TECHNOLOGY INTELLIGENCE

ASSESSMENT

A comprehensive evaluation of key technology topics

Report Number: 2002-80
Information Cutoff Date: 7-15-02
Distribution Date: 8-6-02

SUBJECT: **Environmental Sustainability Strategies and Initiatives at Honda**

PURPOSE: Background and context in support of environmental policy and decisions

SUMMARY:

- Honda strives for excellence in all aspects of the environmental life cycle:
  - The leader in producing high efficiency low emission internal combustion engines
  - A CAFÉ leader for over 10 years. MY2000 data show passenger cars and light duty trucks average 31.4 and 25.4 mpg, respectively
  - Strives to be the first to meet lowered emissions standards
  - A leader in hybrid vehicles – the Civic being the first mainstream hybrid vehicle in the US
  - Implemented a web-based Life Cycle Assessment tool for improved life cycle environmental performance
  - Eliminated all landfill waste from their Japanese manufacturing facilities. All facilities are ISO14001 certified
  - Remanufacturing used components and has developed bumpers made of 100% recycled content
- Honda continues to lobby for higher CAFE in the US
- Developing products to provide a near-term hydrogen infrastructure (not CO_2 neutral) via natural gas reforming and water electrolysis

IMPLICATIONS:

- Honda will continue to leverage their strength in engine technology in efforts to increase US CAFE to the disadvantage of their competition.
- Honda will continue efforts to make fuel economy and exhaust emissions a winning competitive factor in the marketplace.

SOURCE ASSESSMENT: Company annual environmental reports, press releases, corporate web-sites, conference presentations, third party reports, and personal contacts at Honda

POINT OF CONTACT: Name: Robert D. Stephens Phone: 586-986-1608

CONTRIBUTORS: Catherine Cochran and Brian Wicke

ATTACHMENTS: Honda environmental assessment paper

DISTRIBUTION LIST

Advanced Technology Council

Energy and Environmental Core Team

Energy and Environmental Strategy Board

R&D and Planning
- Chris Borroni-Bird
- Larry Burns
- Linda Chota
- Hazem Ezzat
- Roger Fruechte
- Steve Holland
- Jamie Hsu
- Barb Kunkel
- Bob Lust
- Bill Peirce
- Clay Phillips
- Nick Pudar
- Jerry Rogers
- Chris Sloane
- Jim Spearot
- Alan Taub
- Mark Verbrugge

AP
- Hideki Isetani
- Yuji Yamamoto

Competitor Intelligence
- Lisa Pawlik
- Dave Shillingford

GME
- Detlev Heinke
- Veit Held
- Claus Keller
- Burghardt Kiy
- Carsten Knauf
- Stefan Ostling
- Harald Schenk
- Thomas Schmitz
- Wolfgang Voelxen

GM Powertrain
- Gary R. Blair
- Richard Peterson
- Dino Raptis

GMNA Manufacturing
- Paul Ehms
- Alan Hsueh

Market Intelligence
- Mark Thibault

PPC
- Kit Green

Saab
- Bengt Soderlund

WWP
- William M. Hartman

Environmental Sustainability Strategies and Initiatives at Honda

Introduction

Company performance in sustainable transportation covers a broad range of activities. Although the activities that will lead to sustainable mobility are still largely undefined, environmental performance is broadly perceived as critical to long-term sustainability. In this report, the activities underway at Honda for achieving sustainability are covered in the following general categories:

Corporate Policy
Design, Stakeholder, and Strategic Initiatives
Socio-economic/Infrastructure Initiatives
Supply Chain Initiatives
Facilities/Manufacturing
Fuel Economy/Emissions
Developments in Alternative Propulsion
Recycling/Recycled Content

Information on company activities in each of these areas comes from company annual environmental reports, press releases, corporate web sites, conference presentations, third party reports, and personal contacts.

Following a review of activities in each of these areas, Honda's strengths will be reviewed in the Summary section.

The following acronyms will be used in this report:
CVT – Continuously Variable Transmission
ELV – End of Life Vehicles
EMS – Environmental Management System
GHG – Greenhouse Gas
IP – Instrument Panel
IPCC – Intergovernmental Panel on Climate Change
LCA – Life Cycle Assessment
OSU – Ohio State University
UCD – University of California, Davis
UCR – University of California, Riverside
WBCSD – World Business Council for Sustainable Development

Corporate Policy

Honda's commitment to the environment is prominent in their corporate policy statements. Their new corporate slogan for the 21st century is "The Power of Dreams." The Honda web site describes this slogan with the following: "*As it moves and grows into the 21st century, Honda is determined to maintain its harmony with the individual, the community, and the natural environment. To this end, Honda steers its way with three guiding principles: to create new*

value for customers, to promote globalization and to pursue eco-solutions for present and future generations.

