

Climate Risk and Energy in the Auto Sector

*Guidance for Investors and Analysts
on Key Off-balance Sheet Drivers*



Authored by
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and David Gardiner**
April 2006

Commissioned by



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Table of Contents

Executive Summary	i
Key Findings	1
Oil Price Drivers: A Rough Road Ahead	2
Effects Of Key Recent Events on the Auto Industry	2
Back to the Future: Lessons from Oil Price Shocks of 1970s and 2005	3
Policy Drivers: Preparing for the Now and for the Inevitable	6
A Global Focus on Energy Independence, Security and Climate Change	6
The Enactment of the 2005 U.S. Energy Bill	9
Technology Drivers: Creating a Competitive Advantage	12
Hybrid, Hydrogen Fuel Cells, and Other Technologies	12
Biofuels, an Under-promoted Solution	17
Summary of Briefing and Roundtable with Auto Sector Investors and Analysts: December 6, 2005	19

Executive Summary

As investors and auto analysts examined critical events affecting the auto industry at the end of 2005, it became clear that legacy costs, manufacturing efficiencies, marketing prowess and other conventional metrics were not the only drivers of auto company value. In late 2005, several off-balance sheet forces were influencing automobile manufacturers' ability to compete, and these same forces may have significant long-term impact on shareholder value.

Six key factors have combined to send a strong signal to automobile companies that they must shift production to new technologies that enable them to produce vehicles that are more fuel-efficient and emit less pollution. Those six factors are:

- ▶ **Volatile gas prices.** High and volatile gas prices as a result of Hurricane Katrina coupled with limited supply and rapidly rising worldwide demand.
- ▶ **Energy Security.** Dramatic revisions to both the IEA's and the EIA's oil price forecasts, predicting rising oil prices and increasing dependence on five or six middle eastern countries.
- ▶ **Energy Independence.** New calls for energy independence and ending the "addiction" to foreign oil, including the enactment of the 2005 U.S. Energy Bill to accelerate adoption of fuel efficient technologies and biofuels.
- ▶ **New Standards.** New policies globally and domestically ensure that the world's major auto markets are covered by carbon reduction or fuel economy standards.
- ▶ **Alternative Technologies.** The clear emergence of hybrids as an important mid-term auto technology to produce cleaner, more fuel-efficient vehicles.
- ▶ **New Fuels.** The emergence of biofuels as the alternative fuel of choice.

This paper examines these six factors, focusing on recent events and new research reports by Wall Street firms, environmental think tanks, the International Energy Agency and the Energy Information Agency.

The findings of this paper indicate that oil prices, regulation, and new technologies—and specifically the six factors laid out above—are pushing auto manufacturers in one direction: toward the production of cleaner, more fuel-efficient vehicles.

Groups as diverse as Prudential Equity Group¹, Merrill Lynch², JPMorgan³, Environmental Defense⁴, Sustainable Asset Management and the World Resources Institute⁵, the University of Michigan, the National Resources Defense Council⁶, and the Union of Concerned Scientists⁷ have authored reports. These reports signaled a marked change: issues historically viewed as "social" or "environmental" are now seen as fundamental economic drivers of both risks and opportunities for automakers.

The findings of this report support the conclusion that the long-term value of companies in the auto sector depends on their ability to be a leader in manufacturing of fuel-efficient, low-emission vehicles and technologies. Auto companies that understand and respond to these off-balance sheet pressures are best positioned to survive and thrive in the increasingly globally competitive auto market.

Long-term investors—such as the members of the Investor Network on Climate Risk who manage over \$3 trillion in assets—understand that unpredictable oil prices, combined with changes in regulations and the emergence of new fuel types, could cost shareholders of auto companies billions of dollars for reasons ranging from unexpected drops in earnings due to changes in consumer demand with high fuel costs, to increased manufacturing costs due to changes in environmental regulation, to greater than expected costs due to understated or undisclosed liabilities, to an inability to compete in foreign markets where emission regulations are tighter.

The longer auto companies wait to evaluate the impact of increasing oil prices and new climate change regulations, the greater the risk of making capital investment decisions that may not provide the expected long-term financial returns to investors.

This report was initially presented at a briefing and roundtable discussion in New York City on December 6, 2005 for a group of nearly forty auto analysts, investors, industry researchers and others. The briefing in many ways supported the findings of this paper, while at the same time highlighting some interesting contradictions in research results that fostered dialogue about these issues. A summary of the event can be found on page 19.

1. Prudential Equity Group Research. *Electrifying Future for Hybrids*, November 26, 2004.

2. Merrill Lynch. *Energy Security and Climate Change: Investing in the Clean Car Revolution*, June 16, 2005.

3. JPMorgan, *Cars and Climate Change: A Regulatory Battle Brings Risks for Investors*, September 9, 2005.

4. Environmental Defense. *Automakers' Corporate Climate Burden*, 2005.

5. Sustainable Asset Management and the World Resources Institute. *Changing Drivers: The Impact of Climate Change on Competitiveness and Value Creation in the Automotive Industry*, 2003. *Transparency Issues with ACEA Agreement: Are investors driving blindly?*, 2005.

6. University of Michigan and NRDC. *In the Tank: How Oil Prices Threaten Automakers' Profits and Jobs*, July 2005.

7. Union of Concerned Scientists. *Automaker Rankings 2004: The Environmental Performance of Car Companies*, December 2004.

Key Findings

The key findings of this report show that oil prices, regulations, and technology are all pushing auto manufacturers toward increasing fuel-efficiency and reducing emissions. Six emerging trends which may affect long-term shareholder value in the auto sector are:

- 1. Volatile gas prices drive consumer auto demand.** Throughout 2005, gasoline prices were on the rise, but Hurricane Katrina showed the world how fragile the supply and demand curve is. Damage caused oil prices to spike to nearly \$70 per barrel and at-the-pump gasoline prices to surpass \$3 per gallon. As a result, U.S. consumer demand for fuel-efficient vehicles skyrocketed, following historical trends after gas price spikes.
- 2. Energy security concerns are rising and signaling demand for fuel-efficient vehicles.** In November 2005, the International Energy Agency (IEA) issued a stark warning to industrialized nations to significantly reduce dependence on foreign oil. The IEA raised its predictions for long-term oil prices by one-third, and cautioned that current consumption patterns will result in a dangerous dependence of 95 percent of the world's economy on five volatile Middle Eastern and North African countries. Likewise, in February 2006, the US Energy Information Agency issued dramatically increased oil price predictions.
- 3. New standards globally, nationally, and locally will ensure that the world's major auto markets are covered by carbon reduction or fuel economy standards.** Canada, the European Union, China, Australia, Japan, Korea, and others are implementing legislation to reduce greenhouse gas (GHG) emissions and increase vehicle fuel-efficiency, in part responding to the enactment of the Kyoto Protocol in February 2005. In an increasingly global auto marketplace, manufacturers with a focus on fuel-efficiency and cutting-edge technologies are at an advantage to compete in this increasingly complex regulatory environment.
- 4. Energy independence concerns are driving governments to promote fuel efficiency and oil alternatives.** For the first time in thirteen years, the United States passed a federal energy bill in 2005 that provides tax credits to consumers for purchasing fuel-efficient vehicles, and creates new mandates and incentives for the production, distribution, and sale of renewable "biofuels." Domestic and foreign auto companies have opportunities to gain or lose from these new provisions.
- 5. Alternative technologies can create competitive advantage for vanguard auto companies through research, development and deployment of cleaner, more fuel-efficient technologies, especially hybrids.** Auto shows in Detroit and Tokyo evidenced a shift in many automakers' focus toward new technologies, including hybrids, clean diesel, and fuel-cells.
- 6. Alternative fuels, such as ethanol and biodiesel, are increasingly impacting the auto industry.** Consumer demand and foreign government regulation, as well as the new U.S. energy bill's focus on biofuels, has pushed some automakers, like Toyota and Ford, to increase their focus on interim technologies such as hybrids and clean diesel, while others, like GM, have concentrated on deploying flex-fueled vehicles capable of operating on gasoline or ethanol.

Oil Price Drivers: A Rough Road Ahead

Volatile oil and gas prices are pushing auto manufacturers to manufacture vehicles with better fuel efficiency. History—both recent and past—shows that the price of gasoline is a primary factor in consumer choice of vehicles. Consumers demand higher fuel efficiency in vehicles when gasoline prices rise. This is not a new insight, and the 1970's oil embargo changed the competitive landscape for automakers forever. As U.S. companies scrambled to design fuel-efficient vehicles to meet consumer demand, better prepared foreign companies stepped in to fill the market niche.

While it is impossible to predict the exact cost of oil in the future, several key factors indicate that current peaks may not be followed by deep valleys, as was seen in the 1970's and 80's. First, demand is rising, both in the U.S. and abroad. Second, oil supplies are plateauing in some areas and declining in other parts of the world. Third, disruption of distribution channels will continue to be at risk due to regional and international conflict and war, trade barriers, changing weather patterns, and increased severity of storms.

Rising demand, falling supplies, and vulnerable supply chains result in a risky future for oil prices. Thus, long-term shareholder value may depend on how well an auto manufacturer has prepared its product offerings to respond to fluctuating oil prices.

Effects of Key Recent Events on the Auto Industry

In late August 2005, Hurricane Katrina barreled through the Gulf Coast, displacing millions of people, killing more than a thousand, and decimating critical oil production infrastructure with wide effects locally and nationally. Shortages affected gas stations nationwide, and even closed many pumps in the Gulf Coast states. Oil prices peaked at \$69.81 per barrel on August 30, with gas prices at the pump surpassing \$3.00 per gallon. The world saw how easily a natural disaster—one possibly exacerbated by climate change—could disrupt the supply and demand for oil.

