Industry Overview

Equity | United States | Autos/Car Manufacturers
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Alternatives for the clean car evolution

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Pressure for change builds - regulation & alternatives

The automotive industry is increasingly facing constraints on oil consumption and emissions contributing to global climate change. The confluence of energy security concerns and growing awareness of climate change are fueling more stringent and widespread regulations on carbon dioxide (CO_2) emissions and energy efficiency. Moreover, the search for an antidote to the U.S. "oil addiction" is leading lawmakers to focus on promoting biofuels as a possible solution.

Regulatory & policy decisions to watch out for in '07

1) Whether the Supreme Court classifies CO_2 as a pollutant; 2) How governments integrate the auto sector in climate regulations, particularly the EU, over the next year and longer term in the U.S.; 3) Monitor the regulatory and legal actions in California, which has a long history of setting national trends on environmental legislation; 4) Whether the U.S. CAFE standards will be adjusted to decrease the benefit given to automakers for producing flexible fuel vehicles (FFVs), given that 99% of the time, FFVs are driven with regular gasoline.

U.S. consumers' short term memory & demand

Although, there have been government regulations for decades aimed at fuel economy, consumer demand is a force that often trumps regulation in the U.S. The rise in gas prices has enforced some discipline, but it is American's insatiable appetite for bigger, better, and faster that clouds the memory of the crises of OPEC I, OPEC II, and the Gulf War when gas was in short supply.

OEMs' response to demand & regulatory schizophrenia

Although many global automakers often highlight specific powertrain strategies, most are exploring a number of options as the ultimate winner is extremely unclear. Most OEMs point to fuel cells as the holy grail of powertain technology, but considering the timing of introduction (10+ years), the possibility of another alternative emerging exists. In the interim, the alternatives being explored are increased diesel penetration, ethanol & biofuels, and hybrids.

Investment ideas to play cleaner cars

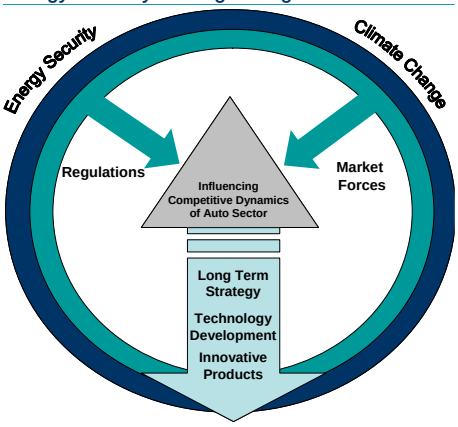
In light of these trends, we would highlight the following companies as ways to capitalize the trends to the changing fuel efficiency landscape.

BorgWarner - Almost all of BorgWarner's key products offer the benefits of higher fuel efficiency and/or lower emissions. We estimate that these products account for at least 70% of the company's revenues.

Valeo - Valeo is a direct play on fuel economy. We estimate that these products account for at least 35% of the company's 2006 revenues.

Magna International - Magna's market-leading high-pressure hydroforming business is a critical technology for creating lighter, stronger vehicles and thus we believe it will play a key role in the intensifying drive for higher fuel economy.

Chart 1: Confluence of Climate Change and Energy Security Driving Change



Source: World Resources Institute

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Executive summary

This report, prepared with the generous contribution of World Resources Institute, presents a framework for understanding the regulatory and market dynamics driving the demand for more fuel efficient and less polluting automobiles, and highlights three investment ideas that are levered to this long-term theme.

The evolving regulatory framework

The automotive industry is increasingly facing constraints on oil consumption and emissions contributing to global climate change. The confluence of energy security concerns and growing awareness of climate change are fueling more stringent and widespread regulations on carbon dioxide (CO_2) emissions and energy efficiency. Moreover, the search for an antidote to the U.S. "oil addiction" is leading lawmakers to focus on promoting biofuels as a possible solution.

However, since our last report titled *Energy Security and Climate Change: Investing in the Clean Car Revolution* (June 2005), we have seen mixed results on progress towards better fuel efficiency. In some regions, there has been some retrenchment around CO_2 standards (e.g. EU and Canada), while others have made strides forward in terms of new regulations (e.g. China) or restructuring of existing regulations (e.g. US). While the stringency of these targets is clearly important from a competitive perspective, how they are structured can also influence competition in the industry.

The auto industry is not well served by these weak and vacillating regulations, which only perpetuate regulatory uncertainty. Moreover, this dynamic encourages short term strategies, specifically on the part of U.S. automakers as they exploit policy loopholes or develop marketing campaigns around *en vogue* technologies. This is not a strategy that creates long term shareholder value. We believe it is better for the industry, and for investors, for Washington to develop a clear, coherent and long term regulatory path for the industry to reduce oil consumption.

What investors should watch for on fuel efficiency regulations in 2007

For investors, there are three main issues on the fuel efficiency front emerging in 2007 that are important to watch.

1. Legal issues around classifying CO_2 as a pollutant. If the Supreme Court allows CO_2 to be classified as a pollutant under the Clean Air Act, this will have profound implications for all GHG-intensive industries, particularly the auto sector. This decision is inextricably tied to the lawsuit brought by the industry against the state of California and therefore could influence the future of the Pavley law, which aims to reduce GHG emissions by 30% in California.

2. An overarching issue that investors should track is whether governments integrate the auto sector in climate regulatory strategies. Over the next 12 months, this is particularly salient in the EU, though over the medium term is also true of the US, as the debate in Congress over what to do with climate policy heats up.

3. Monitor the California regulations and lawsuits. California has a long history of setting national trends on environmental legislation, and politicians, including Governor Schwarzenegger, appear to have taken on climate change as the next iteration of this leadership. While it remains unclear how California Air Resources Board (CARB) will specifically implement the

various GHG requirements that that have been signed into law, what is clear is that these requirements are, in fact, law. Lawsuits or not, the auto industry will likely be impacted by this regulatory trend.

What investors should watch for on biofuel policies in 2007

The Alternative Motors Fuels Act, on the books since 1988, was originally was intended to promote flex fuel vehicle (FFV) production in order to reduce oil consumption. Under the Act, automakers can get credit, up to 1.2 mpg, toward their CAFE requirements for the dual-fuel vehicles (DFV), including FFVs. While the original formula was intended to stimulate consumption of alternative fuels in order to achieve certain energy and environmental benefits, in fact it has had the opposite effect; increasing fuel consumption and emissions.

Today there are several proposed bills that would indeed narrow this FFV loophole (although not eliminate it) and propose altering the formula used to rate FFVs so that they more accurately reflect reality.

U.S. consumers' short term memory & demand

Although, there have been government regulations for decades aimed at fuel economy, consumer demand is a force that often overshadows regulation in the U.S.

The fairly steady rise in gas prices in the last few years has enforced some discipline on demand, but the recent decline is disconcerting as the American consumer will likely revert to gas guzzling vehicles. We believe it is unlikely that there has been a true paradigm shift in consumer preferences to more efficient vehicles as many observers believe. The instances of an American consumer buying a tube TV versus a flat panel TV because it was a better economic decision; or a regular size soft drink versus a super-size because it was cheaper and healthier are almost non-existent; with autos this has materialized in the form of greater truck demand. Americans almost never chose to downsize unless financially forced to do so, but we may be entering such a period. It is this insatiable appetite for bigger, better, and faster that clouds the memory of the crises of OPEC I, OPEC II, and the Gulf War when gas was in short supply.

Automakers' response to demand and regulatory schizophrenia

Although many global automakers often highlight specific powertrain strategies, most are exploring a number of options as the ultimate winner is unclear. Most OEMs point to fuel cells as the holy grail of powertain technology, but considering the timing of introduction (10+ years) it is a dubious solution, and another technology could emerge. In the interim the alternatives being explored are increased diesel penetration, increased ethanol & biofuel use, and the popular hybrid.

The scale of the investment in all new powertrain technology is massive, and it is important to remember the capital that has been committed to the traditional internal combustion gas engine has been depreciated over decades. Therefore, the incremental capital that needs to be dedicated is daunting and likely a drag even for the automakers with solid income and strong balance sheets. Furthermore, the process is likely to be evolutionary as opposed to revolutionary as all industry participants attempt to minimize investment risk.

Investment ideas to play cleaner cars

In light of these trends, we would highlight the following companies as ways to capitalize the trends to the changing fuel efficiency landscape:

- BorgWarner Automotive (U.S.) – (BWA, B-2-7, $56.42)

Almost all of BorgWarner's key products offer the benefits of higher fuel efficiency and/or lower emissions. We estimate that these products account for at least 70% of the company's revenues.

- Valeo (France) – (VLEEF, B-1-7, €29.69)

Valeo is a direct play on fuel economy. We estimate that these products account for at least 35% of the company's 2006 revenues.

- Magna International (Canada) -(MGA, B-1-7, $73.82)

Magna's market-leading high-pressure hydroforming business is a critical technology for creating lighter (as much as 20%), stronger vehicles and thus we believe it will play a key role in the intensifying drive for higher fuel economy.

This report is prepared with the generous contribution and expertise of Fred Wellington and Britt Childs of the Capital Markets and Climate Change team at the World Resources Institute. Based in Washington, DC, WRI is an independent nonprofit environmental think tank that seeks to find practical solutions to environmental problems. WRI has a deep understanding of the complex and changing regulations that dictate the development of cleaner, more economical automobiles. We have relied on this expertise in drafting this report.

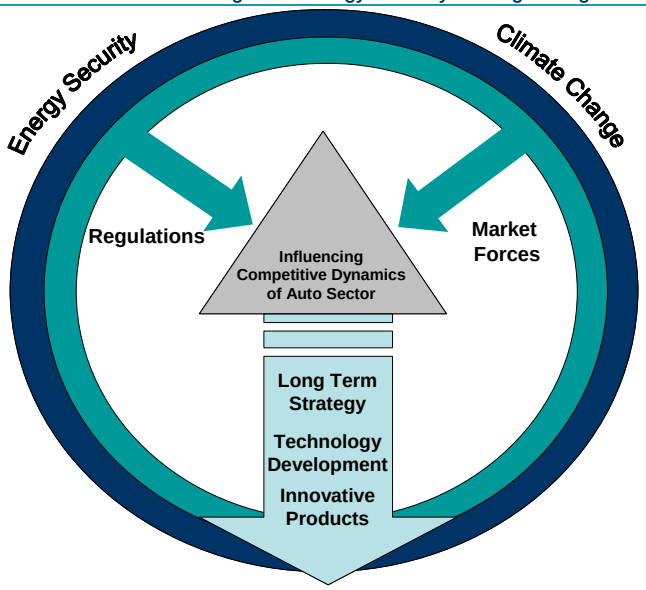
The evolving regulatory framework

The search for alternatives

The confluence of energy security concerns and growing awareness of climate change are fueling more stringent and widespread regulations on carbon dioxide (CO_2) emissions and energy efficiency. Moreover, the search for an antidote to the U.S. "oil addiction" is leading lawmakers to focus on promoting biofuels as a possible solution.

The confluence of energy security concerns and growing awareness of climate change are fueling more stringent and widespread regulations on carbon dioxide (CO_2) emissions and energy efficiency. Moreover, the search for an antidote to the U.S. "oil addiction" is leading lawmakers to focus on promoting biofuels as a possible solution.

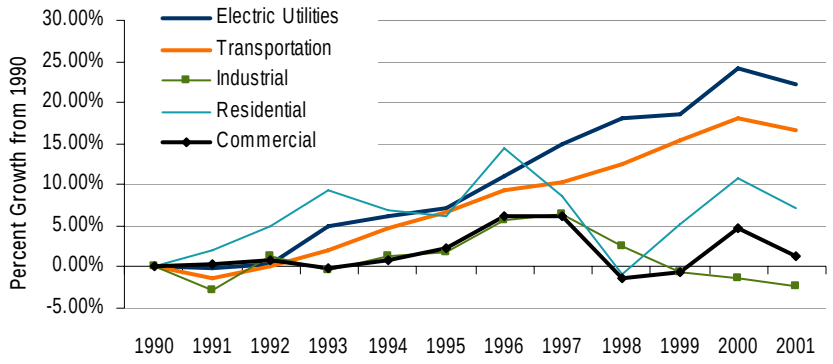
Chart 2: Confluence of Climate Change and Energy Security Driving Change



Source: World Resources Institute

Energy security and climate change issues will not disappear in the foreseeable future; instead these issues are likely to grow in both urgency and importance. This will increase pressure on lawmakers to enact policies and measures to reduce oil consumption and greenhouse gas (GHG) emissions, which continue to rise rapidly (see Chart 3). How these macro issues drive market forces, regulations and technological evolution will have a profound impact on the competitive dynamics in the industry. Investors should consider how these new parameters present investment opportunities that capitalize on trends that emphasize the need for fuel efficiency, cleaner technologies and alternative fuels.

Chart 3: U.S. GHG Emissions



Source: World Resources Institute. Climate Analysis Indicators Tool (CAIT)

Increasingly, biofuels are being seen as a solution to the convergence of climate change and energy security concerns. A "home-grown" substitute for imported oil, biofuels could displace a portion of U.S. oil consumption; as it is derived from biomass, its 'well-to-wheel' emissions can also be friendlier to the atmosphere. Today, the vast majority of the biofuel consumed in the U.S. is produced from corn, so policymakers also see biofuels as a boon for rural America, providing a new and rapidly growing market for their crops. Moreover, many seem to be eyeing biofuels as a growth market, as the Big Three are increasing production of flex fuel vehicles (FFVs) while their primary competitors have, instead, invested in fuel efficiency improvements. If biofuels can, in fact, help address such hot-button issues as energy security, the environment, the agriculture sector, and the U.S. auto industry, it's no wonder policymakers are hopping on the bandwagon.

