

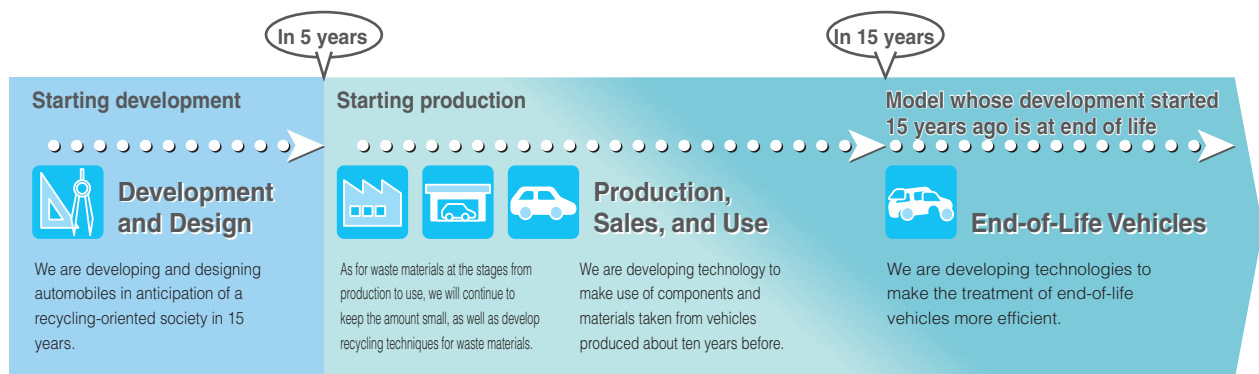
## Recycling

Automobile-related companies are obligated by the Law on Recycling End-of-Life Vehicles, which came into force on January 1, 2005, to share responsibility for recycling and to properly treat end-of-life vehicles (ELV\*<sup>1</sup>). FHI recognizes that the role of automobile manufacturers is important. In addition, we strive to comply with the regulations stated in Directive 2000/53/EC of the European Parliament and of the Council on ELVs effective since September 18, 2000.

### FHI's Fundamental Philosophy

As shown below, FHI will plan, study, and make efforts to decide what direction cars of the future as well as recycling technology should take, with the goal of further promotion of streamlining and realizing low-cost recycling based on the present situation and the future prospects of ELV.

#### Our Future Efforts



### Law on Recycling End-of-Life Vehicles

#### Directive 2000/53/EC of the European Parliament and of the Council on ELVS

The EU directive, to which FHI will respond step by step for automobiles introduced after July 1, 2003, includes the following five characteristics:

- ◆ Prohibition against using substances with environmental impact as much as possible
- ◆ Charge-free acceptance of ELVs
- ◆ Including recyclable ratio in requirements for type certificate
- ◆ Issuance of dismantling procedure manuals
- ◆ Regulation on recycling ratio

#### Law on Recycling End-of-Life Vehicles

The three characteristics of the Law on Recycling End-of-Life Vehicles:

- ◆ Automobile manufacturers must collect fluorocarbons, airbag-related products, and ASR produced, and then break down fluorocarbons and recycle the others.
- ◆ Expenses for recycling must be paid by users in advance as a recycling deposit.
- ◆ Tracking reports of ELVs after they are accepted from users until they are appropriately disposed of is required.

As for fluorocarbons and airbags, FHI established the Japan Auto Recycling Partnership in cooperation with other automobile manufacturing companies to establish a collection system to properly treat those items. As for ASR, \*<sup>2</sup> FHI established ART\*<sup>3</sup> (Automobile shredder residue Recycling promotion Team) jointly with eleven other automobile manufacturers. Moreover, as shown in the chart to the right, FHI established Automotive Recycle System of SUBARU (ARSS\*<sup>4</sup>) to respond proactively to the Law on Recycling End of end-of-Life Vehicles.