Even before Katrina, consumer demand for big SUV's was falling while sales of hybrids and other fuel-efficient vehicles were surging, and after Katrina, the trend soared to new heights. According to the Miami Herald, Floridian "drivers who would otherwise stick to basic sedans or gas-guzzling SUVs are turning their heads to hybrids, lured by the idea of fewer and cheaper trips to the pump." Consumers unwilling to stay on long waiting lists for hybrids turned to diesel engines and other fuel-efficient four- and six-cylinder engines in place of big V-8's. In 2005, hybrid vehicles sales in the U.S. rose by 134 percent over 2004 sales, peaking in August, while sales of SUV's dropped in the same period by roughly 14 percent.

Not long before, US car buyers did not rank fuel economy even among the top 10 attributes in owning a car. If and when gasoline prices start to fall, US automakers may feel a false sense of ease that consumers may be tempted to return to their old buying habits; however, they will do so at their own risk, as the world oil market has fundamentally changed.

- ▶ In the United States, domestic production peaked in the 1970s and has been flat or declining ever since, while demand remains virtually unabated. Despite President Bush's call in his 2006 State of the Union address for an end to America's "addiction" to foreign oil, no domestic supplies remain to be tapped that would end such reliance.
- ▶ The U.S. consumes a quarter of the world's oil—40 percent for passenger vehicles.
- ▶ The nation's demand for oil is projected to grow another 40 percent over the next 20 years, and global demand is expected to rise by 50 percent, more than double the rate at which global production has risen since 1980.
- ▶ Among OPEC producers, spare capacity is at razor thin margins—just 2 percent relative to world demand. Saudi Arabia controls more than 90 percent of this spare capacity.
- ▶ Outside of OPEC, other major oil-producing countries like Nigeria, Russia and Venezuela have faced political and legal troubles that compound the challenge of providing a future steady supply of affordably priced oil.

In November 2005, the International Energy Agency (IEA) released its 2005 World Energy Outlook that raised predictions for long-term oil prices by as much as one-third. The report predicts a drop in real oil prices to \$35 a barrel in 2010 only if oil-producing countries double their current rate of investment in exploration and

production. Another report released in February 2006 by the U.S. Energy Information Agency (EIA)¹ forecasts that oil prices will not fall below \$42 per barrel over the next 20 years, reversing an earlier, more optimistic projection that prices would eventually fall back to \$25 per barrel. Regardless of where oil prices go from here, the fact remains that two-thirds of the world's oil reserves are locked in the Middle East. This has led Faith Birol, the IEA's chief economist to observe:

"We are ending up with 95% of the world relying for its economic well-being on decisions made by five or six countries in the Middle East."



Average CIF Cost of Imported Crude Oil

IEA Monthly Oil Market Report dated 17 January 2006 • www.oilmarketreport.org

As long as civil strife and military conflict remain in the picture for countries like Iraq, Iran, and even Saudi Arabia, oil prices are likely to remain subject to political winds as well as conventional economic laws of supply and demand. The world's dependence on such a small and politically volatile region may result in a dangerous concentration of power to manipulate oil prices, leaving future prices even more uncertain than in the past.

The IEA and EIA reports support the case that structurally higher oil prices are here to stay, thus auto analysts may want to consider whether consumer reactions to gasoline price increases after Hurricane Katrina are predictive of future consumer buying habits if oil prices remain high. History says yes.

Back to the Future: Lessons from Oil Price Shocks of the 1970s and 2005

"The years preceding 2005 look eerily like the years preceding the auto industry recession in 1980. If history repeats itself, auto stocks may be in for a rough period for the next year or so."

~ Stephen Girsky, Morgan Stanley's chief auto analyst in a report to investors
(Girsky is now a GM strategist)

"If gas prices stabilize I think we may see some support in the (full-sized) segment, but not a boost. If gas prices don't stabilize I think it's going to be a very tough endeavor to sell mid-sized and full-sized SUVs."

~ George Pipas, Ford Sales Analysis Manager (speaking at a Bank of America conference in 2005)

1. An intergovernmental body committed to advancing security of energy supply, economic growth and environmental sustainability through energy policy co-operation. The IEA acts as energy policy advisor for its 26 member countries in their effort to ensure reliable, affordable and clean energy for their citizens. IEA was founded during the oil crisis of 1973-74.

General Motors and Ford are working hard to improve profitability, save jobs, and regain competitive advantages in the United States. Their share of the US auto market—still the biggest and by far most lucrative auto market in the world—is hovering near record lows. Their stocks have fallen to prices not seen since the last oil price shock of the early 1980s. In 2006, both companies have announced layoffs of tens of thousands of North American workers.

Yet there was a time not that long ago, in the late 1990s, when these companies were raking in record profits from sales of SUVs, minivans and pickup trucks. But unlike foreign competitors, these US companies may not have had sufficient fall-back plans in case the market turned in a different direction. Already saddled with high pension and benefit costs, and plants operating below their capacity, the margin between record profits and a liquidity crisis was vanishingly small.

To be fair, the auto industry has no more perfect knowledge than anyone else about changing oil prices and the affect that might have on consumer demand for automobiles. Looking back, could anyone have predicted that oil prices would rise by a multiple of 13 during the 1970s, from \$3 to \$39 per barrel? Or that oil prices would collapse in the 1980s and eventually dip below \$10 per barrel at the end of the 1990s? Or that oil prices would spike above \$60 per barrel just five years later?

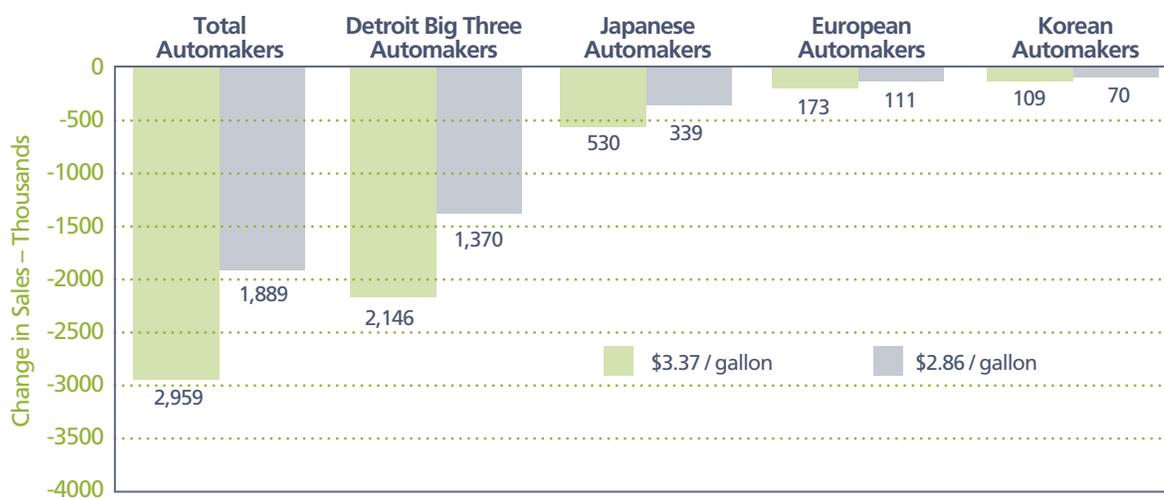
But as the old saying goes, “Fool me once, shame on you, fool me twice, shame on me.” Looking back, it is easy to see that the Arab oil embargo of 1973, and the resulting spike in gasoline prices, put the nation’s “Big Three” automakers—General Motors, Ford and Chrysler—at a competitive disadvantage. Buoyed by low gasoline prices and an accommodative government policy, the Big Three had little incentive to build the kinds of fuel-economical cars that were coming out of Japan and Europe. Having provided this opening to international competition, US automakers have been losing market share ever since. While the Big Three rushed to retool their factories, largely in response to a new federal law in 1975 requiring a doubling of US auto fuel economy standards by 1987, Japanese and European automakers already were prepared to fill this hole in Detroit’s model line. Because their home markets were always at the mercy of foreign oil supplies and governments that taxed fuel heavily, their cars on average got 8 mpg better gas mileage than American-made cars.

But when oil prices began to fall in the mid-1980s, the product cycle swung back in favor of the Big Three. They moved back into production of bigger vehicles with more powerful engines, against which foreign competitors had relatively few offerings. By 2000, sales of “light-duty trucks”—pickups, minivans and SUV’s—rivaled those of passenger cars, and now constitute the majority of passenger vehicle sales in the United States.

During this time, however, the Big Three’s chief foreign competitors did not stand still. They exploited their opening from the earlier oil crisis to prove that they can build vehicles for buyers at all ends of the market—big and small.

So, as good as the 1990s were for the Big Three, the decade turned out to be even better for Japan’s automakers. And the trend continues. In 2004, the Japanese automakers’ share of the US market rose above 30 percent for the first time, while the Big Three’s combined share fell below 60 percent. (As of 2005, it stands at a record low of 58 percent). What had been big profits for the Big Three just a few years ago have turned into sales incentives now, as they struggle to keep their light truck production volumes high and their finances in the black.

Thus, the 1970’s oil price shock changed the face of U.S. auto industry forever. The Big Three have turned into the Big Six, with Toyota, Honda and Nissan building US factories and filling the market share that the others are giving up. And the pace of change may continue to accelerate if fuel prices stay high. In the University of Michigan and NRDC’s 2005 report, *In the Tank: How Oil Prices Threaten Automakers’ Profits and Jobs*, it becomes clear that because Detroit’s Big Three automakers are the most highly leveraged in fuel-inefficient SUV’s, they could lose more than twice as many US sales as Japanese, European and Korean automakers if gas prices climb back toward the \$3 mark.



Compared to forecast base case levels at \$1.69 / gallon.

