – Most EVs and some PHEVs with larger batteries can develop considerable torque, which means faster pick-up for passing and merging.
4. Frictionless braking – All plug-ins offer regenerative braking, which uses the frictionless magnetism of the motor to slow the car. If used regularly, you can probably go for 300,000 miles on the original brakes.
5. Foot freedom when on cruise control in traffic – With conventional cars, you need to keep your foot near the brake when using cruise control in traffic. But if your plug-in has a steering wheel paddle for the regenerative braking (not all do), you can move your feet around and cross your legs as suits your comfort because emergency braking is right under your fingertips.
6. Stability in wind – The battery weight of plug-in cars is low and evenly distributed, so the car is remarkably stable when buffeted by gale-force winds. (Extremely so for a Tesla, not so much for a Smart ED.)

Resources for Decision-making

Fuel Economy.Gov – This web site is a treasure trove of information, with relevant details on all cars sold in America plus helpful background information on a variety of topics related to GHG emissions. Much of the content was developed over eight years of a relatively enlightened administration, and as far as I can tell it remains accurate and reliable. No guarantees going forward, though I suspect deliberately tampering with it has low priority and is risks exposure as multiple independent sources are available here and abroad for measuring what are essentially global vehicles. (One such independent study exposed the VW diesel fraud.)

Ashland City EV Pages - A first-rate overview on EVs and PHEVs, containing nearly all the general information here and presents a great tutorial on the basics of the technology. It includes a nifty calculator for comparing your current gasoline vehicle's operating costs to battery-only EVs (not PHEVs), but has no other information relating to specific makes or models.

Consumer Reports – A reliable and comprehensive guide. Emphasis here is on bread-and-butter issues like safety, economy and reliability. It remains independent and trustworthy. But you do have to pay to access the details.

Car and Driver – The magazine and web site are geared toward automotive enthusiasts who are interested in technology and driving pleasure as well as the basics. You'll find more of an emphasis on performance – acceleration, handling and driver involvement – in their reviews and rankings.

Edmunds – A comprehensive free resource for detailed information, specifications, expert reviews and user reviews (including a couple of mine). Particularly useful is their comparison feature which lets you do detailed, side-by-side comparison of pricing and specifications on up to four cars.

Green Car Reports – This web site covers all green cars, including hybrids. It is wide-ranging and comprehensive on every topic from a business and technology perspective, and includes exhaustive staff and user reviews. It is independent in the sense that it is not tied to any maker, but it obviously promotes the green vehicle industry as a whole.

Plug-in America – As the name implies, the focus here is exclusively on EVs and PHEVs. But it offers a wealth of information within that category.

Financing: Tax Credits and Rebates

Federal Tax Credit

As of this writing, the full electric vehicle federal tax credit remains in place. A version of tax reform legislation originally passed by the House of Representatives in late 2017 had eliminated the credit, but the final legislation has retained it with no changes. This is good news, as it keeps EVs and PHEVs cost-competitive with ICE and conventional hybrid cars.

The credit amount is based on the size of the battery with all EVs and a few PHEVs qualifying for the maximum $7500 tax credit. Lower credits apply to other PHEVs. The amount of the credit for each vehicle is given at this link. Note that the tax credit "sunsets" as soon as a maker sells 200,000 qualifying vehicles; GM, Nissan and Tesla are all getting close but their credits will likely last through 2018.

Oregon EV Rebate

Effective January 1, 2018, the state of Oregon is offering a rebate on purchases of new EVs and most PHEVs. This is a true rebate program, which means you fill out a form and the state sends you a check. The program was part of a transportation bill enacted last year by the legislature, but some of the administrative details are still being hammered out. Also, legal challenges may delay payments. What we know is this:

- Purchases and leases (minimum 24 months) after January 1 will be eligible, but checks may be delayed until funding is available from a new tax imposed on all car sales at dealerships which becomes effective on that date.
- EVs and PHEVs with a MSRP of more than $50,000 will not be eligible. So if you want a rebate on a Tesla, you'll have to keep waiting on that Model 3.
- All purchasers/lessees will be eligible for a rebate based on the size of the vehicle battery. This will be similar to the federal tax credit, with the maximum amount of $2500 for all EVs and the Volt and Clarity PHEVs. A smaller rebate amount will apply to most if not all other PHEVs.
- Low- and moderate-income purchasers may be eligible for an additional rebate based on family income.
- Updated information should be available at this link.

