



Assessment

A comprehensive evaluation of key technology topics

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SUBJECT: Environmental Sustainability Strategies and Initiatives at Toyota

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

- SUMMARY:**
- Toyota's President leads an organizational structure that has positioned environment as a top priority.
 - Dedication to environmental performance pervades every aspect of the business and involves every employee.
 - Extensive efforts address the entire product environmental life cycle:
 - Rigorous goal setting and achievements in the supply chain and in manufacturing (e.g. zero landfill waste from assembly plants)
 - Introduction of fuel efficient conventional and hybrid vehicles
 - Development of recyclable and biodegradable materials
 - Remanufacturing of components to extend useful life
 - Establishment of the world's first ASR recycling plant
 - Toyota is extending the definition of automotive environmental responsibility to include:
 - Remanufacture of used components
 - Development and manufacture of biodegradable materials
 - Dealerships

- IMPLICATIONS:**
- Toyota is attempting to develop and leverage its reputation in environmental excellence to influence vehicle sales.
 - Toyota's extensive and pervasive environmental actions create the opportunity to impact the regulatory process to its advantage in all regions of the world.

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

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Introduction

This report will follow the model of earlier reports ([Environmental Sustainability Strategies and Initiatives at Ford](#) and [Environmental Sustainability Strategies and Initiatives at DCX](#)) and provide both a sustainability and a life cycle perspective on the environmental activities underway at Toyota.

Company performance in sustainable transportation covers a broad range of activities. However, the activities that will lead to sustainable mobility are still largely undefined. Consequently, success in this area is partly a matter of perception. However, in the area of environmental performance, there are more clearly defined metrics for assessment. In this report, the activities underway at Toyota for achieving sustainability are covered in the following general categories:

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

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

The following acronyms will be used in this report:

ASR – Automotive Shredder Residue
CHF – Clean Hydrocarbon Fuel
CVT – Continuously Variable Transmission
DFE – Design for the Environment
DPNR – Diesel Particulate NO_x Reduction
DRGS – Dynamic Route Guidance System
EOL – End Of Life
ELV – End of Life Vehicles
EMS – Environmental Management System
ETC – Electronic Toll Collection
FCHV – Fuel Cell Hybrid Vehicle
FRW – Friends of the Rouge Watershed
GHG – Greenhouse Gas
GRI – Global Reporting Initiative
IP – Instrument Panel
ITS – Intelligent Transport Systems
JAMA – Japan Automobile Manufacturers Association
JAPIA – Japan Auto Parts Industries Association
LCA – Life Cycle Assessment
MONET – Toyota Mobile Network

NGO – Non-government organization
TPO – Thermalplastic Polyolefin
VERTIS – Vehicle Road and Traffic Intelligence Society
VICS – Vehicle Information and Communication System
VOC – Volatile Organic Carbon
WBCSD – World Business Council for Sustainable Development

Corporate Policy

Toyota has positioned environment as its top priority management issue. Based on the Toyota Guiding Principles, Toyota established the “Comprehensive Approach to Global Environmental Issues”, also known as the Toyota Earth Charter. There are four points to this charter, which also consists of Action Guidelines and Action Items, which are included as **Figure 1**. The four points of the charter are:

1. Contributions toward a prosperous 21st Century society – In order to contribute toward a prosperous 21st Century society, aim for growth that is in harmony with the environment, and to challenge achievement of zero emissions throughout all areas of business activities.
2. Pursuit of environmental technologies – Pursue all possible environmental technologies, developing and establishing new technologies to enable the environment and economy to coexist harmoniously.
3. Voluntary actions – Develop a voluntary improvement plan, not only based on thorough preventative measures and compliance to laws, but that addresses environmental issues on the global, national, and regional scales, and promotes continuous implementation.
4. Working in cooperation with society – Build close and cooperative relationships with a wide spectrum of individuals and organizations involved in environmental preservation including governments, local municipalities, as well as with related companies and industries.

As stated in Toyota’s 2001 annual environmental report, this charter “specifies the basic policy, action guidelines and implementation structures regarding Toyota’s efforts to preserve the Earth’s environment.”