The human race now finds itself facing an uncertain future. Among our many troubles, we are confronted by environmental problems, by an urgent need to find new energy sources, and by a need to improve traffic safety if motorized transport is to remain viable. Honda is working to make a difference on all three fronts: reducing environmental pollution, conserving energy, recycling, and improving traffic safety, all on a global basis." They also go on to state, "*we shall make it our mission to provide people with products and services designed with the needs of the community and the environment in mind.*"

Design, Stakeholder, and Strategic Initiatives

Honda is the only major US manufacturer that hasn't joined AAMA and often takes opposing or non-supporting positions to the other OEMs on issues related to CAFE and emissions. Edward Cohen, head of Honda's Washington lobby states that Honda prefers to operate through "under-the-radar activities like bringing our engineers in and having talks with both sides of the aisle." They continue to use their lobby in an attempt to take advantage of their strengths in fuel economy and low emissions to gain legislative and market advantage.

Here is a number of Honda activities and positions:

- Committed to developing future alternative technologies but believes gasoline will remain the fuel of choice for years to come, so remains committed to reducing emissions and increasing the fuel economy of the internal combustion engine.
- The only major US manufacturer to not fight CAFE increases and has also lobbied to have SUVs, pickups, and minivans meet the passenger car fuel economy standards. They are the also the only major US manufacturer to not fight California's CO_2 reduction bill.
- Claims to have 100% PVC-free interiors.
- Conducts gene research – has recently reported discovering a gene that controls the height of rice stalks, which should lead to higher rice yields. Rice fields are recognized to be a significant source of methane, a GHG. Increased rice yield via planting new strains of rice is thought to be largely responsible for stabilization of methane emissions, which are now being overestimated by the IPCC.
- Implemented a web-based Honda LCA System to assess the impact of all areas of company activity. Composed of two integrated subsystems, the LCA Data System and the LCA Management System, Honda claims this activity unifies impact reduction activities that were separately performed in each area of concern: Green Factories, Green Dealerships, Green Offices, Green Purchasing, and Green Logistics. Honda claims to use this system to set target reductions during in-house environmental conferences, followed up by PDCA (Plan, Do, Check, Action). Benefits of using this system are reported as: having the ability to ascertain annual environmental impact of vehicles sold, and being able to forecast future reductions in environmental impact of new products under development.
- Participates in the California Fuel Cell partnership.

- Working to overcome the limitations of the hydrogen infrastructure by developing products for hydrogen production and refueling.
- A member of the Sustainable Mobility Project of the WBCSD.
- Established a fuel cell supply agreement with Ballard Power Systems. Ballard will supply fuel cells and services through 2002.
- Cooperating with Celanese AG to develop fuel cell membrane and membrane electrode assemblies (Celanese technology is protected by at least 65 patents).
- A 10% owner in Catalytic Systems, Inc., a company that develops automotive catalysts.
- Purchased a 20% interest in Fuelmaker Corporation, a manufacturer of natural gas vehicle refueling appliances.
- Purchased an 18.4% stake in Mobility, Inc., a company operating car share programs under the name "Flexcar" in several metropolitan areas (see the Socio-Economic/Infrastructure section for more information).
- Invested $300k in a cooperative research program with UCR's CE-CERT (College of Engineering-Center for Environmental Research and Technology), EPA, and CARB to study the air quality benefits of low emission vehicles and their real-world emissions.
- The single largest contributor to OSU's college of engineering.
- Partnerships with UCR and UCD on car sharing programs.
- Green Dealership Project requires all dealerships to be ISO14001 certified.
- Established a Honda "Eco-Technology" award to promote the development of technologies that are harmonious with the environment and create a humane civilization.
- Sponsors the Annual Tour de Sol, a green car rally organized by the Northeast Sustainable Energy Association.

