CASE STUDY

Ford Hybrid Car Case

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Ford's Hybrid Future

In September 2006, Alan Mulally had just taken over as the CEO of Ford, the fifth largest corporation in the United States. Ford was in trouble, as was the entire American auto industry, partly due to the rapid increase in average gas prices from $1.10 per gallon for regular, unleaded gasoline in January 2002 to more than $2.50 per gallon in September 2006, according to the Energy Information Administration. Sport utility vehicles and trucks, the mainstays of Ford's product line, no longer had the depth of consumer appeal they had in the past. Ford's stock price had declined more than 30% from September 2004, and for the 2006 fiscal year, Ford executives were projecting a loss of almost $6 billion from ongoing operations; paired with restructuring costs, the total projected losses reached approximately $9 billion. Through its "Way Forward" plan, Ford announced buyout offers for 75,000 hourly workers and planned to cut 30% of its 35,000 salaried employees in the United States. Although these cost-saving measures would improve profitability, ultimately, Ford needed to win in the marketplace to regain its past status; to win, it needs to take drastic market-oriented actions.

As part of the Way Forward plan, the previous CEO (and current Chair) William Clay Ford initially announced that the company would build 250,000 hybrid cars annually by 2010. Now Mulally is rethinking that commitment: Would it be enough? Would that be too much? He needs a quick and credible answer to this question before deciding how forcefully to push the hybrid car program within Ford. Mulally also recognizes that the technologies and manufacturing systems that support hybrid cars are growing more and more sophisticated, and companies such as Toyota and Honda, with their head starts in these areas, may move more quickly down the learning curve, producing their cars more cheaply and in greater volumes, which would make it difficult for other companies to catch up to them. To plan Ford's long-term investments in the hybrid car business, Mulally needs a 10-year forecast of the overall U.S. hybrid market, the world's largest consumer of gasoline, along with corresponding forecasts for the sales of Ford's hybrid cars if they are made available to the market.

Background

A hybrid car is an automobile powered by two sources: (1) an internal combustion engine or diesel engine, as in a regular car, and (2) an electric motor. However, hybrid cars do not need to be recharged via electric plugs; instead, they receive charge from the movement of the wheels and store the generated kinetic energy through a process called regenerative braking. Hybrid cars provide higher mileage by requiring a less powerful engine than a comparable regular car and help conserve nonrenewable sources of energy, such as diesel or gasoline. The smaller engine in the hybrid car is powerful enough to move the car along on the freeway, but when it needs to accelerate or get up a steep hill, it needs the assistance of the electric motor and battery to boost the power output. Hybrid cars work much like regular cars and create little difference in terms of how they are driven, refilled with gas, or serviced. However, hybrid cars typically cost approximately $3,000 more than comparable regular cars (base price of $25,000 to $30,000) and offer a 10–15% improvement in gas mileage. The actual savings depend on the driving habits of the user; gradual acceleration, coasting, and the use of cruise control help increase mileage.

Although many experts have predicted that hybrids will be the cars of the future, it remains difficult to predict their popularity with consumers and, consequently, their profitability for auto companies. Within

the past few years, hybrid cars have gone from being novelties, bought largely by environmentalists and technology-oriented consumers, to represent an established, though small, part of the automotive landscape. According to J.D. Power & Associates, hybrids constitute approximately 1.5% of the total U.S. light-vehicle market, but sales have been growing quickly as other segments have stagnated or fallen. Sales in 2005 of 205,000 units were more than double the 2004 sales levels. A recent survey by J.D. Power also reveals that 57% of consumers who expect to acquire a new vehicle within the next two years will consider a hybrid. Worldwide, approximately 800 million cars and light trucks are in operation, and 240 million of these are in the United States. By 2020, 1 billion cars and light trucks are expected to be in use worldwide. All these cars could eventually be replaced by hybrid cars.