Reduction in 2009 Vehicle Sales Under Oil Price Scenarios

Source: University of Michigan and NRDC, "In the Tank"

Decade	Oil Prices	Fuel Economy Regulations	Key Market Changes
1970s	Price shocks in 1973, 1979	Congress enacts fuel economy law in 1975; sets goals for 1987	Big 3 lose market share to Japanese, European competitors
1980s	Prices peak in 1981, then fall	Fuel economy peaks in 1986; diesels withdraw from market	Big 3 retool factories, improve quality and competitiveness
1990s	Prices spike in 1991, fall again	Congress nixes higher targets; fuel economy continues to fall	Big 3 profit from SUVs, vans, and pickups – but so do competitors
2000s	Prices peak at nearly \$70/bbl in 2005	1.5 MPG increase for light trucks; CA enacts contested CO ₂ law; 2005 energy bill passes Congress giving tax credits to consumers for purchasing fuel-efficient vehicles	Big 3 market share under 60%; consumers want power, hybrids, fuel-efficiency

Key Developments in the U.S. Auto Market: 1970–2005

Policy Drivers: Preparing for the Now and for the Inevitable

In conjunction with rising oil prices, new government standards are also driving automakers toward cleaner and more fuel-efficient vehicles. The automobile sector has always been affected by government regulations, and has had to adapt to rapid changes in emission and fuel-efficiency regulations. The next several years and decades will include a number of unprecedented regulatory challenges as a result of two primary factors:

- ▶ New global policies on energy independence and security, as well as climate change
- ▶ Enactment of the 2005 U.S. Energy Bill with new provisions

This paper will give an overview of these forces, and will refer to several in-depth studies produced in 2005 and late 2004 that drill deeply into each subject. This paper will also provide a more in-depth overview of the Energy Bill passed by the U.S. Congress in August of 2005—the first major piece of Federal energy legislation since 1992.

A Global Focus on Energy Independence, Security and Climate Change

Driven by rising oil prices and concerns about energy independence and national security, policy makers around the globe are increasingly pressing for tougher fuel economy standards and shifts to cleaner fuels.

Instability in the Middle East poses a major threat to the world economy, which—as was discussed in the previous section—is becoming increasingly dependent on a few Middle Eastern countries to feed its addiction to oil.

Moreover, dependence on foreign oil has become a major issue for many countries, as rising oil prices fuel expanded trade deficits. One-third of the record U.S. foreign trade deficit now consists of imported oil—and imported autos and auto parts account for another 25 percent. Even auto industry economists acknowledge that the trend is unsustainable.

“America is addicted to oil, which is often imported from unstable parts of the world.”

*President George W. Bush,
2006 State of the Union
Speech*

Ford Addresses Climate Change

In the fourth quarter of 2005, Ford Motor Company took several steps toward addressing climate change.

On November 22, in a speech before the Business Roundtable, Bill Ford talked about the energy and manufacturing challenges facing our country and how industry and government can overcome them by investing in American innovation.

“Now, more than ever, with the competitive pressures of globalization, America needs to respond to the economic challenges of our time,” said Ford. “This is not the moment to stop investing and concede our competitive edge in vital parts of the economy. Just the opposite, we must take the lead and show the world that there is only one, true innovative manufacturing giant. And it has three distinct initials: U.S.A.”

Ford outlined six cooperative measures between industry and government:

1. Urging Congress to dramatically increase R&D tax credit to more directly support companies working on advanced vehicles, components, and fuel technologies.
2. Challenging Congress to consider tax incentives to convert existing plants into high-tech facilities.
3. Calling for investment in American workers with training programs and incentives to upgrade worker skills, preserving American jobs.
4. Pushing governments by 2010 to consider buying only hybrids or other alternatively fueled vehicles.
5. Expanding the infrastructure for ethanol fuels — so we can go from hundreds of fuel stations to thousands.
6. Convening a group of automakers, suppliers, fuel providers and government agencies to address America’s energy challenges.

On December 20, Ford released a first-of-its-kind report in the auto industry analyzing the business implications of climate change on the company’s strategic planning and overall competitiveness.

The report highlighted the severity of the global warming challenge, the need for stabilizing and reducing greenhouse gas emissions, and steps the company is taking to capture new market opportunities as consumer demand grows for climate-friendly, fuel-efficient vehicles.

So, too, is the trend in rising carbon dioxide emissions that cause global warming. As key trading partners make progress toward the goals set out by the Kyoto Protocol, American auto manufacturers may be losing out in the international competition over who can develop clean cars.

Scientists and governments no longer debate the validity of the science supporting anthropogenic climate change. The atmosphere is warming, and human activity—principally the burning of fossil fuels—is a primary cause. The passenger automobile industry bears a great burden:

- ▶ The auto industry accounts for 20 percent of the United States' CO₂ emissions and 12 percent of the world's CO₂ emissions and is the fastest growing major source of emissions globally.
- ▶ The industry's emissions are on track to rise by one-third over the next 15 years, and double worldwide by 2050.
- ▶ If the build-up of carbon dioxide in the atmosphere is to be held at twice pre-industrial levels (which may yet result in 3 to 10 degrees Fahrenheit of warming this century), the United States and the rest of the world must achieve absolute reductions in CO₂ emissions by no later than 2020.
- ▶ The U.S. is likely to consume 40 percent more oil by 2025. Consumption in China and India is expected to rise by 130–140 percent over the same time period.

Despite the fact that scientists call for 50–70 percent reductions in greenhouse gas emissions by 2050, the United States has so far resisted calls to appreciably raise auto fuel economy standards and reduce CO₂ emissions. However such regulations are coming down the pike. They are already taking effect in Europe, Canada and Japan, which have committed to the Kyoto Protocol and its terms of scaling back CO₂ emissions below 1990 levels by 2012.

- ▶ In Europe, manufacturers (including the Big 3 producers) have reached a voluntary agreement that effectively will raise the fuel economy standards for passenger cars to 39 mpg between 1995 and 2008.
- ▶ In Japan, gasoline-fueled vehicles must increase their fuel economy by 23 percent by 2010, over a range of size and weight classes.
- ▶ China has set new standards for 2008 that range up to 43 mpg for its smallest cars and 21 mpg for the largest passenger vehicles.
- ▶ In April of this year, the Canadian government worked with automakers to develop a voluntary agreement which calls for annual GHG emissions from tailpipes to drop by 5.3 million tons by 2010.

With the United States accounting for 25 percent of the world's CO₂ emissions, it is only a matter of time before similar regulatory controls are enacted here. Some companies, such as Ford (see sidebar), are calling on the U.S. government to step up the pace of government involvement, recognizing that foreign competitors are profiting from their governments actions.

Because the federal government is lagging, many states have taken the matter to a local level. California has already passed a law calling for a 30 percent reduction in CO₂ emissions from new vehicles sold in the state between 2009 and 2016. At least ten other states¹ have adopted or are in the process of adopting tailpipe emission standards which would eventually affect one-third of the North American market. The big automakers are fighting to overturn this law.

Country/Region	Type	Measure	Structure	Test Method	Implementation
United States	Fuel	mpg	Cars and light trucks	U.S. CAFE	Mandatory
California	GHG	g/mile	Car / LDT1 and LDT2	U.S. CAFE	Mandatory
Canada	Fuel	L/100-km	Cars and light trucks	U.S. CAFE	Mandatory
European Union	CO ₂	g/km	Overall light-duty fleet	EU NEDC	Voluntary
Australia	Fuel	L/100-km	Overall light-duty fleet	EU NEDC	Voluntary
Japan	Fuel	km/L	Weight-based	Japan 10-15	Mandatory
China	Fuel	L/100-km	Weight-based	EU NEDC	Mandatory
Taiwan, South Korea	Fuel	km/L	Engine size	U.S. CAFE	Mandatory

Fuel Economy Standards for Vehicles Around the World

Source: World Resources Institute and Pew Center on Global Climate Change

1. Maine, Massachusetts, New York, Vermont, Connecticut, New Jersey, Rhode Island, Oregon, Washington State, and Pennsylvania

Merrill Lynch released a brief in June 2005 that describes in detail the international policy arena in which the auto industry operates¹. The brief also provides specific examples of companies well positioned to operate successfully in a carbon constrained world.

These new energy and climate policies are major competitive factors that are changing the ability of auto companies to compete in key markets. Auto companies must be prepared to meet, and exceed, global emission standards in order to compete on a global scale. The companies best poised to produce fuel-efficient vehicles and develop new low-carbon technologies will suffer the least and could even capitalize on the opportunities.

In China, for example, where auto companies from around the world are now setting up shop to profit from double digit growth in auto sales, the government has set emission standards for 2008 that only 19 percent of current US passenger cars and 14 percent of light-duty trucks would be able to meet, according to an analysis by the US Public Interest Research Group.

Moreover, both Toyota and Honda have decided to introduce their highly fuel-efficient hybrid models to the burgeoning Chinese market. Starting in the fall of 2005, Toyota brought the Prius, previously made only in Japan, to a production plant in Changchun, with its Chinese joint venture partner, First Autoworks. Similarly, Honda has agreed to make its Accord hybrid sedan in China with its partner, Guangzhou Automobile Group. As a recent article in Fortune magazine explained,

“...the decision [to bring hybrids to China] makes an important statement. Beijing is eager to promote clean, fuel-efficient vehicles and has made it clear that it expects [Toyota and Honda] to share its best technology with Chinese partners as the price of admission to the Chinese market.”

Auto analysts can examine automakers’ preparedness for such global regulatory burdens by utilizing existing analyses by Environmental Defense², which examines the “carbon burden” of the twelve largest automakers (figure below), or by the Union of Concerned Scientists³, which examines the environmental performance of the big six (figure on following page).

