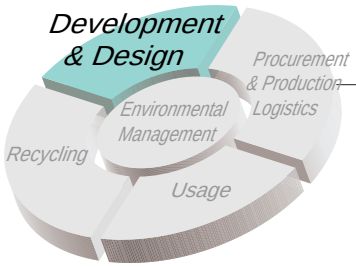



# Further Promotion of Innovation and Practical Usage of Environmental Technology

**Hiroyuki Watanabe**
**Managing Director and Chairman of Environmental Product Design Assessment Committee**

Hiroyuki Watanabe joined Toyota in 1967. He became a member of the board of directors in 1996 following various assignments, including that of Chief Engineer for the Crown, and later led efforts to develop electric vehicles. When he became Managing Director in June 1999, he was also appointed Chairman of the Environmental Product Design Assessment Committee. In addition, he has been overseeing Toyota's efforts to develop fuel-cell systems.

## Promoting Product Development Utilizing ISO 14001

### Achieving Goals in All Environmental Areas

In FY1999, Toyota again applied operation of the Product Environmental Management System based on ISO 14001 to all new models produced and sold in Japan as well as vehicles that underwent complete redesigns. As a result, in all six environmental areas, performance steadily improved and goals were achieved.

The fourth internal audit, performed in October 1999, indicated that "overall operation is proper and in compliance with procedures, and there was a large drop in the number of matters needing improvement, down from 28 last year to just 11 this year."

In addition, the second ISO 14001 maintenance inspection, performed by an external audit body in February 2000, confirmed that Toyota's Environmental Management System is being maintained and improved appropriately.

## FY1999 Environmental Actions in Six Environmental Areas

### (1) Improving fuel efficiency

In response to achieving FY2000 goals of average fuel efficiency for gasoline-powered passenger cars by equivalent inertial weight[1] categories (old version) set by the government, Toyota set its own voluntary goals taking the government figures* into consideration and worked continuously to improve fuel efficiency.

Toyota was able to meet the goals in category 1 and 2, and has a concrete estimation as to when the goal in category 3 will be achieved.

● **The government targets for average fuel efficiency in FY2000 (old version) are:**

Category 1 <875kg>: 18.2km/liter
Category 2 <1,000-1,500kg>: 13.0km/liter
Category 3 <1,750kg->: 9.1km/liter

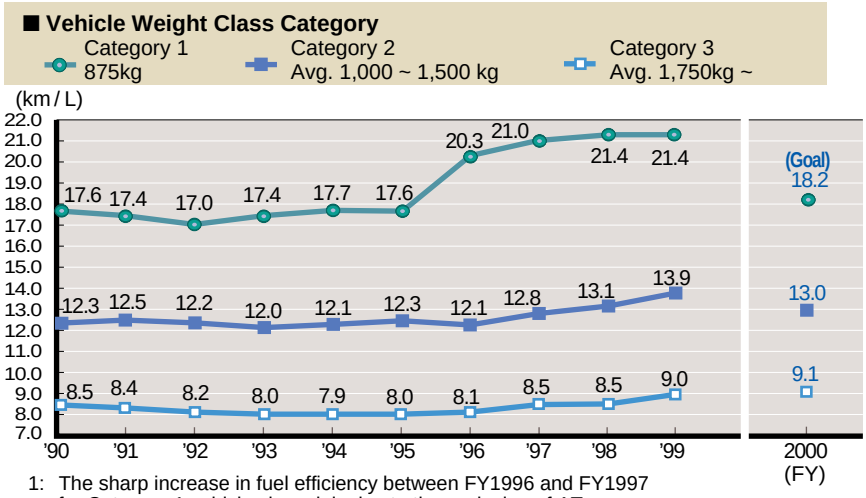
* In conjunction with the revision of the Energy Conservation Law, new government goals were established (to go into effect in 2010 for gasoline vehicles and 2005 for diesel vehicles). Toyota has initiated actions in response to these new goals.

● **Subject Areas and Goals**

| Subject area | FY1999 goal |
|---|---|
| (1) Improving fuel efficiency | ● In consideration of government objectives for passenger car fuel consumption in FY2000 (old version), establish even stricter voluntary standards and achieve fuel efficiency at the top level in each vehicle class by that year. |
| (2) Reducing exhaust emissions | ● Establish voluntary standards stricter than exhaust emissions standards set by law and achieve them on all vehicles. At the same time, Toyota is taking action to comply with the year 2000 restrictions for designated vehicles (gasoline passenger cars) before they go into effect and is responding to the low-emissions vehicle certification system. |
| (3) Reducing external automobile noise | ● Establish voluntary standards to ensure compliance with external vehicle noise standards set by law and achieve them on all vehicles.<br>1. Achieve by the end of 2001: Passenger cars<br>2. Achieve by the end of 2002: Trucks |
| (4) Using less refrigerant in air conditioner | ● Establish voluntary standards for conserving use of substitute refrigerant (HFC134a) and achieve those standards on new mass-production models and models that undergo complete design changes by 2000. |
| (5) Reducing substances of environmental concern | ● Cut the amount of lead use by one-half of auto industry's 1996 level on new mass-production models and models that undergo full-model changes by 2000, and cut use of mercury and cadmium below present levels. |
| (6) Improving recoverability | ● Steadily improve vehicle recoverability[2] and achieve 90% recoverability by 2000. |

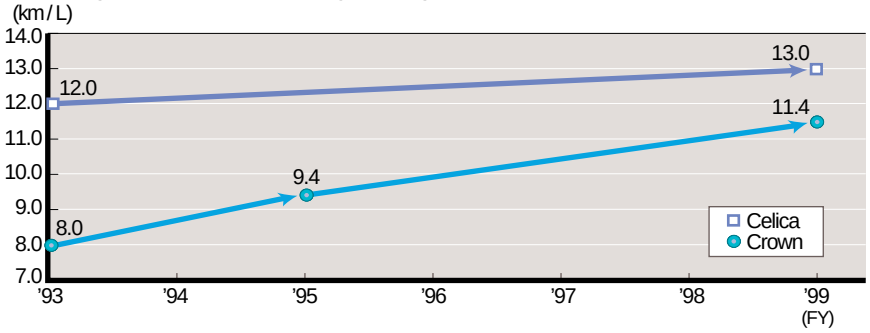
1. Equivalent inertial weight:
   The mass of the test vehicle to be approved when conducting emissions and fuel economy testing.
2. Toyota has established its own recoverability standards and has been working to improve recoverability. Note that no progress was made during FY1999 toward establishing a standard international definition of recoverability.