Many of the policies being contemplated presently are rather narrowly focused and do not constitute a comprehensive national solution to energy and climate concerns.

However, in order to achieve any meaningful reductions in CO_2 emissions or reduced use of foreign oil, policymakers must strike a delicate balance: improving fuel efficiency, while also stimulating production and use of biofuels. Many of the policies being contemplated presently are rather narrowly focused and do not constitute a comprehensive national solution to energy and climate concerns. Moreover, the enthusiasm around biofuels, at both the state and federal level, has yet to coalesce into a coherent strategy or outlook which will eventually inform the decisions of the investment community. The market prefers long term regulatory certainty from Washington in order to efficiently allocate capital to companies developing competitive technological solutions.

The auto industry is not well served by weak and outdated regulations, which only perpetuate regulatory uncertainty. This political dynamic encourages short term strategies on the part of U.S. automakers as they exploit policy loopholes or develop marketing campaigns around en vogue technologies. This is not a strategy that creates long term shareholder value.

The auto industry is not well served by weak and outdated regulations, which only perpetuate regulatory uncertainty, as the need to address rising GHG emissions and oil consumption is intensifying on Capitol Hill. Moreover, this political dynamic encourages short term strategies on the part of U.S. automakers as they exploit policy loopholes or develop marketing campaigns around *en vogue* technologies. This is not a strategy that creates long term shareholder value. We believe it is better for the industry, and for investors, for Washington to develop a clear, coherent and long term regulatory path for the industry to reduce oil consumption. Otherwise, investors might be exposed to a sudden political urgency in Washington to deal with climate change and energy security that could further add to Detroit's woes.

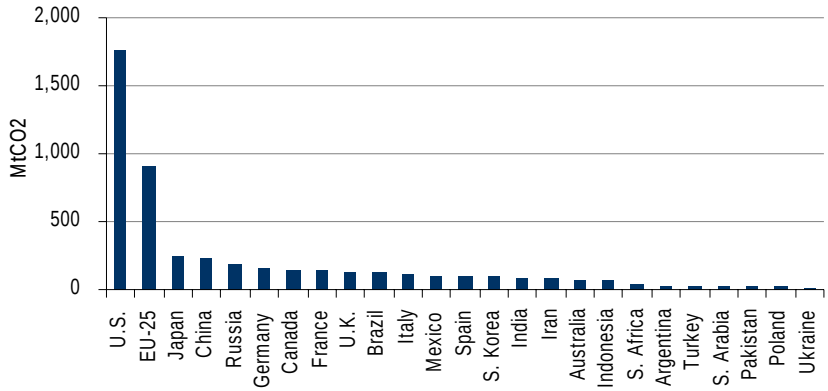
While most industrialized countries are taking steps to reduce GHG emissions under the "Kyoto Protocol," the United States, which withdrew from the Kyoto agreement in 2001, has done little to respond to climate change. However, this appears to be changing. There seems to be no end to the number of climate-related bills being introduced in the current Congress. Nine Northeastern and Mid-Atlantic States have adopted an agreement to cap carbon emissions from utilities; California passed AB 32, regulating stationary GHG emissions in the state in addition to the existing regulatory requirements on transportation GHG emissions. Twenty-two states require utilities to obtain a percentage of the power they sell from renewable sources, and more than 200 U.S. cities have adopted programs to reduce GHG emissions.

U.S. companies are also beginning to shift their political position; many Fortune 500 companies have announced that they favor mandatory federal regulation of GHGs. At a Senate hearing in April 2006, representatives of companies such as General Electric, Wal-Mart, Duke Energy, and Exelon told Senators it was time to move forward with climate legislation – they would prefer to know the rules soon, rather than be surprised by sudden political urgency.

There is little chance that the current Administration will act on climate change legislation, but debate on Capitol Hill has shifted from *whether or not* policies should be enacted to *when and in what form*.

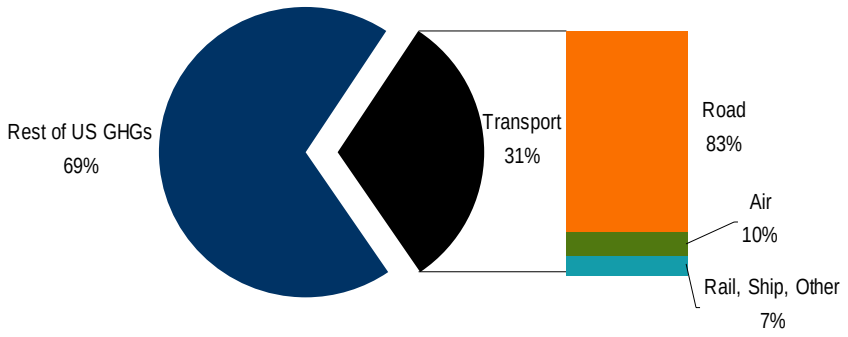
There is little chance that the current Administration will act on climate change legislation, but debate on Capitol Hill has shifted from *whether or not* policies should be enacted to *when and in what form*. It is likely that that the debate in Washington will intensify over the next two years, especially on the back of the emerging patchwork of state programs, which in the absence of federal leadership increases regulatory complexity. While federal legislation would almost certainly begin with modest reductions applied to a few sectors of the economy, modest reductions will not stabilize the global climate. In order to stabilize GHGs in the Earth's atmosphere at a manageable level, most estimates put the required global emissions reductions at approximately 60% from "business as usual" by 2050, and more than 80% over the long term. Given that CO_2 emissions from the U.S. transport sector are approximately double those of the second largest regional emitter, the EU, (see Chart 3), any meaningful action to reduce global transport-related CO_2 emissions will require U.S. participation. In the U.S., the transport sector comprises roughly 30% of aggregate CO_2 emissions and of this total, road-based CO_2 emissions comprise 80% (see Chart 5). If we are to stabilize CO_2 emissions, significant reductions will need to come from reduced oil consumption in trucks and automobiles.

Chart 4: Relative Country Emissions from Transport Sector



Source: Navigating the Numbers, WRI 2005.

Chart 5: U.S. Transport Sector GHG Emissions



Source: World Resources Institute

Below, we look at the evolving regulatory framework as it pertains to vehicle fuel efficiency standards as well as stimulating biofuels as an alternative to gasoline. Moreover, we highlight policy issues for investors to watch in 2007 that can impact the auto industry.

Because CO_2 emissions are directly proportional to oil consumption, it is difficult to separate policies motivated by climate change concerns from those motivated by energy security benefits.

Update on global fuel efficiency regulations

Because CO_2 emissions are directly proportional to oil consumption, it is difficult to separate policies motivated by climate change concerns from those motivated by energy security benefits. Regardless of the motivation, these policies place pressure on the industry to produce vehicles with higher fuel economy and lower emissions. This will stimulate demand for cleaner technologies and fuels as companies begin to compete within these new parameters.

However, since our last report titled *Energy Security and Climate Change: Investing in the Clean Car Revolution* (June 2005), we have seen mixed results on progress towards better fuel efficiency. In some regions, there has been some retrenchment around CO_2 standards (e.g. EU and Canada), while others have made strides forward in terms of new regulations (e.g. China) or restructuring of existing regulations (e.g. US). While the stringency of these targets is clearly important from a competitive perspective, how they are structured can also influence competition in the industry.

Summary of auto GHG or fuel efficiency Standards by region/country

European Union

In March 1998, the auto industry group ACEA and the European Commission agreed to the "ACEA Agreement," a collective undertaking by the European automobile manufacturers association and its members to voluntarily reduce the carbon dioxide (CO_2) emissions rates of vehicles sold in the European Union. Specifically, the agreement established industry-wide targets for average vehicle emissions from new vehicles sold in Europe to reach 140 gCO_2/km by 2008, with the ultimate objective of 120 gCO_2/km by 2012. In addition, an intermediate target range of 165-170 gCO_2/km was established for 2003 to monitor the industry's progress towards the 2008 target.

The agreement covers all vehicles produced or imported into the EU by member companies (BMW, DaimlerChrysler (DC), Fiat, Ford, GM, Porsche, PSA Peugeot

Citroën, Renault, and VW Group). The Korean Automobile Manufacturers Association (KAMA), which includes Daewoo, Hyundai, Kia, and Ssangyong, and the Japanese Automobile Manufacturers Association (JAMA), which includes Daihatsu, Honda, Isuzu, Mazda, Mitsubishi, Nissan, Subaru, Suzuki, and Toyota, have also joined the agreement. All together, vehicles sold by companies under the ACEA agreement make up nearly 90% of total EU vehicle sales.

In 2005 the European Commission launched the CARS 21 (Competitive Automotive Regulatory System for the 21st Century) Group.

CARS 21 concluded that the responsibility for CO2 emissions reduction in the road transport sector cannot lie exclusively with the auto industry. The Group wishes to see contributions from vehicle manufacturers, but also from oil/fuel suppliers, repairers, consumers, and public authorities as well.

[1] This Group convened key stakeholders in the automotive sector to conduct a comprehensive analysis of the competitiveness drivers of the European automotive industry in order to make recommendations for the best regulatory framework. At the end of the analysis and consultation, the Group adopted a 10 year roadmap for a competitive EU auto industry, from which the Commission will develop policy proposals. CARS 21 recognizes the importance of environmental considerations to the competitiveness of the EU auto industry. Therefore, it recommends proposals to reduce pollutant emissions from light and heavy duty vehicles. However, CARS 21 concluded that the responsibility for CO_2 emissions reduction in the road transport sector cannot lie exclusively with the auto industry. The Group wishes to see contributions from vehicle manufacturers, but also from oil/fuel suppliers, repairers, consumers, and public authorities as well. CARS 21 recommends an "integrated approach" with participation from all the relevant stakeholders to achieve the 120 gCO_2/km target. The approach would include vehicle technology, alternative fuels, eco-driving, taxation, congestion avoidance, and improved consumer information. As well, it recommends paying special attention to the role of biofuels, particularly second generation fuels like cellulosic ethanol, in road transport emissions reductions.

In August 2006 the European Commission released a Monitoring Report documenting automakers' progress towards achieving the emissions targets through 2004.[2] The Commission concluded that the progress to date is not satisfactory. Emissions from newly registered cars in the EU-15 were 161 gCO_2/km in 2004 - having achieved the intermediate target range for 2003. However, according to the report, automakers need to "substantially increase their efforts" and improve fuel efficiency by more than 3% annually in order to reach the target.

Only five of the top 20 car brands in Europe (Fiat, Citroen, Renault, Ford and Peugeot) are on track to meet these voluntary targets, according to environmental lobby group Transport & Environment, based in Brussels (FT, 25 October 2006).

Canada

In April 2005, Canada announced a voluntary agreement with the auto industry to reduce GHG emissions from the new passenger vehicle fleet by 5.3 million metric tons by 2010 – equivalent to an overall fuel efficiency improvement of 25% from 2005 levels. According to the agreement, if the industry did not meet this target, legislation would be enacted.

[1] European Commission, 2006. *CARS 21: A Competitive Automotive Regulatory System for the 21st Century - Final Report.* Brussels.

[2] European Commission, 2006. *Communication from the Commission to the Council and the European Parliament: Implementing the Community Strategy to Reduce CO2 Emissions from Cars: 6th Annual Communication on the Effectiveness of the Strategy.* Brussels. Aug 24.

However, in January 2006, the Conservative party was elected, and since then Canada's stance on climate issues has been somewhat uncertain. Prime Minister Stephen Harper has declared that Canada's emissions reduction targets under the Kyoto Protocol, negotiated by a previous administration, are infeasible. Since then, Canada has made only limited efforts to address climate issues although public opinion has forced a level of engagement that the Harper administration may not have otherwise sought. Of particular interest is the administration's attempt to force the auto industry to make emissions cuts. However, despite rumors that the Canadian government would impose tough emissions standards - similar to California's new regulations - on the auto industry in eastern Canada, in September officials backed down slightly and told auto executives that new regulations would be negotiated over the next three years.

In fact, in October 2006, the Harper administration released its Clean Air Act, draft legislation that would form the centerpiece of its "made-in-Canada" environmental agenda. This Act does not mention Canada's participation in Kyoto, has no short term targets, and yet seeks to halve Canada's overall emissions by 2050. The legislation would not address emissions from the auto sector. However, Environment Minister Rona Ambrose announced that in 2007 Ottawa will synchronize its vehicle emissions standards with U.S. EPA's standards, and will establish new rules for car and truck efficiency by 2010.

Japan

The Japanese government established mandatory fuel consumption standards to reduce fuel consumption by 23% by 2010 from a 1995 baseline. The industry is well on track to meet these regulations. Nearly all of the fuel economy improvements required have already been made, particularly from the largest Japanese OEMs. In general, Japan is likely to lean heavily on purchases of GHG offset credits in global carbon markets to meet their Kyoto targets. Therefore we do not expect much more activity related to vehicle fuel efficiency or GHG targets motivated by climate change concerns.