Now that the federal tax credit has survived in Congress, those who purchase or lease an EV (or one of a few $7500-credit PHEVs) should be able to take up to $10,000 off the cost of the vehicle, with even greater savings possible for some lower income Oregonians. Add to that some smart deal-making and this could drop the cost of the lowest-priced EVs down to the $15,000 to $18,000 range.

Should I Buy or Lease?

This is a critical question if the vehicle qualifies for the federal tax credit and you have limited federal tax liability. Be aware that the federal credit cannot be applied to a tax refund. In other words, the amount of your EV credit is limited by the amount of tax you owe. If you only owe $5000 in federal income taxes, then your $7,500 tax credit is effectively reduced to $5,000.

This is one reason why the majority of EV and PHEV transactions are leases. Because the leasing company (often a division of the car maker) is technically the purchaser, the company takes the federal tax credit and applies most of it to the lease as a "capital cost reduction", lowering the price of the car. That in turn lowers your lease payment and the residual amount – what you have to pay if you choose to buy the car at the end of the lease. As an example, this arrangement enabled us to lease our PHEV for $199 a month ($2200 at signing), which was competitive compared to similar "non-green" vehicles.

Green Cars Available Locally

A number of green car makers are not included here as they have no "brick and mortar" presence in the Rogue Valley. Notably absent is Tesla, with the closest showroom in Tigard. However, it's worth noting that the slow-to-market Model 3 does rank number two in low GHG emissions, behind only the Hyundai Ioniq and BMW i3 (tied). This car might be worth waiting…and waiting…for. However, the larger Tesla Model S and Model X fail to make the top ten of greenest cars.

Also without local representation are Audi, Lexus, Jaguar, Mini, Mitsubishi, Porsche and Volvo, all of which have green cars in their current lineups. Of those represented here, only the best-selling models are likely to be in dealer inventory at any given time; others must be ordered. Some recently introduced models, most notably the Nissan Leaf, may not be available until sometime later in 2018.

Note that some close "sibling" models that are identical in GHG to those listed are not included for simplicity's sake. All are either 2017 or 2018 model year. Production on some models, like the Ford C-Max and Energi, is ending with the 2017 model year.

ICE stands for "internal combustion engine", which means it's a conventional gasoline car – but with a small motor. Note that some models with the same name but different engines or transmissions may fail to achieve the combined city/highway rating of 32 mpg (333 grams/mile) or better required to meet our minimum "green car" criteria.

Cost is for the lowest price variant of the model in broad price ranges: $ = Under $16,000; $$ = $16,000 to $25,000; $$$ = $25,000 to $40,000; $$$$ = Over $40,000. Cost here is MSRP minus any applicable tax credits and/or Oregon rebates for EVs and PHEVs. Actual selling price may drop to a lower range on borderline models if you can swing a "good deal."

Cars in each category are ranked "best to worst"; from lower GHG emissions to higher. All are automatic transmission except as noted. With some ICE models, the manual transmission may be marginally worse

than the automatic; these are omitted. The variant with the lowest MPG (GHG emissions) is listed; other variants of the same model may be slightly worse.

Note that EPA mileage figures (on which ICE GHG emissions are based) tend to be optimistic. In my experience I have found them achievable, but only under optimum conditions of weather, terrain, speed and tire pressure. Most real-world results will be lower, but likely will be uniformly low across most models for the same given conditions. Consequently, the relative rankings shown below will not be affected, give or take perhaps 10 grams per mile.

Cars are grouped into three categories according to general use and appeal. New cars available in Ashland (sales and service) are highlighted in green.

Subcompacts and "City Cars"

These are smaller cars primarily designed for driving around the local area, although longer road trips with minimal luggage are possible with some. Seats for 4 unless noted otherwise.

