

Development of Environment-friendly Vehicles

SUBARU is involved in the technological development to improve fuel economy and reduce emissions and noise with an aim for “integration of driving and environmental responsibility.”

We are also engaged in the development of electric vehicles and next-generation batteries to contribute further to environmental preservation.

Improving Fuel Economy

Thought toward Improving Fuel Economy

Automobiles emit carbon dioxide (CO₂) proportional to the amount of fuel consumed. By improving fuel economy, CO₂ will be reduced resulting in the better conservation of limited energy resources and the prevention of global warming.

SUBARU, while utilizing the advantages of Symmetrical AWD and horizontally opposed engine, has been working to improve fuel economy by developing technologies that make engines more fuel efficient, reduce transfer loss in the drivetrain and reduce vehicle weight and running resistance, and we are in the process of introducing vehicles which meet the Japanese FY2010 Fuel Economy Standards over 15%, the target for gasoline vehicles.

Target of Improving Fuel Economy
Expand the scope of vehicles which meet the FY2010 Fuel Economy Standards over 15%

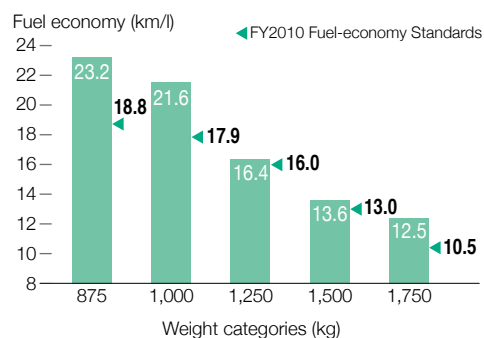
Current Status in Meeting FY2010 Fuel Economy Standards

Gasoline-powered passenger cars meeting the FY2010 Fuel Economy Standards accounted for 91% of the total production, clearing the FY2010 Fuel Economy Standards in all the weight categories.

Gasoline-powered mini trucks met the Standards in all weight categories in FY2001, and then all models met the Standards in FY2002 and thereafter.

The numbers of automobile which meet the FY2010 Fuel Economy Standard for Eco-car Tax Break System has accounted for 59.8% of the total, and increasing 18.6 points compare with FY2008. We are going to promote familiarizing environment-friendly cars.

◆ Status of SUBARU's Compliance with the FY2010 Fuel Economy Standards for Gasoline-powered Passenger Cars



Improving Engine

SUBARU has worked to improve the environmental performance of the New LEGACY by totally redesigning the specifications of its engine for better fuel economy and less emissions to reduce emissions down by 75% from the 2005 standards.

The displacement of the main engine was increased relative to the prior model for improvement of drivability making the car easy to drive. Accumulated improvements for friction reduction and performances enhanced on every detail including those of the electrical and cooling systems led to better actual fuel economy over the preceding model despite the increased engine displacement.



2.5-liter SOHC Engine

Improving the Drivetrain

SUBARU developed a longitudinally positioned new chain-type CVT “Lineartronic” for AWD passenger cars for its 2.5-liter NA model of the new LEGACY, the world’s first for application to mass production passenger cars. The new CVT is a next-generation automatic transmission which has both good environmental and driving performances. A chain-type variator which is more efficient and compact than a belt-type is used for the transmission mechanism. The CVT is integrated with the horizontally opposed engine and symmetrical AWD technology by devising an ingenious layout, which provides class-top fuel economy, pleasure and safe driving distinguishable from conventional CVT-equipped vehicles and better impact safety performance.

Also, a 5AT with internal friction reduced is mounted on the 2.5-liter turbo AT and 3.6-liter AT models, while a newly developed compact 6-speed MT is installed on the 2.5-liter turbo MT model as standard equipment for higher environmental performance.



New chain-type CVT “Lineartronic”

Approach to Fuel Economy Improvement of LEGACY

Light Weight Body

The New LEGACY was developed to have a larger but lighter body with class-leading impact energy absorption structure and the body rigidity to support good driving.

