Questions that Should be Frequently Asked

A Journalist's Guide to Reporting on Environmental Vehicle Technology

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Electric Vehicles

What is the range at 70 mph?

Range is what everyone asks about, but the answer doesn't always mean what it seems. Range numbers are often based on low-speed urban drive cycles or relatively low-speed highway driving. To get anywhere in Los Angeles you have to take a freeway, and that means driving 70 mph. So ask, or better yet, find out for yourself, how far the car will go at real speed.

What is the vehicle energy consumption?

This is half of the range equation. It measures energy use per mile due to drive system losses, aerodynamic drag, rolling resistance, and accessory requirements. Typical units are watt-hours per mile (Wh/mi). Even more than mpg in a conventional car, this number depends on how, and how fast you drive. Again, results at 70 mph are more representative than results from a lazy-day test cycle. Efficient EVs operate in the 150 - 250 Wh/mi range.

If you are doing the testing, make sure to account for elevation changes because they have a huge effect on energy consumption. In mountain driving, for example, the uphill portions may consume twice the energy per mile, but because of regenerative braking, the downhill portions may actually put energy back into the battery.

What is the dischargeable energy capacity of the batteries?

This is the other half of the range equation. A lot of PR-speak talks of 80% depth of discharge (DOD) and 100% DOD, and they talk about C3 rates or other standard tests. What the customer needs to know is how much energy, in kilowatt-hours (kWh), can be taken from the battery before the vehicle can no longer keep up with traffic due to loss of power. In some cars the power reduction will be the result of actual battery depletion, in others it will be due to programmed power-limit modes intended to protect the batteries. In either case the question is — how much energy has the battery delivered when the vehicle becomes power limited?

What is the charging efficiency?

This determines how much of what the customer pays for, (electricity from the grid), makes it into the battery for use in the vehicle. The answer depends on the efficiency of the charger itself and the battery. Batteries may require temperature control during charging, and the energy used for heating or cooling can be significant. Good EVs achieve 80-85% charging efficiency. In hot weather, however, some batteries, such as NiMH for example, charge slowly and require a lot of cooling, so charging efficiency can be below 70%.

What is charge time for full capacity? (see above)

Higher capacity batteries supply more energy but they also take longer to charge, so there is a trade-off in customer utility. All other things being equal, a battery with twice the energy capacity will require twice as long to charge.

What is the charger power rating?

Higher power chargers reduce charge time. Most chargers operate in the 3-7 kW power range. Typical power outlets can often supply 10 or even 20 kW, so high-power chargers improve user convenience by taking advantage of the available power to reduce charge time.

What is the charging rate?

How far can you drive per hour of charge time? That's what an EV driver wants to know. It depends on how powerful the charger is, and how efficiently the vehicle uses the electricity. Efficient EVs with high-power charging can get over 90 miles of range per hour of charge time. Many EVs, especially those based on trucks, can achieve less than 15 miles per hour.

Batteries

How much does the battery cost? How much is it worth?

Many EVs have been introduced with Nickel- or Lithium-based batteries that improve driving range significantly compared to the range that the same vehicle could achieve with lead-acid batteries. The current cost penalty of these batteries, (estimated at $50,000 - $100,000), implies that range improvement is worth $1000 - $2000 per mile.

Eventually the cost of these batteries may come down, but at the same time the EV product planners will have to place the cost of range improvement in the context of what it is worth to the customer. From a vehicle design perspective, $1000 can buy a lot of efficiency improvement, and efficiency, unlike increased battery capacity, reduces driving cost and shortens charge time.

Can the battery produce 100 kW?

Although batteries are usually characterized mostly by their energy capacity (kWh), which determines range, their power capacity (kW) is also a critical characteristic that determines vehicle acceleration and hill-climbing capability. An EV traction motor cannot produce more power than the battery can supply.

A power rating of 100 kW is an arbitrary level, but EVs that weigh 3000 – 4000 pounds require at least 100 kW (134 hp) or more to achieve performance comparable to that of conventional vehicles.

How big would a 100 kW battery be?