In addition to consumer demand for hybrid cars, car manufacturers' interest in hybrid cars is driven by CAFE (Corporate Average Fuel Economy) regulation, according to which an automaker must maintain a minimum mileage of 27.5 miles per gallon (mpg) across passenger cars in its product line and 20.7 mpg across light trucks. The U.S. Congress appears likely to raise these standards in the future in response to societal pressures; according to some experts, the CAFE average may rise to 35 mpg or higher by 2020 across the entire product line (i.e., including all passenger cars and light trucks produced by the manufacturer). Hybrid cars offer the opportunity to raise gas mileage sufficiently to meet this requirement, and therefore, most car manufacturers have either launched hybrid cars or announced plans to do so. An auto manufacturer that fails to meet the standard must pay a penalty to the federal government, which some companies, including BMW, Porsche, and Ferrari, have paid in 2006.[1]

Forecasting Considerations

The chart in Exhibit 1, from www.hybridcars.com, illustrates the variety of opinions regarding sales forecasts for hybrid cars. The black line shows hybrid sales continuing at their current pace, determined in the time since hybrids first were introduced in 2000. Considering the future five-year timeframe, J.D. Power forecasts are well below the line, whereas others (e.g., D.O.E., Freedonia Group, BoozAllen) predict wider public acceptance of hybrids.

[1] The penalty for failing to meet CAFE standards is $5.50 per tenth of a mile per gallon under the target. Thus, a manufacturer that produces cars that average 2 miles below the target and sells 10,000 cars in a given year will pay a fine of $1,100,000 for that year. In 2006, BMW paid a fine of $5.1 million.

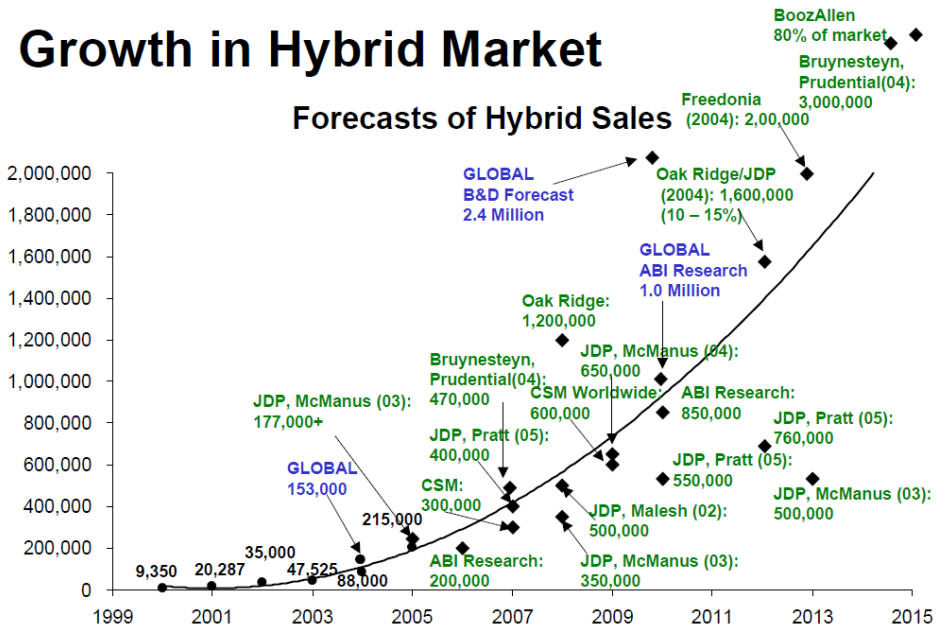

Exhibit 1: Forecasts for Hybrid Cars

The wide variation in forecasts reflects some fundamental uncertainties surrounding this technology and market:

Technology uncertainties: Many alternative technologies offer different price/performance points. The gas–electric hybrid is the most common; alternative technologies include pure electric cars and fuel cell cars. Alternative fuels might be used in nonhybrid cars and could gain popularity, swaying consumers away from buying hybrids. Some alternative fuels currently in use include E85 (an 85% ethanol blend), clean diesel, and natural gas. For 2006, Ford increased its production of four vehicles that can run on a mixture of gasoline and E85 (i.e., F-150 pickup trucks, Ford Crown Victorias, Mercury Grand Marquis, and Lincoln Towncars).