\*1.ELV: End of Life Vehicle

\*2.ASR: Automobile Shredder Residue: Residue left after shredding of the car chassis, sorted by metal type for recycling

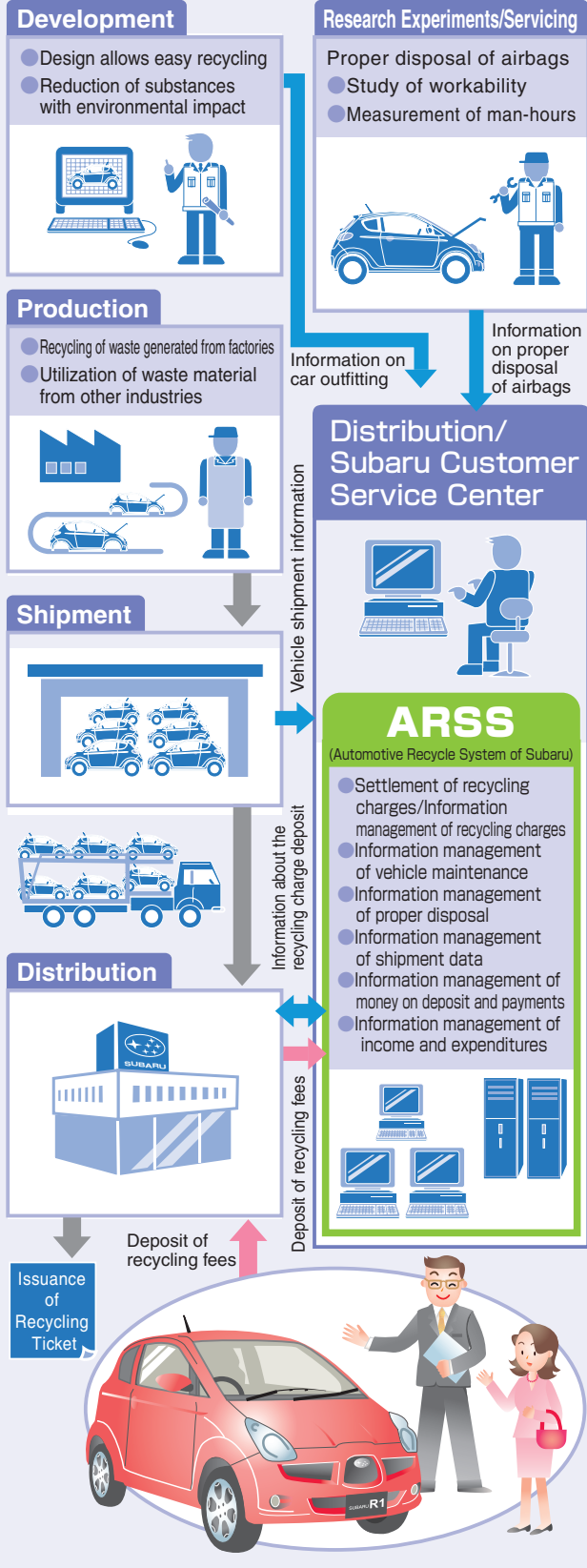
\*3.ART (Automobile shredder residue Recycling promotion Team: Eleven companies including FHI, Nissan Motor Co., Ltd., Mitsubishi Motors Corporation, Mazda Motor Corporation, Suzuki Motor Corporation, Isuzu Motors Limited, Nissan Diesel Motor Co., Ltd., and Mitsubishi Fuso Truck and Bus Corporation, DaimlerChrysler Japan, Co., Ltd., PAG Import, and Ford Japan.