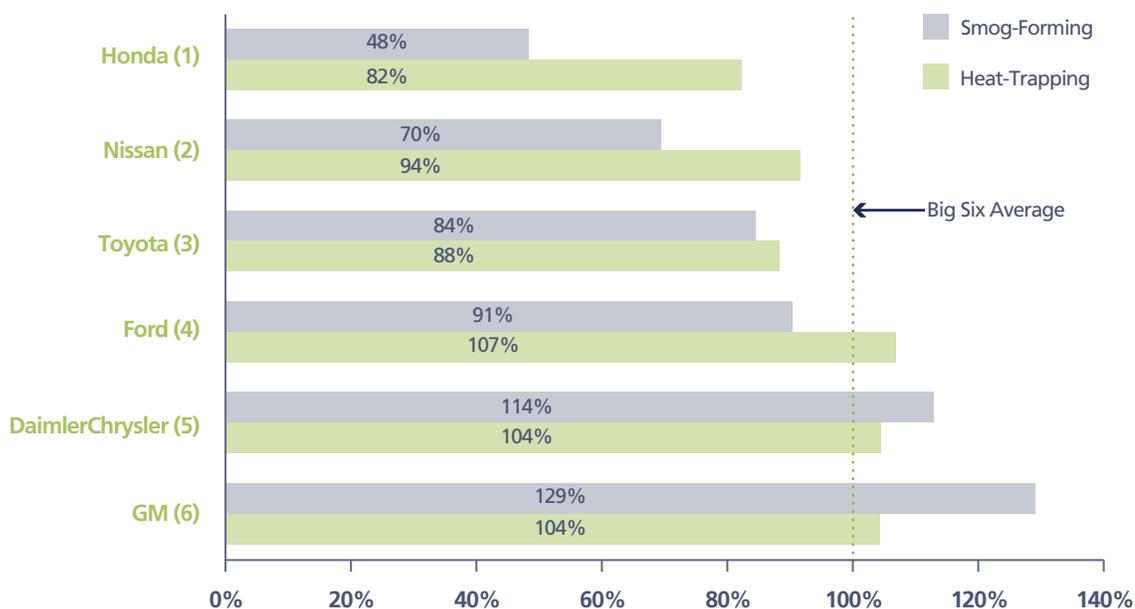


Carbon Burdens of Automakers’ U.S. New Vehicle Sales in 2003

1. Merrill Lynch. *Energy Security and Climate Change: Investing in the Clean Car Revolution*, June 16, 2005.

2. Environmental Defense. *Automakers’ Corporate Climate Burden*, 2005.

3. Union of Concerned Scientists. *Automaker Rankings 2004: The Environmental Performance of Car Companies*, December 2004.



Relative Emissions vs. Big Six Average (2003 Model Year)

For GHG emissions, data from 2005 vehicle models suggests the following rankings:
1. Honda, 2. Toyota, 3. Nissan, 4. GM, 5. DaimlerChrysler, 6. Ford

Enactment of the 2005 U.S. Energy Bill

For the first time in over 13 years, the United States Congress has passed a major piece of energy legislation, which took five years to complete. President George W. Bush signed the bill into law in August.

The bill includes significant new provisions that will drive Detroit and consumers towards more efficient vehicles that are capable of burning cleaner fuels. It sends strong signals that the policy framework for vehicle manufacturers is shifting towards those manufacturers that can produce cleaner and more efficient vehicles.

The bill promotes fuel efficiency through tax incentives to consumers and industries. Although the bill sets minimum-efficiency standards for a number of other consumer products, it does not do so for automobiles; however, the Bush administration is moving ahead with new fuel economy regulations that would increase auto efficiency modestly.

More Efficient and Cleaner Vehicles

Though the funds have not yet been appropriated, the bill offers consumers new tax credits for high-efficiency vehicles, either hybrid or diesel, with credits on a sliding scale based on efficiency and vehicle weight (a credit based on vehicle weight favors manufacturers with large sales of heavier vehicles). The maximum credit for light-duty vehicles is expected to be about \$3,400 for Prius-level performance—a substantial increase over the existing \$2,000 tax deduction. See chart on next page for details.

The bill also authorizes DOE to make grants to manufacturers to encourage domestic production of efficient hybrid and advanced diesel vehicles and to conduct a program to improve the technologies for hybrid/flex-fuel vehicles or plug-in hybrid/flex-fuel vehicles.

“We are harnessing the many opportunities in the Energy Policy Act of 2005, including consumer tax credits for hybrids, the increased incentives for alternative fuel use, and funding to encourage research and development for advanced vehicle technologies.”

Bill Ford, CEO of Ford Motor Company in a letter to President Bush

ACEEE Estimates of Light-Duty Vehicle Tax Credits, 2005

CURRENT MODELS							
Make	Model	Hybrid/ Diesel	Vehicle Class	Adj. City MPG	Fuel Saved (Gal.)	Emissions Pass/Fail	Total Credit (\$)
Chevrolet/GMC	Silverado/Sierra (2wd) ^a	Hybrid	Pickup	18	1,393	Pass	250
Chevrolet/GMC	Silverado/Sierra (4wd) ^a	Hybrid	Pickup	17	1,759	Pass	650
Ford	Escape Hybrid (2wd) ^a	Hybrid	SUV	36	3,155	Pass	2,600
Ford	Escape Hybrid (4wd) ^a	Hybrid	SUV	33	2,907	Pass	1,950
Honda	Accord Hybrid ^a	Hybrid	Car	29	1,583	Pass	650
Honda	Civic GX ^{a,c}	CNG	Car	30	N/A	Pass	3,600
Honda	Civic Hybrid (auto) ^b	Hybrid	Car	50	2,373	Pass	2,100
Honda	Civic Hybrid (man) ^b	Hybrid	Car	47	2,260	Pass	1,700
Honda	Insight (auto) ^a	Hybrid	Car	57	1,498	Pass	1,450
Honda	Insight (man) ^a	Hybrid	Car	61	1,258	Fail	-
Jeep	Liberty ^a	Diesel	SUV	21	1,083	Fail	-
Lexus	RX 400h	Hybrid	SUV	31	3,334	Pass	2,200
Mercedes-Benz	E320 CDI ^a	Diesel	Car	27	1,524	Fail	-
Toyota	Highlander Hybrid (2wd)	Hybrid	SUV	33	3,545	Pass	2,600
Toyota	Highlander Hybrid (4wd)	Hybrid	SUV	31	3,334	Pass	2,200
Toyota	Prius ^a	Hybrid	Car	60	2,744	Pass	3,150
VW	Golf (auto) ^b	Diesel	Car	33	1,627	Fail	-
VW	Golf (man) ^b	Diesel	Car	37	1,349	Fail	-
VW	Jetta (auto) ^b	Diesel	Car	35	1,627	Fail	-
VW	Jetta (man) ^b	Diesel	Car	36	1,349	Fail	-
VW	Jetta Wagon (auto) ^b	Diesel	Car	35	1,628	Fail	-
VW	Jetta Wagon (man) ^b	Diesel	Car	36	2,005	Fail	-
VW	New Beetle (auto) ^b	Diesel	Car	35	1,956	Fail	-
VW	New Beetle (man) ^b	Diesel	Car	37	1,349	Fail	-

UPCOMING MODELS ^b							
Make	Model	Hybrid/ Diesel	Vehicle Class	Adj. City MPG	Fuel Saved (Gal.)	Emissions Pass/Fail	Total Credit (\$)
Chevrolet	Malibu	Hybrid	Car	28	1,464	Fail	-
Chevrolet/GMC	Silverado/Sierra '08	Hybrid	Pickup	20	2,053	Pass	900
Chevrolet/GMC	Tahoe/Yukon	Hybrid	SUV	20	3,221	Pass	1,800
Lexus	GS 450h	Hybrid	Car	28	2,190	Pass	1,300
Mercury	Mariner Hybrid	Hybrid	SUV	33	2,913	Pass	1,950
Nissan	Altima	Hybrid	Car	32	1,956	Pass	1,300
Saturn	VUE	Hybrid	SUV	25	1,236	Fail	-
Toyota	Camry	Hybrid	Car	32	1,956	Pass	1,300

Notes:

- a. 2006 model specifications not available; estimates assume 2005 model specifications
- b. Specifications and credits for these vehicles are estimated based on currently available information
- c. Criteria for alternative fuel vehicle tax credits are different from criteria for hybrid and diesel credits

Low Carbon Biofuels—A Significant New Trend

The new legislation sends a strong signal that the country will shift away from oil as virtually the only fuel that powers the transportation system; it creates new mandates and incentives for the production, distribution, and sale of renewable “biofuels” (which are liquid fuels that come from many types of biomass, including grain crops, grasses, oilseeds, plant wastes, wood residues, and animal wastes). The two main types of biofuel are ethanol and biodiesel, and are described in greater detail in the next section of this report.

The new emphasis on biofuels has implications for auto manufacturers because a standard gasoline vehicle needs only modest modifications to use ethanol. These “flex-fueled” vehicles (FFVs) are capable of interchanging gasoline and ethanol. Today, there are approximately five million flex-fueled vehicles on the roads. These new policy mandates suggest that auto manufacturers may need to convert their entire production to flex-fueled vehicles. In fact, on November 10, a bi-partisan effort by Senators Lugar (R-IN), Harkin (D-IA) and Obama (D-IL) proposed the Fuel Security and Consumer Choice Act. This bill would require all U.S.-marketed vehicles to be manufactured as flexible fuel vehicles within ten years.

The 2005 Energy Bill creates:

- ▶ A Renewable Fuels Standard requiring that the nation’s gasoline supply to contain a minimum level of renewable fuels, starting with 2.78 percent in 2006 and rising to 7.5 billion gallons (double existing levels) in 2012.
- ▶ The bill creates special incentives for the production of cellulosic ethanol. For the purposes of the mandate, a gallon of ethanol from cellulose is considered as 2.5 gallons of renewable fuel. Beginning in 2013, at least 250 million gallons per year must come from cellulose.
- ▶ A new tax credit of up to \$30,000 for service stations that install alternative fuel pumps.
- ▶ A new requirement that vehicles owned by the federal government that are capable of using alternative fuels must do so unless it is “unreasonably more expensive.”

Fuel Cells

Responding to a key priority of the Bush administration, the bill promotes research and development for vehicles powered with hydrogen fuel cells. Many experts believe that these technologies will constitute a long-term shift from the current gasoline-powered fleet, while gasoline-electric hybrids, diesels, and renewable biofuels provide short-term improvements in vehicle efficiency and a shift away from petroleum. The bill vastly ramps up the \$440 million spent so far with authorizations for hydrogen research (\$1.1 billion through 2010); for fuel cells (\$860 million) and for demonstration projects (\$1.3 billion). It sets a goal of 100,000 vehicles on the road by 2010 and 2.5 million by 2020.