Socio-Economic/Infrastructure

Honda has established a concept for car-sharing programs called Intelligent Community Vehicle System (ICVS). ICVS is designed to integrate with mass transportation to alleviate transportation problems such as traffic congestion and parking limitations in urban areas. Honda participates in two car-sharing programs in the US and one in Singapore. CarLink is a project jointly operated by UCD, Honda, Bay Area Transit, and other government and industry partners. Intellishare is a joint project between Honda and UCR that promotes car sharing to reduce congestion and reduce air pollution. Carlink uses 12 Honda Civics and Intellishare uses 15 Honda EV Plus electric vehicles. The program in Singapore currently involves 15 Honda Civic Hybrids available from a number of sites distributed throughout the Central Business District.

Honda has also purchased an 18.4% equity stake in Mobility, Inc., a privately held company that operates car-sharing programs under the brand name "Flexcar." Ride-share programs provide a service that is a cross between car rentals and taxicabs, allowing users access to cars for short periods, typically hours rather than days. In many locations, the available vehicles are small electric or hybrid vehicles to minimize emissions in urban areas. Mobility, Inc. operates in Seattle, WA, Portland, OR, and Washington DC. In some cases, these programs are supported by federal grants.

Supply Chain Initiatives

Honda has established Environmental Recognition Awards for suppliers that exhibit extraordinary contribution to environmental improvement and preservation. Examples include one given to Autoliv for the effectiveness of their EMS system, which over a two year period "reduced aluminum, paper and styrofoam waste by more than 400 tons and has recycled almost 700 tons of plastics, metals and packaging, some of which was previously thought to be non-recyclable."

Facilities/Manufacturing Initiatives

Honda has over 110 manufacturing facilities in 31 countries around the world, producing motorcycles, cars, and other power products. Environmental achievements and initiatives in manufacturing and facilities include:

- All major facilities certified to ISO 14001.
- In 2000, completely eliminated landfill disposal of manufacturing waste in Japan.
- Plans to begin using solar cells to provide power at its manufacturing facilities. The solar cells were developed by a Honda subsidiary.
- Opened a "green" distribution warehouse facility, designed and constructed with recycled and recyclable building materials. Virtually every aspect of the facility was designed for environmental performance, including lighting, heating, flooring, wall finishes, and exterior landscaping. It utilizes a rainwater collection system and uses this gray water for site irrigation and water for toilets. Hallway floors are built with recycled tires and office floors are built with 100% recycled carpeting. Conference room wall coverings are built with recycled telephone books, conference tables from compressed sunflower seeds. The facility was designed and built with the expertise of a number of locally-based environmental organizations working in collaboration with Honda.

Fuel Economy/Emissions

More than any other automotive OEM, Honda is an engine company. Production of high efficiency, low emission engines is the company's strength. At a recent conference, John German, Honda's Manager of Environmental and Energy Analysis stated that Honda's responsibility is to provide vehicles with low emissions and high fuel economy. Their response to "Why be Green?" is that it leads to leadership in quality and value by being ahead of regulation. Honda is consistently the first manufacturer to introduce and achieve certification for vehicles that meet lowered emissions standards.

- Has been a CAFE leader for more than 10 years. MY2000 data show Honda domestic passenger cars and light duty trucks average 31.4 mpg and 25.4 mpg, respectively. (Data are from the US Department of Transportation website at: http://www.nhtsa.dot.gov/cars/problems/studies/fuelecon/)
- The highest rated fuel economy for any production vehicle is the Honda Insight at 95 mpg.

- Has targets of 25% fuel efficiency improvement by 2005 relative to 1995, while also decreasing HC and NO_x by 75%.
- CVT-equipped vehicles accounted for approximately 18% of sales in 2001.
- All Hondas are LEV-rated or better.
- Jointly developed a new catalyst system with Catalytic Solutions, Inc. that reduces the use of precious metals by 50 to 70%.
- Has developed a diesel engine that meets Euro-4 standards. The turbocharged engine uses a NO_x catalyst and diesel particulate filter.

Developments in Alternative Fuel/Propulsion

Honda believes that the gasoline IC engine will be the powertrain of choice for some time to come. At a recent auto conference in Tokyo, Honda's CEO Hiroyuki Yoshino was quoted as saying that "about a 23-percent improvement in fuel economy can be realized from renewing our engine line completely" in conjunction with adding more sophisticated combustion-control technologies such as the recently introduced I-DSI dual-sequential ignition system.

However, Honda is actively developing alternative powertrains such as fuel cell, natural gas, and hybrid vehicles. At the NAVC Conference on Climate Change and Transportation, John German, Manager of Environmental and Energy Analysis, stated that the Honda Civic hybrid was a marketing experiment that, if successful, will lead to the introduction of other hybrids, with five more models ready to go into production.