\*4.ARSS: Automotive Recycle System of SUBARU

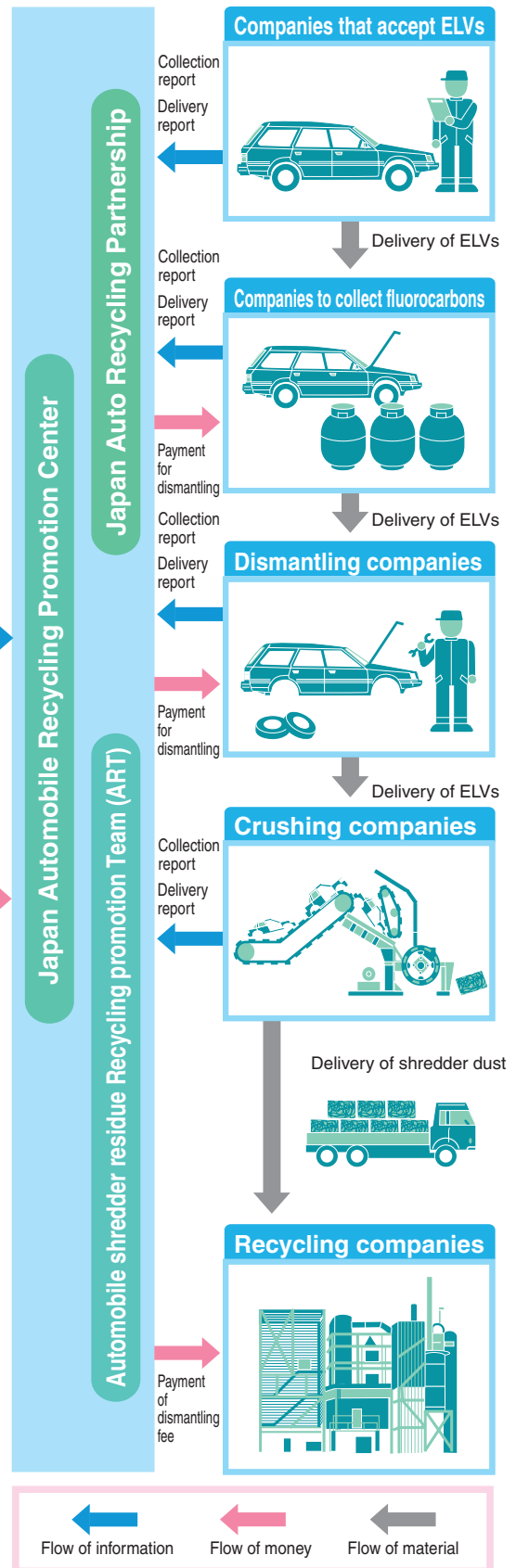
# Subaru's Car Recycling System

## The Process from New Product Development to Distribution

### Subaru Group



## Dismantling ELVs



## Design

### Promotion of Design Allows Easy Recycling

The Recycling Design Project Team researches easy-to-dismantle parts and vehicles and easily recycled parts structure and materials, gives feedback on the development and design of future vehicles, and prevents ASR from being generated.

### Recycling Market Research

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

### Efforts toward the Reduction of ASR

ASR includes a huge variety of materials and chemical substances used for manufacturing automobiles, and these materials consist of a complex mix. Consequently, the team members completely dismantled, disassembled, and analyzed vehicles to identify the reasons ASR is generated, and then created the ASR Calculation Guideline for calculating the amount of ASR generated from a vehicle. Next, the Recycling Design Guideline was drafted to prevent the generation of ASR. These guidelines are utilized for the development of Subaru automobiles.

### Efforts to Improve Recycle-ability

#### [Advances in Airbag Disposal]

Airbags and pretensioner belts significantly contribute to reducing shock to drivers and passengers during accidents. On the other hand, the vast majority of automobiles are put out of service with unused airbags. Automobile manufacturers are asked to dispose of these airbags and similar products under the Law on Recycling End-of-Life Vehicles, but team members are researching the optimal structure, including related components, to pursue a safer and easier way of activating airbags in automobiles and their subsequent disposal.

#### [Advances in Wire Harness Dismantling]

Most of the nonferrous metal, such as copper, contained in vehicles is already being recycled. However, it is thought that it can be collected more effectively if it can be removed before shredding the ELVs. Since wiring harnesses are installed everywhere in an automobile chassis, FHI is considering a structure that makes it possible to collect more nonferrous metal in a shorter time.



Wire harness dismantling experiment

#### [Easier Material Indication]

Most important is that the material in the parts can be seen easily when we recycle. FHI started to indicate the type of material on plastic parts in 1973 before guidelines for the industry were established. The indication was placed on the back side of the parts, but we thought if we could confirm the material type without dismantling the parts, we could avoid such wasteful situations as "we dismantled the part but it was the wrong one." FHI will change the indication position on the bumpers of all our vehicles, including the Legacy and the R2.



Now the material type can be seen without dismantling the bumpers. (Subaru R2)



An example of the material indication (">PP<": PP means polypropylene.)