In a 2005 KPMG survey of 140 senior auto executives, 88% predicted that gas–electric hybrids would gain market share. Even within the gas–electric hybrid market, automakers apply the hybrid technology at varying levels. For example, Honda and Toyota make full-blown hybrid cars, whereas General Motors eased into the sector with a scaled-down, less-expensive hybrid technology that still needed some gasoline to power the transmission. A breakthrough in battery technology may create a shakeout among the alternative technologies. According to the Department of Energy, either lithium ion or lithium polymer batteries may offer the best future technologies. Lithium ion batteries possess nearly twice the energy of NiMH (nickel–metal–hydride) batteries but require significant circuitry to prevent overcharging and undercharging. They also require thermal management and pose some safety concerns.

Hydraulic hybrid technology also is considered superior to the electric hybrid technology, according to the U.S. Environmental Protection Agency (EPA); UPS is currently testing hydraulic hybrid trucks for use in its regular fleet. Auto companies are also testing other technologies; in 2007, BMW plans to produce 100

hydrogen cars for its 7 series. BMW spokesperson Andreas Klugescheid notes that these cars will not be sold but rather given to consumers who may "have a potential impact on making a hydrogen economy happen." These cars will run on hydrogen or gasoline, depending on the driver's preference, which acknowledges the limited availability of hydrogen fuel and the difficulties associated with distributing it.

Market uncertainties: Many uncertainties surround the decisions of both dealers and consumers. For consumers, the potential economic benefit of a hybrid car depends on the price of gasoline. At a gas price of $2.50 per gallon, the breakeven point between a hybrid and a regular gasoline car can occur after 50,000 miles of driving. The higher initial cost is also a barrier to many consumers. To make hybrid cars more attractive to consumers, federal and state governments offer several incentives. The Energy Policy Act of 2005 (EPACT) offers consumers and businesses federal tax credits for their purchase of fuel-efficient, hybrid electric vehicles, in effect through 2007. The amount of tax credit depends on the fuel economy and ranges from $400 to $2500 per vehicle. Some states also offer special incentives for hybrid car drivers, such as solo use of high occupancy lanes (e.g., Georgia, Florida, Arizona), tax credits (e.g., Utah, Illinois, Colorado), or exemption from sales tax on the car (e.g., Connecticut, New Mexico). At the same time, some consumers are willing to buy hybrids, even at higher differential prices, to make a statement (you are what you drive!). The Toyota Prius was such a success that dealers charged additional fees for the car and established buyer waiting lists. According to surveys, some consumers would be willing to pay somewhat more for electricity to power their cars if they knew it was coming from renewable and nonpolluting resources.

Hybrids also may require some changes in driving habits, such as learning to accelerate and stop smoothly and coasting whenever possible. Many consumers also are not aware that, unlike most regular cars, hybrids achieve better mileage during city driving compared with highway driving. Ford is organizing special "driver education" events, during which current owners will team up with Ford engineers to discover ways to improve gas mileage when using hybrid cars. The company hopes that such activities will promote word-of-mouth communications about Ford's hybrid cars. According to Mary Ann Wright, Ford's director of hybrid technologies, through this program, "we created about 300 ambassadors for us. It's free advertising, and we're getting some great feedback from them."

Many celebrities, including Leonardo DiCaprio, Cameron Diaz, Bill Maher, and Will Ferrell, not only drive hybrid vehicles but openly promote their choice. Thus, it is becoming easier for consumers to hear buzz about hybrid cars and educate themselves, such as through Internet research or by discussing the option with friends and acquaintances who may own a hybrid.

The demographics of the typical hybrid car buyer thus may change in the future, especially if the cars grow more attractive to mainstream car buyers. The characteristics of current hybrid car owners are summarized in the following list (Source: Walter McManus, director of the Office for the Study of Automotive Transportation, University of Michigan):

- High level of education.
- Higher income than the average new buyer—approximately $100,000 a year versus $85,000 a year for the average buyer.
- More likely to be female.
- A few years older than the average car buyer—closer to 50 than the average age of 40 years for all car buyers.