The United States

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The oldest regulatory regime to reduce the oil consumption of passenger vehicles is the Corporate Average Fuel Economy (CAFE) program in the United States. This program establishes two fleet-wide average fuel economy standards - one for cars (27.5 mpg) and one for light-duty trucks (22.2 mpg by 2007). This program has remained largely unchanged since the late 1970s, but in March 2006 the Department of Transportation revised the CAFE structure for light-duty trucks. This category includes the vehicles that became increasingly popular through the 1990s: the minivan and the SUV. These vehicles are now subject to a fuel economy standard based on the size of each model, or its "footprint"[3], rather than having a single standard for the entire class. The smaller SUVs will now be held to efficiency standards that more closely resemble the standards for passenger vehicles (roughly 25-27 mpg, up from 21.6 in 2006), while the larger SUVs are still held to lower standards. Moreover, the standards are now extended to SUVs weighing up to 10,000 lbs. which includes models that were previously exempt from any CAFE requirements. The new regulations will be phased in through 2011, allowing auto manufacturers time to adjust, but the Department of Transportation estimates that the new system will increase overall fuel efficiency for trucks by 2% per year and will save nearly 11 billions of gallons of fuel.[4]

[3] The vehicle's wheelbase multiplied by its track width.

[4] http://nhtsa.gov/staticfiles/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/2006FinalRule.pdf

In the absence of federal action to address climate change, several states have adopted policies to limit GHG emissions within their jurisdictions. Most notable to the auto industry is California. In late 2004, the California Air Resources Board (CARB) approved a rule to reduce GHG emissions from passenger vehicles in California by approximately 30% (see Table 1)

On December 7, 2004 this law (also known as the Pavley law, after its sponsor in the California Assembly) was challenged in a federal lawsuit filed by the Alliance of Automobile Manufacturers, the Association of International Automobile Manufacturers, and some California auto dealers.

California and other U.S. states

In the absence of federal action to address climate change, several states have adopted policies to limit GHG emissions within their jurisdictions. Most notable to the auto industry is California. In late 2004, the California Air Resources Board (CARB) approved a rule to reduce GHG emissions from passenger vehicles in California by approximately 30% (see Table 1). Maine, Massachusetts, New York, Vermont, Connecticut, New Jersey, Rhode Island, Oregon, Washington State, and Pennsylvania have all indicated they will follow CARB's rule pending the result of the lawsuit mentioned below. Together with Canada, this constitutes roughly one third of the North American vehicle market.

On December 7, 2004 this law (also known as the Pavley law, after its sponsor in the California Assembly) was challenged in a federal lawsuit filed by the Alliance of Automobile Manufacturers, the Association of International Automobile Manufacturers, and some California auto dealers. The lawsuit stipulates that since the federal government has sole authority to regulate fuel economy, California cannot regulate GHG emission from automobiles as CO_2 emissions from cars are largely a byproduct of their fuel economy. The lawsuit is still in progress and is likely to go to trial in Spring 2007 in federal court in Fresno, CA.

In a similar case filed in September 2006, California Attorney General Bill Lockyer filed a lawsuit against six of the world's largest automakers: Chrysler, General Motors, Ford, Toyota North America, Honda North America, and Nissan North America. Filed on behalf of the People of the State of California, the complaint seeks to hold manufacturers liable for the damages caused by their vehicles' GHG emissions. California alleges that GHGs from the defendants' vehicles have contributed significantly to global warming and have cost the state billions of dollars in addressing impacts such as beach erosion and increased ozone pollution. Lockyer charges that automakers have created a "public nuisance" by producing "millions of vehicles that collectively emit massive quantities of CO_2," and he is therefore seeking "tens or hundreds of millions of dollars" in damages for past, current, and *future* contributions to climate change. At this point, it is too soon to tell how this case will develop.

The fate of these legal challenges is tied to ongoing litigation over the EPA's classification of CO_2 as a "pollutant" under the Clean Air Act. In *Massachusetts vs. EPA*, California and 11 other states joined environmental groups in an attempt to compel the EPA to curb CO_2 and other GHG emissions. The EPA maintains that it has no authority to regulate CO_2, and if it did, regulation would be inappropriate. This lawsuit is currently being heard by the U.S. Supreme Court, which will likely render a decision at the end of the next session in June 2007.

Table 1: California Air Resources Board Approved Standards
CAFE equivalent by vehicle category (mpg)

Year	Cars and trucks less than 3,750 lbs	Trucks weighing 3,751 to 10,000 lbs
2009	28	20
2010	30	21
2011	33	23
2012	38	25
2013	39	25
2014	40	25
2015	42	26
2016	43	27

Source: Feng An and World Resources Institute, Pew Center for Global Climate Change
Note: The California Standards are based on CO_2 emissions, this chart indicates the MPG that would be required to meet these standards

Not only is China seeking to reduce the magnitude of these energy security issues, but it also wishes to address growing congestion and local air pollution problems.

China

The new Chinese fuel economy standards are an ambitious effort on the part of the government to reduce oil consumption from personal vehicles in China, a growing contributor to China's heavy dependence on foreign oil. China recently overtook Japan to become the world's second largest oil consumer, behind the US, and its rapid consumption growth continues. China's oil production is not growing as rapidly as its consumption, making China the third largest net importer of oil, after the U.S. and Japan. Not only is China seeking to reduce the magnitude of these energy security issues, but it also wishes to address growing congestion and local air pollution problems.

In China the sale of privately owned family vehicles rose at a CAGR of 37% from 2000 to 2005. This has caught the attention of the Chinese government which mandated fuel efficiency requirements for all automobiles sold in China in 2004. These new standards are weight-based and will be implemented in two phases (the first in 2005 and the second in 2008), with separate standards for manual and automatic transmissions. Each vehicle sold in China will be required to meet the standard for its weight class. Overall, these standards are more stringent than the current U.S. CAFE program.

The Chinese have enacted several other measures targeting fuel use. In March 2006, the government announced plans to increase the tax on "gas guzzling vehicles": the tax rate will increase to 20% from the current rate of 8%, while the tax on vehicles with small engines will decrease. As well, Beijing lifted a decade-old measure that banned small vehicles in the capital and called for a nationwide repeal of restrictions on small vehicles, which had been in place in more than 80 Chinese cities. While this ban was originally intended as a safety measure, it has been lifted in the interest of reducing oil consumption. Finally, in May 2006, China allowed the price of petrol and diesel to increase by up to 12%.

What investors should watch out for on fuel efficiency regulations in 2007

For investors, there are three main regulatory issues on the fuel efficiency front emerging in 2007 that are important to watch. First are the legal issues around classifying CO_2 as a pollutant. If the Supreme Court allows CO_2 to be classified as a pollutant under the Clean Air Act, this will have profound implications for all GHG-intensive industries, particularly the auto sector. This decision is inextricably tied to the lawsuit brought by the industry against the state of California and therefore could influence the future of the Pavley law as well.

The second overarching issue that investors should track is how governments integrate the auto sector in climate regulatory strategies. Over the next 12 months, this is particularly salient in the EU and Canada, though over the medium term is also true of the U.S., as the debate in Congress over what to do with climate policy heats up.

The third area to monitor is clearly the California regulations and lawsuits. California has a long history of setting national trends on environmental legislation, and politicians, including Governor Schwarzenegger, appear to have taken on climate change as the next iteration of this leadership. While it remains unclear how CARB will specifically implement the various GHG requirements that that have been signed into law, what is clear is that these requirements are, in fact, law. Lawsuits or not, the auto industry will likely be impacted by this regulatory trend.

A new regulatory twist in the U.S.: promoting biofuels

While there appears to be a great deal of activity on the fuel efficiency front, on balance, there has been no real progress over the past year towards meaningful reductions of emissions and fuel consumption in the U.S. or indeed around the world. That being said, there has been more activity on stimulating alternative fuels in the U.S.

While there appears to be a great deal of activity on the fuel efficiency front, on balance, there has been no real progress over the past year towards meaningful reductions of emissions and fuel consumption in the U.S. or indeed around the world. That being said, there has been more activity on stimulating alternative fuels in the U.S.

Since the 1970s policymakers, think-tanks, and industry advocates have proposed policies to promote the development of the biofuels industry, though with little notable success. Today, however, biofuel is back in vogue; in the Midwest and on Capitol Hill the fervor is particularly intense.

There are many different policy proposals currently floating around Congress that relate to biofuels. Many of these proposals aim to accelerate the market penetration of biofuels, promoting infrastructure development by adding E85 pumps, encouraging FFV production, or promoting production capacity.

Table 2: Major U.S. Congressional Bills Related to Biofuels

Policy Name	Sponsors	Demand side measure	Supply side measure
S2817: Biofuels Security Act of 2006	Harkin, Lugar, Johnson, Dorgan, Biden + 1 cosponsor	■ FFV mandate: 100% by 2016 ■ Narrow "dual-fuel loophole"	■ Distribution mandate ■ Increase and extend the RFS
S1994: Fuel Security and Consumer Choice Act	Harkin, Lugar, Obama + 1 cosponsor	■ FFV mandate: 100% in 10 yrs ■ Narrow "dual-fuel loophole"	
HR4409/S2025: Vehicle and Fuel Choices for American Security Act	Bayh + 27 cosponsors (supported by NRDC and Set America Free Coalition)	■ Amend Internal Revenue Code to allow manufacturing tax credit for advanced technology vehicles ■ Infrastructure tax credit	■ Amend mandate for cellulosic (sooner) ■ Increase Energy Policy Act of 2005 appropriation to bioenergy R&D
S2446: American Fuels Act of 2006	Obama, Lugar + 1 cosponsor	■ Tax credit of $100/vehicle for production of FFVs that are NOT counted toward meeting CAFE	■ Tax credit for E85 sales ■ Tax credit for cellulosic ethanol ■ RFS for biodiesel

Source: World Resources Institute

The Energy Policy Act of 2005 (EPAct) included many such options: a renewable fuels standard, fuel tax incentives, flex-fuel vehicle tax incentives, production incentives and subsidies, incentives for infrastructure stimulation, government preferential purchasing for market guarantee, and funding for research and development as well as education and outreach. Proposals include tax incentives, FFV mandates, and FFV 'production incentives' (see Table 2). Senator Bayh's (D-IN) *Vehicle and Fuel Choices for American Security Act* asks for a manufacturing tax credit for advanced technology motor vehicles; Senator Obama's (D-IL) *American Fuels Act of 2006* would provide a tax credit of $100 per vehicle for the production of FFVs that are not counted toward the manufacturer meeting its CAFE requirements, meaning the production of vehicles beyond the artificial 1.2 mpg "bump" that the manufacturer gets to its CAFE ratings (explained in more detail on page 17, *Closing the CAFE/FFV Loophole*).

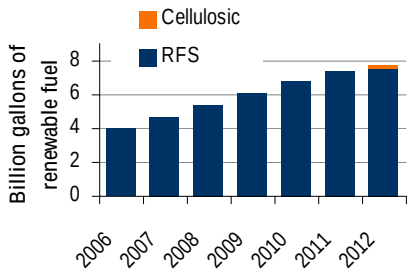
Encouraging the production of FFVs does not necessarily get you the energy savings or reduced emissions unless the new fuel is used – and that fuel is still available in only limited quantities. Conversely, increased production of biofuels does not become economic unless there is adequate consumer demand for alternative fuels from users of FFVs or biofuel vehicles.

Broadly speaking, these policies are either aimed at developing the supply of biofuels available for transport use (so called 'supply-side push') or are focused on encouraging the production of vehicles that can accept multiple fuels, i.e. FFVs (so called 'demand side pull'). This dual approach to regulation creates something of a 'chicken and egg' dilemma around biofuel policy. Encouraging the production of FFVs does not necessarily get you the energy savings or reduced emissions unless the new fuel is used – and that fuel is still available in only limited quantities. Conversely, increased production of biofuels does not become economic unless there is adequate consumer demand for alternative fuels from users of FFVs or biofuel vehicles.

Table 3: Primer on Biofuels

Biofuels for transport are combustible fuels made from organic matter, such as crops and agricultural residue, and can be used as motor fuel in pure form or as a blending component. They can be used as liquid fuels such as ethanol and biodiesel, or as gaseous fuels like biogas or hydrogen. Currently the consumption of biofuel is still quite low - ethanol accounts for less than 2% of U.S. transport fuel - but consumption, particularly of ethanol and biodiesel, is growing rapidly worldwide. Biofuels' many proponents believe that these fuels offer the potential to displace a significant amount of petroleum use and to bring widespread environmental and energy security benefits.
Biodiesel is used in compression ignition diesel engines in pure form, requiring minor engine modification, or up to a 20% blend with petroleum diesel (B20), which requires no vehicle modification. Biodiesel consumption is currently relatively low, but it is the fastest growing fuel in the U.S. In 2005, U.S. production grew to about 75 million gallons from 500,000 just six years earlier. Biodiesel can be made from many feedstocks, including primarily oil-seed crops, like canola, soybean, and sunflower. Organic waste materials, such as waste cooking oil or animal fats, can also be used. Today, the primary feedstock in the U.S. is soybean. The conversion technology is well-established and is not likely to change significantly in the future.
Ethanol, which can be used with regular gasoline, is particularly promising in the U.S. where diesel engines represent only a relatively small percentage of the vehicle fleet. It can be used as a fuel oxygenate, often replacing MBTE as it is phased out. Ethanol can be blended up to 10% without requiring engine modifications (E10). It can also be used in higher concentrations in the U.S., up to E85, a blend of 85% ethanol and 15% gasoline. This blend requires a "flexible-fuel" vehicle with slight engine modifications.
Ethanol, like biodiesel, can be derived from a variety of different feedstocks, by fermenting grains, cereals, sugar crops and other starches. The fermentation technology is well understood, as it is merely a modification of the process used to make moonshine during the Prohibition era.
Sugarcane is the feedstock of choice in Brazil, where ethanol now accounts for a significant portion of Brazil's non-diesel fuel. In the U.S. the primary feedstock is corn. The sugarcane-to-ethanol conversion process is more energy efficient than corn conversion; therefore Brazilian ethanol has lower well-to-wheels CO_2 emissions as well. This demonstrates the variations among different kinds of ethanol: the conversion process, the available feedstocks, the conversion facility's power source - all these factors influence the degree of benefit that will be derived from ramping up ethanol production.
Cellullosic materials, including trees and grasses such as willow and switchgrass, are another feedstock that can also be converted into ethanol. Cellulosic is often called 'second generation ethanol' as the technology is still under development, but it is widely hoped that cellulosic will make an important contribution to the U.S. fuel mix in the medium- to long- term. The conversion process is more complex than simple fermentation: the cellulose must first be converted to fermentable sugar using enzymes. This technology is under development, and the process is still quite capital intensive. Despite these barriers, however, cellulose is widely believed to be the future of the ethanol industry, because it offers several benefits over corn-based ethanol.
Preliminary analyses indicate more substantial environmental benefits from cellulosic ethanol compared to grain-based ethanol. Corn is an energy intensive and soil depleting crop, while cellulosic can be produced from local crops like switchgrass that require less fertilizer and are remarkably easy to grow and maintain between harvests. Reducing fertilizer consumption of the feedstock crop will reduce well-to-wheel GHG emissions of the fuel and improve water quality in surrounding areas. Moreover, cellullosic feedstocks also contain lignin which, while not able to be converted to ethanol, can be burned to power the production facilities, further reducing the industry's environmental impact. Estimates place net GHG emissions reductions from production and use of cellulosic ethanol somewhere between 70% and 90% of the emissions from conventional gasoline.