● **Average Fuel Efficiency Trends by Category**




1: The sharp increase in fuel efficiency between FY1996 and FY1997 for Category 1 vehicles is mainly due to the exclusion of AT vehicles, leaving only MT vehicles in this category.
2: Although AT vehicles (Vitz) were added to Category 1 again in FY1998, the average fuel efficiency improved.

● **Changes in Fuel Efficiency in Major Vehicles** (Vehicles with Automatic Transmission)




## (a) Development and application of the new D-4 direct-injection gasoline engine

In FY1999, the new D-4 engine was adopted for use in the Crown. Crowns with the D-4 2JZ-FSE engine achieved a 21% increase in fuel efficiency from 9.4km/liter to 11.4km/liter through the use of an expanded stratified combustion area stabilized with a high pressure slit nozzle injector that improves fuel injection, and additionally through the adoption of VVT-i and a high-efficiency transmission.

*VVT-i:
Variable Valve Timing-intelligent continuously optimizes intake valve opening/closing timing based on the engine's operational condition, thus significantly improving fuel efficiency and resulting in cleaner emissions.

Senji Kato (middle) of the Engine Engineering Division I, Hidekuni Hashizume (left) and Yukikazu Ito (right) of the Power Train Engineering Division I, examine the design of the new D-4 engine.

## (b) Development and application of small, lightweight gasoline engines

Following the SZ and ZZ series engines, Toyota developed the NZ and AZ series as next-generation gasoline engines. The NZ series features an aluminum block and the use of plastics and stainless steel in the intake and exhaust systems to achieve a lighter weight and smaller size. The series also adopted VVT-i.

These new engines were employed in the Platz, FunCargo, bB and WiLL Vi and achieved fuel efficiency at the highest levels in their respective classes. Also, fuel efficiency increased 28% with the 2AZ-FE engine used in the Estima from 8.3km/liter to 10.6km/liter through the synergy effects of adopting an aluminum cylinder block, magnesium cylinder head covers and a plastic intake manifold as well as VVT-i and front-wheel drive.

In addition, the lightweight 1ZZ-FE engine is employed in the new MR-S and the Celica following a complete redesign. The MR-S achieved fuel efficiency of 14.2km/liter, which is in the top level in its class. The Celica adopted the 2ZZ-GE, which features an all-aluminum cylinder block and achieve a 7% increase in fuel efficiency compared to earlier models.

■ **Major New Engines**

| FY | Model | Displacement (unit: liter) | Models |
|---|---|---|---|
| '98 | 1ZZ-FE | 1.8 | Vista |
| | 1SZ-FE | 1.0 | Vitz |
| '99 | 2NZ-FE | 1.3 | Vitz, Platz, FunCargo, bB, WiLL Vi |
| | 1NZ-FE | 1.5 | Platz, bB, FunCargo |
| | 2ZZ-GE | 1.8 | Celica |
| | 2AZ-FE | 2.4 | Estima |

### (c) Increasing the number of vehicles furnished with high-efficiency transmission "Super ECT[1]"

Toyota is steadily expanding the adoption of the "Super ECT," which increases the efficiency of transmission and contribute to improving fuel efficiency with its highly efficient torque converter[2] and Flex lock-up system[3]. In FY1999, Toyota incorporated it into all new models and all automatic-transmission passenger cars undergoing complete redesigns (seven vehicle series).

In addition, 4WD mechanism is employed in the Crown Majesta, Platz, FunCargo, bB and Estima, where it contributes to improving fuel efficiency by distributing torque optimally between the front and back wheels through electronic control according to driving conditions.

### (d) Better fuel efficiency through lighter weight and lower air resistance

Toyota has undertaken further weight reduction in new models in FY1999. A lighter body with high rigidity has been achieved in the bB through structural analysis by supercomputer of all junctions between body frame parts, panel structures and welding locations. In the Celica, further weight reductions have been made even in the air conditioner and moon roof sliding panel. The largest reductions have been made in the Estima, which has been furnished with the new 2AZ-FE engine, with a reduction of about 150 kg compared to its previous weight.

In addition, improvements have been made in air resistance. In FY1999, $C_D$ (drag coefficient) values of 0.29 and 0.30 were achieved for the Crown and the Estima, respectively.

## (2) Reducing exhaust emissions

Along with the reduction of $CO_2$ through improving fuel efficiency, reducing CO, HC, NOx and other elements in exhaust emissions are important environmental issues. Toyota is setting its own voluntary standards with regard to new regulations and technical guidelines from the Japan Environment Agency and establishing plans for attaining these based on ensuring cleaning performance even after long-term usage (durability), when components such as the catalytic converter begin to deteriorate. In FY1999, many vehicle series and engines met these standards in accordance with the plan.

### (a) 11 Vehicle series cleared J-TLEV[4] standards (in-company evaluation)

Exhaust emission standards for gasoline vehicles in 2000 stipulate reductions in emissions of CO, HC and NOx from passenger cars by about 70% compared to 1998 standards and ensure driving durability of 80,000 km.

With respect to this, Toyota achieved in advance, its own revolutionary targets for FY1999, these goals for 11 vehicle series (34 models).

