

# Do Electric Cars Make Economic Sense for the Mass Market?

Big, seemingly risky investments in GM's Volt and the Nissan Leaf led two automotive economics experts to analyze what makes these vehicles attractive to automakers.

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Virtually every automaker has announced plans for small fleets of plug-in hybrid or electric vehicles in the U.S. market. Environmental goals, sales and promotion, and new regulation all play a role in motivating these plans, even though the market for such products remains unproven. Manufacturing costs remain stubbornly high and consumer demand may fail to materialize.

But two companies, GM and Nissan, have committed to widely publicized launches of mass market plug-in electric vehicles, with 2011 sales goals in the tens of thousands (and ultimately hundreds of thousands). Nissan is spending billions of dollars on battery plant construction. Most automakers have taken far more tentative steps, prompting us to wonder if, from an economist's point of view, these were rational decisions. Put another way, who is the more sensible: the aggressively investing minority or the majority with its more measured path?

## There Goes the Margin

The ability to supply an electric vehicle has been dictated by advances in battery technology for some decades. Today's

state of the art appears to be well-represented by the Nissan Leaf, a sub-compact car with a claimed 100-mile range (far below that of any mainstream internal combustion car), and a battery with an estimated production cost of at least \$16,000. In other words, a vehicle in a class that typically sells between \$16,000 and \$20,000 in the United States will come to market with a battery that alone costs as much as competing cars while providing a very limited driving range. Selling this vehicle with normal margin expectations would mean pricing it at a level likely to attract few buyers.

Accounting for the cost of complying with emissions and fuel economy regulations, a money-losing plug-in can make sound economic sense for a large automaker.

In fact, Nissan has announced that it will sell the Leaf for \$32,780, a price which appears, at best, to leave no room for profit and yet which is still double that of some class-size competitors. A federal tax rebate (and – in some states, subsidies) will help increase demand; indeed, Nissan has received refundable deposits from enough consumers to match the first year's expected production. At these margins, though, Nissan is still likely to be losing money – so why bring the Leaf to market?

## First Mover Factor?

One commonly cited rationale is anticipation of future battery cost reductions and future gas price increases, which could boost the mainstream consumer appeal of a high-priced electric car. Other markets, such as Europe and Japan, tax gasoline aggressively enough that the operating cost savings of the electric car are already more meaningful.

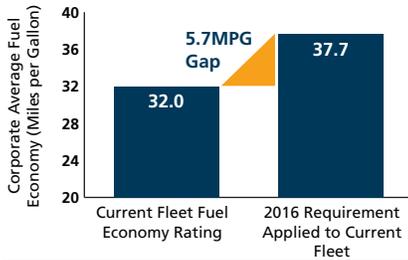
But battery costs have been decreasing at only about five percent per year. Fuel prices are unpredictable, yet the likelihood of achieving a positive standalone return on investment for either the Leaf or GM's similarly timed product, the Volt, seems very low. GM, in fact, has stated that it does not expect its first generation Volt to be profitable.

Both makers may be seeking a first-mover advantage such as Toyota has enjoyed with the current generation of hybrids. Building intellectual property, know-how, and consumer brand awareness in a new

generation of vehicles could add up to a persistent advantage. These are expensive bets, however. Honda invested in first-generation hybrids as early as Toyota but has achieved only a fraction of Toyota's success. This may explain the apparently more careful pace of GM's and Nissan's main competitors.

Another factor may provide economic justification for early investment, though. Upcoming emissions and consumption regulations in the United States and Europe will effectively demand much higher fleet average fuel economy from automakers over the next few years. If GM and Nissan achieve higher sales of plug-in electric cars than competitors do, even at a loss, could the increased fleet fuel economy allow them to avoid regulatory penalties or the kind of expensive technologies needed in other vehicles to bring them into compliance?

### The Challenge of Meeting Nissan's 2016 Fuel Economy Requirement



Versus 2010, Nissan must improve fleet fuel economy by 5.7MPG by 2016

Source: NHTSA

### Running the Numbers

The National Highway Traffic Safety Administration maintains a research arm, the Volpe Center, which has developed a model to estimate the cost of compliance with upcoming fuel economy requirements. The so-called Volpe model evaluates a wide range of technologies for saving weight or improving engines, transmissions, and other powertrain components to increase overall fuel economy. With parameters for the size and weight characteristics of any automaker's fleet, it allows for an approximation of the cost each automaker faces to comply with fuel economy regulations.

Using the Volpe model's estimates, bringing Nissan's fleet into compliance with 2016 standards will cost Nissan \$832 per vehicle. Using lighter weight materials, more efficient engines, lower rolling resistance tires, and similar techniques – we'll call this the Traditional Compliance Strategy – Nissan can bring its fleet from the 32.0MPG it achieves today to the 37.7MPG regulated for 2016.

But the EPA has yet to provide an economy rating for the Leaf. This is non-trivial, since the petroleum or carbon equivalent of the electricity used to charge the Leaf must be estimated. Should it be the carbon associated with U.S. average power generation capacity or should policy set a more favorable rate? The EPA has shown interest in setting rates that provide at least some additional incentives for plug-ins. Nissan claims the Leaf will rate at over 300MPG.

### Estimated Costs per Vehicle to Meet CAFE Standard in 2016 Traditional Strategy vs. Leaf Strategy (2016 Leaf Sales = 120,000)



Compared to the cost of compliance without the Leaf, Nissan can afford to give up \$4,500 in margin on every Leaf

Source: NHTSA, Analysis Group

Using 300MPG as the Leaf rating, one can estimate an alternative "cost" of compliance with 2016 regulations. If Nissan succeeds in selling 120,000 Leafs annually by 2016, without changing fuel economy in the rest of its fleet, its fleet economy would exceed the required level.

### Can Margin Take a Back Seat?

This alternate strategy – we'll call it the Leaf Compliance Strategy – would allow Nissan to meet standards without incremental costs to the rest of its fleet. Given the level of Nissan's U.S. sales, the company could afford to give up \$4,500 in expected margin on each of the 120,000 hypothetical Leafs and achieve the same total profit.

Potentially, this strategy affords far more flexibility than the Traditional Compliance Strategy. With the Leaf-driven fuel economy cushion, *Nissan can compete in every other car class with a less constricting set of parameters* than can automakers following a Traditional Compliance Strategy, who will need to achieve higher fuel economy within each car class.

However, the strategy is predicated on selling enough plug-in cars to make a difference in overall fleet fuel economy. If the plug-in market, even with subsidies, remains modest by 2016, there may not be a market much larger than Leaf's projected volumes. Thus the advantage to moving early and establishing market position first.

And what of GM? It also appears to have an early mover strategy. GM is using a different technology in the Volt, incorporating a back-up generator able to give the car conventional range and refueling capabilities while providing the plug-in electric experience. This may make the car ultimately more broadly appealing but saddles it with higher costs and, ironically, a lower projected fuel economy rating (GM projects 230MPG). Against GM's much larger fleet, the Volt has far less potential to provide the kind of dramatic compliance benefit Nissan sees with the Leaf – making cross-subsidies less affordable for GM and further cementing the Leaf's cost advantage.

### Conclusion

To conclude, we find that there can be merit to the aggressive electric car investment path, but not for all. As U.S. taxpayers owning a stake in GM, we hope GM's Volt strategy will pay off and reenergize the company. Wearing economists' hats, however, we have to favor Nissan's big gamble on the plug-in electric market. ■

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