Cost-Effective HYBRIDS

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Hybrid electric vehicles (HEVs) may be the green thing to do, but can you save enough greenbacks on operating costs to justify paying a higher upfront purchase cost? Maybe, maybe not. As you'll find out here, it all depends.

This article examines economic and financial methods you can use to evaluate the "profitability" of purchasing an HEV. The example I'll use is my purchase of a 2006 Ford Escape Hybrid, actually bought in 2005. In my case, buying a hybrid was an excellent investment that will reap profits far in excess of other financial investments. Because of new federal income tax credits for 2006 and 2007, as the calculations show, it would have been an even better investment had I waited.

The big question is: Can you too benefit by investing in an HEV? You won't know until you run the numbers.

Needs Vs. Wants

For buying a new automobile, the best economic choice is not necessarily the best financial choice. Even an "inexpensive" new car costs thousands of dollars. Though in most of modern America a car is a necessity, it is also a luxury. If you have the money to pay for it, your choice of automobile reflects your *wants* more than your *needs*. Larger size, more power, and other extras are wants, though the purchaser often perceives them as needs.

So, given that I need—er, want—a certain kind of vehicle with a certain set of options and accessories, I can apply economic and finance principles to determine the most "efficient" purchase. This is usually the lowest price tempered by perceived quality—and getting all the bells and whistles that you want.

Financially speaking, you don't "invest" in an automobile. Cars are not only hugely expensive to own and operate (and hugely fun and convenient, so we buy them anyway), but they depreciate in value, while investments usually appreciate. However, given that you can expect reduced operating costs, mostly in buying less fuel and fewer oil changes, you *can* consider the marginal additional cost of purchasing an HEV as a financial investment.

Making the Switch

My 1995 Toyota four-cylinder, four-wheel drive (4WD) Tacoma had 225,000 miles (362,102 km) on it and was beginning to burn oil. It probably could have made it to 300,000 miles (482,803 km), but at the risk of increased

The Ford Escape Hybrid is currently the most energy-efficient SUV on the market.

repair costs and decreased reliability. Therefore, I deemed it "economic" to buy a new vehicle. I wanted an all-wheel drive with some clearance, which is necessary for my work. (I also turned 50 last year, so it was my equivalent of buying a red sports car.)

Since I wanted a 4WD hybrid SUV, I had only two choices—a Toyota Highlander Hybrid or a Ford Escape Hybrid. I've long been a Toyota man, and never did I think I'd buy a Ford. However, compared to the Highlander, the Escape is a small—rather than midsize—SUV, gets better mileage, and costs about US$10,000 less. Finally, when a Toyota engineer was quoted as saying that the vehicle's "intelligent four-wheel drive" meant that the Highlander was not recommended for off-pavement use, my decision was final. I don't drive off-road, but I do drive off-pavement.

Figuring Assumptions

To conduct my evaluation, I built a computer spreadsheet similar to the tables on pages 68 and 69. You can get this Excel spreadsheet and plug in your own numbers from the Promised Files area of the Downloads section at www.homepower.com. It will work for any hybrid vehicle evaluation.

To determine the financial benefits or costs of investing in a hybrid vehicle, several questions had to be answered. Some were easily obtainable and firm, while others were guesstimates. For analysis purposes, I assumed that the car is purchased at the end of a calendar and tax year (Year 0) and is operable for a decade (Years 1–10). It may be at the end of the analysis period that the resale value of the vehicle is higher because it is a hybrid. Or maybe not, if the battery hasn't been replaced. Since it is an unknown market and a decade in the future, I ignored any possible "salvage" value.

Pricing. What is the price difference between the hybrid and conventional versions of the same vehicle with the same options? Determining the actual price of a new car isn't easy. Special fees, what a dealer will give you for a trade-in, manufacturer rebates, and how much the dealer drops the price due to your hard bargaining all determine what you'll pay.