What Is Missing

As described above, the Energy Bill may push consumers to purchase more fuel-efficient vehicles through tax credits. It also provides incentives and mandatory standards for the increasing use of biofuels. However, the bill does not include several provisions that are common in foreign regulations on the auto sector. The bill:

- ▶ does not include mandatory greenhouse gas reductions from auto manufacturers
- ▶ does not enforce increasing fuel economy of vehicles
- ▶ left out a major oil savings provision from the Senate version that would have required the President to take steps to save 1 million barrels of oil per year by 2013
- ▶ weakens existing CAFE standards by extending the dual-fuel loophole, providing manufacturers credits for vehicles that can burn ethanol, even if the car never does so

By ignoring key issues, namely mandatory reduction of GHG emissions and increased fuel efficiency, the federal government increases the odds that states will pick up the slack, as is already seen by the CA legislation described on page 7 (JPMorgan has released an in-depth brief¹ examining how CA’s legislation may affect the auto industry). In addition to California, in early November, New York’s Governor George Pataki announced regulations requiring automobiles in NY to reduce CO₂ emissions by 2009. Vermont has similar plans, and Maine, Massachusetts, Connecticut, New Jersey, Rhode Island, Oregon, Washington State, and Pennsylvania are following. This patchwork quilt of state legislation makes compliance more difficult and more costly.

1. JPMorgan, *Cars and Climate Change: A Regulatory Battle Brings Risks for Investors*, September 9, 2005.

Technology Drivers: Creating a Competitive Advantage

New technological developments are also driving change in the auto industry as hybrid technologies for vehicles and biofuels for fueling emerged in 2005 to create opportunities and risks for auto manufacturers. With oil prices predicted to remain high and with increased regulations on GHG emissions and fuel efficiency standards, the auto companies that are doing the most to advance hybrids, clean diesel engines, biofuels and efficient gasoline-powered vehicles are in the most favored position. For them, these technologies are immediately available to improve fuel economy and reduce CO₂ emissions. Those companies that are placing greater emphasis on longer term solutions like hydrogen fuel cells, and betting more or less on maintenance of current market trends in the meantime, are taking a risk that geo-political events and/or regulatory controls will not eclipse their business development strategies.

In recent months, many excellent studies have been produced comparing automakers' investment in researching and developing a range of short-, mid-, and long-term solutions. Prudential Equity Group published a report on automakers positioned to lead in the manufacturing of hybrids¹. A report by Sustainable Asset Management and the World Resources Institute ranks the big six on the impact climate change will have on competitiveness and value creation². In keeping with the theme of this report, this section will explore two key developments in 2005.

1. **Hybrids, Hydrogen Fuel Cells, and Other Technologies**
2. **Biofuels—An Under-Promoted Solution**

"[GM's goal is to] take the automobile out of the environmental equation."

General Motors Chairman
Rick Wagoner (Jan. 2005)

"If automakers don't reduce smog-forming emissions, greenhouse gases, and the need for petroleum, I believe we won't be in business."

Toyota President Fujio Cho (Aug. 2004)

"We are accelerating our efforts to seek innovative solutions that help address America's energy security needs."

Ford CEO Bill Ford (in a Sept. 2005 letter to President Bush)

Hybrids, Hydrogen Fuel Cells, and Other Technologies

Hydrogen Solution is Still Decades Away

If there is a "silver bullet" solution to the auto industry's energy and environmental challenges, it is in switching from petroleum to hydrogen as the fuel of choice. "It could flat-out reinvent the automobile," exclaimed Larry Burns, GM's vice president for research and development, at the Detroit auto show.

Most of the world's major automakers agree. They are pouring hundreds of millions of dollars into research and development of hydrogen fuel cell vehicles, some of which are already being tested in the field. The promise of this technology is so great that this is a race that no automaker can afford to lose.

Even among the leading industry proponents of this technology, however, there is growing recognition that the race is going to be a very long one. Only a few years ago, companies like GM and DaimlerChrysler suggested that fuel cell vehicles would be ready to enter the commercial market by 2010.

At the 2005 Detroit and Tokyo auto shows, GM unveiled its latest fuel cell concept car, the Sequel, the goal of which is "to design and validate a fuel cell propulsion system by 2010 that is competitive with current internal combustion engines on durability and performance, and that ultimately can be built at scale affordably." No timetable was given for a commercial launch, however.

Thus, a breakthrough technology that some had hoped might be available by 2010 has been pushed back to at least 2015, maybe longer.

1. Prudential Equity Group Research. *Electrifying Future for Hybrids*, November 26, 2004.

2. Sustainable Asset Management and the World Resources Institute. *Changing Drivers: The Impact of Climate Change on Competitiveness and Value Creation in the Automotive Industry*, 2003.

Key Challenges for Hydrogen Are Production, Delivery and Storage

Finding the “hydrogen solution” for the automobile will be an even more daunting task. By most estimates, fuel cells must improve 10 to 100 times in cost, size, durability and ease of manufacture before they are fully viable. In a best-case scenario, that will take a minimum of 10 years. Many experts believe it will be another two to four decades before fuel cell vehicles are ready for mass production.

Production: Because hydrogen does not exist in elemental form, other fuels must be used to create it. Natural gas works for industrial applications, but it provides no CO₂ benefit. The emissions resulting from the manufacture of hydrogen are equal to the emissions saved by not burning gasoline or diesel fuel. When more carbon-intensive fuels like coal are used to make hydrogen, they produce more CO₂ emissions than they actually save. Thus, if hydrogen is going to provide a lasting solution to global warming, it must be derived from renewable energy sources like solar, wind or biomass. Making these other energy sources affordable, safe and widely deployed presents a challenge that is beyond the scope of the auto industry alone to address; it falls more on the shoulders of the electric utility industry.

Delivery: How to deliver hydrogen presents a similar dilemma. At present, there is no infrastructure to ship hydrogen through vast pipeline networks and, ultimately, to filling stations. Solving this problem may involve yet another industry—the petroleum industry. While some oil companies like BP, Shell and ChevronTexaco have established fledgling hydrogen businesses, it remains to be seen how fast they will deploy a multi-billion dollar delivery infrastructure that competes with their existing gasoline supply business. By some industry estimates, the initial investment in new infrastructure could top \$20 billion to supply just 2 percent of vehicles in the U.S. with hydrogen fuel. Moreover, unless and until oil companies can find practical ways to sequester carbon as they convert petroleum feedstocks into hydrogen fuel, they, too, will find themselves having to rely on—or turning themselves into—companies that provide renewable energy or nuclear power. While some oil companies envision a transition from petroleum to renewable energy sources, such a makeover surely would take decades to complete.

Storage: Beyond the production and delivery questions, a great deal of uncertainty remains about the best places to store hydrogen before it is put to use. At present, there are only 25 U.S. filling stations for hydrogen, located mainly in southern California and in the Washington, D.C., area, compared to 175,000 that sell gasoline. (Shell and General Motors announced last January that they will build the first hydrogen filling station in New York City—having already developed several in Washington DC¹). Because it costs roughly \$2 million to convert a conventional filling station into a hydrogen filling station, most hydrogen is stored in bigger, centralized facilities. This option is practical for commercial fleets that travel limited distances, but not passenger vehicles that are widely dispersed. A more radical solution would be to produce and store hydrogen right at people’s homes. Honda is working on a system that converts natural gas used for home heating systems into hydrogen. The fuel then could be used to power up vehicles as they are parked overnight, or even to provide electricity for residential use. Eventually, the reformation of hydrogen could even take place inside the vehicle, while it is traveling, though at present on-board transformers are too large to make this a practical option. The U.S. government has provided tax incentives for the conversion of gasoline pumps to ethanol pumps, but has not yet begun to create incentives to build hydrogen filling stations, thus sending a signal that even the U.S. government sees biofuel a more practical short-term solution.

Hybrid Option Is Here Now

If the “destination is hydrogen,” some companies, with Toyota at the lead, are focusing on moving forward with hybrids as a key short-term strategy. Like most other major automakers, Toyota is pursuing a multi-pronged development strategy that includes fuel cells, advanced internal combustion engines, clean diesels and compressed natural gas. However, Toyota has concluded that a fifth option—hybrid electric vehicles—rises above all others. Instead of pursuing hybrids on a separate track, it is integrating the technology into the other four.

Toyota has decided that no matter what technologies hold the greatest long-term promise, including hydrogen fuel cells, the near-term future belongs to hybrids. In fact, they are here now. Toyota has sold more than 150,000 hybrid-electric vehicles since 1997, mainly its Prius sedan in the United States. Honda is not far behind, having introduced three hybrid models and sold more than 65,000 since 1999.

Other automakers are now racing to catch up. In late 2004, Ford became the first domestic car maker to introduce a hybrid vehicle; it sold over 15,500 Escape Hybrid SUVs in 2005, and has announced plans to

1. www.gm.com/company/gmability/adv_tech/100_news/shell_012705.html

put 250,000 hybrids on the market by 2010. Nissan will introduce its first hybrid vehicle in 2006. GM and DaimlerChrysler, through a joint venture, will roll out new hybrid models in 2007 and 2008.

By that time, however, Toyota will have been making hybrid vehicles for 10 years and sold perhaps a million of them. In 2005, Toyota sold over 108,000 copies of its Prius sedan in the United States alone, surpassing their 100,000 goal. Such a sales goal puts this hybrid car in an elite class; only 11 other models sold at least 100,000 copies in the U.S. market in 2004.

Hybrids: a Key Focus of Marketing at 2005 Auto Shows

Further evidence that hybrids will be a key technology for achieving competitive advantage emerged at the 2005 auto shows.

Detroit, January 2005. A major theme of the 2005 show was “here come the hybrids”—vehicles that combine electric motors with internal combustion engines to increase fuel economy. More than a half-dozen automakers had hybrid production vehicles or concept cars on display. The Ford Escape Hybrid SUV, launched in the fall of 2004, was named the show’s “2005 Truck of the Year.” Last year, the Toyota Prius hybrid sedan took top honors in the car category.