Chart 6: U.S. Renewable Fuels Standard



Source: World Resources Institute

The primary industry promotion measure is in the EPAct in the form of a Renewable Fuels Standard (RFS). The RFS requires that gasoline sold by refiners, blenders, and importers contain an increasing amount of renewable fuel, specifically ethanol (including cellulosic) and biodiesel. The requirement starts at 4 billion gallons in 2006 and increases each year to 7.5 billion gallons in 2012. From then on, the minimum applicable volume of renewable fuel in gasoline will grow in proportion with gasoline production. The RFS requirements also include cellulosic ethanol – in fact, through 2012, one gallon of cellulosic or waste-derived ethanol counts for 2.5 gallons of the RFS volume. By 2012, cellulosic ethanol's contribution to the fuel mix must be at least 250 million gallons (see Chart 6).

Lawmakers are also encouraging the production and purchase of FFVs. The *Energy Policy Act of 2005* already offers a tax credit for the purchase of new alternative vehicles, while Senator Bayh is proposing to expand this credit by terminating the limitation on the number of advanced vehicles that can qualify for the credit. Two House bills, Rep. Meehan's (D-MA) *Green Vehicles Promotion* Act (HR5703) and Rep. Saxton's (R-NJ) HR3273, propose a tax deduction for the purchase of a new FFV, and Meehan's bill would even include credit for the costs incurred in the conversion of *any* motor vehicle into an FFV. In addition to these proposals, several lawmakers want to mandate flex-fuel engines. In Senator Harkin's (D-IA) *Biofuels Security Act of 2006* there is a proposal to mandate the production of FFVs.

E85 requires significant investment in an alternative distribution infrastructure, as well as requiring a vehicle fleet that can run on high blends of ethanol, in other words, FFVs.

Lower blends of ethanol, like E10, on the other hand, offer the benefits of biofuels, albeit on a smaller scale, without requiring new infrastructure.

There are two different approaches to biofuels promotion that are prevalent in the U.S. today. These reflect two different means of ethanol consumption that are compatible with today's vehicle fleet: low level blends (e.g. E10) and E85. On one hand, E85 offers the potential for the large-scale benefits touted by ethanol proponents: reduced GHG emissions, petroleum displacement and opportunity to take advantage of ethanol's high octane rating. However, E85 requires significant investment in an alternative distribution infrastructure, as well as requiring a vehicle fleet that can run on high blends of ethanol, in other words, FFVs. These massive investments need to be justified based on the scale of potential benefits. Lower blends of ethanol, like E10, on the other hand, offer the benefits of biofuels, albeit on a smaller scale, without requiring new infrastructure. Some states have begun enacting blending mandates for ethanol and biodiesel, primarily E10 and B20, which do not require new pumps or special vehicle technology.

However, these alternative policy approaches to ethanol penetration appear to be becoming more bifurcated. In fact, there is a growing disconnect between the current federal strategy, based on E85 and FFVs, and the efforts being pursued by states that are enacting low-level blending mandates. Minnesota is leading this trend: it already requires E10 blending, and passed legislation in 2005 that will require E20 blending by 2013. Governor Tim Pawlenty has called on every state to begin using E10 by 2010 – some are following his lead (see Table 4). Hawaii was the second state in the U.S. to enact an ethanol blending mandate, and Missouri has mandated E10 by 2008. Montana has mandated E10, but the legislation only kicks in after local production reaches a certain minimum level. Louisiana has a similar provision: a 2% mandate for both ethanol and biodiesel, once certain pre-conditions are met that trigger enactment of the legislation. Colorado's legislature had also passed RFS legislation, but it was vetoed by the governor.

Table 4: Current and Proposed State Biofuel Policies

State	Level	Date	Enacted?
Colorado	E10 for 75% of fuel Nov-April	2007	Passed but vetoed
Hawaii	10%	by 2010	Yes
	15%	by 2015	
	20%	by 2020	
	E10	Current	
Idaho	E10	Undecided	No
Illinois	10% of total sales	by 2008	No
	15% of total sales	by 2012	
Iowa	25% of total sales	by 2020	Yes
	E10	by 2010	No
	B2		
Louisiana	2% of total sales (ethanol and biodiesel)	When state demonstrates sufficient local production	Yes
Minnesota	B2	Current	Yes
	E10	Current	
	E20	by 2013	
Missouri	E10	by 2008	Yes
Montana	E10	When local production reaches minimum level	Yes
Nebraska	E10	Undecided	No
	E10	by 2009	No
	B2		
Washington	B2	Current	Yes
	E2	by 2008	
	E10	When state demonstrates sufficient local production	No
	B5		

Source: World Resources Institute adapted from Green Car Congress

This trend towards state-based blending mandates could result in different mandated requirements across the country, which could drive up the costs for refiners and blenders. Moreover, if the federal government is putting resources behind E85 and wants to steer investment into related infrastructure and technology development, there could emerge a considerable policy mismatch which would only increase the regulatory uncertainty currently facing the industry.

What investors should watch out for on biofuel policies in 2007

While it remains to be seen how the regulatory path around biofuels will unfold, below we highlight issues that warrant investor attention due to their potential impact on the automotive industry.

Closing the CAFE / FFV loophole

The Alternative Motors Fuels Act, on the books since 1988, was originally intended to promote alternative fuels in order to reduce oil consumption. Under the Act, automakers can get credit, capped at 1.2 mpg, toward their CAFE requirements for dual-fuel vehicles (DFV), including FFVs. Lawmakers devised a formula (see next page) for calculating an adjusted fuel economy rating for FFVs that would take into account the benefits derived from operating the vehicle on alternative fuels, and therefore would not penalize the manufacturers under CAFE for the reduced efficiency that results from the use of biofuels. In calculating the DFV fuel economy ratings for CAFE, the government only counts the 15% of E85

that is gasoline, resulting in a fuel economy rating for FFVs that is more than 65% higher than the actual fuel economy of the vehicle. This provision was intended to stimulate the use of alternative fuels and reduce national oil consumption; however, the formula assumes that FFVs are operated on alternative fuels 50% of the time, when, in reality, they are fueled with regular gasoline more than 99% of the time.

Figure 1: CAFE fuel economy formula for FFVs

$$\frac{1}{\left(\frac{0.5^*}{\text{Fuel economy (mpg) on gasoline}}\right) + \left(\frac{0.5^*}{\frac{\text{Fuel economy (mpg) on E85}}{0.15^{**}}}\right)}$$

*This figure represents the assumption that the vehicle is fueled 50% of the time by gasoline and 50% of the time by E85.

** This figure represents the amount of gasoline in E85.

Source: World Resources Institute based on US Code 49 Sec 32905 Manufacturing Incentive for Alternative Fuel Automobiles

While the intent of the rule could be justified, the assumptions used in the formula have a perverse effect; increasing fuel consumption and emissions.

However, this formula does not serve to reduce oil consumption as it incorrectly identifies FFVs as having a better fuel economy rating, which does not reflect actual fuel consumption. While ethanol does have a lower heat content and lower mileage, cars that are destined to run on ethanol would penalize a manufacturer's CAFE. Therefore while the intent of the rule could be justified, the assumptions used in the formula have a perverse effect; increasing fuel consumption and emissions.

Today there are several proposed bills that would narrow this FFV loophole. Senator Harkin has two such bills: the *Biofuels Security Act of 2006* and the *Fuel Security and Consumer Choice Act*, and Representative Markey (D-MA) has proposed a bill in the House with the same provisions (HR4673). These proposals suggest altering the formula used to arrive at the inflated fuel economy ratings for FFVs so that they more accurately reflect reality.

E10 or E85?

One major challenge to the expansion of E85 is the lack of distribution infrastructure.

One major challenge to the expansion of E85 is the lack of distribution infrastructure. E85 is hydrophilic (it absorbs water so leads to pipe corrosion and fuel contamination) and solvent and therefore cannot use the existing petroleum distribution infrastructure. Thus it requires an entirely new transport infrastructure.

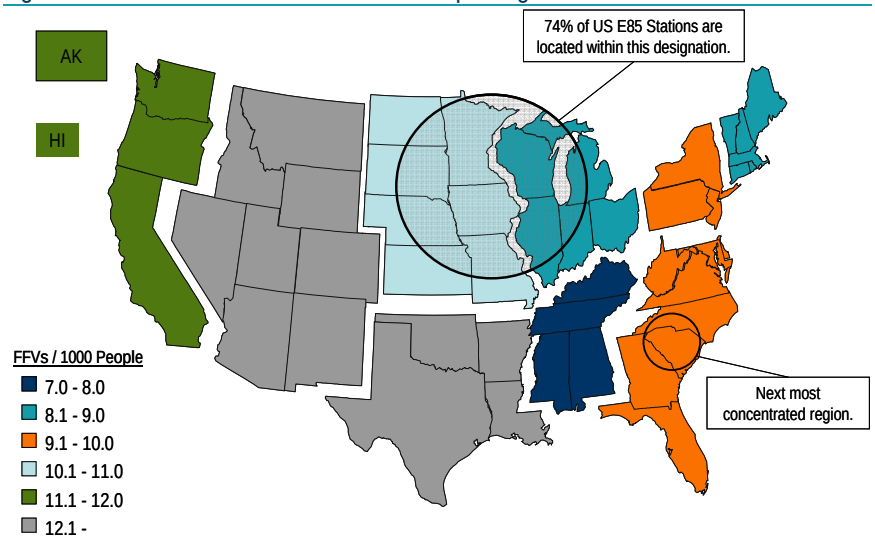
Since ethanol cannot currently be piped to their destination, they are generally transported from the production facility to the blending facilities by rail, truck, or barge. Once biofuels are added to the gasoline blend, the mixture is delivered to the station by truck. This is true for all blends of ethanol.

While E10 requires no new station equipment for distribution, to dispense E85 a station must have dedicated biofuels distribution infrastructure, including either new or extensively cleaned tanks, valves, filters, hoses, and nozzles.

Where the blending levels (E10 and E85) differ is in the end-use distribution infrastructure issue. While E10 requires no new station equipment for distribution, to dispense E85 a station must have dedicated biofuels distribution infrastructure, including either new or extensively cleaned tanks, valves, filters, hoses, and nozzles. None of these may be made with aluminum, a common material in standard petroleum distribution systems, since the biofuel would dissolve the aluminum, which would damage vehicle engines, including those designed for E85. This is further complicated by the mismatch between the federal and state

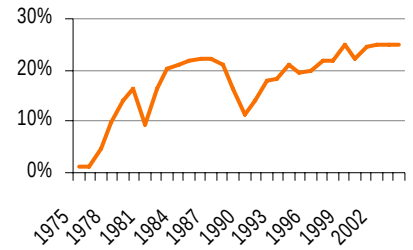
penetration strategies. How this unfolds will impact how ethanol is used by consumers as well as how automakers respond to this new market. Figure 2 looks at how this policy gap is exacerbated by the current sales concentrations of FFVs versus the supply of E85 stations.

Figure 2: E85 Stations vs. Flex-Fuel Vehicle Use per Region



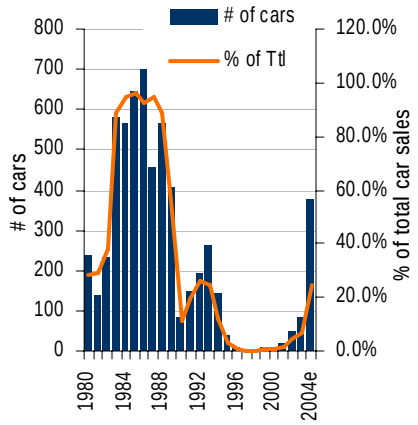
Source: World Resources Institute, based on , AEO Supplement, EIA; US DOE Energy Efficiency and Renewable Energy, Alternative Fuels Data Center

Chart 7: Share of Ethanol in Brazilian Gasoline



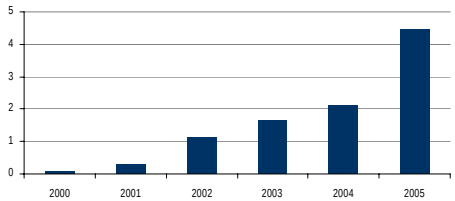
Source: Bradley and Baumert "Growing in the Greenhouse: Protecting the Climate by Putting Development First". World Resources Institute. 2005

Chart 8: Ethanol-fueled Vehicle Sales 1980-2004



Source: Bradley and Baumert "Growing in the Greenhouse: Protecting the Climate by Putting Development First". World Resources Institute. 2005

Chart 9: Ethanol share of total passenger car sales in Sweden, 2001-05



Source: BilSweden.