I started by calculating the difference between the manufacturer's suggested retail price (MSRP) for both the standard (no options) hybrid and nonhybrid versions. With the Toyota Prius, which doesn't have a companion nonhybrid model, you'll need to use the closest comparable model, the nonhybrid Camry. Also, at least with the Ford Escape, several features that were optional on the nonhybrid version were standard on the hybrid model. I had to carefully review the price of the options and extras packages to determine the actual cost of "hybridizing" the vehicle. Finally, consider that hybrids are in a seller's market (demand exceeds supply), while nonhybrids are in a buyer's market (supply exceeds demand). While you can likely bargain down the cost of a nonhybrid, expect to pay list price for a hybrid.

Since SUV sales are sluggish due to higher fuel prices, I guesstimated that I could bargain down the dealer at least US$2,000 on the cost of a nonhybrid, though an old sage once told me that there are three things that a man will most

Running the Numbers

In its April 2006 issue, *Consumer Reports* announced that hybrids are more expensive to own and operate ("The dollars & sense of hybrids," *Consumer Reports*, April 2006).

CR later noted that their April auto issue contained flawed data that said, compared to gasoline cars in the same class, no hybrid vehicles could save their owners money. Their revised figures show that two of the six hybrids analyzed do save their owners money in the first five years.

My review of *CR's* original methodology didn't change my conclusions. *CR's* article was a general overview that compared average operating costs of all cars in a class. For example, the Subaru Forester and the Ford Escape are in the same class, but the less-expensive Forester didn't have some features that I wanted. I compared the hybrid and nonhybrid versions of the Ford Escape with similar options and accessories.

Their calcuations didn't factor in possible state tax credits (very significant in my case), and assumed lower resale values for all hybrids, for which there is yet no evidence. It's equally plausible that hybrids will have a *higher* resale value in the future.

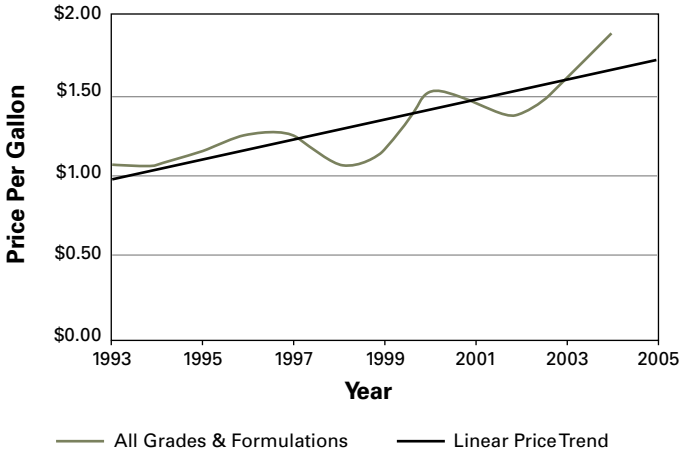
Their article also projected that hybrid repairs will cost more over the life of the vehicle because few independent auto repair shops now work on hybrids. My prediction is that this won't be the case when my rig is out of warranty. And *CR* assumed selling the vehicle after five years, while I'm planning to keep mine for ten.

They also reported that in most cases insurance was higher for hybrids than for nonhybrids. I found no difference in my case and recently learned that Travelers Insurance now offers a 10 percent discount to hybrid owners.

I also used complex financial analysis techniques in my methodology. And, while they used national averages, I used actual numbers based on my personal experience.

To determine if a hybrid is right for you (there is no question it is better for the Earth), you need to collect the data and run the numbers specific to your situation. Like most things in life, "it all depends."

U.S. Retail Gasoline Prices



Source: U.S. Energy Information Administration

always lie about (even to himself): his sexual prowess, his weight, and how much he saved on buying a new car.

