HONDA: Engines of Change

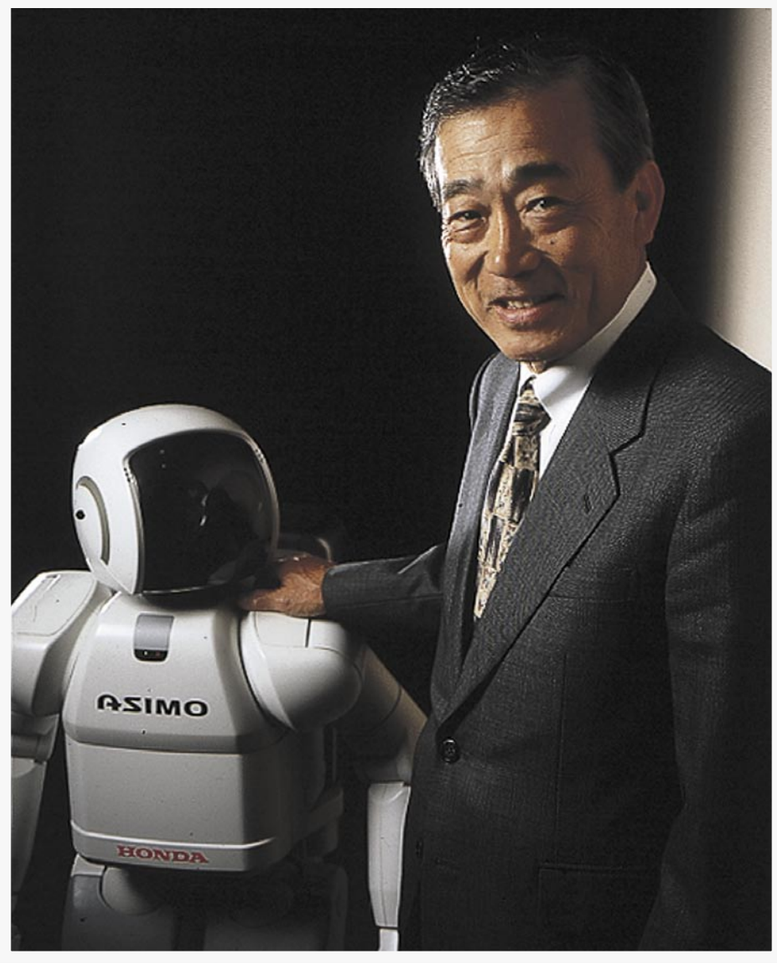
Japan's No. 3 automaker is betting that scientists in a secret engine lab can outsmart Toyota in the clean-car race.

By Kae Inoue, John Lippert and Alan Ohnsman

In 1973, junior engineer Takeo Fukui helped put Honda Motor Co. on the U.S. map with a Civic subcompact that met clean-air standards without a $1,000 tailpipe filter known as a catalytic converter. He was 28.

Today, as Honda's 61-year-old chief executive officer, Fukui is racing to repeat his triumph at a lab 68 miles (109 kilometers) north of Tokyo. There, engineers are building a diesel engine for 2009 that Honda says will meet both new U.S. limits and more stringent California rules on soot and nitrous oxide emissions and still use 30 percent less fuel than gasoline models. Honda allows no media visitors to the lab—Fukui is guarding it as his secret weapon as U.S. gasoline prices soar to an average $2.87 a gallon in early June and 62 percent of Americans worry about global warming, according to a March Gallup Organization Inc. poll.

"People want cars that emit less pollutants, use less fuel



PORTRAIT BY MAKOTO ISHIDA

Honda's latest prototype for a fuel cell–powered car is sportier than the current model because engineers shrank the cells. CEO **Takeo Fukui,** right, has Honda engineers working in diverse fields. The company developed visual sensors for a robot and then transferred them to an Acura sedan.

and protect their occupants," says John Casesa, an auto industry consultant at Casesa Shapiro Group LLC in New York. "These trends play directly to Honda's strengths."