To achieve the goals of the Earth Charter, Toyota established the Toyota Environment Committee in 1992. The organizational chart for this committee is shown as **Figure 2**. Toyota reviews their environmental policy annually and also requires an annual policy be established for each group and each plant. Descriptions of the activities of the subcommittees listed on the bottom of Figure 2 are listed below:

- **Fuel Efficiency and Exhaust:** Promotes technological development related to improvement of fuel efficiency and exhaust emissions
- **Ozone Layer Protection:** Further promotes collection of chlorofluorocarbons and rationalized use of alternatives
- **Clean-Energy Vehicle:** Promotes the development and introduction of clean-energy vehicles.
- **Working Group by Topics:** (exhaust emissions reduction, alternative CFC reduction, etc.)

- **ISO14001 Promotion:** Maintains environmental management system of development and design areas and achieves maintenance and improvement.
- **LCA:** Studies methods for lifecycle assessments and promotes Company's infra-structure maintenance
- **Production Environment Technology:** Conducts technological developments focusing on environmental measures at the pollution source of production equipment and plans measures for equipment
- **Overseas Production Environment:** Promotes transfer of environmental protection technology to overseas businesses
- **Plant Production Environment:** Conducts environmental preservation at each domestic plant and housing works
- **Production Environment Logistics:** Promoting reductions in environmental impact together with logistics
- **Research and Development:** Promotes prior assessment of recoverability and reduction of substances of environmental concern
- **Production Engineering:** Develops recycling technology for shredder residue of EOL vehicles.
- **Domestic:** Promotes dealer activities regarding manifest system and chlorofluorocarbons
- **Overseas:** Constructs collection and recycling network for EOL vehicles.
- **Special Projects in response to recycling laws:** Implemented in 2001.

Toyota Charter and Action Plan

New Toyota Earth Charter Action Guidelines

The Third Toyota Environmental Action Plan

1. Always be concerned about the environment – Challenge achieving zero emissions at all stages, i.e. production, utilization, and disposal.

(1) Develop and provide products with top-level environmental performance.

1. Fuel efficiency
2. Exhaust emissions
3. Clean-energy vehicles
4. Recoverability
5. Substances of environmental concern in vehicles
6. Automobile noise
7. Air conditioning systems

(2) Pursuit of production activities that do not generate waste.

8. Global warming threat
9. Substances of environmental concern
10. Waste and resource conservation
11. Water resources
12. Logistics

(3) Implement thorough preventive measures

13. Prior-assessment systems

(4) Promote businesses that contribute toward environmental improvement.

14. Environment-oriented business ventures

2. Business partners are partners in creating a better environment – Cooperating with associated companies.

15. Suppliers
16. Dealer's cooperation

3. As a member of society – actively participate in social actions.

(1) Participation in creation of recycling-based society.

17. Recoverability

(2) Support environmental government policies

18. Transportation systems
19. Related basic research

(3) Contribute also to non-profit activities

20. Socially-contributing policies

4. Toward better understanding – Actively disclose information and promote environmental awareness

21. Among the public
22. Among employees

Figure 1. Toyota Earth Charter Action Guidelines and Action Items

Toyota Environment Committee

Established in 1992

Chairman: President Fujio Cho

Directs important environmental programs and promotes environmental protection company wide