Tax Breaks & Subsidies. What government subsidies are available for purchasing a hybrid vehicle? As an Oregonian, I can receive a US$1,500 income tax credit (directly reducing the bottom line of my tax bill). Eighteen other states also offer incentives, though some incentives are limited to merely letting hybrid drivers drive solo in the high occupancy vehicle lanes.

For 2006 and 2007, you can get a federal income tax credit between US$250 and $3,150, depending upon the model. Among other factors, the credit is based upon estimated fuel savings of the vehicle compared to others in its class. Some "hybrids" are so modest in their design that they don't qualify for any federal tax credit.

Miles You Drive. I estimated my annual mileage based on my own documented historical use. The more miles you drive, the better the financial returns on your hybrid investment. Check your odometer: The average American racks up at least 15,000 miles (24,140 km) annually.

Fuel Cost. What are you paying for a gallon of fuel? Just note this the next time you fill up at the pump.

Fuel Economy. What is the estimated mileage difference between the hybrid and nonhybrid options? Choose the closest comparable nonhybrid model. U.S. Environmental Protection Agency (EPA) ratings are not particularly accurate for a given model—the tested "highway" speed is 48 mph (77 kmh), but they are relatively comparable between models.

Scheduled Maintenance. What is the cost of an oil change, and what is the recommended mileage between oil changes for each model (hybrid and nonhybrid)? I estimated US$30 for the cost of an oil change. HEVs offer significant savings in avoided oil changes. A hybrid engine can go twice as far between oil changes because the engine is not actually running for many of those miles.

Future Fuel Costs. Since we're factoring in operating costs over the anticipated ten-year "life" of the car, we'll need to guesstimate how much fuel prices will—on average—rise annually. Though the national average gasoline price per gallon spiked at US$3.12 the first week of September 2005, it started the year at US$1.82 and ended it at US$2.24. Last year saw steadily increasing demand in the United States (despite higher prices), rapidly increasing demand in China, production disruptions due to Gulf of Mexico hurricanes, and continued instability in the Middle East.

Considering the historical data (see graph at left) and that the United States is still fighting Oil War II, I forecast an increase of 10 percent annually. The collection, analysis, and dissemination of data by the U.S. Energy Information Agency (EIA) is excellent. However, I feel that EIA's forecasts are suspect, given that it is not in the interest of this (or any) administration (not to mention Big Oil) to forecast higher energy costs. In any circumstance, if gasoline prices increase faster, the more profitable the hybrid investment; if gas prices rise more slowly, the less profitable the investment.

Inflation Rate. We'll also need to estimate the inflation rate. I guessed 3 percent per year, which is about what it has been in recent history. Though U.S. Federal Reserve Board Chair Alan Greenspan has retired, his successor Ben Bernanke is likely to keep a tight reign on inflation.

Kerr's Ford Escape Hybrid Cost Analysis

2006 or 2007 Tax Year	Data*
MSRP of hybrid electric vehicle (HEV)	$29,140
MSRP of comparable non-HEV	$24,650
Bargained-down savings on non-HEV	$2,000
Out-of-pocket cost of purchasing an HEV	$6,490
State income tax credit	$1,500
Federal income tax credit for Escape hybrid	$1,950
Estimated miles driven annually	20,000
Cost of 1 gallon of gasoline (estimated)	$2.50
Estimated overall EPA mileage of HEV (mpg)	31.0
Estimated overall EPA mileage of non-HEV (mpg)	20.5
Annual cost of fuel for HEV	$1,613
Annual cost of fuel for non-HEV	$2,439
Annual fuel-cost savings of operating an HEV	$826
Estimated cost of oil change	$30
Recommended miles between oil change (HEV)	10,000
Recommended miles between oil change (non-HEV)	5,000
Estimated annual rate of fuel cost increases	10%
Estimated annual general inflation rate	3%
Car loan interest rate	0%
Car loan term (whole years)	0
Cost of capital (aka "discount rate")	10%

*All dollar amounts in US$

Loan Interest Rate. I didn't borrow any money to purchase my new HEV, but if you borrow money to buy a new car, you'll need to know how much interest you're paying on the part of the car loan that covers investing in a hybrid. Don't delude yourself into believing that you are paying no interest on a "0 percent interest" loan—the interest is just buried in the loan principal. To discover the interest, compare the loan principal, term, and total payments with what you would pay if you paid cash.