Companies around the globe are catching green fever, jockeying to persuade customers and investors that they're good citizens of the Earth. London-based BP Plc, Europe's largest oil company, is also the third-biggest maker of solar cells that convert the sun's rays to electricity. In May, General Electric Co., the world's second-biggest company by market value, agreed to work with China to develop wind power equipment, jet engines with lower emissions and more-efficient locomotives. China says it plans to spend 1.5 trillion yuan ($187 billion) in the next 15 years to boost renewable energy.

'We want people to ask, "Will the world need Honda in the year 2010?"' its U.S. sales chief says.

Honda increased its annual research budget for the year ending on March 31, 2007, to a record 545 billion yen ($4.8 billion), 6.8 percent more than a year earlier and a 17 percent leap from the ¥467.7 billion in the year ended in March 2005. Fukui is seeding everything from fuel cells to humanoid robots, to a business jet whose fuselage is made of composite plastics that are 10–15 percent lighter than aluminum. Honda acquired patents to high-yield rice genes last year. It's trying to learn the basics of genetic science with the aim of making ethanol from sugar cane to run cars, says Motoatsu Shiraishi, 59, president of research and development.

Honda's common theme in what may seem random forays into quirky fields is to move people and things efficiently, thus conserving energy and reducing waste. "We'd like to have the brand image as the world's biggest contributor to the environment," Fukui says during an interview on the 10th floor of Honda's Tokyo headquarters, where he works with 19 other executives in one large room.

Fukui says Honda has an advantage over car-making rivals because its engines power lots of things—from motorcycles, where it's No. 1 in the world, to lawn mowers. That gives Honda flexibility in an auto industry slump. "Developing our business along the lines of mobility will improve the toughness of Honda against economic fluctuations," says Fukui, a motorcycle fan who sports an amulet that identifies a rider's blood type in case of a crash.

Honda makes the most of its environmental strategy, even if the game plan sometimes takes unexpected turns. It earned the crown as the top organic soybean processor in Ohio after determining that shipping empty auto-part crates from U.S. plants back to Japan was wasteful. It hired local farmers to grow soybeans and now sends the crop home in once-empty containers. In February, Honda started selling a dietary supplement made from fermented soybeans that helps dissolve blood clots.

John Mendel, Honda's U.S. sales chief, says the far-ranging research can appear haphazard. "This is something that bugs investors, because they don't know where we're going," he says. Investors will tolerate the strategy as long as Honda stays true to its values, he says. "We want people to ask, 'Will the world need Honda in the year 2010?' and we want them to answer, 'Hell yes,'" he says.

Honda's shares reflect optimism about the company's future. They gained 39 percent during the 12 months ended on June 5, to ¥7,440 on the Tokyo Stock Exchange. Honda's American depositary receipts, each of which would represent one of Honda's Japanese shares after a 2-for-1 stock split that was scheduled for July 1, rose 31 percent to $32.78. Shares of Toyota Motor Corp., Japan's largest carmaker and Honda's biggest rival, rose 56 percent to ¥6,040. Shares of General Motors Corp., the world's No. 1 auto company, fell 14 percent to $26.05 in U.S. trading during the same time.

"Investors are buying Honda's shares with a 10-year perspective of the strength of its competitive technology, including gas-electric hybrids," says Masayuki Kubota, who oversees $2.1 billion at Tokyo-based Daiwa SB Investments Ltd., explaining the lag against Toyota. "Even its conventional engines are more efficient than GM's or Ford's."

Eric Noble, president of Car Lab, an Orange, California–based consulting firm that conducts technical evaluations of most new cars and trucks, concurs. "The view is that the people with the best engine technology are Honda and Yamaha in terms of total efficiency," Noble says, referring to Shizuoka, Japan–based Yamaha Motor Co., the world's No. 2 motorcycle company and a designer of some high-powered engines for Ford Motor Co. and Toyota. "Among garden-variety cars, it's Honda."

In time, investors will pay the same premium for Honda's shares as for Toyota's, predicts Michael Bruynesteyn, an analyst at Prudential Equity Group Inc. in New York. Another reason for Honda's share price lag against Toyota is that being an environmental advocate hasn't been cheap. Honda spent $3,193 per vehicle worldwide for research, development and capital expenses in 2005. That's $256 more than the $2,937 at Toyota and almost double the $1,611 at GM, says John Murphy, a Merrill Lynch & Co. auto analyst in New York.