Tokyo, November 2005. Although power and speed were also key themes at the Tokyo auto show, the hands-down emphasis was on “clean and green” technologies. Every news article about the event reported on the show’s focus on new, efficient technologies. New York Times reporter James Brooke put it this way:

“...carmakers are competing at the Tokyo Motor Show to send car buyers a message: They have learned the lessons of the Prius.”

Toyota, Lexus, Ford, Nissan, Daihatsu, Mazda, GM and Yamaha displayed an array of hybrids and fuel cell vehicles. While Toyota and Honda are in a race to meet the hybrid demand in the U.S., a market that accounts for the bulk of worldwide profits them, two American firms are at odds about the value of hybrids in the U.S.

At both auto shows, General Motors unveiled the Sequel, a sport utility vehicle that sought to represent a technological leap over hybrids, with Lawrence D. Burns the company’s VP for R&D stating, “We believe we can design and validate a competitive fuel cell propulsion system by 2010.” Whether it can be manufactured to retail scale affordably is another question.

At the show, Ford emphasized its commitment to catching up to Toyota and Honda with its goal of producing 250,000 hybrids a year by 2010. Ford also plans to put 280,000 “flex-fueled” vehicles (that can run on gasoline or ethanol) on the road in 2006, introducing four new models: F-150, Crown Victoria, Grand Marquis and Town Car.

Hybrid Production Is Expanding Rapidly

By the time fuel cell vehicles enter mass production a few decades from now, hybrid systems may be standard equipment on most lines of motor vehicles. As of 2004, however, hybrids accounted for only about 0.5 percent of the 17 million passenger vehicles sold in the United States. Accordingly, the ramp-up in future production will be steep. Projections vary widely, but sales of hybrid vehicles in the U.S. could reach 500,000 units by 2007 and perhaps top 3 million within a decade, accounting for more than 15 percent of vehicle sales overall. The United States is considered the prime market for hybrids because of the range of vehicles that get relatively poor gas mileage now and the high disposable income of consumers who can afford to pay for the vehicles’ higher up-front costs.

Toyota: Having doubled sales of its popular Prius hybrid sedan in 2003 and 2004, Toyota embarked on an especially ambitious expansion plan in 2005. It increased annual production of the Prius to 180,000 units, and sold over 108,000 allocated to the U.S. market. In addition, in the spring of 2005 it launched hybrid versions of its Highlander SUV and the first hybrid in its Lexus luxury car line, the RX 400h. By November of 2005, the Highlander hybrid represented 28 percent of all Highlander sales, and the Lexus RX 400h represented 25.7 percent of RX 300/400h sales. Other hybrid model announcements are expected shortly. Altogether, Toyota sold over 300,000 hybrid vehicles globally by the end of 2005—and is planning to sell as many as 1 million hybrid vehicles by 2007. Toyota President Fujio Cho wants to offer hybrid technology across all of the company’s model lines by 2010.

Honda: The hybrid version of the popular Civic sedan accounted for most of Honda’s 65,000 hybrid vehicle sales from 1999 through 2004. Honda introduced the first hybrid vehicle to the U.S. market in 1999—a two-seater called the Insight that gets 66 mpg in city driving. (The Toyota Prius was not brought to the United States until the summer of 2000.) Honda introduced a hybrid version of its Accord sedan in December 2004. Like Toyota, Honda has more hybrid models waiting in the wings. Its next big launch may be an all-new hybrid version of its Odyssey minivan in 2006. Altogether, Honda’s

hybrid production volume is expected to approach 50,000 in 2005, and sold nearly 37,000 by the end of October 2005. More than half of its model line may be offered in hybrid versions by 2007.

Ford: Ford recently announced that it plans to have 250,000 hybrids on the market by 2010. With the fall 2004 launch of the Escape Hybrid SUV, Ford became the first domestic automaker to bring a full hybrid vehicle to market. The Escape Hybrid gets 50 percent better mileage in city driving and about 20 percent better mileage on the highway than the conventional Escape, and was recently rated by the EPA and DOE as the 2005 most fuel-efficient SUV¹. Ford hoped to sell 20,000 units of its Escape Hybrid in 2005, but only reached 15,500. The introduction of the Escape Hybrid was delayed several times as Ford engineers worked out kinks in the design. According to industry sources, the main problem was in the computer-gear interface of the power control system, which regulates the flow of energy to the drivetrain from the electric motors and the internal combustion engine. In the end, Ford decided to license some of Toyota's patents on its Hybrid Synergy Drive system rather than developing its own alternative. Ford has moved forward by a year the launch date of a hybrid version of the Mercury Mariner SUV; it was released early in 2006. (The Mariner is built on the same platform as the Escape.) By 2008, Ford plans to introduce a hybrid version of two mid-sized sedans, the new Ford Fusion and Mercury Milan. Ford's Japanese partner, Mazda, will introduce a Tribute Hybrid SUV in 2007.

General Motors: General Motors will not launch its first full hybrid passenger vehicle until 2007—fully 10 years after Toyota introduced the Prius in Japan. In the spring of 2004, GM introduced an integrated starter alternator system for a limited edition of its Chevrolet Silverado pick-up truck. This is a flywheel system that shuts off the engine when the vehicle is idling, resulting in a 10–12 percent boost in fuel economy. GM expected to sell about 1,500 of these modified pick-ups to fleet customers in 2005. GM's Saturn division will introduce a mild-hybrid version of the Saturn Vue SUV in 2006, and a mild-hybrid version of the Chevy Malibu in 2007.

More significant will be GM's launch of a new full-hybrid system in 2007 that builds on a hybrid design that its GM Allison division introduced in the transit bus market in 2003. This "two-mode" hybrid system features two gears that provide more low-end torque for towing heavy loads, better high-speed acceleration and better fuel economy in highway driving. Because the system utilizes comparatively small electric motors, however, the gain in fuel economy will be limited to about 25 percent. Initially, GM plans to introduce full hybrids in two of its biggest and least fuel economical SUVs—the Chevy Tahoe and GMC Yukon. Whether the boost in mileage ratings from about 15 mpg to 19 mpg will be enough to stem a recent downturn in sales of such full-size SUVs remains to be seen. In any event, because this two-mode system fits within the housing of a conventional automatic transmission, it offers design flexibility for vehicles that employ front, rear or all-wheel-drive.

DaimlerChrysler: Until recently, DaimlerChrysler placed little emphasis on the hybrid vehicle market. Its main focus in the U.S. market has been to reintroduce diesel engines, which have fallen out of favor since the 1980s. (Volkswagen is taking a similar approach; it has ignored the hybrid market entirely.) In a key move, however, DaimlerChrysler announced in December 2004 that it was teaming up with GM for development of the two-mode hybrid system. (In making the announcement, the two companies explained that they had given similar presentations about this technology at a 2003 industry conference, and decided it made sense to join forces.) DaimlerChrysler has revealed very little about its hybrid development plans, other than to say that its first vehicle to employ the two-mode system will be a Dodge Durango SUV, launched in 2008. At the 2005 Detroit auto show, Daimler also displayed a hybrid concept version of its Mercedes S-class sedan, but has not said when such a model might be introduced. Since 2004, Chrysler has sold a limited quantity of its Ram pick-up truck with a regenerative braking system (about 100 a year), which is available to fleet customers only.

Nissan: Rounding out the "Big Six" automakers, Nissan will offer a hybrid version of its Altima sedan in 2006. The model will utilize a full-hybrid system, with most of its components licensed from Toyota. Unlike the other Japanese automakers, Nissan has taken a wait-and-see attitude toward hybrid vehicles. Nissan's rapid growth in the U.S. market has come largely from expansion of its truck and SUV model offerings. Its full size Titan pick-up truck is now selling at the rate of 100,000 units a year, only 18 months after it was introduced. Commenting on hybrids at the 2005 Detroit auto show, Nissan CEO Carlos Ghosn remarked, "We are not as bullish on hybrids as other people because the business case is not obvious. For many hybrid manufacturers today, the costs are higher than the value. We're a little bit cautious. We believe there is a possibility to bring the value above the cost, but we're not there. And I doubt anybody is there."

1. <http://usgovinfo.about.com/od/consumerawareness/a/fueleco2005.htm>

Hybrids Offer Key Short and Long-term Advantages for Manufacturers

Putting this all in perspective, automakers that invested early in hybrid technology—Toyota, Honda and now Ford—may be able to realize key short-, medium- and long-term advantages:

Brand imaging: In the short term, these automakers can highlight their investment in a new technology that—unlike fuel cells—is on the market here and now. The availability of hybrids distinguishes them from an increasingly crowded field of producers, and it helps them establish a “clean” moniker for their brands. Despite higher sticker prices, the technology is sure to attract a wide range of interested customers. Just as many car buyers are willing to pay \$2,000 to \$4,000 extra to have a more powerful V8 engine, there will be those who are willing to pay for the “guilt free” performance, high-tech gadgetry and novel appeal that today’s hybrid vehicles have to offer.

Fuel inflation hedge: In the medium-term, the fuel economy advantages of hybrids cannot be overlooked. While higher sticker prices for hybrids won’t be recovered through fuel savings when gasoline sells for less than \$2 per gallon (or in the three-year time span that most Americans tend to own new cars), hybrids still offer one of the best hedges against higher fuel prices. This form of insurance may become a key consideration in the resale value of hybrid vehicles over time. (Most of these vehicles also now come with 8-year, 80,000-100,000-mile warranties on their hybrid components.) Likewise, from the perspective of the manufacturers of hybrid vehicles, they can take comfort in knowing that if fuel prices rise, their hybrid offerings provide a buffer against market share losses that other types of vehicles may suffer.