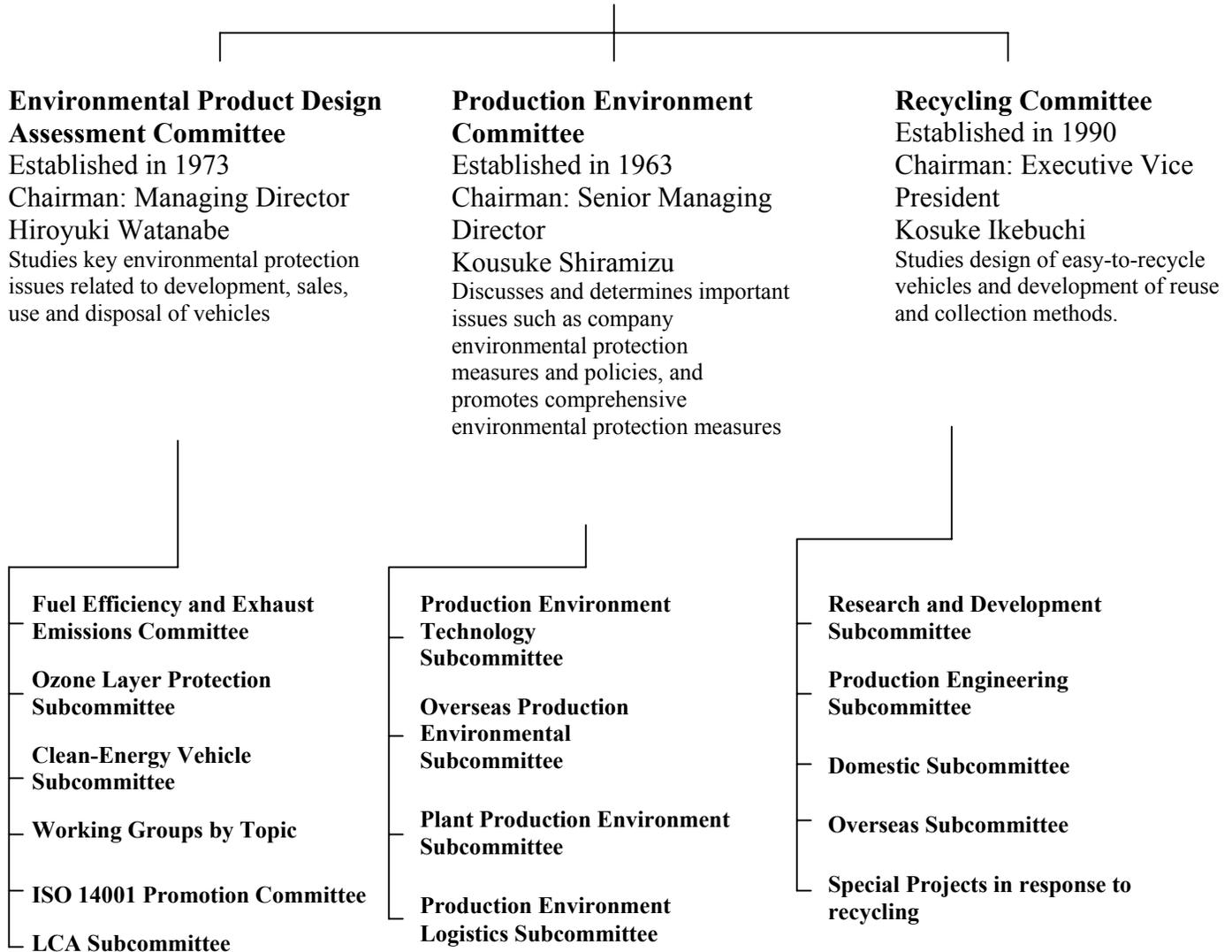


Figure 2. Toyota Environment Committee

Design, Stakeholder, and Strategic Initiatives

In keeping with their Earth Charter, Toyota has established working relationships with a number of NGO's and government agencies. Strategic decisions and incorporation of DFE activities are also impacting their products. Here are examples of activities and strategies undertaken internally within Toyota:

- Toyota's Global President, Fujio Cho leads the Toyota Environment Committee and sets the company's agenda. In a speech at the 2001 Detroit International Auto Show, he said: "Toyota and the other automakers will not survive the 21st century unless we pull together now and find ways to limit the car's impact on our earth...Clearly it's time for the world's automakers to deal with this issue. We need to make this new century the start of a unified effort to better tune the automotive industry to the needs of the earth...we plan to accelerate our efforts to foster even more industry cooperation over the next three years. It is more than just good business for Toyota; it is the key to the future of our industry and a necessity for a healthy future for people everywhere."
- Have appointed 230 Environmental Leaders, each responsible for promoting environmental awareness:
 - Conduct environmental leadership training every two months or so
 - Have placed on the Internet a Toyota Environmental Textbook (47,000 hits in first month) and distributed it to 1,000 affiliated companies.
- All Toyota personnel undergo environmental training.
- Conduct a Global Environment Month each June (and has done so since 1972) in which every employee is involved in some way. Examples of activities include environmental lectures, office waste reduction activities, providing information on the Toyota Earth Charter, publication of an environmental awareness magazine, recycling training sessions, environmental event badges distributed to all employees, and environmental beautification projects.
- Have established a Global Warming Prevention Council (reports up through the Production Environment Committee).
- Have established the Biotechnology and Aforestation Business Department to establish a profitable business while contributing to environmental improvements through tree planting (one means of carbon sequestration). It is possible (but not confirmed) that this business has led to the development of the sweet potato and fermentation processes used in the production of Toyota's biodegradable plastic, discussed in the Recycling/Recycled and Renewable Content Section of this report.
- Have established a Production Environment Logistics Subcommittee (reports up through the Production Environment Committee).
- Have established a PVC-free strategy (but reversed this strategy by introducing the 2002 Camry, which uses a PVC-based IP). Toyota is still developing an alternative TPO material to provide the desired look and feel.
- Have created the North American Environment Committee for North American affiliates to discuss environmental issues and their countermeasures.
- Have added the environment as another category of its Toyota Top Team Award, given to recognize the activities of its dealers and distributors.