Mendel says it's money well spent. "If people are feeling depressed about the economy and gas prices, they'll want a sure thing," he says. "That's when we thrive." Honda's trucks, which are built on car chassis, already meet the higher U.S. fuel economy standards the U.S. Department of Transportation requires for 2011. Ford, GM and Toyota will have to spend $600 per vehicle to reach the new guidelines, says Takaki Nakanishi, an analyst at JPMorgan Securities Inc. in Tokyo. The standards require SUVs, pickup trucks and minivans to average 24 miles per gallon, up from 21.6 mpg now.

Honda is hoping to make greater leaps with vehicles powered by fuel cells. It spent $1 million to build a boxy car that looks like a Civic. Jon Spallino in Redondo Beach, California, leases it as a test driver for $500 a month. The car

runs on Honda-developed fuel cells that create energy by combining hydrogen and oxygen through a chemical reaction, leaving only water vapor as a byproduct.

Spallino says he likes the instant acceleration the electric drive provides. "Not only am I not sacrificing anything, the driving experience is really fun," says Spallino, 40, chief financial officer of Southland Industries, an Irvine, California–based construction firm.

In the driver's seat

Honda is friendlier to the environment and customers than its larger competitors.

	Global sales, 2006; in millions of units[1]	U.S. fuel economy, miles per gallon[2]	Smog-forming emissions, grams per mile[3]	Retained value, after three years[4]	Operating profit margin[5]
GM	8.5	22.9	0.84	43%	(3.5%)
Toyota	8.2	27.1	0.54	52	8.3
Ford	6.2	22.3	0.59	41	(0.9)
DaimlerChrysler	4.4	22.9	0.74	39	2.7
Honda	**3.4**	**29.0**	**0.31**	**53**	**6.4**

[1]Projection. [2]City/highway fleet average, 2005 models. [3]2003 models. [4]DaimlerChrysler's figure is based only on Dodge and GM's figure is based only on Chevrolet. [5]For 2005, except Toyota and Honda, which are for fiscal year 2006. Sources: Automotive Lease Guide, Environmental Protection Agency, Global Insight, Merrill Lynch, Union of Concerned Scientists

Honda signed up Spallino last year and is the only company testing a fuel-cell car by asking a person to drive it day in, day out. Ford, GM and Toyota are running tests of fuel-cell cars through corporations and universities, not individuals. "Honda has provided very courageous leadership with this technology," says G. Scott Samuelsen, director of the National Fuel Cell Research Center at the University of California, Irvine.

Next, Fukui wants to use existing natural gas lines to provide hydrogen to feed the fuel cells in cars instead of waiting for countries to build hydrogen delivery systems that would enable cars to be filled up. Honda is testing a Home Energy Station in Southern California that converts natural gas into enough hydrogen to run a family's vehicle and supply electricity and hot water for their house. Eventually, Honda may power the Home Energy Station with solar panels, which it intends to start mass-producing in 2007, Fukui says.

In a few months, Honda will let testers drive a new fuel-cell model—a sporty, low-slung version. Honda's designers had more leeway with the look because they first reduced the fuel cell to half the size of the one in Spallino's car, fitting it under the center console instead of sprawling it under the entire passenger compartment. Honda hopes to speed up production and leasing of the new car in 2009. Neither Honda nor its competitors have announced specific production plans.

Honda knows engines because that's where it got its start. After World War II, the company strapped surplus motors designed for electric generators onto bicycles. It began making its own engines in Hamamatsu, Japan, in 1947. Then, in 1948, it built its first motorcycles. During the next six decades, Honda has pushed its engineers to find the cleanest and most efficient way to mix air, fuel and explosive sparks inside an engine.

Last year, it built 19.6 million engines, more than any other company on the planet. Some 3.4 million went into its own cars and trucks, making Honda the world's eighth-largest automaker. "Honda has always had the best engine technology, and that's a strength in a high-fuel-price environment," says Jeffrey Scharf, whose Santa Cruz, California–based Scharf Investments holds Honda shares within its $575 million portfolio.