Building the fuel cell platform: In the long term, the greatest benefit for automakers pursuing hybrid technology is that it builds key building blocks for a fuel cell-based vehicle platform. There is some irony in this for companies that historically have put the greatest emphasis on fuel cell technology; their lack of attention to hybrids as an integral, interim solution may have cost them. “I think they now realize that the fuel cell hurdle is going to be higher than they had expected,” commented auto analyst Chris Cedergren of the automotive market research firm Nextrend, upon hearing the recent news that GM and DaimlerChrysler’s are teaming up to pursue hybrid technology. Conversely, companies that invested early in hybrids may reap the greatest long-term benefit when fuel cell technology finally comes into its own. As Prudential Securities analyst Michael Bruynesteyn wrote in a November 2004 research brief: “The amortization period becomes the focal point, where both Toyota and Honda are viewing their investments as part of the long-term R&D for the development of fuel cell vehicles... and not just over the life of the gasoline-electric hybrid vehicle programs. The long-term view of Toyota and Honda enabled both to invest aggressively in hybrid vehicle development, and as a result, the two companies are clearly the leaders in this technology....”

“We failed to appreciate that Toyota basically treated [hybrids] as an advertising expense. They said ‘we need these to demonstrate our technological superiority, demonstrate our concern for the environment, capture the imagination of the growing environmental movement in the U.S. and get all those East Coast and West Coast intellectual opinion leaders, movie stars, etc., on our side,’ which they very successfully did. So even if they lose money on it, it’s cheap at twice the price.”

Bob Lutz, GM’s vice chairman in charge of product development, during the 2005 Detroit auto show

Biofuels, an Under-Promoted Solution

Biofuels are one of the key intermediate steps between today’s inefficient, dirty engines and tomorrow’s fuel cell powered vehicles. By 2050, biofuels could supply the equivalent of 7.9 million barrels of oil per day in America, equal to 35% of the current oil market.

Not only does the new federal energy bill create new mandates and incentives for the production, distribution, and sale of renewable biofuels, but on November 10, a bi-partisan effort by Senators Lugar (R-IN), Harkin (D-IA) and Obama (D-IL) proposed the Fuel Security and Consumer Choice Act. This bill would require all U.S.-marketed vehicles to be manufactured as Flexible Fuel Vehicles (FFVs) within ten years.

Biofuels are liquid fuels that come from many types of biomass, including grain crops, grasses, oilseeds, plant wastes, wood residues, and animal wastes. The two main types of biofuel are ethanol and biodiesel.

Ethanol is gasoline-type fuel made by fermenting any biomass high in carbohydrates (starches, sugars, or cellulose) into alcohol. Today, most ethanol in America is produced from food crops, especially corn, and American output of corn-based ethanol is rising by 30% a year. However, recently developed technologies for converting cellulose (corn stalks, switchgrass and other feed stocks) to ethanol provide exciting opportunities to vastly increase ethanol production while reducing potential conflicts with environmental protection and food production. Ethanol can be used as a fuel additive or as the main component in its own blend. Flexible fuel vehicles, which run on mixtures of gasoline and up to 85% ethanol, are now available.

Biodiesel is a diesel-type fuel made by separating glycerin from animal and vegetable oils to create methyl esters. Like ethanol, it can be used as an additive to reduce vehicle emissions, or in its pure form as an alternative fuel for diesel engines. Biodiesel's fuel performance is the same, and in some instances better, than low sulfur diesel. Biodiesel is very similar to the petrochemical-based diesel fuel, so it does not require any vehicle or storage modifications. Today, about 35 plants across the country make nothing but biodiesel.

Biofuels Go Mainstream

During the 2006 Super Bowl, General Motors became the first U.S. automaker to launch a high-profile biofuels campaign called "Live Green, Go Yellow."

The campaign promotes GM's ramped up production of flex-fueled vehicles (FFV's) that can operate on traditional gasoline or a blend of gasoline and 85% ethanol (E85).

1. GM already has 1.5 million vehicles on the road that are E85 compatible.
2. The company plans to produce 400,000 FFV's per year beginning in 2006.
3. In California, Illinois, and other states, GM is partnering with government, fuel providers and fuel retailers to help build the infrastructure for E85 ethanol.
4. Seven GM SUV models and two GM sedans will be offered as FFV's.

In addition to the company's recent focus on FFV's as an important mid-term solution to energy security and climate change, GM has also invested over one billion dollars in fuel cell research and development as a longer term solution.

Biofuels are Good for the Environment

As already noted, several U.S. states have joined with most developed-world foreign governments in implementing CO₂ emission reduction regulations. Biofuels reduce vehicle GHG emissions. Biofuels used in high blends also produce fewer carbon monoxide, particulate, and air toxic emissions than gas or diesel.

- ▶ Used in today's cars, ethanol from cellulose would cut carbon dioxide emissions by 86 percent compared to gasoline and by 94 percent if used in a fuel cell.
- ▶ A hybrid SUV running on a biofuels blend (5 gallons of ethanol to 1 gallon of gas) would get 162 miles per gallon of gas it used.
- ▶ The Natural Resources Defense Council (NRDC) calculated¹ that by 2050 biofuels could reduce U.S. GHG emissions by 1.7 billion tons per year—equal to more than 80 percent of transportation related emissions and 22 percent of total emissions in 2002.
- ▶ According to the National Renewable Energy Laboratory, the net emission of carbon dioxide from biomass energy sources will be zero as long as plants continue to be replenished for biomass energy purposes.

1. National Resources Defense Council, *Growing Energy How Biofuels Can Help End America's Oil Dependence*, December 2004

Biofuels are Good For Economic and National Security

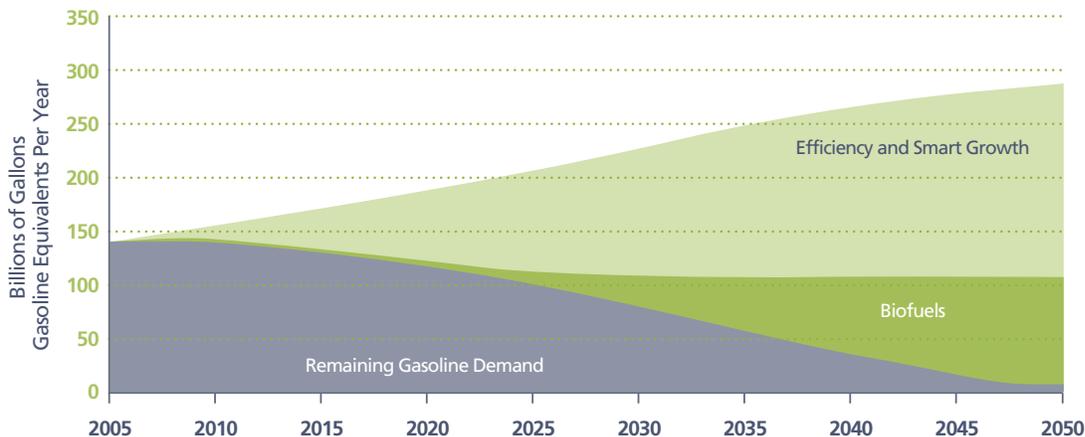
As noted in the first section of this report, America's national security is threatened by its precarious dependence on imported oil, and biofuels can create a reliable, homegrown source of liquid fuels. America is already producing and selling billions of gallons of biofuels each year, and its potential is large. However, despite its huge potential, there are only about 600 fueling stations nationwide that offer high ethanol blends of E85, making current consumer availability very poor.

- ▶ By late 2005 ethanol capacity is projected to hit 4.4 billion gallons a year, up from 3.4 billion in 2004.
- ▶ America has 84 ethanol-producing plants, 16 being built, and more being planned.
- ▶ Over 5 million American cars are already fuel-flexible, meaning they can run on gasoline or ethanol interchangeably, and producing new fuel-flexible vehicles costs very little. Traditional gasoline stations can distribute biofuels without any significant changes to their apparatus.
- ▶ The energy bill includes a requirement to sell 7.5 billion gallons of biofuels by 2012, with an additional 250 million gallons from cellulosic feedstocks by 2013.
- ▶ Shell Oil predicts "the global market for biofuels such as cellulosic ethanol will grow to exceed \$10 billion by 2012."
- ▶ U.S. produced ethanol could top 50 billion gallons a year, displacing 2.6 million barrels per day of oil (about 13 percent of total current consumption), according to the Energy Future Coalition.
- ▶ With a plan to develop cellulosic biofuels by 2015, America could produce the equivalent of 7.9 millions barrels of oil per day by 2050, more than 50 percent of U.S. oil use for transportation and more than three times current Persian Gulf imports.

Biofuels are Cost Competitive

Although high-ethanol blends are more expensive than gasoline on a per BTU basis, biofuels are competitive alternatives to oil today, and will be more competitive in the future.

- ▶ Unsubsidized U.S. biofuel is competitive when oil is \$50 a barrel or higher.
- ▶ Advanced biofuels production facilities could produce alternative fuels at between \$0.59 and \$0.91 per gallon of gasoline and at \$0.86 per gallon for diesel by 2015. These prices are competitive with the average wholesale prices over the last four years: \$0.91 per gallon of gasoline and \$0.85 per gallon of diesel.
- ▶ Building a 100-million gallon per year ethanol facility costs about \$157 million.
- ▶ National subsidies designed to boost the biofuels market make biofuels competitive with oil even at \$21–\$29 a barrel. Ethanol's federal tax credit is now 51 cents per gallon. Small producers, making up to 30 million gallons a year, get an extra 10 cents. Last fall, Congress passed a law reducing the 24.4-cent-per-gallon federal excise tax on diesel fuel by one cent for every percentage point of farm-based biodiesel that was mixed in.



Reduced Gasoline Demand through Biofuels, Efficiency, and Smart Growth

Source: Natural Resources Defense Council

Summary of Briefing and Roundtable with Auto Sector Investors and Analysts: December 6, 2005

Overview

On December 6, 2005, auto sector analysts and other members of the investment community met to discuss the impacts of high oil prices, fuel efficiency and the future of the auto industry. The meeting was sponsored by Ceres, the Investor Network on Climate Risk, the Natural Resources Defense Council (NRDC), JPMorgan, Cornell University and the Office for the Study of Automotive Transportation at the University of Michigan (OSAT). JPMorgan hosted the half-day briefing at its headquarters in New York City.