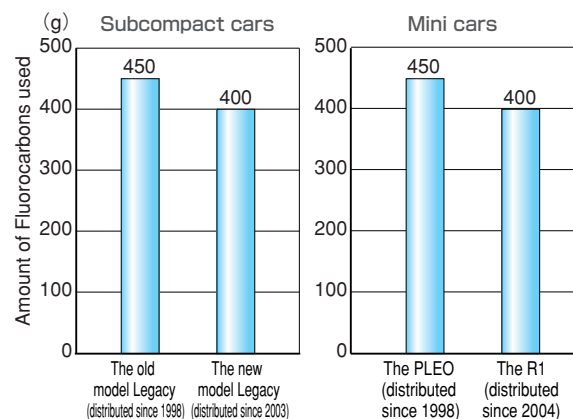
### Efforts to improve proper disposal

The Law on Recycling End-of-Life Vehicles also regulates proper disposal of substances with environmental impact, particularly fluorocarbons used as refrigerants in air conditioners, airbags, and similar products. Concerning future vehicle development, FHI recognizes it will be essential to produce vehicles that can be disposed of more easily.

### Reduction of Fluorocarbons

By 1994, FHI finished changing over from specified fluorocarbon CFC12 to HFC134a, a substitute CFC that does not harm the ozone layer. However, HFC134a is thought to influence global warming. We reduced the amount of HFC134a, and we are researching substitute refrigerants other than fluorocarbons.

#### ■ Reduction in the Amount of Fluorocarbons Used



#### Advances in Airbag Disposal

Since they are very easy to dismantle, FHI used disc-type inflators for passenger seat airbags to achieve easier disassembly of inflators.

## Reducing Substances with Environmental Impact

We are committed to curtailing our use of substances that have an environmental impact at an early date, not only to reduce the damage to the global environment, but also to remove the need for complicated recycling equipment and operations for ELV treatment. We think it is necessary to reduce substances that have an environmental impact; consequently, we are making efforts to promote the recycling of parts and materials.

### Introduction of IMDS

IMDS (International Material Data System) is a database system developed by a European automobile manufacturer that FHI is using to manage substances that have an environmental impact and for calculating recyclable ratios. After introducing IMDS in 2003, Subaru started to research a variety of vehicles. We will continuously strive to ensure that our efforts are successful to meet the requirements for 2008. In that year, the recycling rate potential will be of vital importance in Europe.

### Reducing the Use of Lead

New model compact automobiles use no lead in the wheel balancers, which reduces the amount of lead used to less than one-tenth the 1996 industry average.

### Responding to the Voluntary Activity Plan of the Japan Automobile Manufacturers Association, Inc.

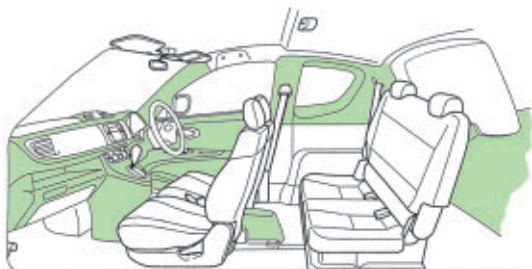
In accordance with "Substances with Environmental Impact—Voluntary-activity by the Japan Automobile Manufacturers Association, Inc." (issued by JAMA in December 2002), we will promote the reduction of mercury, cadmium, and hexavalent chromium.

## Production

### System for Grade Integration of PP Plastic

Previously, a great deal of waste was created in our materials manufacturing, compounding, and parts mold-processing procedures since we had different mixes of PP materials depending upon the parts. In order to keep such waste to a minimum, we promoted the integration of PP grades. Each integrated material for bumpers and interior parts has been applied to most vehicle parts. We are also going to further improve efficiency by making plastic materials easier to recycle.

#### How Integrated Materials for Interior Parts are Used (R1)

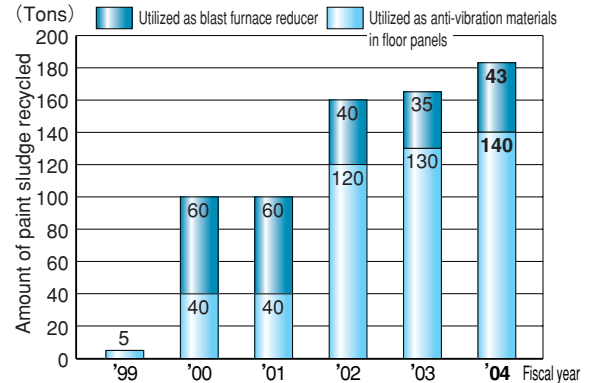


Green parts: Integrated materials are used in these parts.