Table 5: Brazil's Experience with Biofuels

Brazil's 30 years of experience with biofuels warrants mention because it is often touted as the global model of alternative fuels. In the 1970's international commodities markets were placing a significant strain on Brazil's economy: the oil crisis had dramatically increased the price of oil, harming Brazil's trade balance, and the international market price for sugar, one of Brazil's chief exports, was falling rapidly, prompting the sugarcane industry to seek alternative sources of revenue. In 1975, in order to address both of these challenges, the government decided to encourage the production of alcohol for transport to replace gasoline. In Brazil, the government controls the distribution and marketing of gasoline to a much greater degree than in the US so ethanol promotion was primarily achieved through mandatory pump installation and blending mandates.

Today ethanol accounts for a significant portion of Brazil's fuel mix, but the implementation of the program was not without setbacks. Distribution and pricing were not problematic due to government control and low oil prices throughout the 1980's. However, one of the major setbacks in the program involved the vehicles. In 1979, vehicles running on pure (or "neat") ethanol entered the market. These so-called 'gasohol' cars became quite popular. However, in 1989 an ethanol shortage seriously dented consumer confidence in the ethanol industry. During the 1990's when oil prices were low and government support for the ethanol program was waning, the pricing advantage that ethanol enjoyed virtually disappeared, and the sale of neat ethanol vehicles dropped to almost zero. In 2001, economics began to swing in ethanol's favor again, and interest in ethanol vehicles began to rise with the arrival of FFVs as this allowed consumers to switch fuels depending on price.

In terms of environmental impact, the use of ethanol in Brazil has saved an estimated 600 Mt CO_2 over the lifetime of the program – roughly equivalent to annual CO_2 emissions of the United Kingdom. Air quality has generally improved, and biofuel manufacture produces around 1350 GWh per year of surplus electricity, a figure that is rising fast as technology improves. The savings in oil imports and associated debt servicing have saved the country around $100 billion in hard currency. Brazil's external debt would be 50% higher today were it not for ethanol, and over one million jobs in rural Brazil depend on ethanol and sugar production.

Promoting biofuels in Europe as well

The EU has ambitious targets for biofuels

The EU, which is today the world's largest producer of biodiesel, targets a market share for biofuels of 5.75% by 2010 and 20% by 2020. The current market share for biofuel is estimated at 1.4%. Experts estimate the annual investment in bioenergy in Europe at more than EUR2bn.

Ford of Europe, Volvo and Saab have led the movement to offer flex fuel vehicles in Europe. Renault and PSA will begin offering FFVs in 2007. While all PSA diesels already can run using 30% biofuels, by 2009 Renault wants half of its engines in Europe to have the ability to run on a mixture of gasoline and bioethanol and that all its diesels can run using 30% biodiesel.

Sweden leads European bioethanol market

Sweden is leading Europe in supporting the growth of bioethanol as an eco-friendly renewable fuel. This is part of the Swedish government's strategy to free the country of dependency on oil by 2020. Sweden makes buying an E85 car attractive by offering tax and insurance incentives plus free city parking for flex fuel cars.

In December 2005, ethanol car registrations climbed to record highs in Sweden at 8.7%. The fleet at the end of 2005 was about 25K cars with ethanol running capacities.

Currently, 80% of Focus and C-Max sold by Ford in Sweden have a flex fuel powertrain. FFVs account for 40% for Ford unit sales in Sweden. More than 80% of the 9-5s that Saab sells in Sweden run on E85.

Direct biofuel plays

ML Oil team estimates that European biofuels production would need to grow by about 35% per annum to meet the 2010 target, potentially making it a US$ 12bn a year industry by the end of the decade. Our colleagues identifies the following companies as direct plays on biofuel.

Table 6: Constituents of ML Renewable Energy Index, Biofuel plays

Abengoa	Spain	Ethanol
Pacific Ethanol	US	Ethanol
Cosan	Brazil	Ethanol
Biopetrol	Germany	Biodiesel & glycerol
Verbio*	Germany	Biodiesel & Ethanol
Crop Energies*	Germany	Ethanol
Verasun Energy	US	Ethanol
Aventine Renewable Energy	US	Ethanol

* Recent IPOs. Source: ML.

Consumer demand and automakers' resulting powertrain strategies

In this section we illustrate the impact of the combination of consumer demand and regulation on new vehicle demand in the U.S. Consumer demand appears to be the dominant factor and will likely be the major driver of future powertrain strategies of the U.S. Big Six (GM, Ford, Toyota, DaimlerChrysler, Honda, and Nissan). However, regulation will be a substantial influence.

As discussed in the previous section, the uncertainty over which new powertrain technology will fulfill vacillating regulatory requirements while simultaneously appealing to consumers is a difficult question to answer with any level of certainty. In response, most OEMs, specifically the U.S. Big Six are pursuing a number of strategies including more efficient ICEs, diesels, hybrids, ethanol (biofuels), and fuel cells. Given the decades of massive capital invested in the traditional ICE engine, the majority of which has already been depreciated, this necessary incremental capital commitment is a burden with uncertain returns.

Chart 10: Line at a gas station, 6/15/79

Source: Library of Congress

Chart 11: OPEC I causes gas shortages

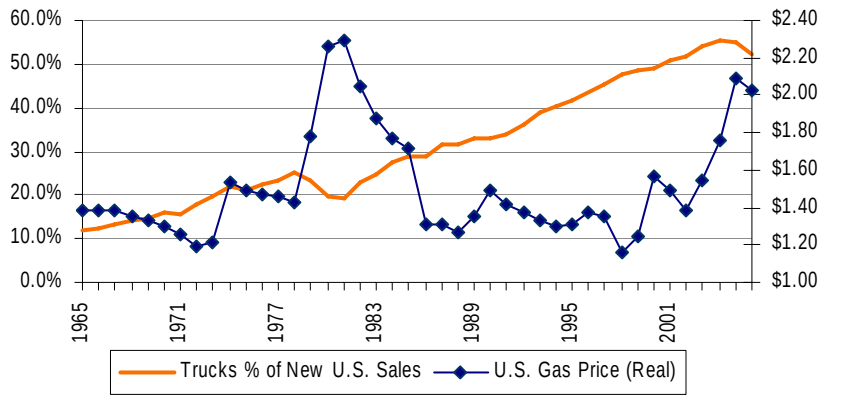
Source: United States Department of Energy

U.S. consumers' short term memory & demand

As discussed in the previous section, there have been government regulations for decades aimed at fuel economy for economic, environmental, and national security reasons, but consumer demand is a force that trumps regulation consistently in the U.S.

The fairly steady rise in gas prices in the last few years has enforced some discipline on demand, but the recent decline is disconcerting as the American consumer will likely revert to gas guzzling vehicles. We believe it is unlikely that there has been a true paradigm shift in consumer preferences to more efficient vehicles as many observers believe. The instances of an American consumer buying a tube TV versus a flat panel TV because it was a better economic decision; or a regular size soft drink versus a super-size because it was cheaper and healthier are almost non-existent; with autos this has materialized in the form of greater truck demand (Chart 12). Americans almost never chose to downsize unless financially forced to do so, but we may be entering such a period. It is this insatiable appetite for bigger, better, and faster that clouds the memory of the crises of OPEC I, OPEC II, and the Gulf War when gas was in short supply (Charts 10 &11).

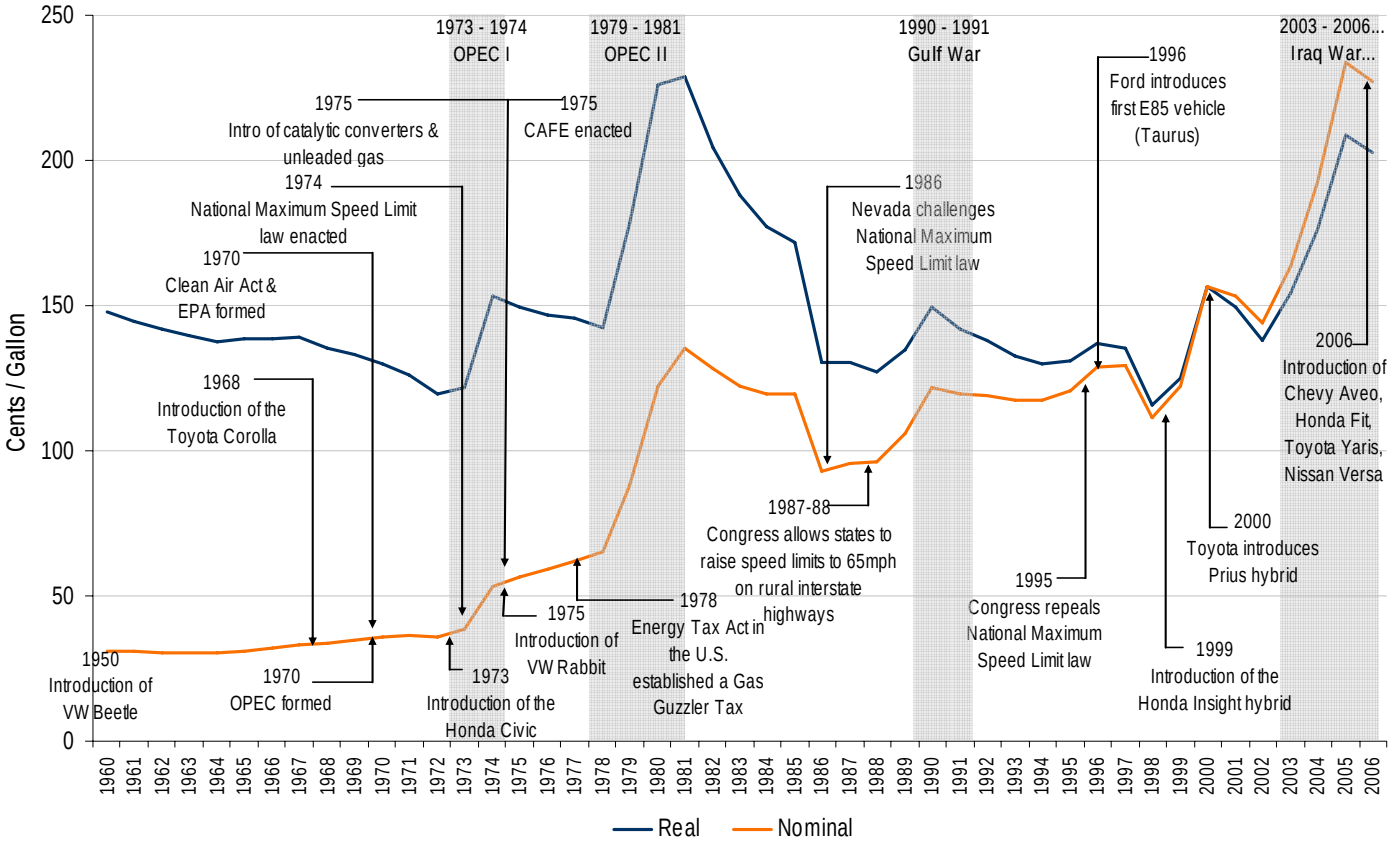
Chart 12: Trucks as % of total fleet



Source: Ward's, R.L. Polk, Energy Information Administration (EIA)

It was these periods of pressure on oil supply and rising gas prices that drove new and stricter government regulation of the auto industry beginning most notably with the national maximum speed limit in 1974 (55mph) and CAFE (corporate average fuel economy) standards in 1975. However, these periods have also seen fuel efficient vehicles gain in popularity such as the Honda Civic in 1973, the VW Rabbit in 1975, the Honda Insight in 1999, and the Toyota Prius in 2000; and more recently the Chevy Aveo, Toyota Yaris, Honda Fit, and Nissan Versa (Chart 13).

Chart 13: Historical real & nominal gas prices



Source: Energy Information Administration (EIA), industry sources

It should be noted that the increase in gas prices over the last seven years (1998-2005 the recent trough to peak) is only rivaled by the surge in prices during OPEC II, the only period of time in at least the last five decades when new vehicle mix shifted away from trucks towards more fuel efficient cars. A similar shift began in 2005 and is continuing into 2006. Obviously there are numerous forces driving the recent rise in oil prices, and the Iraq War itself is not the sole driver, but the parallels with OPEC I, OPEC II, and the Gulf War are eerily being shrugged off by American consumers, with hints of a response just beginning to emerge.