- Have held Global EMS Liaison meetings in each of the last two years. This year's meeting was a three-day event. It is held to promote and improve environmental management by overseas affiliates.
- Toyota Motor Sales, USA established an Environmental Coordination Office (ECO) to engage in responses to key environmental issues. ECO is responsible for providing overall environmental coordination and works closely with top managers from product planning, recycling/conservation, compliance, communications, and dealer/partnership programs.
- Have produced the Product Consulting Guide on the Environment and an accompanying video for Toyota dealers in May 2001.
- Publishes Environmental Specifications in all new vehicle model catalogs and also places this information on the Internet (3,000 hits/month). This data is also published by the Green Purchasing Network.
- Utilized LCA-based DFE in the development of the Estima hybrid.
- Is conducting LCAs in conjunction with JAMA and the Ministry of Economy, Trade, and Industry.
- Is creating their own EMS (under the Production Environment Group).

Toyota has activities underway with a number of stakeholders. Examples include:

- Testing the e-com, a 2-seat electric vehicle, in car sharing programs at the University of California at Irvine. This vehicle is also being used in car sharing programs with the city of Tokyo and with Toyota-affiliate companies. The system consists of the vehicle, IC card keys, reservations systems, recharging stations and real-time information/telematics systems.
- Working with Tokyo-based Green Earth Center in a 3 year, 3700 acre reforestation project to counter expansion of desert land in China.
- Have had a forestation project underway in Australia since 1998, in which 500 hectares of Eucalyptus trees are being planted per year. The project is scheduled to continue over a ten-year period. Toyota is conducting joint follow-up studies with the China Science Academy regarding this program.
- Formed a partnership with Coordinating Committee for Automotive Repair to provide Toyota dealers with on-line access to best management practices on pollution prevention.
- Donated Prius vehicles to 8 different Italian cities.
- Participated in 37 environmental events held by Japanese national and local governments in 2000.
- Has been a member of the WBCSD since its inception.
- Has a Senior Vice President on the board of the Electric Vehicle Association of the Americas.
- Is a member of the California Fuel Cell Partnership.
- Has an active environmental grant program to support environmental organizations and causes, as further discussed in the Socio-Economic section of this report.

In addition to these, Toyota has established partnerships with Exxon, GM, and VW. Toyota and Exxon will “*share business and technological information, identify critical cross-industry factors impacting future vehicle technology, and conduct joint research on new transportation*”

vehicle systems. The alliance recognizes the need for an integrated research approach to develop hardware and fuel combinations that provide improved energy efficiency and reduced emissions.” The agreement with GM involves the companies' combined R&D efforts to focus on electric vehicles (EV), hybrid vehicles (HV), fuel cell electric vehicles (FCEV) and other vehicles applying these advanced technologies. The partnership with VW covers the exchange of information on recycling in Europe and Japan and cooperates on developing technologies for recycling ASR and plastic components. In addition, Toyota has licensed NO_x storage/reduction technology from both VW and DCX.

Japan has enacted a Pollutant Release and Transfer Register (PRTR) law, which requires companies to report to the government the amounts of substances of concern. Toyota worked with Hitachi to establish an Information Processing System to comply with this law and established Eco Research Company, Ltd. (51% owned by Toyota) in March, 2001. This company will handle Toyota's management of information relevant to materials of concern.