- Drive fewer miles on average.
- Plan to keep their car longer than the average person—a little more than five years rather than less than five years.
- Willing to pay more for an environmentally friendly (or "green") product.
- Want to do something to help reduce vehicle pollution.
- More pessimistic about the future of fuel prices than the average person.

Forecasting Hybrid Car Adoption Using the Bass Model

A key consideration in developing forecasts using the Bass model is an understanding of the diffusion process of analogous products. Several different product categories may provide suitable analogs based on the "substitution" of one type of technology by another. Using this logic, the market research group at Ford has proposed that the diffusion process of diesel cars in Europe might provide a suitable analogous situation because, over time, diesel cars substituted for gasoline cars as the technology of choice. Starting with Volkswagen's introduction of its Golf diesel car in 1976, the adoption of diesel cars has progressed steadily, and diesel vehicles now account for more than 50% of new car registrations in Western Europe. However, according to Christy Swiecki, an auto industry analyst, the adoption of hybrid cars in the United States is likely to be slower, if the experience of switching to renewable energy is any guide. Although wind, solar, and geothermal sources of energy are more environmentally friendly, their adoption rates have been slow, partly because traditional sources of energy (e.g., coal, petroleum) remain relatively inexpensive and convenient, and alternative sources may not provide greater economic benefits when the total consumer experience is taken into account. According to Swiecki, initial enthusiasm for hybrid cars will fade, especially once the market expands beyond the traditional high-income, environmentally friendly consumers and as people begin to realize the potential environmental issues with respect to the disposal of the rechargeable batteries in their hybrid cars. She therefore projects sales of hybrid cars in 2015 will be, at most, in the range of 6–8% of the total light-vehicle market of approximately 16.5 million vehicles.

Another approach to forecasting views hybrid technology as a "feature enhancement" to a regular car that increases its mileage. In that case, hybrid cars would be perceived as just another "under-the-hood-innovation" that delivers more fuel efficiency without sacrificing power, and they should appeal to a broad market. Using this perspective, the market research group at Ford has proposed that the adoption patterns of antilock braking systems (ABS) and fuel-injection technologies might be useful analogs. Both these technologies were built into products and offered as enhanced features that the customer could choose to buy.

Although ABS originally was created for use in aircrafts, by the early 1970s, ABS technology was being developed for automobiles. In 1978, Bosch created the first ABS that could be successfully mass produced, and Mercedes-Benz and BMW began to offer the technology. The early versions weighed about 6 lbs (compared with 1.5 lbs today) and cost several thousand dollars. By 1985, less than 1% of all new vehicles worldwide were equipped with ABS—mostly high-profile, high-cost vehicles. In 1985, the Chevy Corvette came standard with ABS for the first time, and by 1989, it was standard in all Porsche models, followed by Mercedes-Benz in 1992. By 2000, 60% of new cars worldwide had ABS, and by 2003, this rate had increased to 69%.

Fuel injection is another potential technology enhancement that could serve as an analog for hybrid cars. In a gasoline engine, small amounts of fuel mix with air during combustion. Since the inception of the auto

industry, carburetors were the predominant method to meter the amount of fuel used. An engine's air-to-fuel ratio must be controlled accurately in different operating conditions to achieve the desired performance metrics. With the development of electronic fuel injection (EFI) technology, fuel could be metered very accurately and precisely, which helped increase gas mileage and reduce air pollutants compared with their levels in carbureted engines. Even though EFI was a much superior technology, the transition from carburetors to EFI was gradual, taking about 14 years from 1979 to 1993 for EFI to displace carburetors. Reasons for the gradual transition included the initial high cost of EFI systems (about $600 more per unit than carburetors) and the lack of clearly perceptible benefits for car owners. As a result, the early EFI systems appeared only in luxury and performance cars, which could absorb their higher costs into the overall price.