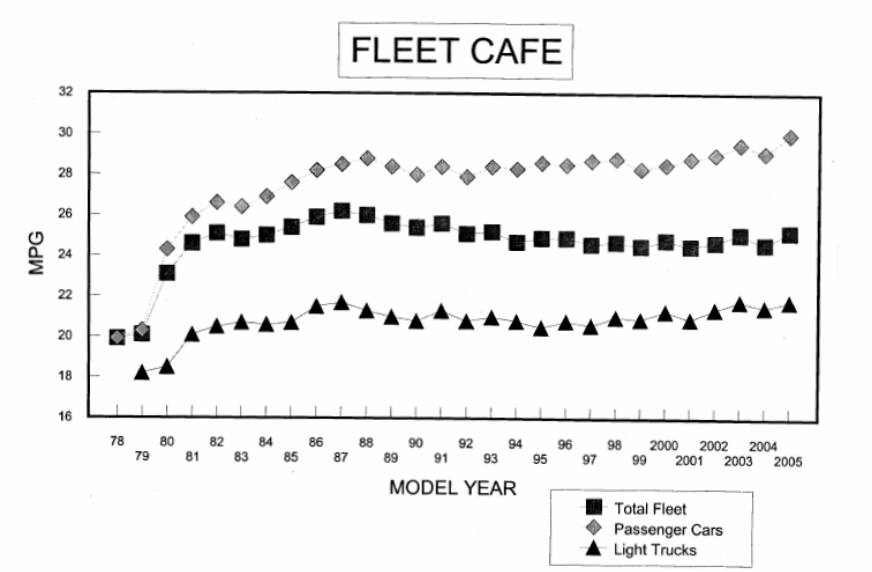
Table 7: CAFE standards

Model Year	Pass. Cars	Light Trucks		
		Combined	2WD	4WD
1978	18.0			
1979	19.0		17.2	15.8
1980	20.0		16.0	14.0
1981	22.0		16.7	15.0
1982	24.0	17.5	18.0	16.0
1983	26.0	19.0	19.5	17.5
1984	27.0	20.0	20.3	18.5
1985	27.5	19.5	19.7	18.9
1986	26.0	20.0	20.5	19.5
1987	26.0	20.5	21.0	19.5
1988	26.0	20.5	21.0	19.5
1989	26.5	20.5	21.5	19.0
1990	27.5	20.0	20.5	19.0
1991	27.5	20.2	20.7	19.1
1992	27.5	20.2		
1993	27.5	20.4		
1994	27.5	20.5		
1995	27.5	20.6		
1996	27.5	20.7		
1997	27.5	20.7		
1998	27.5	20.7		
1999	27.5	20.7		
2000	27.5	20.7		
2001	27.5	20.7		
2002	27.5	20.7		
2003	27.5	20.7		
2004	27.5	20.7		
2005	27.5	21.0		
2006	27.5	21.6		

Source: U.S. Dept . of Transportation

The consumer response to the increase in gas prices is in the early stages, and the shift in demand to more fuel efficient vehicle has typically been temporary. This combined with mediocre increases in CAFE standards (Table 7) has resulted in almost no improvement in the actual fuel economy of vehicles on the road in the U.S. (Chart 15). Instead, the increased efficiency of engines has been dedicated to Americans driving larger and higher performance vehicles as opposed to lowering consumption of gas and oil.

Chart 14: Average fuel economy for vehicle on the road has not improved since the early '80s



Source: U.S. Dept of Transportation

Automakers' response to demand and regulatory schizophrenia

Although many global automakers often highlight specific powertrain strategies, most are exploring a number of options as the ultimate winner is unclear.

Although many global automakers often highlight specific powertrain strategies, most are exploring a number of options as the ultimate winner is unclear. Most OEMs point to fuel cells as the holy grail of powertain technology, but considering the timing of introduction (10+ years) it is a dubious solution, and another technology could emerge. In the interim the alternatives being explored are increased diesel penetration, increased ethanol & biofuel use, and the popular hybrid. These technologies are summarized in Table 8.

The scale of the investment in all new powertrain technology is massive, and it is important to remember the capital that has been committed to the traditional internal combustion gas engine has been depreciated over decades. Therefore, the incremental capital that needs to be dedicated is daunting and likely a drag even for the automakers with solid income and strong balance sheets. Furthermore, the process is likely to be evolutionary as opposed to revolutionary as all industry participants attempt to minimize investment risk.

Table 8: Major powertrain options

	Conventional ICE	Diesels	Hybrids	Ethanol	Fuel Cells
Fuel economy (mpg)	25-30 mpg	45-50 mpg	55 mpg	20-25 mpg	na
Emissions Rating (EPA/CARB)	Tier 2 Bin 5/LEV	Tier 2 Bin 8	Tier 2 Bin 5 or lower (eg Prius Bin 2)/SULEV	better than conventional ICE	na
Strengths going forward	Accepted market standard; lowest incremental costs for improvements due to economies of scale	Excellent fuel economy; improved emissions profile; torque increasing steadily	Strong image, compelling fuel economy potential; reasonable performance	Decreases U.S. dependence on foreign oil; low cost technology	Decreases U.S. dependence on foreign oil; virtually no emissions
Weaknesses going forward	Does not offer the fuel economy realizable in diesels or hybrids; most exposed to fuel shocks	High incremental costs over ICE; emissions targets need to be hit in US	High incremental cost above ICE; economy sensitive to environment and driving style	Lack of distribution infrastructure; low mpg	High cost technology; Requires large spaces for hydrogen storage; Lack of distribution infrastructure
Strongest market in	US, China	Europe	US	US	US
Weakest market in	Europe	US, Asia Pacific	China	nm	nm

Source: Merrill Lynch and industry reports

With the extreme uncertainty on the proper direction to take, and large capital commitments most automakers are pursuing numerous powertrain strategies. The strategies are summarized in Table 9 and discussed in detail in the following sections for the U.S. Big Six.

Table 9: Big Six OEM strategies

	GM	Ford	DCX	Toyota	Honda	Nissan
ICE (MY05 NA production mix)	4-CYL: 15% 6-CYL: 45% V-8: 36%	4-CYL: 11% 6-CYL: 4-% V-8: 44%	4-CYL: 15% 6-CYL: 59% V-8: 25%	4-CYL: 46% 6-CYL: 41% V-8: 14%	4-CYL: 58% 6-CYL: 42% V-8: 0%	4-CYL: 39% 6-CYL: 50% V-8: 12%
Diesels	Plans for light duty Silverado diesel in MY09	Only on medium/heavy trucks; Announced plans to offer a light duty F-150 diesel	New E320 Bluetec diesel meets EPA requirements; Will offer on Bluetec on GL320, ML320 & R320	Clean diesel offered only in Europe; No announced plans to introduce any diesel vehicles in the U.S.	Developed clean diesel technology which may be better than Bluetec; Will be on vehicles in 2009	No diesels currently; May introduce diesel Titan, Armada or Infiniti QX56
Ethanol	Market leader; E85 offered on 9 MY06 vehicles and 7 MY07 vehicles	E85 offered on 5 MY06 vehicles; Partnership with VeraSun to increase ethanol availability	E85 offered on 9 MY07 vehicles; Over next 2 years E85 vehicles will be 25% of Chrysler Group production.	Historically favored hybrids over ethanol; Will launch 100% ethanol capable vehicle in Brazil; Considering producing ethanol vehicle in the U.S.	Will offer ethanol capable vehicle in Brazil; No announced plans to introduce in U.S.	Currently offers two E85 compliant trucks (Titan King Cab & Titan Crew Cab) in select areas; Will offer E85 compliant MY07 Armada
Hybrids	JV with DCX & BMW to develop "two-mode" hybrid; Will have 7 hybrid vehicle offerings by 2008	By MY08 will offer 5 hybrids; Backed down from original plan to produce 250k hybrids by 2010	JV with DCX & BMW to develop "two-mode" hybrid; Plans to offer this technology on Dodge Durango in 2008	Market leader with 71% share (based on hybrid sales data), 4th generation technology, real world testing advantage	First U.S. entrant; Currently 15% market share; Offered on Accord, Honda and Insight; real world testing advantage	No hybrids available currently; Plans to offer MY07 hybrid Altima using Toyota's components but Nissan's system software controls
Fuel Cells	Historically favored this technology over hybrids; currently testing Chevy Equinox fuel cell vehicles	Currently testing a Ford Focus fuel cell hybrid (FCH)	Has the largest fleet of fuel cell vehicles; also introduced the first fuel cell commercial vehicle in 2004	Latest version is Highlander; Being tested in California	Latest fuel cell vehicle utilizes hydrogen fuel and a new lighter and flatter stack layout which allows for a sleeker vehicle design	Most recent fuel cell vehicle is MY05 X-TRAIL with lithium-ion battery and 70MPa high pressure hydrogen storage capacity

Source: Merrill Lynch and industry sources

GM's strategy

Fuel Cell

GM historically favored fuel cell technology over hybrid technologies. The company still promotes fuel cell development. As recently as September 2006, GM disclosed its plans to produce 100 Chevrolet Equinox SUVs in 2007 to test its current technology. However, most experts agree that the fuel cell vehicles will not be used mainstream for at least 15 years and GM itself views 2010 as the earliest it could begin selling these vehicles to the mainstream market. The company has begun to recognize that other technologies, including improvements to the traditional ICE, need to be leveraged to meet both consumer demand and regulatory requirements for reduced emissions.

Hybrids

Recognizing the market importance of offering a hybrid option, GM is now playing catch-up with its three hybrid technologies with varying fuel economies on light vehicles. However, it should be noted that GM has successful advanced hybrid technology for larger vehicles such as city buses. GM began limited sales of its Chevy Silverado and GMC Sierra light hybrid pickups in model year 2005, which yield a 10% fuel economy improvement. Nationwide sales of the Silverado and Sierra began in MY06. GM also began offering the Saturn VUE hybrid this summer, which yields a 20% fuel economy improvement. In MY08, the company will offer hybrid systems similar to the VUE hybrid on the Chevrolet Malibu and Saturn Aura.

Also, GM, DCX and BMW are collaborating on the development of a "two-mode" hybrid transmission. This new technology is meant to address two problems that current hybrids have: 1) inability to tow heavy loads and 2) inability to drive uphill for sustained periods of time without discharging the batteries. If successful, combined with GM's Active Fuel Management system, it will increase fuel efficiency of large SUVs and large cars by 25%. GM plans to offer this technology on the new Chevrolet Tahoe and GMC Yukon in 2007.

Biofuel

GM also started putting its own stamp on the alternative fuel race in January 2006 when it launched the 'Live Green, Go Yellow' advertising campaign. GM recognized a marketing opportunity in the recent trend of consumer interest in "green" technologies. Given that GM was already producing E85 compliant trucks and cars, but consumers were largely unaware of the technology, the company launched a massive ad campaign to educate consumers on the use of this alternative fuel, which GM leads on. In 2006, GM expects to produce 400k flexible fuel vehicles. Although its practicality is questionable, given the lack of an ethanol fuel distribution infrastructure, the marketing campaign has stirred customer interest and given GM a stick with which to compete against its greatest rival, Toyota. If an ethanol distribution network were established, this would be much more than just a marketing campaign.

Diesel

Diesel vehicles are an area which General Motors is focused, albeit on a longer-term horizon. Similar to Ford and DCX, GM has been offering heavy-duty diesel vehicles and full size vans in North America for years but has yet to introduce a light vehicle diesel. GM announced in August that it will introduce a light duty V-8 turbo-diesel in '09MY which should improve fuel efficiency for NA light trucks by 25% and meet the stringent 2010 diesel emissions standards. In order to develop this vehicle, GM may leverage the diesel technology it developed with Fiat in the

JV that began in 2000. Although the relationship was dissolved in 2005, GM and Fiat maintain joint ownership of the 1.9 liter diesel technology developed through the venture and a Polish facility which produces a 1.3 liter diesel engine. Fiat's diesel technology has been a key element of its relative success in the European market, and could give GM an advantage in Europe and the U.S. GM may also leverage its relationship with Isuzu to develop clean diesel technology for the U.S. market.

Ford's strategy

Ford's approach to fuel efficiency has been a diverse portfolio recognizing there will unlikely be a unique solution.

Hybrid

Recognizing the significant consumer interest in hybrids, specifically the Prius, Ford developed an Escape hybrid in 2004, the first hybrid SUV on the road. The company also offered a hybrid version of the Mercury Mariner in 2005 (pulling it one year ahead) with the intent to produce 250k hybrids by 2010. However, interest in these vehicles was tepid and, in August, Ford retracted its hybrid goal. The company still plans to introduce the MY07 Mazda Tribute and hybrid versions of the Fusion and Milan in 2008, but has not announced any other plans for hybrid vehicles. Instead, the company is focused on improving fuel efficiency and emissions by 2010, the same time frame. Although widely reported as such, Ford's hybrid systems do not contain Toyota technology, and the company holds almost 200 associated patents.

Biofuel

Ford also offers E85 engines in the F-150, Crown Victoria, Grand Marquee and Town Car. The company should produce about 250,000 E85 vehicles in 2006. In an attempt to increase the number of gas stations with E85 pumps Ford entered a partnership with VeraSun Energy Corporation in November 2005. However, the company has not been as vocal as some of its competitors about its efforts.

Fuel cell

Ford is also exploring two types of hydrogen powertrain technologies: hydrogen ICEs and hydrogen fuel cells. The company has already delivered 30 Ford Focus Fuel Cell Vehicles (FCVs) to organizations outside of Ford for testing purposes. In Q3:06, the company Ford began producing a hydrogen ICE for E-450 shuttle buses, which may be delivered later in 2006. For generally views the hydrogen ICE as a step towards fuel cells, as the company like all automakers is heavily invested in internal combustion engines.

Diesel

Ford's diesel offerings in the U.S., similar to GM and DCX, are concentrated only in the medium and heavy truck segments of the market. The company did announce as part of its NA turnaround plan, that it will fit a light duty F-150 with a diesel engine. In 2007, the company will offer a new 6.4-liter V8 diesel in its MY2008 Super Duty trucks. In Europe, it has been collaborating with PSA since 1998 to develop clean diesels for the European commercial and executive car segments. Ford is the lead on 6-cylinder and V-8 diesels, while PSA is the lead for 4-cylinder engines. Most recently, in October 2005, Ford announced that it is producing a 2.2-liter clean diesel engine for its European commercial vehicle, the Ford Transit and PSA's LCVs. PSA will supply both Ford's and its own medium/large and executive vehicles with a premium 2.2-liter high output diesel engine.