Socio-Economic/Infrastructure Initiatives

Toyota has established the Toyota Environmental Activities Support Program, which they have advertised as being in commemoration of the company's 1999 receipt of the United Nations Environmental Program's Global 500 award. The program has an annual budget of 200 million Yen. Examples of this program's activities include:

- Donation of \$380,000 to the National Arbor Day Foundation.
- Financial support to environmental organizations in the year 2000 include:
 - \$200,000 to Alaska's Pratt Museum for a marine science education program.
 - \$150,000 to New York's Wildlife Conservation Society for teacher training.
 - \$85,000 to the Rochester Institute of Technology for K-12 teacher training on environmental issues.
 - \$1,000,000 to the National Audubon Society for education programs in Los Angeles.
 - \$30,000 to FRW to support community-based efforts to restore the Rouge River.

Examples of other Toyota activities in this area:

- Have over 160 electric vehicles being used in 5 different car sharing test programs.
- Have been very actively involved in the development of intelligent highway traffic systems:
 - A member of ITS (previously VERTIS, ITS has branches worldwide)
 - Development of alternative traffic systems
 - Development of ETC systems
 - The current President of ITS, Japan (Shoichiro Toyoda) is the former President of Toyota
 - Been involved in the development of DRGS – a traffic information system that determines and provides guidance on optimal routes with least congestion
 - Been involved in the development of VICS – real-time information broadcasts to car navigation systems about congestion, accidents, parking
 - Developed MONET – upon-request real-time travel information to vehicles

- Have worked to reduce vehicle noise – all Toyota passenger cars meet a voluntary noise reduction standard. (Japan’s noise standards are the strictest in the world).
- Toyota Motor North America, Inc. has announced a \$1 million donation to the American Museum of Natural History in New York City. The gift will support the AstroBulletin, which displays live high-definition views of the Earth’s landforms and oceans, giving visitors a unique perspective on the environment. Visitors can also see images of space from orbiting observatories, ask questions on computer touch screens, and explore recent astronomical research.

Supply Chain Initiatives

Toyota has countered a trend in the automotive industry toward divestiture in supplier companies. There are more than 200 companies that make up the Toyota “*keiretsu*” and Toyota has \$14B invested in their top ten suppliers. This helps Toyota control the direction of supplier activities and guarantees their support for Toyota’s objectives. Supply chain initiatives include:

- As part of Toyota’s Supplier Environmental Program, approximately 500 suppliers will be required to become ISO 14001 certified and to have EMS systems in place that are compliant with ISO 14001.
- Have established a “Parts LCA Working Group” with 14 suppliers in which they have
 - Introduced Toyota’s LCA methods
 - Exchanged manufacturing data
 - Continued to promote supplier LCA activities
- Have established environmental purchasing guidelines:
 - Distributed to 700 material and parts suppliers
 - Requested that suppliers be ISO 14001 certified by 2003
 - To assist in managing substance of concern
- The Toyota Global Warming Prevention Council has required environmental action plans from 31 companies to cover activities up through the year 2005.
- First automobile company to participate in Green Power Certification System. They have signed up to use 2M Kwh of wind-generated power per year.
- Toyota Motor Sales, USA was honored by the DOE for its use of green power.
- Established a Production Environment Logistics Subcommittee through which they have
 - Achieved a one year reduction of 3,300 tons of CO₂ emissions by implementing improved logistics plans – improved load efficiencies, altered transport routes, and mode shifts
 - Reduced packaging
 - Promoted the use of clean-energy vehicles – now totaling 26 natural gas and LPG
- Toyota developed internal criteria for buying “green product” office supplies (an example they have given are products with environmental labels) with a goal that 100% of office supplies be green products.

Facilities/Manufacturing Initiatives

Toyota has a very strong effort underway in this area of their business. They continually set measurable goals and monitor progress. Company-wide accomplishments in this aspect of Toyota's business include:

- Zero landfill waste generation was achieved at all assembly plants. (Toyota reported a case study for one plant, showing that by the third year of implementing these efforts the cost savings exceed expenditures). This was a company goal that was reached three years ahead of schedule.
- Have saved 4.4B yen in FY2000 through energy savings and waste volume reductions.
- Achieved a 78% waste reduction in FY2000 relative to FY1995.
- Exceeded their goal of stabilizing CO₂ emissions in FY2000 relative to 1990.
- Reduced scrap by 48% in FY2000 relative to FY1995.
- Reduced packaging materials by 20% in FY2000 relative to 1995.
- Certified all North American manufacturing facilities to ISO 14001.
- Introduction of cogeneration equipment in a number of manufacturing facilities.