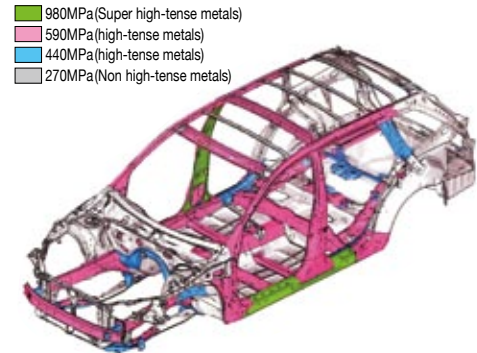
A newly used cradle in combination with the front body framework optimized for higher energy absorption in a frontal impact allows the base body framework to exhibit better impact performance. 980 MPa-class high tensile steel plates are used at vital locations which contribute to reducing interior deformation in a side impact.

Furthermore, balanced body rigidity was pursued by reviewing the joint structures of structural members and securing both strength and rigidity effectively by partial reinforcements, which resulted in holding weight increase, exhibiting agility and better fuel economy.

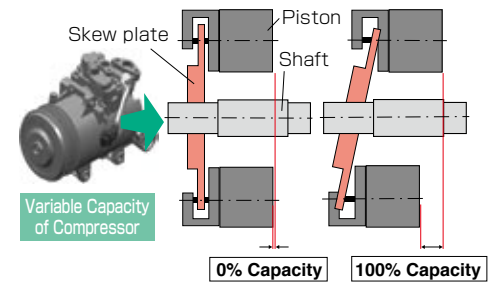
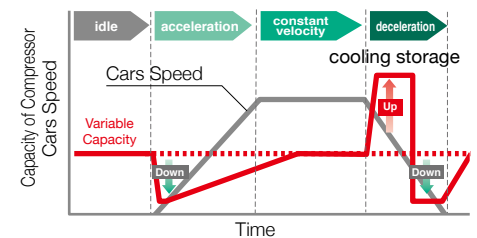
Approaches to Enhancement of Practical Fuel Economy

We are also working hard to improve the fuel economy under practical use by customers. For instance, in order to have both pleasant drive and interior environment, the characteristics of the engine and transmission were improved and the engine load was lessened through optimal control of the air conditioner for fuel saving.

The New LEGACY adopted an air conditioning system with a compressor of which displacement varies continuously in response to driving conditions and interior environment. Especially, both low fuel consumption and comfort were achieved by increasing the compressor capacity at less fuel consuming decelerations for cooling storage and reducing the capacity at fuel consuming accelerations. We will keep going for further improvement of actual fuel economy out of consideration for environmental conservation.



Variable Air Conditioner System



Approaches to Assisting Eco-drive

Communication among Driver, Car and Environment

SUBARU is also positively engaged in developing Eco drive assist devices as an interface to promote communication between a driver and his or her car. We are spreading the Eco driving assist equipments, the Eco Gauge and Shift-up Indicator (for MT-equipped vehicles) as same as them added on the LEGACY marketed in 2006. The New LEGACY also has the Eco Gauge (for all models) and Shift-up Indicator (except North American models).

The further improvement will be continued for Eco driving assist equipments.

■ Eco Gauge

The needle of the Eco Gauge swaying to the “+” direction indicates an economic driving condition to the driver. About 5% saving in fuel economy (in-house testing) can be expected by consciously controlling the accelerator to keep that condition.

■ Shift-up Indicator

When an economic engine rpm is reached, the indicator starts blinking, prompting the driver to shift up.



Eco Gauge for LEGACY



Shift-up Indicator for LEGACY

Green Products

Cleaning Exhaust Gas

Basic Concept of Cleaning Exhaust Gas

Substances such as carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx), which are emitted from automobiles, are one of the causes of air pollution in metropolitan areas where there is intensive motor traffic. In order to improve the state of the air, SUBARU is gradually launching clean gas vehicles (certified by the Ministry of Land, Infrastructure, Transport and Tourism) that meet standards stricter than the regulations.

▶ Target of Cleaning Exhaust Gas

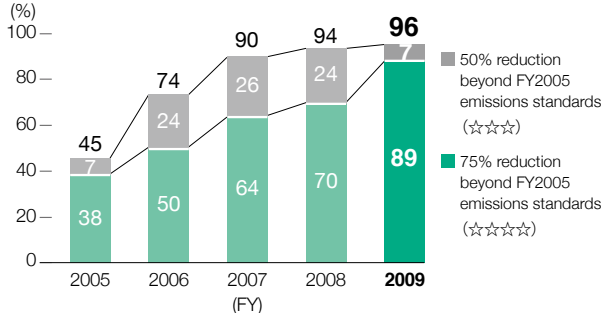
Low emission models which outperforms the FY2005 emission standards by 75% reduction to be expanded with further technical developments.