Among these, 11 vehicle series (26 models), including the Crown (excluding the 2.5 liter turbo and 4.0 liter 4WD), achieved reductions in NOx and HC of 25% beyond exhaust emission standards for 2000. Thus, they cleared Toyota's voluntary standards (according to an in-company evaluation) with respect to the J-TLEV (Japan Transitional Low Emission Vehicles) standard values in Japan Environment Agency Exhaust Emissions Technology Guidelines for Low-Emission Vehicles.

The Crown's new direct-injection engine achieved the following:

- Control of NOx generation through controlling the combustion temperature of the fuel-air mixture according to load
- Improvement in catalytic converter material
- Adoption of "fine hexagonal cell structure ceramic filter substrate," which increased the exhaust emissions contact surface area, and achieved greater performance in the NOx storage reduction three-way catalytic converter.

This was the first time for a vehicle with a direct-injection engine cleared Toyota's voluntary standards with respect to the J-TLEV.

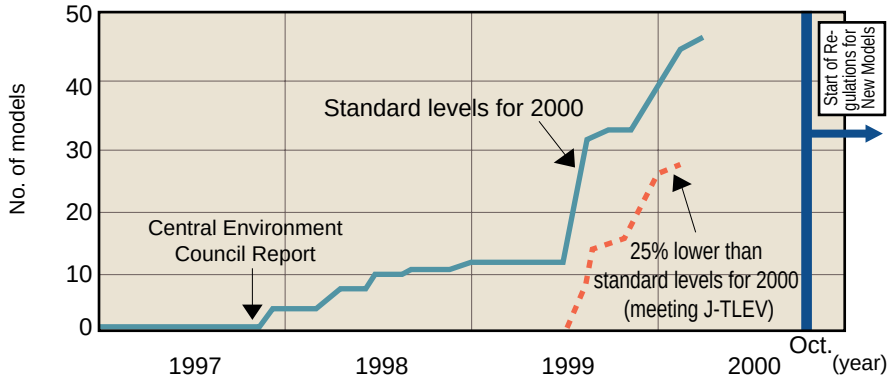
In clearing these voluntary standards, Toyota adopted VVT-i and forward-placed catalytic converter technology in the Estima's engine. A fuel atomizing injector, which is aimed at improving the combustion of the fuel-air mixture, independent control of fuel injection to each cylinder, posterior exhaust layout and other technologies have contributed to improvements in the NZ-type engines of the Platz, FunCargo and other vehicles.

● **Vehicles Meeting Exhaust Emission Standards of FY2000**

| Vehicle series | Model | Engine |
|---|---|---|
| Estima L/T | **ACR40W ACR30W** | 2AZ-FE |
| | **MCR40W MCR30W** | 1MZ-FE |
| Crown Crown Estate Crown Majesta | **JZS173** | 1JZ-GE |
| | **JZS171** | |
| | JZS171 | 1JZ-GTE |
| | **JZS179** | 2JZ-GE |
| | **JZS175** | 2JZ-FSE |
| | **JZS173W** | 1JZ-GE |
| | **JZS171W** | |
| | JZS171W | 1JZ-GTE |
| | **JZS175W** | 2JZ-FSE |
| | **JZS177** | 2JZ-FSE |
| | **UZS175** UZS173 **UZS171** | 1UZ-FE |
| FunCargo | **NCP20** | 2NZ-FE |
| | NCP21 NCP25 | 1NZ-FE |
| Platz | **SCP11** | 1SZ-FE |
| | NCP16 | 2NZ-FE |
| | NCP12 | 1NZ-FE |
| Windom Mark II Wagon | **MCV20 MCV20W** | 1MZ-FE |
| Vitz | **SCP10** | 1SZ-FE |
| | **NCP10** NCP15 | 2NZ-FE |
| Celica | **ZZT231** | 2ZZ-GE |
| | **ZZT230** | 1ZZ-FE |
| MR-S | **ZZW30** | 1ZZ-FE |
| Progrès | **JCG15** | 1JZ-GE |
| bB | **NCP30** | 2NZ-FE |
| | NCP31 NCP35 | 1NZ-FE |
| WiLL Vi | **NCP19** | 2NZ-FE |

* Bold type indicates that these models cleared the J-TLEV emission levels.

● **Trend in the Number of Gasoline Vehicle Models Achieving Year 2000 Emissions Regulations**



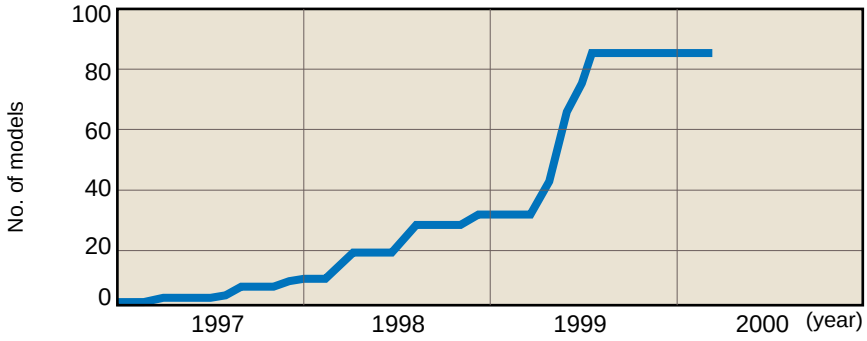

### (b) Cleaner diesel engines

In FY1999, Toyota achieved the 1997 and 1998 exhaust emission standards (the latest exhaust emissions regulation) for diesel vehicles in all of its vehicles within the grace period. Further reductions of NOx, smoke and PM[5] have become an issue regarding diesel vehicles.

The 1KZ-TE engines of the new model vehicles Granvia, Regius, Grand Hiace and Touring Hiace launched in FY1999 use technology such as electronically controlled fuel injection systems, electronically controlled EGR systems, oxidizing catalytic converters for diesel engines, which achieve reductions of 50% or more of SOF (soluble organic fractions) in the exhaust emissions, and highly efficient turbochargers with intercoolers. These reduced NOx, PM, CO and HC in the exhaust emissions, and restricted the black smoke that is characteristic of diesel engines to levels imperceptible to the eye even at high altitudes where conditions are tough.