## Recycling Waste Materials (Paint Sludge\* 1)

We found a way to recycle paint sludge from the paint factory. We are recycling paint sludge as anti-vibration materials for automobile floor panels and as blast furnace reducer. We are also considering recycling it for other uses. As for recycling paint sludge, the 2002 Environment Report, "Paint Sludge Recycling Plant" (see p. 30) explains the process in detail.

### Amount of Paint Sludge Recycled

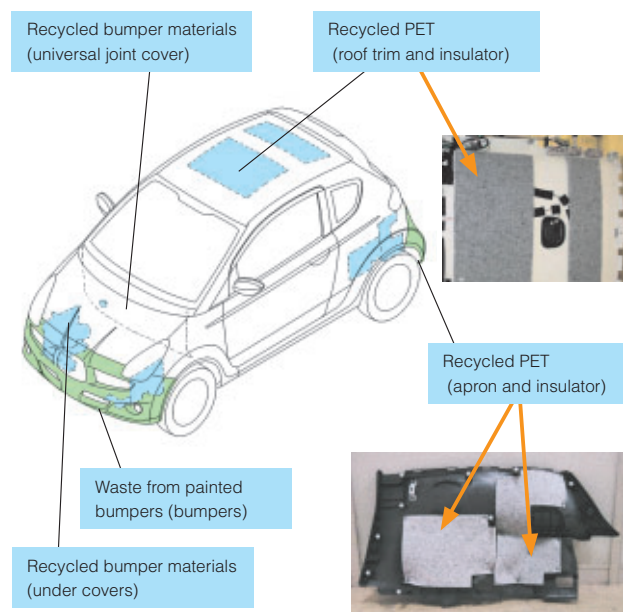


## Utilizing Other Industrial Wastes

### Continuous efforts

FHI will actively utilize recycled materials generated by industries other than the automobile industry. For waste materials generated in production plants, we are also promoting development of technology so that we can recycle and utilize the waste materials from automobile production.

### An Example of Utilizing Recycled Materials in the New Minicar Model R1



\*1. Paint sludge: Waste produced during the surfacer and the top coat in the car painting process. (Waste paint that did not adhere to the automobile body)

## Sales and Services

### Environmental Efforts by Subaru Dealers

FHI is working on environmental issues with Subaru dealerships as the Subaru team.

- ◆ Comply with environmental laws and regulations, and further contribute to the environment of the local community.
- ◆ Continue to improve the environmental management systems to create environment-friendly dealers

All dealers of the Subaru team are working on environmental compliance activities under the above-mentioned mottos. Since the simultaneous kick-off of the activities in December 2003, each sales company has set up a model base and carried out thorough inspections of environmental compliance for further improvement. In the summer of 2004, the Subaru team held workshops at seven locations throughout Japan, promoted voluntary activities, deepened the level of awareness, and aimed to expand the activities to the nationwide sales bases.

Currently FHI is continuing the thorough inspections of environmental compliance and improvement activities in the nationwide sales bases for consummation by 2005. Also, to deal with the Automobile Recycle Law enforced in January 2005, FHI has encouraged dealers to participate in the



seminars sponsored by the government and other concerned organizations, prepared the *Procedural Manual for Subaru Dealers*, and held a workshop in each sales region in the fall 2004.

Procedural manual concerning the Low on Recycling End of Life Vehicles \*1



Environmental compliance through thorough inspections and improvement activities

Regarding the environmental management system, Aomori Subaru CO.,Ltd. and Fuji Subaru CO.,Ltd. obtained ISO 14001 Certification in December 2004 and in January 2005, respectively. Now the certification has been acquired by total four Subaru teams, including Chiba Subaru Inc. and Iwate Subaru Inc.

### Using Reassembled and Used Parts

FHI has worked on environmental issues in line with nationwide Subaru dealers as the Subaru team. As one of our efforts, we are using recycled (that is, rebuilt) and used parts. Using rebuilt parts\*2, such as engines, transmissions and water pumps, was started in collaboration with the related manufacturers in 2004. Dealing with used parts, such as exterior panels, lamps, windshields and wheels, was started in collaboration with existing used parts network groups in April 2004.