Environmental improvements at Toyota's manufacturing facilities have often begun as initiatives at individual facilities. As these facilities have progressed toward demonstrating the feasibility of improvements in specific areas, they have been incorporated within Toyota as company-wide goals. As such, individual facility accomplishments are indicators of future company-wide initiatives. Examples of accomplishments at individual facilities include:

- Reduction in nitrogen content of wastewater at 4 plants by 20%.
- Reduction in welding splatter from 60 tons/year to 10 tons/year.

Some of the goals that Toyota has set for their manufacturing facilities include:

- Reducing water consumption by 20% at all facilities by 2005 relative to 1995.
- Converting 100% of office supply purchases to green products.
- Reducing combustible waste by 33% by 2005 relative to 1990.
- Eliminating 95% of hazardous waste going to landfill by 2005 relative to 1999.
- Reducing VOC emissions from paint.
- Replacing sand with erosion-resistant ceramic beads at the Kamigo casting plant, which produces about 50% of Toyota's engines.

Toyota is also working to eliminate waste nickel generated from painting and plating operations. Two approaches are being pursued: 1) development of materials not containing nickel, and 2) introducing a chelating coagulation process to treat nickel-containing wastewater until the new materials are developed.

Fuel Economy/Emissions

This is a very strong aspect of Toyota's business. Product accomplishments here include:

- Nineteen cars, trucks, minivans, and SUV's (more than any other manufacturer) are in the "Best of 2002" list in the Green Book, published by the American Council for an Energy Efficient Economy.
- Having more vehicles rated "most fuel efficient" in their classes than any other automotive brand. The Echo, RAV4, Avalon full size sedan, Tacoma compact pickup, Sienna minivan, and Prius hybrid are all leaders in their respective classes for fuel economy.
- Have exhibited a highly fuel-efficient concept car, ES3, at the Toyota auto show, reported to achieve 105-mpg fuel economy. The ES3 is a lightweight (700 kg) vehicle equipped with a DI Diesel and CVT with regenerative braking, which supplies current to a high voltage capacitor used for restarting the engine or recharging the battery. The ES3 also is equipped with the DPNR catalyst system. It has been reported that Toyota is planning to introduce a full hybrid version of the ES3 in California.
- Have established an "ecology" category of concept cars. Together, Toyota and Daihatsu have demonstrated a number of these vehicles at different auto shows, including the ES3 and the Ultra Fuel Economy (UFE). The Daihatsu UFE concept vehicle employs lightweight plastic body panels and aluminum components to reach an overall body mass of 630 kg and attains 55 km/L (130 mpg) fuel economy on the Japanese driving cycle.
- All Lexus V-8 passenger cars are ULEV certified for 2002.
- Developed a DPNR (diesel particulate-NO_x reduction catalyst system).
- In FY2000, developed two new direct injection gasoline engines and one new direct injection diesel engine. These have been installed on five vehicle lines.
- Have introduced several vehicles that are Step 4 compliant.
- Have introduced the Prius that meets California's SULEV standard and also the EU's Step 4 emission levels.
- Have developed diesel engine technology to compete in Europe and have entered into an agreement to sell diesel engines to BMW.

In response to a Japanese Cabinet resolution to encourage development of clean-energy vehicles, Toyota has also set a goal of having 15% of its Japanese fleet being clean-energy vehicles. Currently in Japan, 18% of Toyota's vehicle introductions are considered clean-energy vehicles.

It is also worth noting that Toyota will now be supplying diesel engines to BMW.

Developments in Alternative Fuel/Propulsion

Toyota Motor Corporation Executive Vice President Dr. Akihiko Saito has said: "For a better environment, we believe hybrid technology will be around for the next 100 years, even if cars eventually fly." In several forums, Toyota has expressed the belief that the best future application of fuel cell technology is in hybrid vehicles. They have developed (sometimes in

conjunction with Daihatsu, which is 51.2% owned by Toyota) a number of FCHVs, conventional hybrids, and other alternative propulsion technologies. Citable examples include:

- Introduced the FCHV-4 and FCHV-5, fuel-celled powered hybrid vehicles. The FCHV-5 utilizes high-pressure hydrogen storage, whereas the FCHV-4 uses Toyota's Clean Hydrocarbon Fuel and an on-board reformer to generate H₂. Vehicles with these technologies were shown recently at the Tokyo auto show.
- Daihatsu has demonstrated a MOVE FCV-K-II, a fuel cell (high pressure hydrogen storage) hybrid minicar that also has a CVT (shown at the Tokyo auto show).
- Developed a FCHV-BUS1 (in conjunction with Hino Motors, Ltd.), powered by a high pressure hydrogen system.
- Daihatsu has demonstrated a Ultra Fuel Economy vehicle with a claimed fuel economy of 55 km/L (130 mpg on the Japanese driving cycle). The vehicle uses a hybridized 660cc diesel engine and has a total mass of 630 kg.
- Daihatsu demonstrated the Atrai Hybrid-IV at the Tokyo auto show, a micro van with a 660cc engine with Dynamic Variable Valve Timing combined with a flywheel motor and electronically controlled 4 speed transmission. This system is claimed to improve fuel economy by 30% on the Japan driving cycle.
- Intend to launch a FCHV on a limited basis in 2003.
- Plan to produce 300,000 hybrid vehicles per year by 2005.
- Unveiled a hybrid system called THS-M (Toyota Hybrid System-Mild). When a THS-M vehicle comes to a stop, the system goes into "idling stop" mode, automatically shutting down the engine. When decelerating or braking, the motor acts as a generator to convert braking energy into electrical energy that is recovered by the battery.
- Introduced ZEV SUV's available in California.
- Introduced a 4-wheel drive hybrid minivan in Japan.
- Introduced a CVT in the Opa.
- Introduced the Estima hybrid, the world's first electric 4-wheel drive system coupled to a gasoline engine with CVT.
- Introduced 2 new CNG powered trucks in Japan.
- Developed the e-com, a 2-seat electric vehicle being tested in car-sharing programs.

Recycling/Recycled and Renewable Content

Recyclability standards have been set for the EU and are proposed by the Japanese government, so performance in this area is largely mandated. However, efforts to utilize recycled and renewable material content in vehicles are a matter of company discretion. Toyota has many noteworthy accomplishments in the areas of recyclability and recycled content. Three potentially significant trends that stand out in this list of developments are Toyota's move into bio-degradable plastics, remanufacturing of used components, and the recycling of ASR.

Toyota:

- Developed TSOP (Toyota Super Olefin Polymer), a recyclable material that does not deteriorate even after repeated reuse. This material reduces weight by 10% from the previously used material. It is being extensively used in the Lexus LS430 (front and rear bumpers and side rocker panels) and made up 25% of all plastics used by Toyota in

FY1997. Toyota also claims that this material enabled them to reduce the number of plastics used in interior and exterior parts from 20 to 2, improving recyclability.

- Developed materials with improved recoverability over PVC, thus reducing PVC use to 1/3.
- Are using a renewable material, Kenaf, in door trim and package trays. The material was produced in conjunction with Araco Corp.
- Developed a biodegradable plastic from starch extracted from plants. In April 2001, Toyota teamed with Mitsui & Co., Ltd. to establish a joint venture company – P.T. Toyota Bio Indonesia, which will produce animal feed and biodegradable plastics, using a specially developed sweet potato as a raw material. The company plans to build a plant in 2003 to produce the raw materials for biodegradable plastics using its own original fermentation process. Toyota claims this material will replace petroleum-based plastics for use in vehicle interiors, food containers, and household electronics.
- Utilized biodegradable plastic in conjunction with natural fibers in parts produced for the ES3 concept vehicle.
- Purchased the biodegradable plastics division of Shimadzu Corporation.
- Claims to have used 530,000 tons of recycled content in FY2000.
- Started the world's first ASR recycling plant.
 - Reclaimed 2,620 tons of ASR for recycled sound proofing material
 - Reclaimed 210 tons of copper
 - Reclaimed 71 tons of glass
- Achieved 90% recyclability for vehicles recycled at the ASR plant.
- Began recovering and recycling of NiH batteries.
- Developed, in conjunction with Kojima Sangyo Co., Ltd., a method to recycle polyurethane bumpers into a material used for vehicle components (e.g. battery trays).
- Toyota, in conjunction with JAMA and JAPIA, built an HFC134a recovery and destruction system, which has been in operation since May, 2001. A similar system to recover CFC 12 has been in operation since 1998.
- Have collected and recycled 546,000 bumpers from dealers.