In FY1999, 12 vehicle series (54 models) of diesel vehicles, including RVs and vans, met the emission standards of 1997 and 1998, and all achieved Toyota's voluntary goal of "smoke at imperceptible levels."

● **Trend in the Number of Diesel Vehicle Models Responding to Engine Emissions Standards for 1997 to 1998**




● **Vehicles meeting the emissions standards of 1997 and 1998, and achieving Toyota's voluntary target of "smoke at imperceptible levels" (Diesel vehicles)**

| Series | Model |
|---|---|
| Land Cruiser Prado | KZJ90W, 95W |
| Land Cruiser | HZJ71, 71V, 74V, 74K, 76V, 76K, 79 |
| Hiace Wagon | KZH100G, 110G, 120G, 106G, 106W, 116G |
| Hiace Van | KZH132V, 138V |
| Granvia<br>Grand Hiace | KCH10W, 16W |
| Regius<br>Touring Hiace | KCH40W, 46W |
| Lite Ace<br>Town Ace | CM70, 75, 80, 85 |
| Quick Delivery 100 | LH82K |
| Quick Delivery 200 | BU280K, 281K |
| Megacruiser | BXD20V |
| Dyna<br>Toyoace | BU301, 301A, 306, 306V, 346, 400, 410, 420, 430, LY102, 112, 122, 132, 152, 162, 202, 212 |
| Coaster/Coaster Big Van | BB58, HDB50, 51, HZB40, 41, 46V, 50, 56V |

1. ECT: Electronic Controlled Transmission
2. Torque converter:
   Using fluid to convey power, it has the function of amplifying torque, or the engine's rotational power.
3. Flex lock-up system:
   An automatic transmission device, which uses mechanical force and hydraulic pressure to choose the proper power transmission allocation in accordance with driving conditions. At slower speeds, in particular, it improves fuel efficiency by increasing the efficiency of transmission.
4. J-TLEV: Japan Transitional Low Emission Vehicles
   Vehicles which fit the definition outlined in the Japan Environment Agency's Exhaust Emissions Technology Guidelines on low-emission vehicles.
5. Particulate Matter:
   Granular material consisting mainly of fly ash and unburned hydrocarbon.

### (c) Firm establishment of basic technology for new catalytic converter system for use in diesel vehicles

Toyota announced in July 2000 the Diesel Particulate NOx Reduction System, which utilizes NOx storage reduction three-way catalytic converter technology to remove particulate matter and NOx from diesel vehicle exhaust emissions and continuously cleans them. Toyota plans to confirm system performance including cleaning performance, durability and reliability and to install the system in diesel engines beginning in 2003 corresponding to the supply of low-sulfur diesel fuel.