#### Using Rebuilt Parts

Designated items
Engine
Automatic transmission
Manual transmission
CVT (Continuously Variable Transmission)
Alternator
Starter
ECU (Engine Control Unit)
Water Pump

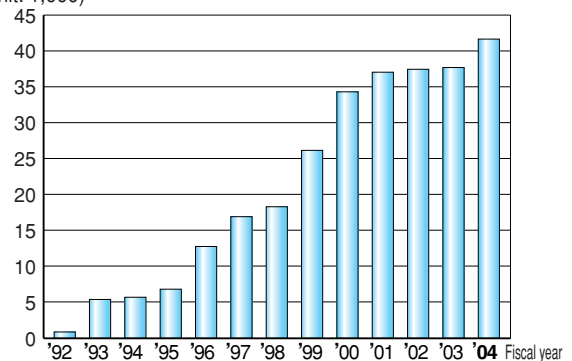
### Disposal

FHI 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 scrapped bumpers to recycle for use in other parts of vehicles. In fiscal 2004, we collected 41,700 scrapped bumpers from all over Japan, which is a 1% increase from the previous year.

The scrapped bumpers were recycled for use in other parts of Subaru as shown in the graph below,

#### Progress Made in Scrapped Bumper Collection

(Unit: 1,000)



#### Parts Produced from Scrapped Bumpers

Model	Parts
R1, R2, Pleo	Universal joint cover, undercover
Legacy	Under spoiler, battery pan

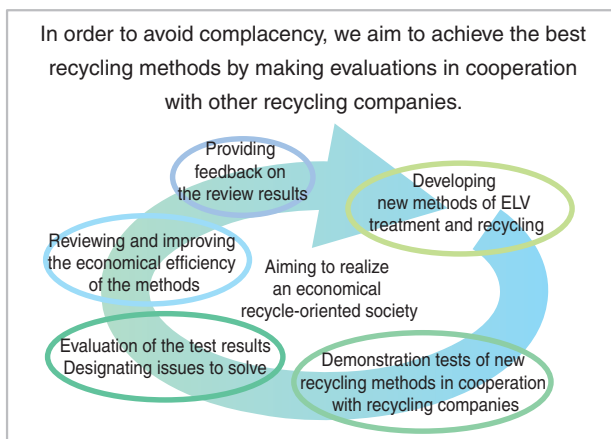
\*1. This guidance describes, along with actual examples, the recycle charge deposit practice when purchasing a new car and the contractor's takeover practice at a dealer's shop.

\*2. Rebuilt parts (based on used parts called "core") mean parts that are dismantled, cleaned, reassembled, any worn or damaged interior components being replaced with used components, and then resold. Reused parts mean parts that are taken from a used automobile, cleaned, refurbished, and resold. Recycled parts consist of those two categories.



## Disposal of End-of-life Vehicles

FHI is working with companies that process end-of-life vehicles to conduct research and development for the improvement of the recycling processes. The results of joint development are made public in order to contribute to the realization of a recycling-oriented society. We are also a manufacturer that develops and sells recycling equipment as well as being an automobile manufacturer. We will continue to make a strong effort to develop more effective systems in the field of automobile recycling technology. The main technologies that we are working on include one for recycling auto window glass, one for preventing noise when the airbags activate in vehicles, and one for dismantling ELV.



### Developing Auto Window Glass Recycling Technology

Most of the automobile shredder residue from ELVs is landfilled, but FHI believes that removing and recycling auto window glass, which currently accounts for approximately 20% of the shredder residue, will contribute significantly to waste reduction and bring certain advantages.

[Advantages of glass recycling]

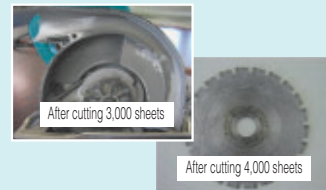
- ◆ ASR generation can be reduced  
⇒Of the 3Rs (reduce, reuse, and recycle) of ASR, reduce is achieved to the maximum extent.
- ◆ Actual recycling efficiency can be increased  
⇒The year 2015: We will increase the actual recycling efficiency up to more than 95%

- ◆ Recyclers' burden can be mitigated  
⇒By removing glass from an ELV, the press, shearing, and crushing machines used for ELV recycling will wear less, thereby reducing maintenance costs