Here are some of Honda's activities underway in alternative fuel vehicles and powertrains:

- Participates in the California Fuel Cell partnership.
- Currently testing the FCX V-4 fuel cell vehicle, which might be released on the market in a very limited number by the end of fiscal 2002. Initially, these vehicles will utilize Ballard fuel cell stacks, later switching to Honda's proprietary fuel cell.
- Established the first hydrogen refueling station in the Los Angeles area, utilizing hydrogen extracted by solar powered electrolysis of water. The station, located at Honda's R&D center, supports the company's fuel cell vehicle development program.
- Discontinued development of on-board reformers for fuel cell vehicles, aiming instead for development of high-pressure hydrogen storage. Honda expertise in development of fuel reformers will be redirected toward development of low-cost reformers to be used as part of the fuel infrastructure.
- Signed a MOU with Plug Power to develop home-based hydrogen refueling stations that utilize natural gas as the source fuel. Plug Power has suggested these systems might be sold with each fuel cell vehicle to provide an immediate hydrogen infrastructure.
- Conducting joint development of electrolysis-based hydrogen generation systems with Shinko Pantec Co.
- Jointly working with Sanyo to develop nickel/hydrogen batteries for hybrid cars.
- Released the Civic Hybrid with CVT (EPA rating of 48/47). The 1.3L i-DSI (dual and sequential ignition) engine uses 2 spark plugs per cylinder with staggered firing to

improve emissions, cylinder deactivation during deceleration, and idle-stop to improve fuel economy. The vehicle attains 65 mpg on Japan's 10/15 driving cycle.

- Claims to have an engine under development that will provide efficiencies and emissions comparable to hybrids but at much lower costs.
- Will introduce direct injection gasoline engines in passenger cars in 2003.
- Developed a natural gas-powered vehicle that EPA rated the cleanest internal combustion engine ever tested.
- Marketing a home refueling station for natural gas powered vehicles for $1k.
- Developed an ultra-low emission diesel engine that meets the Euro 4 emission control standards for 2005. The engine with a variable turbocharger uses a NO_x catalyst and PM filter to achieve low emission levels.

Recycling/Recycled and Renewable Content

Honda conducts research and development on dismantling and recycling methods and technologies at their Tochigi R&D Center, where they operate a disassembly line.

- In conjunction with Kyowa Sangyo and Takase Gosei Kagaku, Honda developed a technology to recycle used polypropylene bumpers. The technology is being used to produce new bumpers containing 100% recycled polypropylene from old bumpers. Other companies recycling used bumpers are blending the recycled material with virgin polypropylene. Honda recovered 221,566 bumpers in 2000.
- Developed an IP that is 100% recyclable.
- Developed machinery to improve dismantling efficiency.
- Moving toward automotive glass recycling by developing a technique to recover about 80% of ELV glass.
- Remanufactures 47 varieties of 5 different components (power steering gearbox assemblies, power steering pump assemblies, torque converters, distributors, and driveshafts).
- Debuted the Pilot at the NY Auto Show with claims of 90% recyclability.

Summary

Honda's hallmark is the development of high efficiency, low emission engines. This, in conjunction with their focus on producing small vehicles, provides them with leadership in CAFE. They have established the reputation of being the first OEM to meet lowered emission standards.

Honda believes their clean, efficient ICEs will remain mainstream for years to come. Honda is a leader in hybrid powertrain development, being the first OEM to introduce a hybrid in the US. Their Civic hybrid is the world's first mainstream hybrid. If hybrids are successful, Honda is prepared to market five additional models.

Honda is an extremely efficient, flexible manufacturer and has completely eliminated landfill waste from manufacturing facilities in Japan. Their major facilities are ISO 14001 certified. In addition, they have a showcase "green" distribution warehouse facility in the US.

Honda recently announced they will market the FCX V-4 fuel cell vehicle by the end of fiscal year 2002 (March 2003). To assist in the transition to a hydrogen economy, they have partnered with companies to develop home-based hydrogen generation systems.

Honda has also made significant progress improving the environmental aspects of ELVs. They have developed a technology to recycle used polypropylene car bumpers and now manufacture bumpers using 100% recycled content. They have developed a 100% recyclable IP. Honda has developed a methodology for recycling 80% of ELV glass. The company remanufactures 47 varieties of 5 different automobile components.