Make	Model	Type	GHG Emissions	EV/PHEV elec. range	Notes	Cost
BMW	i3 BEV	EV	80 g/mile	114 miles		$$$
BMW	i3 REX	PHEV	100 g/mile	97 miles	Total range 180 miles	$$$
Smart	Fortwo ED	EV	100 g/mile	58 miles	Seats 2	$
Smart	Fortwo	ICE	305 g/mile		Seats 2	$
Fiat	500	ICE	314 g/mile		Manual transmission	$
Chevrolet	Spark	ICE	323 g/mile			$

Compact to Mid-size Sedan and Hatchback

Cars here, with a few exceptions, listed here fall into a very broad "family car" category. Most are spacious enough for reasonable comfort on long road trips, and most will carry five adults and luggage without being too cramped – again with exceptions noted. Otherwise, size, amenities and cost vary widely.

Make	Model	Type	GHG Emissions	EV/PHEV elec. range	Notes	Cost
Hyundai	Ioniq	EV	80 g/mile	124 miles		$$
Chevrolet	Bolt	EV	90 g/mile	238 miles		$$$
Volkswagen	e-Golf	EV	90 g/mile	125 miles		$$
Ford	Focus electric	EV	100 g/mile	115 miles		$$
Kia	Soul electric	EV	100 g/mile	111 miles		$$
Nissan	Leaf	EV	100 g/mile*	150* miles	*Est., final data for 2018 N/A	$$
Merc-Benz	B250e	EV	130 g/mile	87 miles		$$$
Chevrolet	Volt	PHEV	140 g/mile	53 miles	420 miles total range; center rear seat has limited legroom	$$
Honda	Clarity	PHEV	140 g/mile	47 miles	330 miles total range	$$
Toyota	Prius Prime	PHEV	140 g/mile	25 miles	640 miles total range; roomy but seats 4 only	$$
Kia	Optima	PHEV	180 g/mile	29 miles	610 miles total range	$$$
Hyundai	Ioniq Blue	Hybrid	184 g/mile			$$

Ford	Fusion Energi	PHEV	190 g/mile	21 miles	610 miles total range	$$$
Hyundai	Sonata	PHEV	190 g/mile	27 miles	590 miles total range	$$$
Toyota	Prius Eco	Hybrid	190 g/mile			$$$
Hyundai	Ioniq	Hybrid	194 g/mile			$$
Toyota	Camry Hybrid	Hybrid	205 g/mile			$$$
Toyota	Prius 1.8	Hybrid	205 g/mile			$$$
Honda	Accord Hyb.	Hybrid	222 g/mile			$$$
Chevrolet	Malibu Hyb.	Hybrid	232 g/mile			$$$
Toyota	Prius C	Hybrid	232 g/mile			$$
Ford	Fusion Hyb.	Hybrid	254 g/mile			$$$
Hyundai	Sonata Hyb.	Hybrid	254 g/mile			$$$
Kia	Optima Hyb.	Hybrid	260 g/mile			$$$
Toyota	Prius V	Hybrid	260 g/mile			$$$
Lincoln	MKZ Hybrid	Hybrid	267 g/mile			$$$
Toyota	Avalon Hyb.	Hybrid	267 g/mile			$$$
Cadillac	CT6	PHEV	280 g/mile	31 miles	430 miles total range	$$$$
Toyota	Camry XLE/SE	Hybrid	281 g/mile			$$$
BMW	330e	PHEV	290 g/mile	14 miles	350 miles total range	$$$$
Honda	Fit 1.5L	ICE	296 g/mile		Small	$$
Honda	Civic 1.5L	ICE	296 g/mile			$$
BMW	i8	PHEV	300 g/mile	15 miles	330 miles total range; 4 passenger roadster	$$$$
BMW	530e	PHEV	300 g/mile	16 miles	370 miles total range	$$$$
Hyundai	Elantra 1.4L	ICE	305 g/mile			$$
Mazda	2 1.5L	ICE	305 g/mile		Small	$$
Toyota	Yaris 1.5L	ICE	305 g/mile		Small	$
Ford	Fiesta 1.0L	ICE	305 g/mile		Small, manual transmission	$
BMW	530e X-drive	PHEV	310 g/mile	15 miles	AWD; 360 miles total range	$$$$
Nissan	Versa 1.6L	ICE	314 g/mile		Small	$
Chevrolet	Cruze 1.4L	ICE	314 g/mile			$$
Ford	Focus 1.0L	ICE	314 g/mile		Manual transmission	$$
Toyota	Corolla 1.8	ICE	314 g/mile			$$
Honda	Accord 1.5L	ICE	323 g/mile			$$
Hyundai	Elantra SE 2.0	ICE	323 g/mile			$$
Toyota	Corolla 1.8L	ICE	323 g/mile			$$
Volkswagen	Jetta 1.4 L	ICE	323 g/mile		Manual transmission	$$
BMW	740e X-drive	PHEV	330 g/mile	14 miles	AWD; 340 miles total range	$$$$
Kia	Forte 2.0L	ICE	333 g/mile			$$
Kia	Rio 1.6L	ICE	333 g/mile		Small	$
Nissan	Sentra 1.8L	ICE	333 g/mile			$$
Toyota	Camry 2.5L	ICE	333 g/mile			$$
Chevrolet	Sonic 1.4L	ICE	333 g/mile		Manual transmission	$
Hyundai	Accent 1.6L	ICE	333 g/mile		Small	$
Subaru	Impreza 2.0L	ICE	333 g/mile		AWD, 4-door models only	$$
Mazda	3 2.0L	ICE	333 g/mile			$$