From Market Forecasts to Forecasts for Ford

Ford is primarily interested in how many hybrid cars it will be able to sell in the next 10 years so it can make sound judgments about how much capacity for hybrid cars to build in its factories, as well as the amount of effort it should devote to training its dealer network that will sell the cars. Therefore, market-level forecasts need to be converted into forecasts for Ford brand hybrid cars. Exhibits 2 and 3 summarize sales of hybrid cars from 2000 to 2006 and sales of Ford hybrid cars relative to the total market in 2006. Ford introduced the Ford Escape hybrid in late 2004 and the Mercury Mariner hybrid in early 2006.

Year	Number of Hybrid Models (Light Vehicles)	U.S. Sales of Hybrid Cars (Units)	U.S. Total Number of New Cars (Light Vehicles) Sold
2000	2	9,350	13,181,000
2001	2	20,287	13,510,000
2002	2	35,000	13,639,000
2003	3	47,525	13,594,000
2004	5	88,000	13,609,000
2005	7	215,000	13,551,000
2006	10	252,636	13,271,000

Exhibit 2: Sales of Hybrids in the United States

Notes: Light vehicles include passenger cars, sport utility vehicles, vans, and pickup trucks.

Car Model	Combined (city + highway) EPA mpg	Jan. 2006	Feb. 2006	Mar. 2006	Apr. 2006	May. 2006	Jun. 2006	Jul. 2006	Aug. 2006	Sep. 2006	Oct. 2006	Nov 2006	Dec 2006	Total Unit Sales 2006
Honda Insight	57	59	72	79	110	92	77	91	109	19	9	2	3	722
Toyota Prius	55	7,654	6,547	7,922	8,234	8,103	9,696	11,114	11,177	10,492	8,733	8,008	9,291	106,971
Honda Civic	50	3,165	1,780	2,232	3,087	2,890	2,601	2,673	3,411	2,508	2,288	2,208	2,408	31,251
Honda Accord	31	351	783	581	614	520	396	504	499	389	287	311	363	5,598
Toyota Camry	39	n/a	n/a	n/a	86	3,032	4,268	5,023	4,977	4,044	2,806	3,100	4,005	31,341
Toyota Highlander	29	2,263	2,631	2,987	3,768	3,755	2,705	2,784	2,581	2,347	1,643	1,667	2,354	31,485
Lexus RX400h	29	1,477	1,803	2,470	2,247	2,006	1,190	1,220	1,514	1,687	1,239	1,327	1,981	20,161
Lexus GS450h	26	n/a	n/a	n/a	141	294	231	157	192	164	177	176	252	1,784
Ford Escape	34	801	1,233	1,441	3,039	2,434	1,569	2,060	1,789	1,369	1,343	1,323	1,748	20,149
Ford Mercury Mariner	31	97	108	149	381	428	315	423	351	282	259	161	220	3,174
Total		15,867	14,957	17,861	21,707	23,554	23,048	26,049	26,600	23,301	18,784	18,283	22,625	252,636

Case Study Questions

Question 1
Summarize and justify alternative scenarios (i.e., compelling stories about the future) ranging from pessimistic to optimistic with regard to market performance of hybrid cars.

Question 2
Develop forecasts of hybrid car penetration in the U.S. market from 2007 through 2016 for each scenario you develop, along with a justification and explanation for your forecasts. (In applying the Bass model, note that market penetration data for the three analog products mentioned in the case, namely, ABS, EFI, and Diesel cars, were all reckoned in terms of the percentage of the target market that adopted the product. Thus the maximum market potential can at most be equal to 100).

Question 3
Recommend short-term and long-term strategies that Ford should pursue based on the forecasts that you develop.

Note: This case was developed by Professor Arvind Rangaswamy with assistance from Megan Ruth De Stefano and Sasi Amarlapudi. The case is based on publicly available information as of January 2007. Its purpose is to illustrate a business situation involving forecasting, based on real events; it does not purport to represent actual decisions made by the Ford Motor Company. Data and the case situation described here are based on information obtained from public sources listed in the body of the text and the following: U.S. Department of Transportation; http://www.hybridcars.com; USA Today, October 14, 2005; Plunkett Research, Ltd.; The Wall Street Journal, September 13, 2006.