Three experts presented research findings and offered their opinions about these topics, followed by a roundtable discussion of four automobile investment specialists and two institutional investors. The audience included nearly forty participants representing a variety of organizations including investment banks, research firms, financial advisors, fund managers, and other fiduciaries.

Latest Analysis on Oil/Gas Price and Effects on Auto Sector

Dr. Walter McManus, Director of the Office for the Study of Automotive Transportation at the University of Michigan, kicked off the briefing. Dr. McManus described research completed by OSAT and NRDC in July that modeled the potential effects of increasing average gasoline prices to \$80 per barrel or \$100 per barrel against a baseline of \$45 per barrel. Key findings of the study included:

- ▶ Profits at GM, Ford, and DaimlerChrysler could shrink by \$7–\$11 billion.
- ▶ GM, Ford and DaimlerChrysler would be likely to absorb nearly 75 percent of the decline in total sales volume.
- ▶ Fourteen US factories and two Canadian factories are at risk for closure and layoffs.
- ▶ At least 297,000 jobs could be on the line, 37 percent of them in Michigan, Ohio, and Indiana.

Dr. McManus's findings supported the premises that high oil prices are a key driver in the U.S. vehicle market and automakers, investors and lawmakers should act immediately by making fuel efficiency a key priority for auto companies, recognizing the link between fuel efficiency and shareholder value, and enacting legislation that incentivizes fuel efficiency.

Global Markets for Clean Cars in China and Elsewhere

Michael Walsh, an International Vehicles Consultant, discussed the impact of growth and consumption of automobiles in emerging markets—China and India in particular—on the production of fuel efficient vehicles. China is already seeking ways to increase energy security and reduce oil imports (as the world's second largest consumer of oil), manage climate change risks (90 percent of vehicles sold today are in countries with some type of greenhouse gas reduction strategy), and create a sustainable transportation system.

The Chinese government has developed policies to increase fuel efficiency, lessen environmental impacts, promote hybrid, clean diesel, and fuel cell research, and reduce fuel consumption per vehicle by 15 percent by 2010. New fuel economy requirements will be enacted in 2008 .

The Case that Fuel Prices Do Not Affect Consumer Choices

Marc Levinson, an industry economist at JPMorgan, presented an alternate finding that gasoline prices and fuel efficiency are not actually drivers for consumer vehicle purchases. Consumers' initial reaction to rising gas prices may be to temporarily reduce driving; however, driving and vehicle-purchase patterns soon return to normal.

As evidence that increasing the cost of driving (such as through increased fuel prices) does not alter consumers choices of driving patterns or vehicle choices, Mr. Levinson cited:

- ▶ Increased driving fees don't change driving habits. In London, the £8 fee to drive in the city has not deterred drivers). In Canada, drivers are willing to pay \$0.21 per mile to bypass Toronto traffic. And in California, drivers are willing to pay a high fee for access to quick lanes.

- ▶ Increased fuel prices alone don't result in less driving. In London, petrol prices rose 80 percent between 1990 and 2000, yet per capita car travel increased by 11 percent.
- ▶ Incentives draw consumers into higher priced, lower fuel-economy vehicles. Consumers seek many factors when purchasing a vehicle—including comfort, ride, size, etc. Fuel economy is low on the list.

The regulatory environment is likely to have a greater impact on fuel efficiency than consumer choice will. However, regulations could actually increase driving habits (for example, hybrid owners may drive more because they feel it is inexpensive and environmentally safe for them to do so).

Uncertainty, Flexibility, and Disclosure

The roundtable discussion brought a range of perspectives to the topic by including institutional investors (Kelly Forrest of CalPERS and Janice Hester Amey of CalSTRS), auto analysts (Michael Bruynesteyn of Prudential Equity Group, and John Casesa of Merrill Lynch), environmental NGO's (Roland Hwang of Natural Resources Defense Council), and auto research specialists (Kim Korth of IRN, Inc.).

No consensus was reached about the effects of fuel prices and climate change on the auto sector; however, three conclusions were widely agreed upon:

- 1. Regulatory uncertainty is bad for the auto sector.**
- 2. Flexibility in manufacturing is a key factor in measuring future profitability.**
- 3. Increased disclosure on the risks and opportunities posed by fuel prices, climate change, and other factors is desirable.**

Regulatory Uncertainty is Bad for the Auto Sector

Globally and domestically, emissions regulations are increasing as a result of government and public concerns about climate change, energy security and high fuel prices. Panelists agreed that automakers with more flexibility in their ability to react to the changing regulatory environment should be valued higher than those who do not. Although it is very difficult to quantify uncertainty, in some cases, regulatory uncertainty is actually depressing valuation as the present value of future cash flows of an automaker whose fleet is made up of primarily high-emitting vehicles may be substantially lower than the present value of future cash flows of an automaker whose fleet is more fuel efficient.

Some automakers, such as Ford, have begun to get more deeply engaged in advocating for federal emissions policies. As foreign auto companies gain market share in the US, their influence in American politics will grow.

Flexibility in Manufacturing is a Key Factor in Measuring Future Profitability

Panelists expect a continuing trend away from large SUV's to crossover vehicles (CUV's)—a sport utility vehicle body on a car instead of light truck base—and cars. Some attribute this to rising fuel prices and a desire for increased fuel economy, but others attribute this shift to other factors such as better comfort, lower clearance, and better road handling of (CUV's) and cars. Regardless of the cause, all agreed that manufacturers with more manufacturing flexibility will be in a better position to respond to changing consumer demands.

Changes in the automobile product cycle can take anywhere from six to ten years, and only two manufacturing facilities in the US (one is Nissan's and one is Honda's) are capable of rapidly switching from producing SUV's to more fuel-efficient vehicles. Therefore, it is in the best interest of US manufacturers—whose plants are designed to build large cars—to promote sales of existing models, even if those models are not responsive to rising fuel prices and a changing regulatory environment. More and more original equipment manufacturers (OEM's) and suppliers will be exploring new powertrain technologies to improve fuel efficiency in large vehicles.

Overall, there was consensus that GM and Ford have less flexibility than Toyota, Honda, and Nissan.

Increased Disclosure on the Risks and Opportunities Posed by Fuel Prices, Climate Change, and Other Factors is Desirable.

The briefing participants and presenters agreed that increased disclosure is critical for investors, analysts and researchers. A better understanding of how auto companies are managing legacy costs, plant closings, regulatory uncertainty, rapidly shifting consumer demand, increasing oil prices, and a growing global market is critical to understanding and valuing companies.



High Oil Prices, Fuel Efficiency, and the Future of the Auto Industry

Briefing and Roundtable

December 6, 2005

- 9:00–9:10 Welcome and introduction by JPMorgan Securities**
- 9:10–9:25 Latest analysis on oil/gas price and effects on auto sector**
- ▶ Dr. Walter McManus, Director of OSAT, University of Michigan
- 9:25–9:40 Global markets for clean cars in China and elsewhere**
- ▶ Michael Walsh, International Vehicles Consultant and recent MacArthur “Genius Grant” recipient.
- 9:40–9:45 Respondent: Marc Levinson, JPMorgan**
- 9:45–10:30 Roundtable**
- ▶ Moderator: Mindy Lubber, Ceres
 - ▶ Participants: Michael Bruynesteyn (Prudential Equity Group), John Casesa (Merrill Lynch), Kelly Forrest (CalPERS), Janice Hester Amey (CalSTRS), Roland Hwang (NRDC), Kim Korth (IRN, Inc.)
 - ▶ Proposed questions for discussion:
 - *How important is fuel economy to automaker performance?*
 - *To what extent should financial analysts and investors incorporate risks of higher fuel prices and stricter carbon regulations into their work and ratings?*
 - *Do analysts have adequate tools to assess the risk or do better tools need to be developed?*
 - *How do policy changes, especially in U.S., impact shareholder value?*
- 10:30–10:40 Break**
- 10:40–11:30 Open Q&A from investors and analysts in audience**
- 11:30–11:45 Wrap up and conclusions**

Participating Organizations

Alliance Capital Management Corp.
Bear Stearns
Boston Common Asset Management
CalPERS
CalSTRS
Calvert Group
Ceres
David Gardiner and Associates
Energy Foundation
Fidelity Management & Research
Fortress
HBK Investments, L.P.
Interfaith Center for Corporate Responsibility (ICCR)
IRN Inc.
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JP Morgan Chase
Longacre Management, LLC
Majestic Research
Merrill Lynch
Nathan Cummings Foundation
Natural Resources Defense Council
New York City Comptroller's Office
Oak Hill Advisors, Inc.
Office of the New York State Comptroller
OSAT, University of Michigan
Prudential
Teamsters
TriState Coalition for Responsible Investment
Vista Research

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David Gardiner is Principal and President of David Gardiner & Associates (DGA). Mr. Gardiner has over twenty-five years of experience analyzing and shaping successful federal and international environmental policy in the public and private sector. **Miranda Anderson** is Vice President for Investor Analysis at DGA and specializes in strategic and operational management and corporate responsibility. Her career has spanned both the non- and for-profit sectors, holding management positions in such industries as energy and environmental development in emerging markets, international development, and wireless telecommunications. **Pascal Noel** is a research associate at DGA.

David Gardiner & Associates, LLC (DGA) provides innovative environmental and sustainability services to clients in the private- and public-sectors. The firm has core expertise in climate change, clean air, clean energy, corporate responsibility, investor services, business and non-profit management, and sustainable development. DGA focuses on key sectors where sustainability issues have a significant impact, including electricity, transportation, land use, and investor and financial markets.

About Ceres

Ceres is a coalition of investment funds, environmental organizations, and public interest groups. Ceres' mission is to move businesses, capital, and markets to advance lasting prosperity by valuing the health of the planet and its people. Ceres represents more than \$400 billion in assets. Investor members include state and city pension funds, socially responsible investment firms, religious groups, labor unions, and foundations.

Ceres serves as Secretariat for the **Investor Network on Climate Risk (INCR)**. INCR is a group of 50 institutional investors managing nearly \$3 trillion of assets which promotes better understanding of the risks of climate change among institutional investors. For more information, visit www.ceres.org and www.incr.com.

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