FHI started to study a method for side-door glass recycling into glass wool in January 2000 and developed devices for side-door glass collection, windshield crushing, and inner-film separation, thus established a reuse technology for these types of glass into automobile glass. Since April 2003, we have been expanding the amount of glass collected and reused in cooperation with 12 dismantlers and 3 sheet glass providers. Through the 2003 demonstration tests, the quality of glass collected by 12 dismantlers proved to be a certain level. So we proceeded in 2004 with cost and infrastructure maintenance to incorporate the collection, recycling, and reuse jobs into monthly routines. Based on the condition that one dismantler can collect at least 8 tons per month (windshield: 5 tons, side-door glass: 3 tons) and constantly put them into a sheet glass kiln, we determined the sustainable quality as a dismantler and the acceptable quality as a sheet glass provider. Thus more practical glass recycling activities have been promoted.

### Windshield Collection Method

Glass is cut with a circular saw and collected.



Tool durability has been improved by adopting a sawtooth with carbide tip" and changing the physical-safety cover part into a bearing.

### Side-door Glass Collection Method

Glass is crushed with a hammer and dropped into a dish underneath.



Foreign material mixing prevention is improved.

### Quality Improvement of Collected Glass

The quality of collected glass has been improved remarkably by adopting a side-door glass collection tool and by educating dismantlers.

#### The Amount of Foreign Materials Included in Collected Side-door Glass (Unit: ppm)

	First test in 2001	Second test in 2003	Third test in 2004
Iron	112.2	28.0	0.6
Aluminum	none	none	none
Inflammables	31.3	15.6	4.8
Gravel	0.6	0.6	none

#### Tool Manufacturers

Company Name	Location
Makita Corporation	Anjo City, Aichi
Lobtex Co., Ltd.	Higashi-Osaka City, Osaka

#### Dismantling Companies

Company Name	Location
Car Steel Co., Ltd	Maebashi City, Gunma
Nagano Automobile Recycling Center Co-op	Tobu Town, Nagano
Ibajihan Recycling Center Co., Ltd.	Minori Town, Ibaraki
Tsuruoka Co., LOtd.	Oyama City, Tochigi
Metal Recycling Co., Ltd.	Kawashima Town, Saitama
Showa Metal	Koshigaya City, Saitama
Keiaisha Co., Ltd.	Yokohama City, Kanagawa
Renaissance Co., Ltd.	Kimitsu City, Chiba
Nippon Auto Recycle Co., Ltd.	Toyama City, Toyama
Sanomaruka Co.	Fujinomiya City, Shizuoka
Shinsei Co., Ltd.	Mihara Town, Osaka
Mitsui Bussan Raw Materials Development Co.	Sakai City, Osaka

### Efforts to Activate Airbags in Vehicles

#### - Soundproof Device -

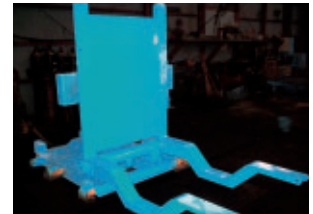
FHI is working to develop a soundproof device to reduce noise in the surrounding area, as well as to improve working conditions, in order to be able to remove airbags without dismantling the chassis. Taking both eco-friendliness and workability into consideration, we made a six-piece lead-free soundproof sheet that can cover a car chassis to muffle the sound. By improving working conditions inside the vehicles, the sound escaping from a car muffled with the sheet can be lowered by 10 decibels when the airbag is inflated.

### Overturning Machine for Dismantling: the "Tentomushi" (Ladybug)

An ELV can be anchored on the two arms of this machine and tilted or lifted so that the parts can be removed safely and effectively. The removed parts are recycled or reused. Underneath lies a workbench, which receives waste liquid (cooling water, engine oil residue, etc.) to prevent spills from dropping to the floor.



Parts can be removed easily and effectively by tilting the ELV.



The body of the "tentomushi" used for dismantling an ELV.

#### Column

#### FHI Won the JSAE Exposition Award at the JSAE Spring Forum

Our research paper on ELV Glass Recycling Technology won the JSAE Exposition Award at the 2004 JSAE Spring Forum. This prize has been set up to encourage revitalization and improvement of academic expositions. FHI was evaluated for developing state-of-the-art technology with quality and economy balanced in this field.



Takaaki Ohtake, then manager of the Material Research Department, received the JSAE Exposition Award at the JSAE 2004 Spring Forum.