Compact Crossover/SUV/Minivan

The line between "hatchback" and "crossover" is a fuzzy one indeed, but in general the crossovers will offer a bit more cargo room with a more squared-off rear end. The SUVs will sit up higher and have greater road clearance as well as more interior space. The Chrysler Pacifica minivan seats 7.

Make	Model	Type	GHG Emissions	EV/PHEV elec. range	Notes	Cost
Ford	C-Max Energi	PHEV	210 g/mile	29 miles	570 miles total range	$$$
Chrysler	Pacifica	PHEV	210 g/mile	33 miles	570 miles total range; seats 7	$$$
Kia	Niro FE	Hybrid	213 g/mile			$$
Kia	Niro Touring	Hybrid	248 g/mile			$$$
Ford	C-Max	Hybrid	267 g/mile			$$
Nissan	Rogue	Hybrid	314 g/mile		Front-wheel drive (FWD)	$$$
Nissan	Rogue	Hybrid	323 g/mile		All-wheel drive (AWD)	$$$
Toyota	RAV-4	Hybrid	333 g/mile		All-wheel drive (AWD)	$$$

Local Sources for New "Green Cars"

Ashland

Butler Ford
1977 Hwy 99 N
800-283-9241
Note: Hyundai and Kia models may be test-driven and purchased at the Ashland location; however, warranty service is provided only at the respective Medford locations.

TC Chevy
2045 Hwy 99 North
541-552-5300

Medford

Airport Chevrolet, GMC, Buick and Cadillac
3001 Biddle Road
541-770-1300

Butler Hyundai
5000 Crater Lake Ave
888-366-9458

Butler Kia
4950 Crater Lake Ave
800-687-2795

Crater Lake Ford, Lincoln and Mazda
2611 Biddle Road
541-887-6176

Lithia Chrysler, Dodge, Jeep and Fiat
4540 Grumman Drive
541-930-3023

Lithia Honda
4095 Crater Lake Hwy
541-930-3021

Lithia Nissan
4560 Grumman Drive
541-930-3025

Lithia Toyota
1420 N. Riverside Ave
541-930-3030

Mercedes-Benz of Medford (also Smart Cars)
3240 Crater Lake Ave
541-774-1000

Medford BMW
4600 Grumman Drive
541-930-3024

Southern Oregon Subaru
3103 Biddle Road
541-245-2000

<u>Grants Pass</u>

Grants Pass Toyota
375 Redwood Highway | (541) 982-4995

Jim Sigel Automotive
Chevrolet – Honda - Nissan
1601NE 7th Street | (541) 476-0811