DaimlerChrysler's strategy

DaimlerChrysler's powertrain strategy is straightforward. The company's near term goals are focused on traditional engines (i.e. gasoline and diesel), which with evolutionary technology can probably still yield 10-20% efficiency gains. In the long run, the company is working on developing hybrids, alternative fuels and fuel cell technology.

Diesel

DCX has advanced diesel technology. The company currently offers the Mercedes-Benz E320 BLUETEC and in early 2007 it will launch the Jeep Grand Cherokee diesel. Currently, neither vehicle can be sold in five of the 50 states due to strict emissions policies which restrict the level of NOx emissions. In 2008, the company is also planning to launch the new GL320 BLUETEC, ML320 BLUETEC and R320 BLUETEC SUVs that utilize an AdBlue injection system which releases ammonia and neutralizes NOx into (harmless) nitrogen and water and allowing these vehicles to be sold in all 50 states.

Hybrid

Currently, DCX has no hybrid offerings in the passenger car market. The company is planning to introduce hybrids in early 2008, beginning with the Dodge Durango, which will be offered with the two-mode hybrid system. The two-mode technology, which is currently being developed in a JV between DCX, BMW and GM, will address two problems that current hybrids have: 1) inability to tow heavy loads and 2) inability to drive uphill for sustained periods of time without discharging the batteries.

Ethanol

DCX offers a number of E85 vehicles. In MY07, the company is offering nine models including the Chrysler Aspen, Chrysler Town and Country, Chrysler Sebring, Jeep Commander, Jeep Grand Cherokee, Dodge Durango, Dodge Caravan and Dodge Dakota as well as a 2.5-liter Mercedes-Benz C230. In the next two years the company expects E-85 capable vehicles to make up 25% of Chrysler Group production.

Fuel Cell

DCX is working on fuel cell powertrains as well. The company has the largest fleet of fuel cell vehicles among the major OEMs. DCX is currently testing a fleet of over 100 vehicles with customers including cars, buses and vans. The company also introduced the first fuel cell commercial vehicle, the Dodge Fuel Cell Sprinter, in 2004.

Toyota's strategy

Hybrids

Toyota's Prius has been the leading hybrid vehicle in the U.S since its introduction. Toyota began selling the Prius in Japan in 1997 and in the U.S. in 2000. In MY2004, the company introduced a redesigned version of the Prius, which gained popularity. In 2005, Toyota began a $30mm marketing campaign based on its Hybrid Synergy Drive technology to promote the introduction of the hybrid versions of the Highlander and the Lexus RX400. In 2006, the company introduced a hybrid version of the Camry and the Lexus GS450. Year-to-date, the company has sold 147k hybrid vehicles (company data through August) and has a 71% market share in the U.S (based on hybrid sales data released by companies). Toyota has announced that it plans to introduce a hybrid version of their full-size pickup, the Tundra, and has stated publicly its goal of doubling the number of models which offer a hybrid powertrain from the seven it offers today to 14 by the early 2010s.

The company has recently announced its plans to develop a plug-in hybrid, which could be either a combination of an electric vehicle with a gas or diesel engine or a combination of a gas or diesel hybrid with an external recharger.

Fuel cells

Toyota's fuel cell efforts have also led to a hybrid. The company began development of fuel cell technology in 1992 and developed its first fuel cell hybrid vehicle (FCHV) in 1996 in Japan. The company has designed four FCHVs and has been testing its latest version which is a Highlander FCHV in California. However, the company has placed much more emphasis on hybrids as the near-term "green" solution.

Biofuels

Until recently, Toyota downplayed the biofuel alternative due to the lack of availability of the fuel and its production from renewable resources. Toyota recognized that biofuel emission levels are low but the company cited the "lower energy content, relatively high cost and faster degradation prior to use" as obstacles for widespread use of the fuel. However, the company recently announced it will introduce in the spring of 2007 a vehicle that can use 100% ethanol fuel for the Brazilian market, where ethanol is widely used. Toyota also said in July 2006 that it is "strongly considering" the production of ethanol-capable vehicles in the U.S.

Diesel

Toyota's diesel efforts have been in Europe where diesel vehicles are much more popular than in the U.S. The company's D-CAT (Diesel Clean Advanced Technology) was initially offered on the Toyota Avensis in the UK and Germany. Toyota does not currently offer any diesel vehicles in the U.S. and has not yet announced any plans for a diesel light vehicle.

Honda's strategy

Hybrid

In 1999, Honda introduced the Insight, which was the first hybrid vehicle sold in the U.S. The two-seat Insight carried Honda's Integrated Motor Assist (IMA) system, which combined a 1.0 liter VTEC engine with a nickel-metal hydride battery to generate an EPA rating of 61 mpg for city driving and 70 mpg on the highway. In 2002, the company began offering a hybrid Civic and at the end of 2004, Honda introduced the Accord hybrid. Year-to-date, Honda holds 15% market share of hybrid vehicle sales in the U.S. The company announced in May its plans for a new dedicated hybrid family vehicle in 2009, which will be offered at a price level that is lower than the Civic hybrid. Honda expects to produce 200k units of the new hybrid worldwide and 100k for the North American market.

Diesel

Among the Japanese OEMs, Honda has been the most active in the clean diesel arena. In September, the company announced it will develop a clean diesel engine aimed at meeting the EPA's Tier II Bin 5 requirements by using a newly designed catalytic converter which uses ammonia to convert NOx into nitrogen. Unlike DCX's Bluetec, Honda's technology will not require a tank of urea to convert the NOx. The EPA has raised concerns with DCX's Bluetec technology, which leaves drivers with the responsibility of maintaining the urea tank. Honda has not yet announced the specific vehicles it will offer the clean diesel technology on, but plans to begin selling it in the U.S. in 2009.

Fuel Cell

Honda has been active in the development of a fuel cell vehicle. The company introduced its first two fuel cell vehicles, FCX-V1 and FCX-V2, in 1999. FCX-V1 used hydrogen and used a fuel cell stack produced by Ballard Power Systems. FCX-V2 used methanol and a fuel cell stack designed by Honda. Honda's latest fuel cell vehicle is approximately 30kW more powerful than the MY05 version and is now vertically oriented (rather than the previous horizontal orientation), which allows the fuel cell stack to be placed in the transmission tunnel. Most other competitors' designs place the fuel cell stack under passengers which raises the center of gravity of the vehicle. Honda's new design allows for a sleeker vehicle design and better handling due to the vehicle's lower center of gravity. The new fuel cell stack is 20% smaller and 30% lighter than the current MY05 version. The company expects to market this new vehicle among a limited U.S. and Japanese customer base in 2008.

Biofuel

Until recently, Honda has not been particularly active in ethanol powered vehicles. In September, however, the company announced plans to offer a vehicle in Brazil that can run on any fuel which has between 20% and 100% ethanol to gasoline ratios. The company has not announced any plans to introduce flexible fuel vehicles in the U.S. market.

Nissan's strategy

Hybrid

Unlike Toyota and Honda, Nissan has not introduced a hybrid to the market. In 1999, the company had developed its NEO hybrid technology, but the development was abandoned during the Nissan Revival. In 2002, Nissan formed a technical partnership with Toyota to develop hybrids but Nissan has stated publicly its need to develop its own hybrid technology rather than continue to rely on Toyota's expertise. Meanwhile, however, Nissan will offer the 2007 Altima with a hybrid option which uses Toyota's components, but utilizes Nissan's system software controls. The company also launched a hybrid medium-duty truck called Atlas 20 in Japan manufactured by Isuzu. The company is continuing to develop its own hybrid using lithium-ion batteries which are also used for the development of Nissan's fuel cell vehicles.

Diesel

Nissan has cited clean diesel as a market opportunity, and may introduce a diesel version of its pickup, the Titan and large SUVs including the Armada and the Infiniti QX56. In Europe, the company offers over 40% of its vehicles equipped with diesel technologies. Nissan may use its existing European diesel technology, or use the technology developed in its alliance with Renault, or it may purchase the diesel technology from another OEM or supplier for these new vehicles in North America.

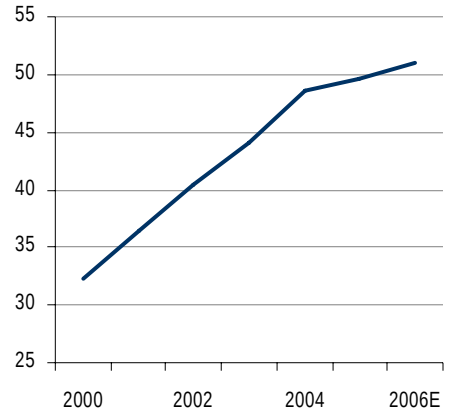
Fuel Cell

Nissan's work on fuel cell development began in 1996 which resulted in the first drivable vehicle in 1999. In 2001, the company began road testing in California using an XTERRA fuel cell vehicle. At the same time, with Renault, the company started a five-year development program with an ¥85 billion investment. More recently, the company has developed a MY05 X-TRAIL fuel cell vehicle which uses a lithium-ion battery and has a 70MPa high pressure hydrogen storage capacity, which is 30% larger than the previous version. The company began road testing on it in February 2006.

Biofuel

Nissan currently offers E85 engines on two versions of its Titan trucks, the King Cab and the Crew Cab in select regions. In MY07, the company will offer a E85 compliant 5.6-liter V8 Armada. The company has stated plans to introduce more vehicles that are E10 capable.

Chart 15: Diesel penetration in Europe



Source: J.D.Power and ML estimates.

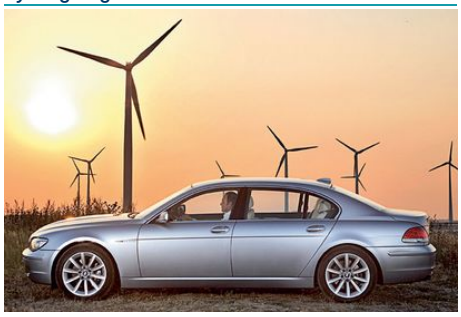
Other OEMs' strategies

European passion for diesel unabated

Most of the European OEMs are relatively behind in the hybrid race and have not been marketing alternative fuel vehicles. This sounds logical as hybrid success in Europe has been much smaller than in North America[5], given the share of diesel in the European market (c.50%, see Chart 16) and its superior fuel economy. That is not to say that the European manufacturers have not become more conscious of the marketing appeal of hybrids to technology and environmentally aware customers, who tend to make up a large part of the premium vehicle buying base. At the 2004 Paris auto show the European manufacturers went to great lengths to explain why they considered contemporary hybrid technology used in vehicles like the Toyota Prius to be a blind alley, a distraction from the real prize of fuel cells and hydrogen. A year later after Toyota had garnered numerous plaudits for its hybrid technology, the Europeans had recognized that they may be correct but they had still lost the argument. The market was less interested in debating the logic of their argument (hybrids added weight and cost while diesels still offered better fuel consumption) but rather preferred to buy into the environmental message that Toyota and to a lesser extent Honda had so successfully marketed. The result was evident at the 2005 Frankfurt auto show, where most of the European manufacturers proudly discussed and displayed their own hybrid concepts, still some way off their market introduction.

The Europeans are unlikely to catch up with the Japanese on hybrids, but they still have a real advantage when it comes to diesel. As clean diesel fuel becomes available in the U.S., these companies have the ability to bring their clean diesel technologies from Europe to the U.S. In particular, Audi, BMW, Mercedes-Benz and Volkswagen may be forming an alliance to increase the popularity of diesels in the U.S. Suppliers like Bosch are also lobbying to improve the reputation of diesel, tainted by the dramatic attempt by GM to sell unreliable diesel powered Oldsmobile vehicles in the early 80s in North America.

Chart 16: BMW 7-series bi-fuel liquid hydrogen/gasoline



Source: BMW

BMW

BMW participates in a JV with DCX and GM on hybrids and is actively working on hydrogen technology. It launched the BMW Hydrogen 7 in October 2006, which it claims to be the world's first gas-powered luxury car, able to run on liquid hydrogen as well as gasoline. BMW insists the vehicle is not a one-off concept. The Hydrogen 7 is built on BMW's 7-Series line, and about 100 will be delivered to business-lease customers across Europe in 2007. The Hydrogen 7 features a 6.0-liter V12 engine – the same as the range-topping 760i on which it is based, but optimized to run on hydrogen – plus a 74-liter petrol tank, and another chamber in the trunk containing 8kg of liquid hydrogen. Using a button on the steering wheel, the driver switches between the two fuels. From the outside, the only visual clues are some modifications to the rear bumper to accommodate the hydrogen system's pressure-control valves. Because hydrogen does not have as high a calorific value as gasoline, the V12 develops only 260bhp rather than 445 bhp for the regular 760i, reducing the 0-62mph sprint from 5.5 seconds to 9.5 seconds. Fuel economy also suffers. The hydrogen tank has a range of only 125 miles, and the lack of a hydrogen filling station infrastructure increases the reliance on the gasoline tank. This is clearly an intermediate step before BMW introduces hybrids using hydrogen fuel cells.

[5] European sales represented only 10% of Toyota's global hybrid sales in 2005.

BMW is at the forefront of diesel technology and direct gasoline technology. It has a JV with PSA on small gasoline engines (used in the new Mini) giving it much better scale effects than it could achieve on its own.