Discount Rate. What is your personal or business discount rate— the rate of interest used to determine the present value of a stream of future income? Generally, you take the prime rate and add 2 to 3 percent. In late 2005, the prime rate was 7 percent, which would give a discount rate of 9 to 10 percent.

Adding It Up

Let's examine the spreadsheet ("Kerr's Ford Escape Hybrid Cost Analysis"). It is constructed on the assumption that I will own the car for ten years (such is my habit), and projects the annual savings in fuel and oil changes out a decade, discounting them back to present-day dollars.

Analyze This!

The beauty of electronic spreadsheets is the ability to easily analyze different scenarios. Certain costs are known, while other costs must be estimated. Estimates are very rarely spot on. What if there are no tax subsidies? What if gasoline prices increase only at the general rate of inflation? What if the battery lasts 200,000 miles?

By considering the range of alternatives, you can anticipate the financial consequences of your predictions. But in my case, I found that even the potential worse-case scenario (no tax benefits, fuel cost increases limited to the general inflation rate, and having to replace the traction battery) still reflects a good investment.

Kerr's Ford Escape Hybrid Cost Analysis

Investment Analysis	Year 0 2005	Year 1 2006	Year 2 2007	Year 3 2008	Year 4 2009	Year 5 2010	Year 6 2011	Year 7 2012	Year 8 2013	Year 9 2014	Year 10 2015
Out-of-pocket cost (investment)	-$6,490	—	—	—	—	—	—	—	—	—	—
Annual fuel savings	—	$826	$909	$1,000	$1,100	$1,210	$1,331	$1,464	$1,611	$1,772	$1,949
Federal &/or state tax incentives	—	$3,450	—	—	—	—	—	—	—	—	—
Annual oil change savings	—	$60	$62	$64	$66	$68	$70	$72	$74	$77	$79
Finance charges	—	—	—	—	—	—	—	—	—	—	—
Battery replacement	—	—	—	—	—	—	-$3,000	—	—	—	—
Annual savings	-$6,490	$4,336	$971	$1,064	$1,166	$1,278	-$1,599	$1,536	$1,685	$1,849	$2,028
Cash flow	-$6,490	-$2,154	-$1,183	-$120	$1,046	$2,324	$725	$2,261	$3,946	$5,795	$7,823
Annual return on investment	—	67%	15%	16%	18%	20%	-25%	24%	26%	28%	31%

Average return on investment	22%
Net present value	$2,619
Internal rate of return	23%
Simple payback (deduce from cashflow; the years to turn and remain positive)	3.1

Hybrid Electric Vehicle Availability

Compacts & Sedans	Expected Availability	Est. Fed. Tax Credit*
Toyota Prius	Now	$3,150
Honda Civic (automatic)	Now	2,100
Honda Civic (manual)	Now	1,700
Honda Insight (automatic)	Now	1,450
Lexus GS 450h	2006	1,300
Nissan Altima	2006	1,300
Toyota Camry	2007	1,950
Honda Accord	Now	650
Chevrolet Malibu	2007	650
Honda Insight (manual)	Now	0
Ford Fusion	In the works	—
Hyundai—two subcompact models	In the works	—
Mercury Milan	In the works	—