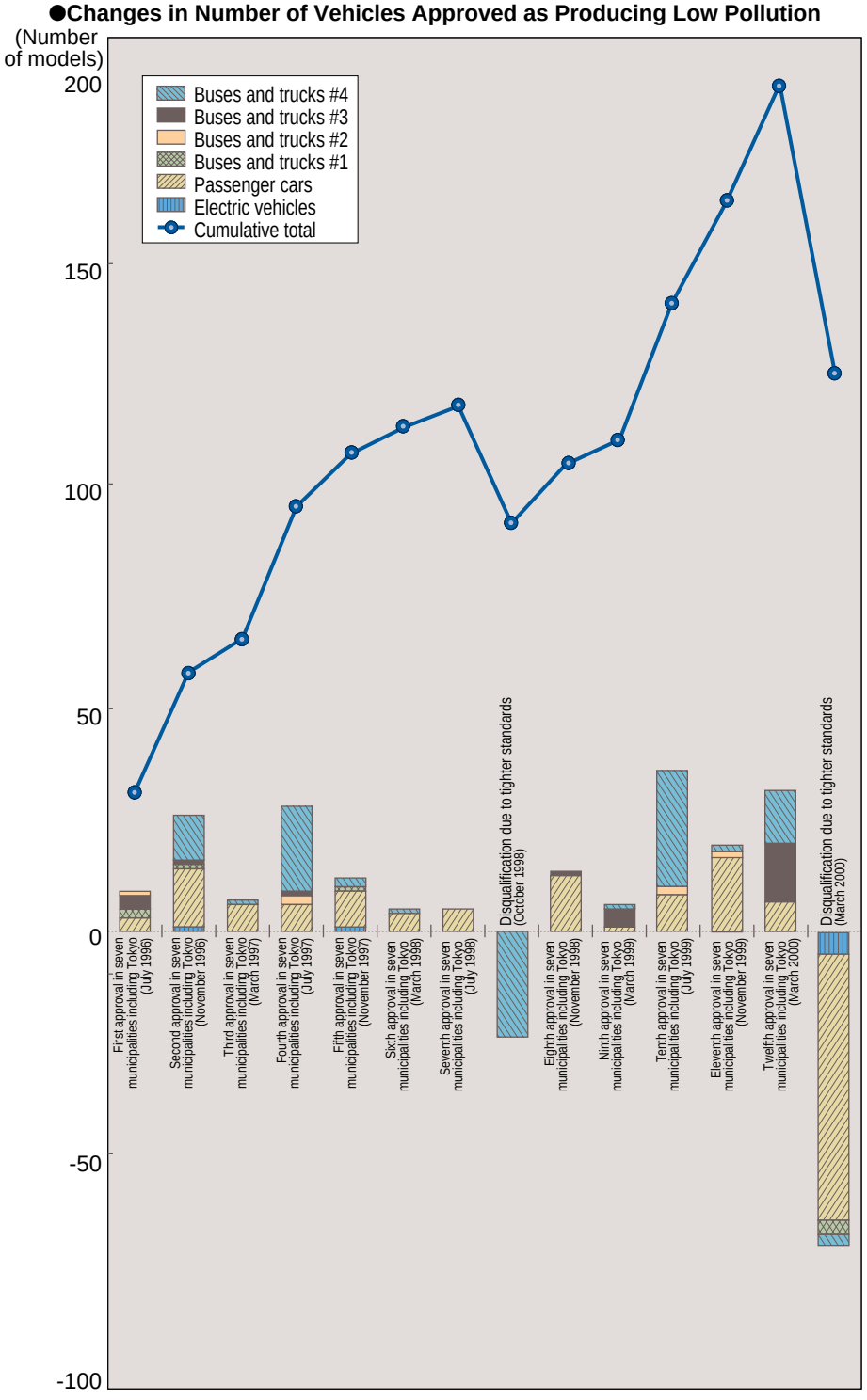
Catalytic converter system DPNR

### (d) 83 Models certified under low-emission vehicle designation system

The low-emission vehicle designation system adopted by seven Tokyo area municipalities and six Kyoto, Osaka and Kobe area municipalities sought participation three times in FY1999, and Toyota participated each time, obtaining certification for 83 additional models (67 models were excluded from designation as a result of the tightening of standards in March 2000).

Following the tightening of the standards, 30 passenger car models met the new standards.

**●Changes in Number of Vehicles Approved as Producing Low Pollution**




Note: The number of certified vehicles decreased after the 7th round because the certification standards were tightened on October 1, 1988, resulting in the cancellation of certification for buses and trucks #4. The reason for the decrease in certified vehicles following the 12th approval was a tightening of the certification standards in March 2000, resulting in the exclusion of passenger cars from the designated category.
For details on the low-emission vehicle designation system of the seven Tokyo arrea municiplities see the FY1998 Environmental Report or visit Toyota's website at http://www.global.toyota.com

## (3) Reducing external automobile noise

Toyota has worked on continuous improvements to meet the goal of applying its voluntary standards on external automobile noise to all vehicles. In FY1999, 19 passenger car series and two truck series (for a total of 21 vehicle series) met the standards.

Major noise reduction measures include the following. To reduce engine noise, an engine cover, a rubber insulator and a sound-absorbent engine undercover have been added. Intake system noise has been cut by utilizing a dual intake system and a large-capacity surge tank. Concerning the exhaust system, use of an exhaust manifold with a separator and a triple-skin main muffler work to reduce external automobile noise.

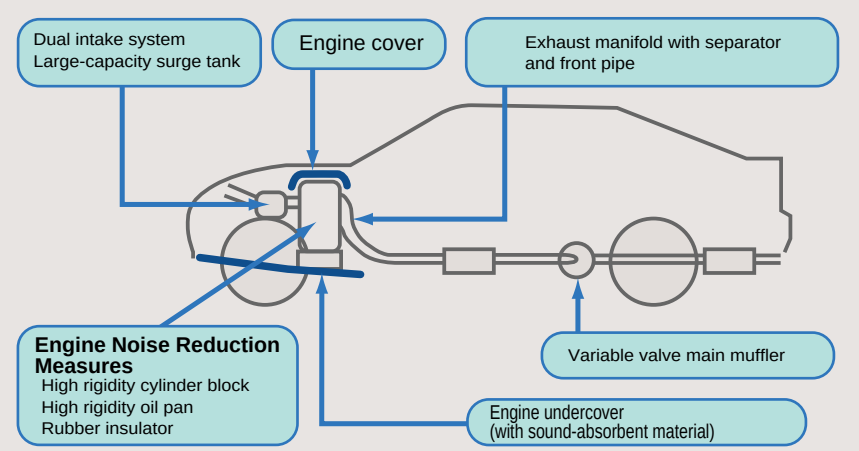
## (4) Reducing air conditioner refrigerants

In 1993, Toyota discontinued the use of CFC12, which was identified as a substance that depletes the ozone layer, and completed a switchover to HFC134a, an alternative refrigerant, in all vehicle series. As a next step, Toyota worked to improve air conditioners so that they would require less refrigerant mass. Decreasing the refrigerant mass also reduces the chances of leakage.

These goals were achieved with 10 vehicle series – eight passenger car series and two truck series – in FY1999. Refrigerant volumes were reduced by an average of 20%.

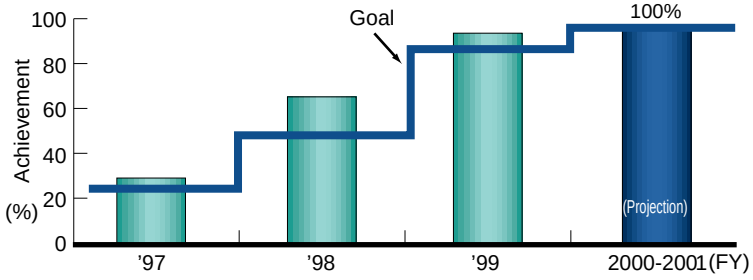
Research and development of an air conditioner utilizing $CO_2$ refrigerant, which has much less environment impact, was established as a goal in the Third Environmental Action Plan and work has commenced. Development is also progressing towards the 2005 completion of a system to recover and reuse HFC134a.