Honda had the lowest average emission level among major automakers, including 0.31 gram per mile of smog-forming chemicals such as nitrous oxide. That compared with 0.84 gram for GM. Honda also had the highest average fuel economy, at 29 miles per gallon, compared with 22.9 mpg for GM. These figures, the latest available, refer to 2003-model vehicles, says David Friedman, research director for clean vehicles at the Union of Concerned Scientists, a Cambridge, Massachusetts–based environmental group. The scientists named Honda the greenest automaker in December 2004.

Chris Wachenheim, executive vice president of Purchase, New York–based Greenhaven Associates, says Honda's green strategy isn't the only feature attracting him. He's comforted by Honda's $7.5 billion in net cash and marketable securities and is satisfied with its allocation of 30 percent of net income to dividend payments and share repurchases. "Honda is very shareholder oriented," says Wachenheim, who doubled his holdings of Honda's ADRs to 6.1 million during the quarter ended on March 31.

Honda earned a record ¥597 billion during the fiscal year ended on March 31, up 23 percent from ¥486.1 billion a year earlier. Sales rose 14.5 percent to ¥9.9 trillion.

For all of its exotic research and conservation efforts, Honda trails Toyota in marketing surveys ranking the environmental sensibility of automakers, Honda's U.S. sales chief Mendel says. He declined to provide specifics.

Mendel attributes Toyota's bigger buzz to marketing, noting that actors such as Charlize Theron arrived at the September 2005 Emmy Awards ceremony in Los Angeles in Toyota's Prius, a four-door hybrid sedan that goes as far as 55 miles on a gallon of gas. "It became a badge of honor in Hollywood to park your hybrid next to your Hummer," Mendel says.

Toyota does a better job of selling itself because it's less dominated by engineering purists, Car Lab's Noble says. "Certain things the market demands aren't always rational in the eyes of an engineer," he says.

That happened with the first U.S. hybrids. Honda introduced its Insight a few months before Toyota's Prius in 1999. Honda's two-door coupe travels 66 miles on a gallon of gas, the farthest of any car sold in America. Yet Honda sold just

666 Insights in 2005 compared with 107,897 Priuses. It plans to discontinue the Insight in September.

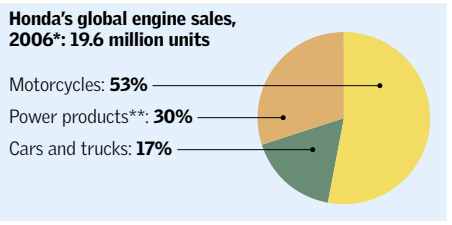
Noble says Honda erred by tuning the Insight for maximum fuel-efficiency rather than the quick acceleration U.S. drivers appreciate in the Prius. Honda can let its technical obsessions slip out of control. The brand dropped to No. 12 from No. 4 in the 2005 J.D. Power & Associates survey of new-vehicle owners for 2005. Toyota's Lexus division ranked first, with 81 problems per 100 vehicles, compared with 112 for Honda. Mendel describes Honda's drop as self-inflicted. Many owners thought its Ridgeline pickup was defective because Honda provided too many options for which doors would lock automatically when the truck was parked, Mendel says. Honda ranked sixth in the survey for 2006. Toyota was fourth, and Lexus was second.

Fukui says he hopes Honda's new diesel will reclaim the environmental halo Toyota grabbed with its Prius. "When Honda's clean diesel is out, it will have equal abilities to compete with gasoline hybrids," Fukui says, adding that Honda tries to be more agile and innovative than Toyota because it has to. "They are very centralized, like the Roman Empire," Fukui says.

As for American companies, "they are preoccupied with short-term profit performance," Fukui says. "It's our mission as an automotive manufacturer to protect the global environment."

Revving up revenue

Honda puts engines in jets, motorcycles and lawn mowers, not just cars.