Improvement and Enhancement of Low Emission Vehicles

The New LEGACY is all certified as low emission vehicles which meet the FY2005 Standards by the Ministry of Land, Infrastructure, Transport and Tourism with at least 75% below the Standards (☆☆☆☆), while 89% of these production models achieved the Standards with at least 75% reduction (☆☆☆☆). Thus, the vehicles certified as low emitting totaled 96% of the whole non-mini production.

SUBARU will keep going forward for the dissemination of low emission vehicles.

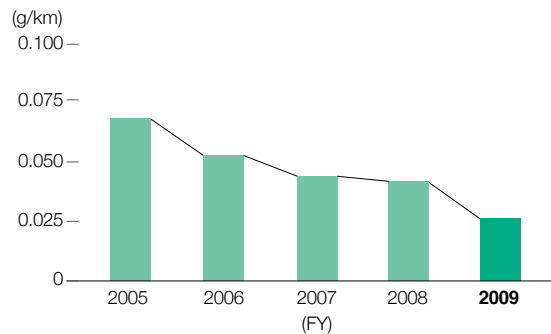
◆ Trends in Percentages of Low Emission Gasoline-powered Passenger Cars (%)



The amount of NOx emission reduction by SUBARU vehicles every year

By launching low emission vehicles which meet the standards represented by the low emission vehicle certification standard into the market, SUBARU has been able to reduce the average amount of NOx emitted by SUBARU vehicles every year as shown in the chart below.

◆ Trends in NOx Averages of SUBARU Vehicles (g/km)



◆ Trends in Sales Numbers of Vehicles authorized as Low Fuel Economy in FY2009

The Sales number of Vehicles authorized as Low Economy and Low Emission Gasoline-powered*1

		Passenger vehicle		Truck		Total of Vehicle (rate)
		Standard-sized car Small-sized car	mini car	Standard-sized car Small-sized ca	mini car	
Low-emission car	Electric vehicle	0	161	0	0	161 (0.1%)
Vehicles authorized as Low Economy and Low Emission Gasoline-powered	75% reduction beyond FY2005 emissions standards☆☆☆☆	67,166	37,009	0	1	104,176 (59.3%)
	50% reduction beyond FY2005 emissions standards☆☆☆☆	4,463	2	0	629	5,094 (2.9%)
Total		71,629	37,172	0	630	109,431 (62.3%)
Total of Sales						175,768 (100%)

*1 Vehicles which achieved in advance the FY2010 fuel economy standard based on the Energy Saving Act and were certified as low emission vehicles according to the low-emission vehicle certification procedure.

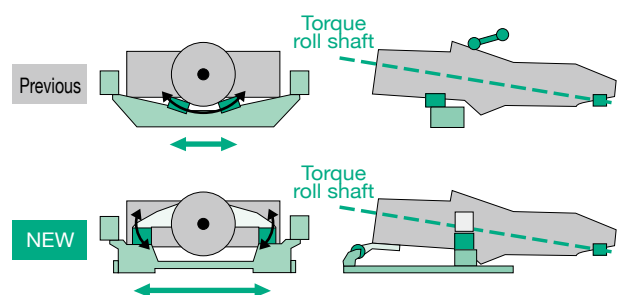
Noise Reduction

Reduction of noise and vibration in the New LEGACY

Another area SUBARU is actively involved is the development to effectively reduce vehicle noises from such prime sources as tires, engine and intake and exhaust systems.

The New LEGACY put on sale in May 2009 produces practically less traffic noise on city streets by the extended adoption of CVT with high environmental performance on its model line. Also, a new "Cradle-Structure Mount" was adopted for reduction of noise and vibration as well as improvement of ride comfort.

◆ Reduction of Noise and Vibration by the Cradle-Structure Mount



(Please refer page 54 below, a picture of Cradle-Structure Mount)

Clean Energy Vehicles

Start to sell Electric vehicle “Plug-in STELLA”

Clean energy vehicles have such features as emitting fewer Green House Gas (CO₂) and air pollutants (CO, HC, NOx, etc.) and have less environmental impact than gasoline engine vehicles. However, there are technical problems related to cost and driving distance. SUBARU has been developing clean energy vehicles such as electric vehicles that have the gasoline engine vehicle-level performance and utility. Also, we are positively working on developing next generation batteries.