● **Example of Measures to Reduce Noise Pollution**



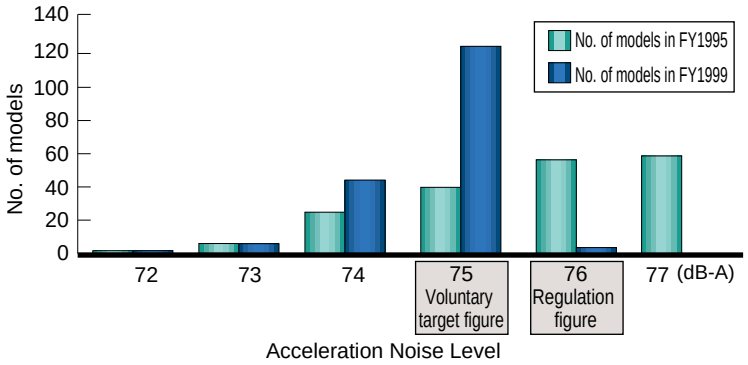

Example of Noise Reduction Measures on the Celica

● **Noise Reduction Goal Achievement in Passenger Cars**




*Achievement refers to the number of vehicle series, within all series (46 vehicle series), that meet stricter regulations.
Note: FY1999 breakdown of the 19 vehicle series: Platz, FunCargo, WiLL Vi, Celica, bB, MR-S, Supra, Soarer, Majesta, Crown, Land Cruiser Prado, Estima, Hiace Wagon, Regius, Granvia, Vitz(NZ series), Crown Comfort, Comfort and Townace Noah

● **Trends in Acceleration Noise of Passenger Cars**




Acceleration Noise Level

Please see "Recycling" on pages 56 to 58 for details concerning (5) Reduction in substances of environmental concern and (6) Improvements in recoverability.

## Development and Promotion of Clean-Energy Vehicles

### Further Advances in Hybrid Vehicles (HV)

In order to promote and popularize clean-energy vehicles, Toyota is advancing with development of fuel cell electric vehicles. At the same time, it also considers important "hybridization with existing power sources" so that new infrastructure facilities are not necessary.

In October 1999, Toyota announced a compact nickel-metal hydride battery which was developed jointly with Panasonic EV Energy, to be used in HV drive trains. In addition to improved pole plates and materials, this battery features an angular shape, rather than a cylindrical one as previously. As a result, it achieved a volume reduction of 40% and weight reduction of 20%. This contributed to better fuel efficiency as well as enabled the vehicle's luggage space to be expanded.

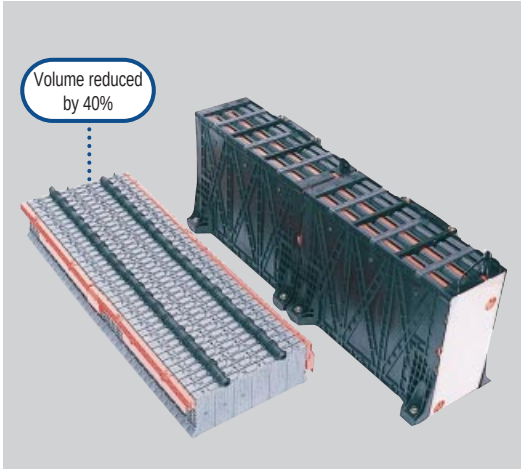
The new Prius

The new model Prius was launched in May 2000 and equipped with this new compact nickel-metal hydride battery. The fuel efficiency has been raised to 29 km/liter from 28 km/liter in the previous model, and at the same time, its acceleration performance has improved. Moreover, the vehicle was able to ensure plenty of width and length in the luggage space, which is one of the primary functions of a car.

In addition, development of a new catalytic converter has improved emissions performance at start-up, when the engine is cold. This has achieved a 75% reduction in NOx and HC below the emissions standards for 2000. This marks the first time a gasoline vehicle has attained the level of "Ultra-low emission vehicle" as set forth by the Ministry of Transport in "Approval System of Low-Emission Vehicles ."


Luggage space with plenty of width and length thanks to the smaller battery


Reclinable rear seat, split at a 6:4 ratio, with a "trunk-through" function



New model (left) and old model (right) of the nickel-metal hydride battery


Considering the design of the new battery (from the left): Masayoshi Iwase, Nobuaki Kiya, Shogo Yoneda and Tomokazu Yamauchi of the EHV Engineering Div.

## Expansion of Experimental Operation of EV Commuter System

Toyota has developed a joint use system, called "Crayon," which combines EV commuter vehicle, e-com, with data communications technology and serves as a new commuting system for reducing environmental impact. In July 1999, full-scale operation of the new system was initiated in Toyota City. The system was improved in January 2000, reducing the period users have to reserve ahead of time and allowing more people to use it. As of April 2000, Crayon employs 50 e-coms[1] and provides transportation for 500 members.

In addition, between January and March 2000, Toyota performed a joint test of an EV commuter system incorporating 20 e-com and ITS technology, in corroboratory experiments[2] of a second car system for residential areas by the Association of Electronic Technology for Automobile Traffic and Driving.

Toyota plans to continue conducting research on commuter system models that have less impact on the environment using EVs.

Second Car System for Residential Areas Experiment (in Tama New Town, Tokyo)

## Number of Clean-Energy Vehicles sold in FY1999

The number and types of clean-energy vehicles Toyota sold in Japan during FY1999 and their respective market shares were electric vehicles: 46 units (20.9%); hybrid vehicles: 14,289 units (94.6%); and CNG vehicles: 178 units (11.1%). The combined total for the three types was 14,513 down from the previous fiscal year, as sales of the Prius stabilized. They account for about 1% of overall Toyota's vehicles sold.

Toyota has also established "diesel alternate LPG vehicles," which are trucks and trash-collection vehicles equipped with LPG-powered engines, in order to deal with the environmental impact of commercial vehicles, especially those with diesel engines. Toyota sells 600 to 700 such vehicles a year. Overseas, Toyota, in cooperation with the State of California carried out a demonstration program of electrical vehicles equipped with advanced batteries and sold 255 units in 1999.