SUVs & Minivans		
Ford Escape SUV (2WD)	Now	$2,600
Toyota Highlander SUV (2WD)	Now	2,600
Lexus RX 400h SUV	Now	2,200
Toyota Highlander SUV (4WD)	Now	2,600
Ford Escape SUV (4WD)	Now	1,950
Mercury Mariner SUV (4WD)	2007	1,950
Chevrolet/GMC Tahoe/ Yukon	2007	1,800
Saturn VUE	2007	1,300
Dodge Durango	In the works	—
Honda Pilot	In the works	—
Mazda Tribute	In the works	—
Porsche Cayenne	In the works	—
Toyota Sienna minivan	2007	—

Trucks		
Chevrolet/GMC Silverado/Sierra	2008	$900
Chevrolet/GMC Silverado/Sierra (4WD)	Now	650
Chevrolet/GMC Silverado/Sierra (2WD)	Now	250
Dodge Ram	In the works	—

Source: American Council for an Energy Efficient Economy

One extraordinary item is listed in the spreadsheet: battery replacement. The jury is still out on battery replacement for HEVs, but the evidence for battery longevity seems compelling. The first generation Prius warranted its traction (as opposed to "starting and accessories") battery for eight years or 100,000 miles (160,934 km). Very few batteries have been replaced and almost all are still in service well beyond the warranty period.

The traction battery in the Escape hybrid also is warranted for eight years or 100,000 miles. In the so-called "green states" (those with California-level emissions standards), the identical vehicle is warranted at ten years or 150,000 miles (241,402 km). The longer warranty is required to obtain the "AT-PZEV" (Advanced Technology-Partial Zero Emission Vehicle) rating.

Both anecdotal reports from consumers, and research by government and industry strongly suggest that traction batteries will last far longer than originally anticipated. It's very likely the battery will last well beyond 100,000 miles, if not well beyond 150,000 miles. Nonetheless, the risk is mine to assume after the warranty expires. Since I estimated that I drive 20,000 miles annually, and my traction battery will be out of warranty in Year 6, I have included the estimated cost of a replacement battery (US$3,000) in that year.

The Bottom Line

Considering just the anticipated savings in fuel costs and oil changes, the simple payback period (a simplistic capital budgeting technique) on the additional cost of my purchasing and operating an Escape hybrid—as opposed to a comparable Escape nonhybrid—is a little more than three years.

The annual average return on investment (an unsophisticated capital budgeting technique) is 22 percent. The internal rate of return (a sophisticated one) is 23 percent. These expected returns are tax-free, because money I don't have to spend is money I don't have to earn and pay taxes on. Comparing these returns to what my (generally taxable) savings and retirement accounts are producing means I'm dollars ahead.

The most recent stock-market bubble—which has now long since burst—was yielding an annual return on investment between 20 and 30 percent. There is far less risk investing in a hybrid vehicle than in the stock market. I made reasonable assumptions about battery replacement, general inflation, projected costs of gasoline, and miles driven, which led to a conservative analysis of the minimum return I could expect for purchasing the hybrid option.

The net present value (at a 10 percent discount rate) is US$2,615. In other words, for spending US$6,490 today to "hybridize" my new vehicle, I come out US$2,615 ahead in present value, given the anticipation of future savings. It's like writing a check for US$6,490 and immediately getting an asset worth US$9,105 (US$6,490 + US$2,615). You're richer today because you'll have fewer future expenses.

Of course, money is not the measure of all things. Nonetheless, it's always nice when a good investment for myself coincides with doing well for the planet.

Access

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American Council for an Energy-Efficient Economy • www.aceee.org

Bloomberg • www.bloomberg.com/markets/rates • Prime rate information

Bradley Berman's Hybridcars.com • www.hybridcars.com

Energy Information Agency • www.eia.doe.gov • U.S. gasoline prices

Jason Siegel's GreenHybrid • www.greenhybrid.com

State incentives for hybrid vehicles • go.ucsusa.org/hybridcenter/incentives.cfm

Union of Concerned Scientists Hybrid Web Site • www.hybridcenter.org

www.fueleconomy.gov • EPA mileage ratings and official IRS tax credit determinations