Environmental-friendly electric vehicle “Plug-in STELLA” which has same level of safety compared with gasoline-powered car has started to sell in July, 2009. The environmental load-reducing product, Plug-in STELLA is an electric car optimally balanced as a city commuter. The sales was 161 in FY2009.

Received “e-Nenpi (Good Fuel Economy) Award for the 4th Consecutive Year

■ Mini- Class Vehicles

SUBARU were presented with the “e-Nenpi (Good Fuel Economy) Award 2009-2010” in honor of the fact that they were ranked first in the new vehicle category for average fuel economy ranking for the year (Jan. thru Dec. 2009) by IRI Commerce and Technology, Inc. which provides the “e-Nenpi (Good Fuel Economy)” service for managing information on personal vehicles via cellular phones. R2 has received the top Award for 4 times and R1& STELLA also were presented as the top 5 vehicles in this time. SUBARU’s vehicles, such as the R1, the R2 and the STELLA, have been topping the list of the “Top 10 Fuel Economy Gasoline Powered Mini Cars” for 4-years since FY2006, (announced by the Ministry of Land, Infrastructure, Transport and Turlsm).

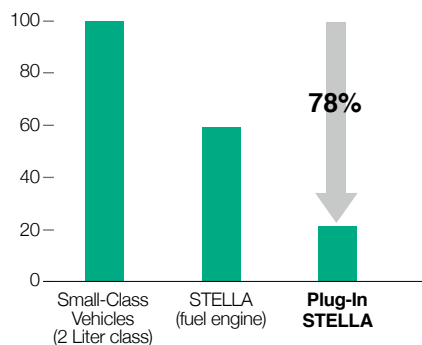
■ Small-Class Vehicle

The CVT (weighing 1,520 kg or over) of the EXIGA with a 2-litre DOHC engine performed 25 percent better than the FY2010 target fuel economy standards and ranked in the top 6th of “the most 10 fuel efficient cars in 2009” in the 1,516-1,765 kg weight category (excluding manual transmission models), which was announced by the Ministry of Land, Infrastructure, Transport and Tourism. The new LEGACY with the 2.5-liter SOHC engine and CVT (vehicle weighing 1,520kg or more) performed 15% and 20% better than the 2010 target fuel economy standards.



Electric vehicle Plug-in STELLA

◆ The CO₂ emission per 1Km run of Plug-In STELLA is compared to other type of vehicles supposing Small Class Vehicles’ =100



Trophy of Received “e-Nenpi (Good Fuel Economy) Award of Mini-class vehicles in 2009-2010



R2

Extension of the distance between the mount supports made it possible to effectively control engine vibration, especially in rolling direction. In particular, it shows an excellent effect on reducing vibration in idling and noise in acceleration. With these combined, the LEGACY boasts class leading quietness.

The Cradle-Structure Mount

Automobile Recycling

Making Effective Use of Limited Resources

SUBARU has established the Automotive Recycle System of SUBARU (ARSS^{※3}) as part of active efforts to recycle and properly dispose of End-of-Life Vehicles (ELVs^{※2}), according to the Japanese End-of-Life Vehicles Recycling Law^{※1} (hereinafter referred to as the ELVs Recycling Law). The recycling ratio of ASR in FY2009 was 82.1%, satisfying the Japanese legal standard required for FY2015 (The recycling ratio of ASR: 70% or higher). The effective recycling ratio reached 97%, clearing 95% targeted for FY2015. Recycle-conscious design will be promoted for further improvement of effective recycling ratio.

- ※1 the Japanese End-of-Life Vehicles Recycling Law to recycle and properly dispose of end-of-life vehicles (Enforced in January 1, 2005)
- ※2 ELV (End of Life Vehicles)
- ※3 ARSS (Automotive Recycle System of SUBARU)

Efforts in the Design Stage

Emphasis on Design Allowing Easy Recycling

We will keep on producing automobiles considering recycling, in order to make good use of limited resources.

■ Recycling Market Research

The Recycling Design Project Team members continuously visit dismantlers, shredding companies, and waste disposers in various parts of Japan to exchange views on the current and future market trends for actual ELV treatment. The results are used to determine the principles for designing automobiles with due consideration for recycling and extract specific subjects for future research.

■ Efforts to Improve Recyclability

Advances in Wire Harness Dismantling

Because a large amount of copper is used in a wire harness, if the wire harnesses can be removed before the ELVs are shredded, the collection and separation of iron and copper will be enhanced and their value in terms of resource recycling will increase. SUBARU is conducting studies for a harness layout and automobile structure that make it possible to effectively collect more copper and in a shorter time. The achievement of this investigation is including to the New LEGACY.