Toyota is also increasingly involved in remanufacturing of used components: They report having remanufactured:

- 23,400 automatic transmissions
- 300 turbo chargers
- 15,800 power steering systems
- 3,800 torque converters

In addition to these established remanufacturing operations, Toyota has established a new joint venture to remanufacture air conditioner compressors, with plans to refurbish as many as 110,000 units in 2003

Summary

Toyota utilizes a combination of top-down company management and employee engagement to promote and complete environmental initiatives across every aspect of the business and the vehicle life cycle. The Toyota Environment Committee is chaired by the company president, who sets the environmental agenda for the company. Company environmental goals are established on a yearly basis and progress monitored. Every employee is engaged in the process through publication of environmental magazines, website communications, and annual environmental conferences with presentations, training sessions, and environmental programs.

Toyota includes their dealers and marketing efforts in their environmental initiatives. They provide their dealers with a Product Consulting Guide on the Environment and an accompanying video. They publish Environmental Specifications in all new vehicle model catalogs as well as adding this information to the company website. Also, Toyota added the environment as another category of its Toyota Top Team Award, given to recognize the activities of its dealers and distributors.

Toyota is beginning to use LCA-based DFE in vehicle development programs, having used this in the development of the Estima hybrid. They also have LCA programs underway with JAMA and the Ministry of Economy, Trade, and Industry. Toyota has also established an LCA working group with a number of suppliers. This adds efficiency to the process because the time consuming aspect of performing an LCA is largely associated with the acquisition of data from suppliers.

Toyota has significant financial investments in many of their major suppliers. This helps Toyota control the direction of supplier activities and guarantees their support for Toyota's objectives. Toyota affiliated companies are required to provide environmental action plans. Toyota has also established Environmental Purchasing Guidelines, which help to promote their environmental goals.

Toyota has a strong history of managing their manufacturing activities. They routinely set increasingly stringent environmental goals. They have attained zero landfill waste from all assembly plants and they have certified all of their North American manufacturing facilities to the ISO14001 standard.

Toyota has established a reputation for producing highly fuel efficient and environmentally friendly vehicles. They have more vehicles rated "most fuel efficient" in their class than any other manufacturer. Also, they have more vehicles in the "Best of 2002" list in the Green Book than any other manufacturer. In the area of emissions, Toyota has introduced a number of vehicles that meet ULEV and Step 4 emissions standards. Toyota has the largest existing fleet of production hybrid vehicles of any OEM. They believe the future use of fuel cells in vehicles is their application in hybrid vehicles. They now have the FCHV-4 with high pressure H₂ storage and the FCHV-5, which uses a reformer in conjunction with CHF. Both are hybrid electric fuel cell vehicles. Toyota, in conjunction with Hino Motors, Ltd., has also developed a fuel cell powered bus, the FCHV-BUS1. They have announced their intent to introduce a FCHV on a limited basis in 2003. Their business partner, Daihatsu, has also developed the MOVE FCV-K-

II, a fuel cell hybrid vehicle that also has a CVT. In addition, Daihatsu had developed a diesel hybrid, which they describe as a Ultra Fuel Economy vehicle, claiming it attains 55 km/L (130 mpg) on the Japanese driving cycle. Daihatsu has also demonstrated the Atrai Hybrid IV, a microvan, reportedly attaining 30% improved fuel economy over a comparable vehicle with conventional propulsion. Toyota's commitment to hybrid technology is indicated by their announced intent to produce 300,000 hybrids per year by 2005.

In other areas of alternative propulsion, Toyota has introduced two vehicles equipped with a CVT – the Estima and the Opa. They have also developed the e-com, a 2-seat electric vehicle that they are testing in a number of ride sharing test programs, have introduced two new CNG-powered trucks in Japan, and have a ZEV SUV available in California.

In the area of ELV initiatives, Toyota has three significant developments underway. One is an increasing effort in the remanufacturing of used components. Another is the development of components from a biodegradable plastic. Toyota is building a plant in Malaysia to produce the raw materials for this plastic and have also purchased the biodegradable plastics division of Shimadzu Corporation. Lastly, Toyota has built an ASR recycling plant to develop applications for ASR and increase vehicle recyclability.