*Fiscal year. **Includes generators, pumps, snowblowers, lawn mowers, tillers, trimmers and marine engines. Source: Honda

One thing Fukui will have to do is figure out how to lure buyers in Europe. Honda sold its first car there in 1973. This year, the company will capture 1.5 percent of Western European sales compared with 7.1 percent in Asia and 8.8 percent in North America, London-based analyst Neil King of Global Insight Inc. predicts. Toyota will claim 5.5 percent of West European sales; it made the region a bigger priority after voluntary restraints on Japanese imports ended in 1999, King says.

After three decades of trying, Honda still hasn't delivered the style and handling that European drivers demand, says John Wormald, a Chichester, England–based analyst at consulting firm Autopolis. "The idea of putting styling and marketing on an equal footing with engineering hasn't quite gotten through at Honda," he says.

When he became CEO in 2003, Fukui slowed Honda's growth to focus on *genryukyoka,* or strengthening the company's core in Japan. In 2004, he added a second assembly line in Lincoln, Alabama, for sport utility vehicles. As he expanded beyond Honda's traditional family sedans, his North American factories started running at less than full capacity and profit margins narrowed, Prudential's Bruynesteyn says. Honda's North American unit, the main driver of the stock price, generated a 5.2 percent operating margin in the year ended in March 2006 compared with 9.4 percent two years earlier, Bruynesteyn says.

The arrival of three new or redesigned SUVs is likely to help Honda's North American profit margin recover to 7.2 percent in the year ending in March 2007, Bruynesteyn says. Even though these SUVs use less fuel and emit fewer pollutants than their competitors, they've allowed rivals to narrow Honda's environmental lead, Friedman says.

Fukui has even bigger plans. On May 17, he said Honda will build or expand enough factories in Brazil, Canada, China, India, Japan and the U.S. to boost vehicle sales by 32 percent to 4.5 million in 2010, with the aim of increasing profit. "We need to improve the operating margin even by a little," Fukui says, referring to the North American drop in 2006. "What's more important is that we need to improve the operating profit figure itself."

Founder Soichiro Honda set the tone for his company's technical innovations and competitive zest. An auto repair shop owner, Honda won Japan's fifth nationwide auto race in 1924 by fitting a biplane engine onto a chassis built by Mitchell Motor Car Co. of Racine, Wisconsin. "Imitations do not stand a fair chance of surviving in competition with originals," he told workers.

Honda built his first car in 1957 over the objection of the Japanese government, which wanted him to merge with Nissan Motor Co. He was the first to open a Japanese-owned car factory in the U.S., in Marysville, Ohio, in 1982.

Fukui was already a car fanatic when he arrived at Honda in 1969. He had majored in chemistry at Tokyo's Waseda University, which has trained more prime ministers than any school in Japan, saving weekends for driving in mountaintop races all over the country. For his senior thesis, he wrote one of Japan's first studies on how much nitrous dioxide a car emits on the road.

Fukui was swept along when Soichiro Honda devoted the company to what he called "compound vortex controlled combustion." In CVCC, an engine's carburetor mixed air and fuel in carefully timed stages to promote complete combustion and minimize byproducts. It was the linchpin of Honda's plan to meet emission requirements in the U.S. Clean Air Act of 1970 and expand overseas.

Fukui recalls Honda's founder screaming at him when metal pellets used to filter tailpipe emissions in a CVCC test vehicle dissolved from the heat, making the output even more toxic.

The eventual success of CVCC propelled Fukui to Honda's motorcycle racing program, a showcase for the company's engineering. In 1985, his team won world championships for 250- and 500-cubic-centimeter models using the same rider. The

triumph was so complete that by 1986, Honda could no longer use its motorcycle rivalry with Yamaha to keep engineers motivated, says Ben Knight, vice president of R&D in the U.S. As an alternative, Honda began studying humanoid robots, Knight says.

The robot team researched how fruit flies avoid colliding in a closed space. Today, Honda's 130-centimeter (51.2-inch) Asimo robot uses pattern recognition and ultrasonic sensors to "see" well enough to serve tea. Honda installs similar sensing technology in its Acura RL sedan, which can "see" an accident and start braking.