Lithia Chrysler – Dodge of Grants Pass
1421 NE 6th Street | (541) 291-9880

Mocks Ford – Lincoln – Mazda
913 SE 6th Street | (541) 476-6656

Most Popular Plug-in Cars Sold in the Rogue Valley

Following is a list of the ten best-selling plug-in cars that are available locally. Again, Tesla is not listed, though if you've "tasted the Tesla Kool-aid" any lack of local presence is likely not an issue. For all other cars, having nearby service support is worthwhile. Also, cars higher on the list are likely to have more proficient service expertise locally. Note that the BMW X5 PHEV does not qualify as it exceeds the 333 grams/mile limit, and the Fiat 500e is not sold locally. The Ford C-Max Energi may have limited availability later in 2018 (discontinued with 2017 model year) while the new 2018 Nissan LEAF may not be available during the first months of 2018. Green again indicates Ashland sales and service.

List below is ranked by cumulative sales in the US from January through November 2017. Several promising new models have been introduced for 2018 while some 2017 models will be discontinued, so expect changes to the list in the 2019 edition.

1. Chevrolet Bolt (EV)
2. Toyota Prius Prime (PHEV)
3. Chevrolet Volt (PHEV)
4. Nissan LEAF (EV)
5. Ford Fusion Energi (PHEV)
6. Ford C-Max Energi (PHEV)
7. BMW i3 (EV or PHEV)
8. VW e-Golf (EV)
9. Chrysler Pacifica (PHEV)
10. BMW 330e (PHEV)

The Manufacturing Penalty and Used Options

Should I buy a new green car now? Or a used one? Or keep driving what I have?

There are no easy answers to those questions, as we have to deal with some fuzzy grey areas. The only obvious answer is that when you buy any car, new or used, it's always better to buy one with lower GHG emissions as opposed to one with higher emissions. And the greener the better when you're buying new, as that will shorten the time required to amortize what I call "the manufacturing penalty."

Manufacturing just about anything involves GHG emissions, and cars are no exception. The size of the penalty is difficult to compute, but some estimates make it equivalent to more than three years of driving a typical vehicle. The only certainty here is that a larger and more complex car – green or otherwise – will impose a greater manufacturing penalty than a smaller and simpler car. More steel and aluminum and plastic, plus more manufacturing processes, result in higher GHG emissions. Therefore, even though a fully loaded Tesla Model X may be impressive in its low emissions per mile, it will take longer to overcome the manufacturing penalty than with the smaller and less sophisticated Chevy Bolt. It might even take that Tesla X five years or more to break even with a petite, gas-driven Smart for Two!

The duration of the penalty also depends on annual miles driven. If you drive your personal vehicle less than 10,000 miles a year and your present vehicle emissions are under 400 grams/mile, then maybe it's

better to hang in there for a few more years and wait for both the cars and the grid to get even greener. But if your present vehicle is over 400 grams/mile and you drive more than 10,000 miles a year, then the planet may be better served if you make a change sooner rather than later.

All new cars impose a "manufacturing penalty", regardless of how powered. It is true that, for cars of equivalent size (e.g. Nissan Leaf to Toyota Corolla), the EV will have about a 15% higher penalty, largely because of the battery. But a recent "cradle to grave" study by the Union of Concerned Scientists shows that this additional penalty is canceled out within 6 – 13 months of typical driving.[10] Also, you can offset your net penalty in part by refraining from purchase of other energy-intensive manufactured goods (appliances, electronics etc.) that you may crave but don't really need.

Here's an example that might prove helpful. Let's say you now own a 2008 Honda Accord with the 2.4 L 4-cylinder engine and 5-speed automatic transmission. In its day it was considered an "economy car" but it nevertheless emits 444 grams/mile of GHG. Let's assume you drive it 10,000 miles a year, split about evenly between around town and highway trips. If you were to replace it with a comparably sized PHEV (Chevy Volt or Toyota Prius Prime) at 140 grams/mile, your GHG emissions for one year would drop by 3.04 metric tons. Is this significant? The average American is responsible for about 16 metric tons of total direct emissions (those over which we have some personal control) every year[11], a figure that includes car emissions. So yes, cutting that number to below 13 metric tons (a 19% decrease) would amortize the additional manufacturing penalty in a relatively short period.