VW and Porsche

Volkswagen is working on hybrid technology with the support of Continental and ZF. Porsche, one the highest regarded manufacturers of gasoline engines and still very hostile to diesel technology, is also cooperating with VW on hybrid technology, whose first use will be in the next generation Cayenne SUV.

Volkswagen has been a pioneer in diesel technology in Europe. It is changing over in the 2007 model year from mechanical fuel injection (the diesel pump system) to a high-pressure electronic engine (common rail engines). It is important to keep in mind that VW was the only carmaker using the diesel pump technology, making it more expensive. As a result of this technology change, VW will not offer diesel engines in the US until the MY2008. The company will stockpile the 2006 model until it can begin offering the new MY08 version beginning in January 2008. In the interim, the company's only new diesel offering will be the V10 Touareg. The company waited until fall to start selling the new diesel Touareg, which was ready for sale in June, in order to wait for the new low sulfur diesel regulations to kick in. The V10 Touareg meets emissions standards in only 45 states in the U.S.

PSA

PSA is trying to capitalize on its diesel expertise by developing a diesel-electric hybrid, which it plans to launch by 2010. Along with VW, PSA has been one of the earliest to invest in diesel technology. Both benefit today from impressive scale effects. As well as its partnership with Ford on diesels, PSA has also jointly developed a small gasoline engine with BMW for use in its smaller car and in BMW's brand new Mini.

Renault

Renault has also been a pioneer in diesel technology and is now leveraging on the Alliance with Nissan to reduce development costs and maximize scale effects on powertrains. Renault has been nominated as the center of excellence for diesels within the Alliance while Nissan concentrates on gasoline engines.

Fiat

Fiat was an early pioneer of diesel technology. Its component operation, Magneti Marelli invented common rail technology in the late 1980s before selling it to Bosch in the early 1990s. Although its powertrain joint venture with GM was dissolved, Fiat still supplies GM with engines.

Hyundai

Hyundai has set a target to sell a hydrogen-powered vehicle for less than $40,000 by 2015. The company is still far from achieving the plan but has set the target in the belief that just as hybrids took off quickly, they believe the first OEM to market with a relatively affordable fuel cell vehicle will win the market. Hyundai recently announced that it will not produce a hybrid vehicle until 2009. The company was originally planning to sell its first hybrid vehicle in Korea in 2006 and in the U.S. in 2008 or 2009. However, the company has retracted its plans, citing currency problems.

Investment ideas from our universe

In this section, we present investment ideas and recommendations for investors looking for exposure to the clean car evolution. We highlight stocks from the U.S., Canada, and Europe.

BorgWarner Automotive (U.S.)

Levered to Fuel Economy & Emissions

Perhaps the company in our universe most leveraged to the trends outlined in this report is Detroit-based BorgWarner Automotive. In auto industry terms, BorgWarner is a relatively small ($4.3 billion revenues in 2005), fast-growing (11% CAGR revenue growth implied by 2006-2008 backlog), technology-driven supplier. The company is famous for its manual transmissions, a business it has since exited, but the design, engineering, manufacturing skills honed from the development of such complex systems serve the company well today.

As shown in Table 4 below, almost all of BorgWarner's key products offer the benefit of higher fuel efficiency and/or lower emissions. BorgWarner expects 55% of new business by 2008 to be made up of Engine Timing systems, Turbochargers, DualTronic Clutch modules and AWD/4WD transfer cases. We estimate that these products account for at least 70% of the company's 2006 revenues.

Table 10: BorgWarner's key products and benefits

Key Product	Higher Fuel Efficiency	Lower Emissions	Other Key Benefits	Company Group
Turbochargers (1)	X	X	Increased power in gas & diesel engines	Engine Group
Variable Cam Timing	X	X	Improved engine performance	Engine Group
Thermal Management Components & Systems	X	X	Reduced noise, applications in medium/heavy and off-highway vehicles	Engine Group
Diesel Cold Start Technology	X	X	Faster engine start-up	Engine Group
Exhaust Gas Recirculation	X	X	Important for clean diesel; reduces NOx	Engine Group
Engine Timing System	X	X	Longer engine life, lower noise	Engine Group
Transmission Systems / Friction Products	X		Improved shift quality; enables higher speed transmissions	Drivetrain Group
DualTronic Clutch Modules	X	X	Smooth automatic shifting with manual fuel economy	Drivetrain Group
Interactive Torque Management (ITM)			Improved handling in all-wheel drive vehicles	Drivetrain Group
Transfer Cases (2)			Four wheel drive for rear wheel drive vehicles	Drivetrain Group

Source: Merrill Lynch, BorgWarner
(1) 16% of company sales in 2005; (2) 12% of company sales in 2005.

In addition to higher fuel efficiency and lower emissions, BorgWarner's turbochargers also improve performance. Turbochargers have been used in Europe to improve the performance of diesel direct injection engines. However, in the U.S., we believe gas direct injection (GDI) engines will have a greater market acceptance than diesels. BorgWarner's turbocharger technology can enhance performance in GDI engines as well.

Recommendation

We rate BorgWarner Neutral, as the stock's current valuation appears to reflect the company's attractive growth prospects.

Magna International (Canada)

Broad Capabilities

Toronto-based Magna International is the third largest auto supplier in the world, with 2005 revenues of $22.8 billion. The company makes a variety of highly-engineered automotive products, ranging from components like seat frames to modules like cockpits to complete vehicles (see Table 11).

Table 11: Magna's Automotive Groups & Key Products

	2003	2004	2005
Revenue			
Complete vehicle assembly	$1,614	$4,450	$4,110
Interior & seating systems	$3,171	$3,938	$4,047
Metal body systems	$2,909	$3,243	$3,657
Powertrain & drivetrain systems	$1,537	$2,286	$3,505
Exterior systems	$2,218	$2,557	$2,888
Mirrors & electronic systems	$1,368	$1,461	$1,418
Closure systems	$1,012	$1,176	$1,213
Tooling, engineering & other	$1,516	$1,542	$1,973
Total Revenue	$15,345	$20,653	$22,811
YoY % Change			
Complete vehicle assembly	nm	175.7%	-7.6%
Interior & seating systems	nm	24.2%	2.8%
Metal body systems	nm	11.5%	12.8%
Powertrain & drivetrain systems	nm	48.7%	53.3%
Exterior systems	nm	15.3%	12.9%
Mirrors & electronic systems	nm	6.8%	-2.9%
Closure systems	nm	16.2%	3.1%
Tooling, engineering & other	nm	1.7%	28.0%
Total Revenue	23.5%	34.6%	10.4%

Source: Company filings.

Hydroforming: Key Technology for Lighter Vehicles

The Cosma metal forming business, which is part of the Metal body systems segment, accounts for about a third of profits and is the historical foundation of the company. Within Cosma resides Magna's market-leading high-pressure hydroforming business. Hydroforming is a critical technology for creating lighter, stronger vehicles and thus we believe it will play a key role in the intensifying drive for higher fuel economy.

Hydroforming is a process by which metal tubes are extruded into a desired shape by the injection of water at very high pressure (up to 100,000 PSI, but typically 30,000-60,000 PSI) into both ends. The process offers numerous benefits, including:

- Up to 20% lighter weight because the process offers the precision to move ("flow") metal into areas only where additional strength is needed (eliminates the need for a minimum metal thickness)
- Up to 40% parts reduction because one hydroformed part can replace a multi-part stamped assembly because of the process's ability to form complex shapes as a single piece
- Increased strength and stiffness because the material is work-hardened during forming
- Superior dimensional accuracy because removing welding reduces heat deformation

- Reduced tooling investment because the process eliminates welding and the need for an "upper" and "lower" tool in the traditional clamshell design

Applying a 20% weight reduction to a complete midsize passenger car unibody structure with a weight of 550 pounds, the implied weight savings is 110 pounds. Total vehicle weight savings should be even greater because a lighter body structure would allow for lightweighting other components.

Magna believes that hydroforming has broad applicability in lightweighting vehicle structures. As shown below, the list of new applications is long and includes some very large, high dollar value components like door ring apertures (essentially the entire side of the vehicle that surrounds the doors) and cross-car beams, which run the width of the car behind the instrument panel.

Table 12: High Pressure Hydroforming Applications

In Production Today	High Potential
Front frame rails	Front windshield (A) pillars
Engine cradles	B & C Pillars
Rear suspension members	Door ring apertures
Control arms	Cross-car (IP) beams
Radiator supports	Impact bars
Roof rails	Sills
Front end structural modules	Hydroformed-intensive closures (doors, liftgates, etc.)

Source: Magna, Merrill Lynch

Recommendation

Magna is rated Buy.

Price Objective Basis and Risk

We believe a reasonable EV/EBITDA multiple for Magna is 3.5x our 2007 estimates, which leads us to our price objective of $86. The average North American supplier EV/EBITDA multiple is currently 5.4x for 2006e and 4.7x for 2007e. Conservatively applying approximately a 25% discount to the industry average, which Magna has historically traded at, implies a multiple of 3.5x 2007 estimates. Currently, Magna's 2007 EV/EBITDA is just 3.0x, which is a 36% discount to the industry average. Our DCF further supports our valuation argument as it implies a fair value in the range of $100.

Risks - 1) control of the company by insiders through super voting shares; 2) key model program concentration; 3) near-term production cuts by the Big Three; and 4) a traditional cyclical downturn in U.S. auto demand.

Valeo (France)

Increasingly focusing on powertrain efficiency

We estimate that about 35% of Valeo revenues are directly in relation to fuel economy. Valeo is focusing its growth strategy around three domains: Powertrain Efficiency (PE, EUR3.5bn revenues in 2005), Comfort Enhancement (CE, EUR3.3bn) and Driving Assistance (DA, EUR2.5bn). Valeo has acquired early 2005 JCI engine management business, now integrated in its PE domain and is in the process of divesting a Motors and Actuators business, now viewed as non core. Valeo's PE domain includes transmissions (among world leaders), engine cooling (world leader), electrical systems (among world leaders) and engine management systems and is attracting a rising proportion of Valeo's R&D efforts.

Fuel economy: 5 solutions from Valeo

Valeo identifies 5 areas of improvement in its portfolio that can be offered to carmakers. Table 13 below presents some of the products involved.

Table 13: Fuel economy - 5 areas of improvement

Area of improvement	Product	Potential fuel economy gain
Power on demand	Low consumption A/C compressor	-3%
Power on demand	BELTLESS engine	-5%
Thermal management	THEMIS	-4%
Transmission automation	DUAL CLUTCH transmission	-6%
Hybridization	MICRO-HYBRID StARS System	-10% / -15%
Hybridization	MICRO HYBRID 2G with regenerative braking	-15% / -20%
Engine valve control	CAMLESS system	-20%

Source: Valeo.

We would highlight two products, which we view as offering a significant potential:
- StARS first (for Starter-Alternator Reversible Systems or Start/Stop), Valeo's micro hybrid solution, allows carmakers to get 80% of a full hybrid benefits for 20% of the cost. It features the capacity to stop and then restart the engine immediately and silently. The technology saves fuel and avoids pollution when the vehicle stops in traffic or at a red light. Valeo has an offer from micro to full hybrid but believes that the current cost of full hybrid (c.EUR3,500) is too high for the mass market. A diesel mild hybrid (Stop/Start and brake regeneration) is seen as the best compromise in terms of cost versus fuel economy. StARS is offered in two Citroen vehicles (C2 and C3 Stop&Start) and should be in other vehicles shortly.

- CAMLESS system. Engine cylinder head design adopts Smart Valve Actuation (SVA) in place of the conventional mechanical operation of engine valves by the cam belt, camshaft and hydraulic cam followers. In a camless engine, each engine valve is operated individually by an actuator linked to an engine mounted Valve Control Unit (VCU) that ensures the optimal positioning of all valves and performs the power drive function. Valeo estimates that this technology reduces fuel consumption and emissions by 20%. No commercial contract has been signed yet but several OEMs are actively working on the technology.

Recommendation

We rate Valeo Buy.

Price Objective Basis and Risk

We see fair value at EUR34, based on our 2007 forecast. At this level, Valeo would trade on 14.9x earnings, 4.3x EV/EBITDA and 41% EV/Sales (10x, 3.8x and 39% on our 2007 estimates), reflecting more accurately the company's growth and margin prospects. At EUR34, Valeo still offers an attractive 5.8% FCF yield (8% 08E).

Industry-related risks for auto parts companies are volatility in light-vehicle production, rising raw material costs, pricing pressure from customers, increased R&D transfers from OEMs, recalls (implying potential warranty claims) and exchange rates volatility. Valeo's specific risks relate to its relatively high exposure to non ferrous metals prices and the execution risk on potential acquisitions.

Price Objective Basis & Risk

Magna

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Risks - 1) control of the company by insiders through super voting shares; 2) key model program concentration; 3) near-term production cuts by the Big Three; and 4) a traditional cyclical downturn in U.S. auto demand.

Valeo

We see fair value at EUR34, based on our 2007 forecast. At this level, Valeo would trade on 14.9x earnings, 4.3x EV/EBITDA and 41% EV/Sales (10x, 3.8x and 39% on our 2007 estimates), reflecting more accurately the company's growth and margin prospects. At EUR34, Valeo still offers an attractive 5.8% FCF yield (8% 08E).

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Coverage Universe	Count	Percent	Inv. Banking Relationships*	Count	Percent
Buy	33	39.29%	Buy	7	21.21%
Neutral	36	42.86%	Neutral	7	19.44%
Sell	15	17.86%	Sell	3	20.00%

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Neutral	1420	47.97%	Neutral	412	29.01%
Sell	215	7.26%	Sell	48	22.33%

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