Material Identification Improvement

It is most important that the material of each part can be recognized easily when we recycle. SUBARU started to identify the type of material on plastic parts in 1973 even before guidelines for the industry were established. Material identifications had been attached on the rear side of each part before. However, the position was changed, as we believed we could avoid such wasteful actions as dismantling a part to confirm the material type. SUBARU has changed the identification positions on all car models, including the LEGACY, the IMPREZA, the FORESTER and the EXIGA since 2001.

The material type is able to be seen without dismantling the bumpers.

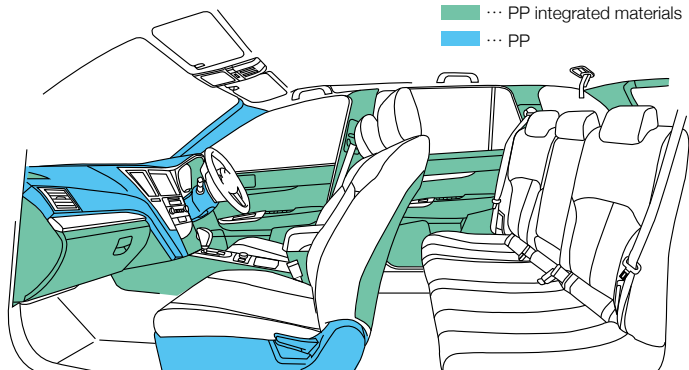


An example of the material indication: "PP" means polypropylene



◆ Using Integrated Materials for Interior Parts: Olefin Resin in the New LEGACY

- ... PP integrated materials
- ... PP



■ Efforts to Improve Proper Disposal

Particularly, since proper processing of CFC (air conditioner refrigerant) and airbags is regulated by the Act on Recycling, et. of End-of-Life Vehicles (the Automotive Recycling Law), we are aware that processing them in easier ways is indispensable.

Reduction of Fluorocarbons Used in Air Conditioners

SUBARU uses a substitute fluorocarbon, HFC134a, for refrigerants in air conditioners, which does no harm to the ozone layer, but which is still believed to accelerate global warming. We are conducting active countermeasures to reduce the amount of HFC134a and the leakage while using air conditioners and also research into substitute refrigerants other than fluorocarbons.

Advances in Airbag Disposal

Airbags and pretensioner seatbelts contribute significantly to reducing the shock to drivers and passengers in automobile accidents. On the other hand, the vast majority of automobiles are put out of service with unused airbags. Because automobile manufacturers are asked to dispose of airbags and similar products under the ELVs Recycling Law, we are conducting research into the optimal structure for airbags, including related components, that will make it safer and easier to activate them in automobiles and subsequently dispose of them.

■ Reduction of Substances of Environmental Concern

Based on the Japan Automobile Manufacturers Association's voluntary action programs, we have been working to reduce the 4 substances of environmental concern (lead, mercury, cadmium and hexavalent chromium) and are partially moving ahead of schedule.

In FY 2009, we especially focused on lead-free solder and extended its application to switches and relays in and around the instrument panel and other electrical and electronic components such as sensors in the air-conditioner unit.

◆ Reduction Targets and JAMA's Voluntary Action Program for New Models

Substance	Target (period achieved)	Details of Reduction Efforts:
Lead	Since Jan. of 2006	Reduce the amount per vehicle produced to less than 1/10 the 1996 levels
Mercury	Since Jan. of 2005	Use prohibited except in a few applications (e.g., minute amounts in combination panels, discharge headlights and in the liquid crystal panels of GPS systems)
Cadmium	Since Jan. of 2007	Use prohibited
Chromium(VI)	Since Jan. of 2008	Use prohibited

■ Reducing VOCs^{※1} in Vehicle Interiors

In order to reduce the use of VOCs such as formaldehyde and toluene, which can cause nose and throat irritation, we are revising whether to make changes to the components and adhesive agents used in vehicle interiors. In the New LEGACY of FY2009, we achieved the goals set by JAMA^{※2} by reducing the concentration of the 13 substances defined by the Ministry of Health, Labor and Welfare in Japan to levels below the figures set in the guidelines for interior concentration. We have achieved the goals ahead of schedule in the New EXIGA of FY2008 as well, and in the future, we will continue our efforts to reduce the levels of such substances to below the figures set in the guidelines to make the environment in vehicle interiors more comfortable.