● **Number of Toyota's Clean-Energy Vehicles Sold (in Japan)** <Unit: vehicles>

| | FY1998 | FY1999 |
|---|---|---|
| Electric vehicles | 93 | 46 |
| Hybrid vehicles | 18,558 | 14,289 |
| CNG vehicles | 110 | 178 |
| Subtotal | 18,761 | 14,513 |
| Percentage relative to all Toyota vehicles sold in Japan | 1.1% | 0.9% |
| Total number of Toyota vehicles sold | 1,678,668 | 1,674,631 |

● **Total market for all makers (in Japan)** <Unit: vehicles>

| | FY1998 | FY1999 |
|---|---|---|
| Electric vehicles | 250 | 220 |
| Hybrid vehicles | 18,600 | 15,100 |
| CNG vehicles | 1,400 | 1,600 |
| Subtotal | 20,250 | 16,920 |
| Percentage relative to all vehicles sold in Japan | 0.3% | 0.3% |
| Total number of vehicles sold in Japan | 5,866,782 | 5,881,989 |

* Total of clean-energy vehicles:
Partly estimated by Toyota
All Toyota vehicles sold in Japan and total number of vehicles sold in Japan: Based on surveys by Japan Automobile Dealers Association and Japan Minivehicles Associations

## Introduction of Clean-Energy Vehicles on Company Campus

In 1995, a Cabinet resolution was adopted by the Japanese Government requiring 10% of all government vehicles to be clean-energy vehicles. Toyota has since set a goal of making at least 15% of its in-company use vehicles to clean-energy vehicles. By March 2000, it had introduced 302 clean-energy vehicles (a 16% introduction ratio), mostly Priuses.

● **Trends in Toyota's In-Company Use Clean-Energy Vehicle Introduction Ratio**

| | FY1998 | FY1999 |
|---|---|---|
| Number of vehicles owned | 252 | 302 |
| Introduction ratio | 14% | 16% |

1. e-com:
A two-passenger electric commuter vehicle.

2. Corroboratory experiments: Comprehensive experiments in "Research and development of ITS technology using clean-energy vehicles" by the New Energy and Industrial Technology Development Organization (NEDO) entrusted to the Association of Electronic Technology for Automobile Traffic and Driving.

## ● Environmental Data for FY1999 Japanese New Models and Complete Redesigns (Passenger Cars)

| | Name | Platz | FunCargo | Celica | Crown | Crown Majesta | MR-S | Estima | WiLL Vi | bB |
|---|---|---|---|---|---|---|---|---|---|---|
| Specifications | Vehicle Model | GH-NCP12 | GH-NCP20 | GH-ZZT231 | GH-JZS175 | GH-UZS171 | GH-ZZW30 | GH-ACR30W | GH-NCP19 | GH-NCP31 |
| | Engine | 1NZ-FE | 2NZ-FE | 2ZZ-GE | 2JZ-FSE | 1UZ-FE | 1ZZ-FE | 2AZ-FE | 2NZ-FE | 1NZ-FE |
| | Transmission | 4AT | 4AT | 6MT | 5AT | 5AT | 5MT | 4AT | 4AT | 4AT |
| | Weight (kg) | 930 | 1010 | 1160 | 1630 | 1730 | 970 | 1640 | 950 | 1080 |
| Start of Sales | | Aug. 99 | Aug. 99 | Sep. 99 | Sep. 99 | Sep. 99 | Oct. 99 | Jan. 00 | Jan. 00 | Feb. 00 |
| Ozone Depleting Material | CFCs | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used |
| Gas with Global Warming Effects | Amount of HFC134a as air conditioning refrigerant | 440 | 440 | 430 | 600 (750)[1] | 650 (800)[1] | 500 | 880 | 440 | 440 |
| | $CO_2$(g/km) [test mode in 10-15 mode] | 134 | 137 | 181 | 207 | 268 | 166 | 223 | 137 | 157 |
| Fuel Efficiency (km/liter) | Fuel test mode in 10-15 mode (Figure reviewed by Ministry of Transport) | 17.6 | 17.2 | 13.0 | 11.4 | 8.8 | 14.2 | 10.6 | 17.2 | 15.0 |
| | Major measures to improve fuel efficiency: In-cylinder direct injection | . . . | . . . | . . . | ❍ | . . . | . . . | . . . | . . . | . . . |
| | Major measures to improve fuel efficiency: Variable valve timing | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| | Major measures to improve fuel efficiency: Torque converter with lockup mechanism | ❍ | ❍ | . . . | ❍ | ❍ | . . . | ❍ | ❍ | ❍ |
| | Major measures to improve fuel efficiency: Power steering using electric and hydraulic sources | . . . | . . . | . . . | . . . | . . . | ❍ | . . . | . . . | . . . |
| External Vehicle Noise (Acceleration noise) (dB-A) | Adapted regulation figures | 76 | 76 | 76 | 76 | 76 | 76 | 76 | 76 | 76 |
| | Other figures | 74 | 74 | 75 | 75 | 75 | 74 | 75 | 74 | 74 |
| Exhaust Emissions[2] | J-TLEV level of low emissions applicable during the transient period (in-house evaluation) | . . . | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | . . . |
| | Compliance with year 2000 regulations | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Substances of Environmental Concern Used in Parts | Lead (Compared to the 1996 figure) | Used (less than half) | Used (less than half) | Used (less than half) | Used (less than half) | Used (less than half) | Used (less than half) | Used (less than 1/3) | Used (less than 1/3) | Used (less than 1/3) |
| | Mercury (Discharge tubes for lightings) | Not used[3] | Extremely small amount | Extremely small amount | Extremely small amount | Extremely small amount | Not used[3] | Extremely small amount | Not used[3] | Extremely small amount |
| | Cadmium (Electronic control parts) | Extremely small amount | Extremely small amount[4] | Extremely small amount | Extremely small amount | Extremely small amount | Extremely small amount | Extremely small amount | Extremely small amount | Extremely small amount |
| | Sodium Azide | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used |
| Recycling[5] | Parts using easy-to-recycle materials (TSOP) | Bumpers and interior parts | Bumpers and interior/ exterior parts | Bumpers and interior parts | Bumpers and interior/ exterior parts | Bumpers and interior/ exterior parts | Bumpers and interior parts | Bumpers and interior/ exterior parts | Bumpers and interior/ exterior parts | Bumpers and interior/ exterior parts |
| | Sound-proofing materials made of recycled shredder dust (RSPP) | ❍ | ❍ | ❍ | ❍ | . . . | ❍ | . . . | . . . | . . . |
| | Aluminium castings using copper recycled from shredder residue | ❍ | ❍ | . . . | . . . | . . . | . . . | . . . | ❍ | ❍ |
| | Using Recycled PP[6] | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

* Basically, the data above relates to the best-selling grade.