As CEO, Fukui stressed that being environmentally friendly didn't mean sacrificing performance. In 2004, he met reporters at the Tochigi Technical Center north of Tokyo in a red leather racing suit. He drove 290 kilometers per hour around the test track in a Formula One car and then 260 kph on a motorcycle. He announced that Honda had developed a scooter with a gas-electric hybrid engine and drove off on a scooter powered by a fuel cell.

Honda uses racing to show young engineers that competition and environmentalism can go hand in hand. On May 28, Honda supplied all 33 engines for the Indianapolis 500 auto race. GM and Toyota dropped out of Indy-style competition last year. Honda gained a decisive advantage over those two rivals in 2004 by injecting fuel into its 700-horsepower Indy engine at a slightly different angle, generating 28 more horsepower, says Robert Clarke, president of Honda's racing unit. Honda's Indy engines will run on ethanol next year, Clarke says.

Having an engineer at the top impresses competitors. "Honda is a very knowledge-driven company," says Tom Stephens, a group vice president at GM. "The people who are in charge know engines."

Honda introduced its first diesel engine, a 2.2-liter, four-cylinder model, in Europe two years ago. For the four- and six-cylinder clean diesels it plans for the U.S., Honda first sends exhaust through a plasma reactor, or a gaseous layer of electrically charged atoms, according to a U.S. Patent and Trademark Office Web site. That isolates harmful nitrous oxide and forms nitrogen dioxide, which is reduced or absorbed by alkali metals and silver.

GM has tested plasma reactors and hasn't concluded they're the best for cutting nitrous oxide, Stephens says. DaimlerChrysler AG prefers to squirt urea, or liquefied ammonia, into the exhaust. The Stuttgart, Germany–based automaker plans such a system on its Mercedes-Benz E-Class sedan in a few years, says Simon Godwin, manager of regulatory affairs in Washington. A urea tank and controls may cost as much as a gas-electric hybrid system, or $2,000, says George Peterson, president of consulting firm AutoPacific Inc. in Tustin, California. Drivers must refill the tank as often as they change their oil, Godwin says.

Fukui says his catalyzer is simpler and will make Honda the first company to meet 2009 emission standards. "If they can get it out there, it's an engineering tour de force," says Robert Weber, who analyzes exhaust systems at TIAX LLC, a Cambridge, Massachusetts–based consulting firm.

Honda is extending its focus on energy conservation to its factories. In Suzuka, Honda welds its cars with a *Senjyu Kannon* robot, named after a Buddhist goddess who uses her 1,000 arms to protect the Earth. Each robot has six arms, and each arm has four welders that move separately. The robots wait as cars arrive alongside, move slowly to designated spots above the surface and then apply thousands of welds in a few seconds. The factory now uses 24 robots to weld cars compared with 120 previously.

Fukui, who spent two-thirds of his 37-year career at Honda in its research department, sponsors regular contests that judge employees and suppliers on making Honda more efficient. In March, seven workers from a unit of Takata Corp. traveled from Monterrey, Mexico, to Nashville, Tennessee, for a competition. The workers make sensors that block air bags from deploying if a child is in the front seat. Customers include Mazda Motor Corp., Mitsubishi Motors Corp., Ford and Honda.

During a 25-minute presentation, some workers read words spelled phonetically on their PowerPoint slides because they spoke little English. They described how they cleaned up a warehouse and used a computer to track parts inside the factory. They said they cut the inventory of parts and time spent looking for parts, saving $77,738 a month.

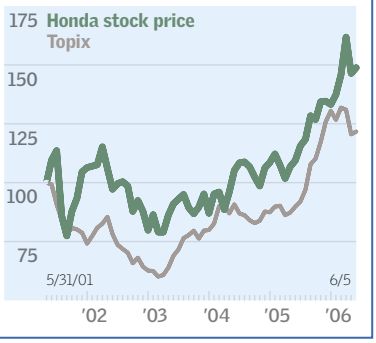
"Honda wants workers even on the remotest production line to use their intelligence, not just their hands and their backs," says Doug Stringer, manager of Takata's operations support group. "They provide more support in this area than our other customers."

One result is that Honda's 2006-model cars and trucks in the U.S. should retain 53 percent of their value after three years, says Raj Sundaram, president of Santa Barbara, California–based Automotive Lease Guide LLC, which advises banks on new-car financing. That compares with 52 percent for Toyota, 43 percent for Chevrolet and 41 percent for Ford.