※1 VOC (Volatile Organic Compounds)
 Volatile Organic Compounds means the Organic Compounds easy to volatilize in natural temperature, like formaldehyde and toluene. They are recently supposed to be one of primary factors of the Sick house syndrome which causes the stimulation on eyes, noses, throats when enter new houses or buildings.

※2 Voluntary target: to reduce interior concentration of the 13 substances identified by the Ministry of Health, Labor and Welfare to levels equivalent to or lower than the figures stipulated in the guidelines for new vehicle models (produced and sold in Japan in 2007 and afterward) under the Voluntary Approach in Reducing Cabin VOC Concentration Levels initiated by JAMA.

Automobile Recycling

Processing of End of Life Vehicles (ELV)

Approaches to “Total Recycling of Resources”

SUBARU has formulated the “Information on Removal of Copper Containing Parts in End of Life Vehicles” to further bolster the recycling rate of ELV, which is open to the public in the website of ART^{※1}. (Japanese only) Currently, a method called “Total Recycling of Resources” is employed as a means to improve the recycle rate without generating ASR in recycling cars.

This involves throwing stripped end of life vehicles into an electric furnaces or the like to melt its iron contents for re-commercialization as construction materials and others. Parts, the source of ASR, are burned in the furnace to be used as heat source (thermal recycle), eliminating the landfill process.

Before implementing this “Total Recycling of Resources”, minimizing the copper contents in the stripped vehicle scraps is required to keep quality in

the resulting steel products. For this minimization, how to remove copper containing parts efficiently and thoroughly becomes the key point.

The focus of the “Information on Removal of Copper Containing Parts in End of Life Vehicles” is on the disclosure of information, where “the wiring harness” occupying major parts of copper is laid out on, on past production vehicles which currently constitute the most part of ELV population.

Formulating the information on the LEGACY domestically sold in 1994 and the VIVIO domestically sold in 1993 was released for public review in May, 2008. In December 2008, the information related to the FORESER (launched in Japan in 1997) and the IMPREZA (launched in Japan in 1992) was disclosed, to the public, thus covering many of SUBARU vehicles to be scrapped as ELV.

※1 ART (Automobile shredder residue Recycling promotion Team)
Automobile Shredder residue Recycling promotion Team is separated 2 teams; one is ART team operated by Nissan, Matsuda, Mitsubishi, Fuji Heavy Industries, and other 12 companies. Another is TH team operated by Toyota, Honda, Daihatsu and others.

Collection of Used Bumpers

Recycle Used Bumpers for Other Parts

SUBARU established an in-house system in 1973 to identify the materials used in plastic parts, ahead of the timetable for industry guidelines for the establishment of such systems. This system is very helpful when the company collects bumpers which are used and changed for repairs to recycle for use in other parts of vehicles. In FY 2009, we collected 38,733 used bumpers from all over Japan, which is 94.5% toward the previous year (41,055).

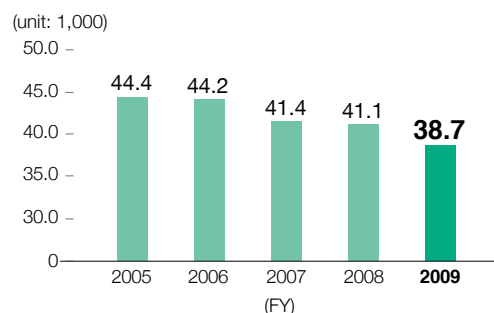
The used bumpers were recycled for use in other parts of SUBARU as shown in the right graph.

Issuance of “Monthly Recycle Communication”

The “Recycling Communication” which is a communication tool to promoted recycling between Fuji Heavy Industries Ltd. and SUBARU dealers has been in place since September, 2008.

It is issued once a month and covers useful topics such as why foreign substances need be removed from used bumpers collected from dealers. We are responding to inquiries from dealers which are prompted by such information. We will work to make it more active as a two-way communication tool.

◆ Trends in Number of the Scrapped Bumpers Collected



◆ Parts Produced from Scrapped Bumpers

Car Models	Parts
LEGACY	Trunk trim
FORESTER	Under floor cover
IMPREZA	Trunk trim
SAMBAR	Air guide, Engine cover, Splash board