Nickel- and Lithium-based batteries provide less power per unit of size (volume) than lead acid batteries. As a consequence, the package size of alternative batteries may become impossibly large as battery power increases. The implication, based on current performance levels, is that alternative batteries can improve range, but only at the expense of performance. Like the range/cost tradeoff mentioned above, the range/performance tradeoff is another challenge facing EV product planners.

Hybrid Vehicles

Are the fuel economy values calculated for sustaining or depleting the battery charge?

Fuel economy values will look better if some of the energy over a driving cycle comes from the battery. If the battery can be charged form the wall, then the fuel economy based on charge depletion gives an indication of the petroleum energy requirement of the vehicle, but not necessarily of its energy efficiency. If the battery can only be charged from the onboard power source, then fuel economy based on charge depletion is bogus.

What is the mpg at sustained 70 mph?

A big advantage of hybrid-drive vehicles is the ability to recapture driving energy through regenerative braking. This has a big effect in urban driving, but only a minor effect on the highway. A public aware of the 80 mpg promises of PNGV, or the 3L/100 km objectives of some European vehicle projects, or even the 66 – 70 mpg claims for Japanese hybrid vehicles, may be disappointed at the actual highway fuel economy of hybrid vehicles which are likely to be in the 35 to 45 mpg range.

What is the dischargeable energy capacity of the non-fuel onboard energy storage?

The size of the battery, or flywheel, or ultracapacitor that stores energy from regeneration and for acceleration determines how much the vehicle can rely on stored energy versus how much it must rely on fuel energy.

Can it be plugged in?

Hybrids that cannot be plugged in require onboard conversion of fuel for all of their energy. This means that emissions from fuel conversion, whether on the car or off the car, must be considered just as power generation emissions are considered for EVs.

What speed can be sustained up a 6% grade? For how many miles?

For example, can the hybrid sustain speed up the Grapevine Grade on Interstate 5? Extended hill climbing requires a good balance between non-fuel energy storage (battery) and the power of the onboard engine. The smaller the battery, the larger the engine required to make the Grapevine climb. The larger the engine, the less it is able to run at constant power and the more it must follow the load as in a conventional vehicle.

Fuel Cell Vehicles

Does the vehicle run on hydrogen?

If it does, then the vehicle is similar to an electric vehicle, because hydrogen, like electricity must be generated. Hydrogen does not exist as an energy source in nature. It must be produced, at some significant energy cost, usually from methane or by decomposing water. For a hydrogen fuel cell vehicle, all of the questions asked about EVs pertain. In particular, these questions should be asked. Is the hydrogen generation process efficient? Is it clean? Where do I fill up on hydrogen? How far can I travel on one fill up? What is the efficiency of the system? Is regenerative braking available? Is an onboard storage battery also required?

Does the vehicle run on methanol or gasoline?

If it does then the vehicle includes a reformer that creates hydrogen for the fuel cell from the fuel carried onboard. Reformers produce some emissions, and they consume energy, so reformer equipped fuel cell vehicles resemble internal combustion engine vehicles in some ways. Comparing the two raise the following questions? What is the overall efficiency of the reformer and the fuel cell? What are the emissions? What is the power rating? How quickly can power be increased from "idle" to maximum?

Low Emission Vehicles

What are off-cycle emissions such as at full throttle acceleration to 75 mph?

Air quality does not care whether emissions are on-cycle or off-cycle. If typical driving produces high emissions, then the value of low-emission certification is questionable.

Are your LEV or ULEV emissions proportionately lower for all operating conditions or only for the certification driving cycle?

Off-cycle emissions may be unavoidably higher than on-cycle emissions for many cars, but if they aren't any lower than off-cycle emissions for cars certified at higher emissions levels, then the LEV or ULEV certification offers only limited benefits.

What are lifetime, real-world emissions projected for this vehicle?

This would include off-cycle driving, deterioration, malfunctions, negligence, tampering, and all the other things that happen over a vehicle's lifetime. Probably no one knows the answer, but it's a good question, because the answer, times the 200+ million cars in service, is what determine whether we have clean air or not.