1. The figures in parentheses are applicable if there is a rear air conditioner.
2. Level of emission gases from passenger cars (see the list below)
3. "Extremely small amount" applicable if a navigation system is installed.
4. Optional detachable room lamps once used nickel-cadmium batteries, but now use nickel metal-hydrid batteries
5. The data regarding recoverability rate is intentionally omitted from the above data sheet because its international definition has not been established (even as of FY1999). Toyota, however, has already established its own standard and is making efforts to recover more end-of-life vehicles.
6. Where recycled PP parts are used (see the list on the right)

### 2: Level of emission gases from passenger cars

| | (Standards for year 1998) | (Standards for year 2000) | J-TLEV level of low emissions applicable during the transient period |
|---|---|---|---|
| Carbon Monoxide (g/km) | 2.1 | 0.67 | 0.67 |
| Hydrocarbon (g/km) | 0.25 | 0.08 | 0.06 |
| Nitrogen Oxide (g/km) | 0.25 | 0.08 | 0.06 |

### 6: Where Recycled PP parts are used

| | |
|---|---|
| Platz | Engine undercover, spare tire board |
| FunCargo | Engine undercover, back door trimming, floor and deck boards |
| Celica | Sound-absorbing felt for engine undercover |
| Crown | Engine undercover, toolbox, luggage trimming substrate, fuel-inlet pipe protector |
| Majesta | Engine undercover, toolbox, luggage trimming substrate, fuel-inlet pipe protector |
| MR-S | Trimming for room partition; front luggage cover (OPT) |
| Estima | Engine undercover, fuel-inlet tank protector, rear wheel opening extension |
| WiLL Vi | Engine undercover |
| bB | Engine undercover, back door trimming |

## Development Results: The New Crown Boasts Improved Fuel Efficiency and Cleaner Emissions

# Achieving the Highest Levels of Environmental Performance on Toyota's Flagship Car

### Pursuing Cutting-Edge Technology and a High Degree of Social Integrity

Since the Crown was launched in 1955, it has served as Toyota's flagship car, and as a brand symbolic of Japan's luxury class cars. Its cumulative domestic sales surpassed 4 million in 1999. In developing the 11th generation Crown, the theme that Toyota adopted was "fusion of tradition and innovation" to create a new image for the Crown in the pursuit of driving performance, comfort and safety as well as environmental performance.

Director Tetsuo Hattori (Chief Engineer at the time), who played a major role in the project, explains: "We needed not only the latest technology, but a high degree of social integrity to satisfy long-time Crown fans and create a sense that the new Crown was created especially for them."

### Environmental Performance of the New Direct-Injection Engine

Toyota launched the Toyota direct-injection D-4 gasoline engine as a fuel efficiency improvement measure in 1996. It was further improved to be adopted for use in the new Crown.

In addition, a high-pressure slit nozzle, which spreads atomized fuel in a fan shape during formation of the fuel-air mixture, was developed and has served as central technology for lean burn engines. The 3.0-liter D-4 (2JZ-FSE) engine achieved fuel efficiency of 11.4km/liter (according to the fuel test in 10-15 mode), which is in the top level in its class, and already meets the new fuel efficiency standards set to go into effect in 2010. Furthermore, the NOx storage reduction three-way catalytic converter technology, which utilizes a fine hexagonal cell structure ceramic filter substrate, vastly increases emissions cleaning performance.


Director Testuo Hattori (right) and Chief Engineer Mitsuhisa Kato (left) played key roles in the development of the new Crown.

When it was launched in September 1999, the new D-4 engine received enthusiastic support. The new Crown series included four models with five different engines, and as the chart below shows, approximately 48% of customers chose vehicles with the D-4 engine.

● **Sales Results of the New Crown and Vehicles Equipped with D-4**

| Model | Sales units | Ratio of D-4(%) |
|---|---|---|
| Majesta | 15,646 (6,784) | 43 |
| Royal, Athlete | 43,100 (22,142) | 51 |
| Estate | 4,435 (1,543) | 35 |
| Total | 63,181 (30,469) | 48 |

*( ) indicate vehicles equipped with D-4

Accumulative total from 1999/9 to 2000/3
(Note: Estate was launched in 1999/12)

### As a Compilation of the Twentieth Century

Improvements in environmental performance are not limited to the D-4 engine. The adoption of VVT-i and a high-performance transmission, a decrease in the power used by the air conditioner, and reductions in air resistance ($C_D$ value) through the use of a flat bottom and "rectifying" components resulted in improvements in fuel efficiency surpassing previous versions of all models. All models achieved reductions in CO, HC, and NOx emissions that exceed the current regulations by 70% or more and meet FY2000 emissions regulations.

In addition, all models except the 2.5-liter turbo and the 4.0-liter 4WD vehicles achieved reductions in CO and HC that exceed the FY2000 regulations by 25% or more and met the J-TLEV standards in the Environment Agency Exhaust Emissions Technology Guidelines for Low-Emission Vehicles.

Moreover, Toyota adopted new highly recyclable thermoplastic TSOP, RSPP sound-proofing material and other recycled materials, expanded material identification markings to the entire width of the bumpers, and reduced the amount of lead used by half compared to previous models.

Director Hattori and Chief Engineer Mitsuhisa Kato who succeeded from him commented that: "By continuously taking on the challenges of innovative technologies, we showed that tradition can transcend the times and continue to serve a purpose. In this sense, we think we can say that the Crown is a vehicle that serves as a comprehensive survey of the twentieth century."