Honda's 2006 Civic was the only small car to receive a Top Pick Award–Gold for safety last year from the Insurance Institute for Highway Safety. Fukui redesigned the car so individual components of its metal shell act as a honeycomb to direct the force of a collision away from passengers. He demonstrated the effect at Tochigi last year by crashing

Honda is hot

Shares have risen as profit growth attracts investors.



Index: May 31, 2001 = 100. Source: Bloomberg

a Civic into a minivan at 62 miles an hour. The Civic's passenger compartment remained intact.

"Honda has a sustainable competitive advantage because its engineers are excited and interested in what they do," says Norihito Kanai, an analyst at Tokyo-based Meiji Dresdner Asset Management Co., which manages $2.5 billion in equities.

There's always the Toyota factor, and the challenges of global warming and rising gasoline prices, to keep them motivated. "Honda and Toyota have invested the most effort and developed the best technology for hybrids and fuel cells," says Daniel Sperling, a transportation professor at the University of California, Davis. "It comes down to cost and durability, so it's premature to crown a winner."

The two companies watch each other constantly. "In just about every meeting I've been in, whether it's manufacturing or purchasing or human relations, Honda is always on our minds," says Terry Henderson, assistant general manager of a Toyota foundry in Troy, Missouri.

Honda and Toyota need each other, even as they're grinding competitors into the dust, says James Womack, president of the Lean Enterprise Institute research group in Brookline, Massachusetts. "Without Honda, Toyota would be too conservative, and without Toyota, Honda would be too crazy," he says.

Toyota sold 7.9 million cars and trucks last year, more than double the 3.4 million Honda sold. A big threat is that Toyota revs up production and its marketing machine, leaving Honda further behind. Yet with its expertise in making engines ever more efficient and its Home Energy Stations, fuel cells and clean diesels, Honda may persuade customers and investors that it has the inside track for anyone who's betting on the power of green.

KAE INOUE covers Asian automakers at Bloomberg News in Tokyo. JOHN LIPPERT is chief of the Detroit bureau. ALAN OHNSMAN covers transportation in Los Angeles.
kinoue@bloomberg.net
jlippert@bloomberg.net
aohnsman@bloomberg.net

BLOOMBERG TOOLS

Tracking Honda's Reach in Research

Honda has increased its spending for research and development every year since 1994. By contrast, Ford has increased R&D spending in eight of the past 12 years, and General Motors has done so in only five of those years. To see Honda's R&D Expenditures, first type 7267 JP <Equity> FA <Go> and click on the Details–Pg 2 tab at the bottom of the screen. Next, click on Research and Development Expense. Japanese companies report in two ways: on a parent level and on a consolidated basis. To set consolidated as your default, click on the Settings button on the gray tool bar. Tab in to the field to the right of Japanese Company Data, and enter *C* for Consolidated. Press <Go> to save the default setting, and then press <Menu>. For the fiscal year ended in March 2006, Honda's R&D spending was ¥510 billion, which was equivalent to 5.15 percent of net sales.

To compare that figure with R&D spending at other large automakers, type RV <Go>. Click on the Template List button on the red tool bar, and select Income Statement. Click on the Edit button, and select Data Columns. In the SEARCH field, enter *R & D,* with spaces around the ampersand, and click on the Go button to display R&D-related data items. Click on R & D Expenditure to Net Sales in the list of search results and then on Save/Return. Click on the Edit button again, and select Properties. In the first field to the right of Market Cap Filter (Mln), enter *10000.* In the field to the right of Currency Override, enter *USD.* Doing that will limit the comparison to companies with market capitalizations of more than $10 billion. Click on the Update button. Click on the arrow to the right of Sector, and select BICS Subgroup. Then click on the arrow to the right of Region, and select Worldwide. The search results, as shown below, display the world's 15 largest carmakers by market cap.

CHRISTOPHER RUNG

To compare the return of Honda shares with the returns of benchmark indexes, type 7267 JP <Equity> COMP <Go>.