On the other hand, if the Accord is a 2014 model, with the same size engine but the newer transmission, your emissions are about 356 grams/mile. That's a significant improvement, and it might be better to keep the car for several more years unless it doesn't suit your needs for other reasons.

New or Used?

As a general rule that I apply to all car transactions, and especially for green cars, I advise buying new only if you expect to keep the car for at least ten years. The same applies to a lease: fine to do so as outlined above, but only if you reasonably expect to purchase at the end of the lease. The only down side to hanging on to it after the lease expires is that you are not helping to increase the supply of used green cars, which does have benefits to others in the market. Again, it all boils down to the same conundrum. The global climate would benefit greatly if we quit making and buying cars altogether, ceasing all driving and instead walking, cycling and using mass transit exclusively. However, that's simply not going to happen anytime soon, so it's best to tilt the balance toward greener vehicles every step of the way.

Shopping for a used green car is generally the same as shopping for any other used car, with all the attendant hassles and frustrations. (Been there, done that – too many times!) A fair supply of conventional hybrids is generally available in the Rogue Valley at reasonable prices, thanks in large part to the "fracking" low gas prices. EVs and PHEVs may be harder to find as there haven't been that many sold in the area in past years. You may have to travel up to Eugene or Portland if you're looking for a particular model or condition. If it's an older EV with limited range, getting it home may require one or two extended stops for charging or paying to have the car shipped home.

Closing Caveat

Figures given for total combined GHG on EVS and PHEVs are computed for the power grid of this region. They should remain valid if you expect to continue living anywhere on the West Coast. If you plan to move to a state more dependent on coal-powered generation (Colorado, West Virginia) the relative EV advantage will diminish substantially. If you move to Vermont, however, your EV will be marvelously close to a true zero emissions vehicle when charged from that progressive state's ultra-clean power grid.

About the Author

A 28-year Ashland resident, Bruce Borgerson is a self-employed technical writer and a member of the city's Transportation Commission, the Sierra Club and SOCAN (Southern Oregon Climate Action Now). He has purchased more new and used cars in his lifetime than he cares to admit. Current vehicles in his immediate, two-person household are a 2017 PHEV (140 grams/mile) and a 2006 compact SUV (485 grams/mile). He also manages vehicles for his two grown children: a 2017 subcompact (323 grams/mile) and a 2007 compact (344 grams/mile). Please e-mail any questions or corrections to wave@mind.net.

Donations Gratefully Accepted

If you would like to financially support this guide, feel free to Venmo a donation to 541-488-5542. Suggested amount is $2 to keep the bookkeeping simple. I will donate half of all amounts received to SOCAN and Rogue Climate (split 50-50), with the other half stashed away for our next 2-for -1 green car upgrade. (SUV and PHEV both traded in for one EV in 2027.)

Notes:

(1) https://www.eia.gov/todayinenergy/detail.php?id=29612

(2) http://css.umich.edu/factsheets/carbon-footprint-factsheet

(3) https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

https://www.eia.gov/todayinenergy/detail.php?id=29612

(4) https://www.bpa.gov/news/pubs/factsheets/fs-201303-measuring-the-carbon-ontent.pdf

https://www.bpa.gov/news/pubs/generalpublications/gi-bpa-facts.pdf

(5) https://www.washingtonpost.com/graphics/national/power-plants/?utm_term=.e2ea8e0b802f

(6) https://www.eia.gov/tools/faqs/faq.php?id=307&t=11

(7) Calculated by comparing upstream and tailpipe emissions for multiple vehicles at fueleconomy.gov.

(8) https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle

(9) Derived from comparing emissions of EVs and a number of comparable fossil-fuel vehicles at fueleconomy.gov, with upstream emissions included for both. Also from:

https://energy.gov/eere/vehicles/fact-950-november-7-2016-well-wheel-emissions-typical-ev-state-2015

(10) http://www.ucsusa.org/sites/default/files/attach/2015/11/Cleaner-Cars-from-Cradle-to-Grave-full-report.pdf

(11) https://calculator.carbonfootprint.com/calculator.aspx?tab=8 This methodology also includes secondary emissions from purchase of goods and services by individuals.