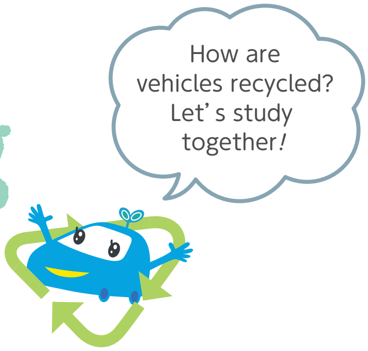
Vehicle Recycling

TOYOTA

Vehicle Recycling



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Toyota Environmental Challenge 2050

To move toward a net positive impact rather than just trying to reduce negative factors to zero, Toyota has set itself six challenges.
We are taking on steady initiatives toward the year 2050 in order to realize sustainable development together with society.

Challenge 5

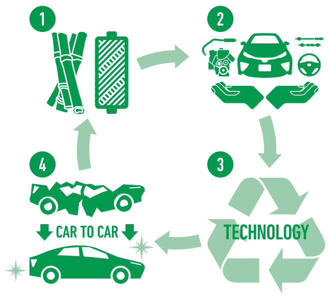
"Challenge of Establishing a Recycling-based Society and Systems"

1. Prevent pollution from end-of-life vehicles
2. Eliminate resource risks (depletion, sudden rise and supply)
3. Prevent global warming

We promote two projects by rolling out domestic technologies and systems to the world.

TOYOTA Global 100 Dismantlers* Project

TOYOTA Global Car-to-Car Recycle Project

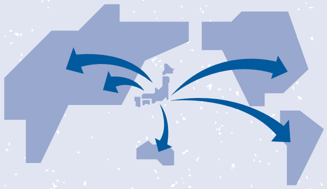


* Dismantlers : Business operators who disassemble vehicle to collect waste, remove parts, or recover materials.

TOYOTA Global 100 Dismantlers Project

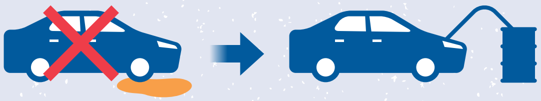
If end-of-life vehicles are inappropriately abandoned or dismantled, these may cause "environmental destruction" and "adverse effects on the health and safety of local residents".
To prevent these problems, we promote this project.
By using technologies and know-how accumulated in Toyota for treating end-of-life vehicles, we contribute to establish "automobile dismantling facilities" by utilizing Toyota Tsusho or local dismantlers around the world.

We establish a society and systems that can treat end-of-life vehicles appropriately without imposing environmental impact, and collect more resources from end-of-life vehicles.



Collection of CFC/HFC

Collection of waste oil and waste fluid



Automobile Recycle Technical Center

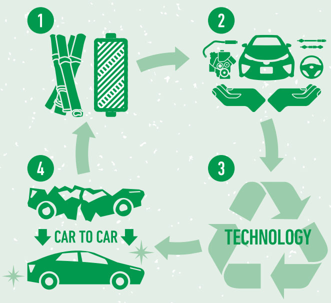
(Handa City, Aichi Prefecture)

The center conducts research on efficient dismantling methods for vehicle parts and regionally specific dismantling operations.

GLOBAL TOPICS

Model dismantling plant in Beijing, China

In Beijing, China, a Chinese dismantling company, a Japanese dismantling company and Toyota Tsusho jointly established a model dismantling plant in 2014. Approximately 32,000 end-of-life vehicles were properly treated with environmentally sound operation in FY2015.



TOYOTA Global Car-to-Car Recycle Project

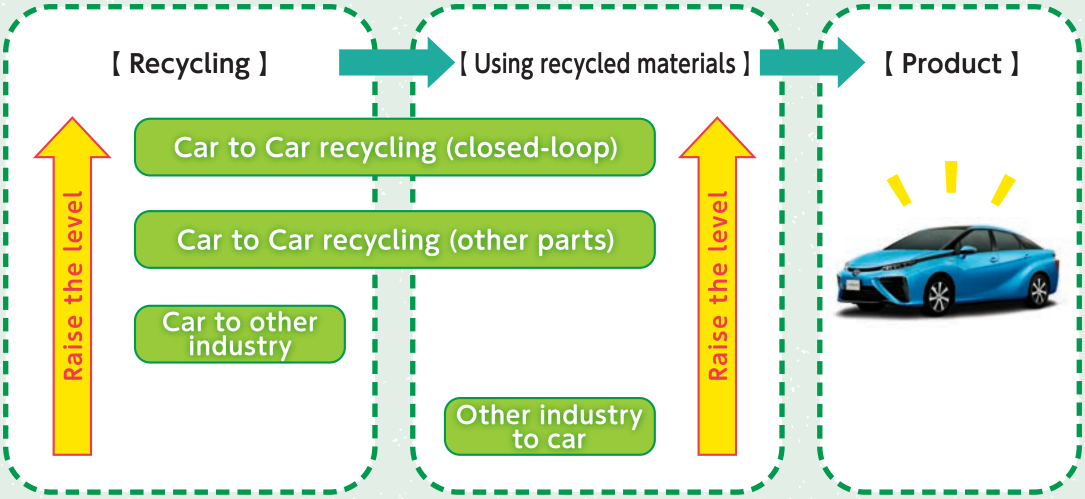
To realize an ultimate recycling-based society, we promote this project with a focus on eliminating resource risks and preventing global warming, based on the concept of 3R (Reduce/Reuse/Recycle).

Thorough promotion of 3R and use of recycled materials

1. Reduction of usage of materials with resource risks — **Reduce**
2. Promotion of remanufacturing/reusing the parts originated from repair/replacement and end-of-life vehicles — **Reuse**
3. Promotion of using low CO_2 recycled materials — **Recycle**

The ultimate goal of this project is closed-loop recycling, the concept that the vehicles parts and materials are recycled into identical parts.
While taking step-by-step approach, we gradually raise the level.

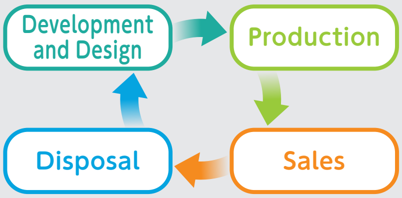
Raise the level in both phases of 'Recycling' and 'Using Recycled Materials', and promote using recycled materials for products.



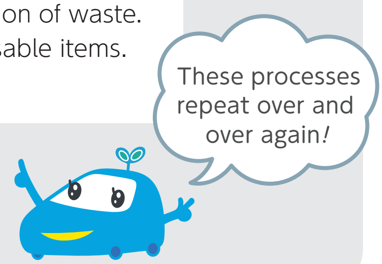
Resource saving and recycling, looking at the entire life cycle of vehicle

It is necessary to consider recycling through the entire life cycle of vehicle, from its production to the end of life.

Toyota applies the three activities in these stages of the vehicle life cycle

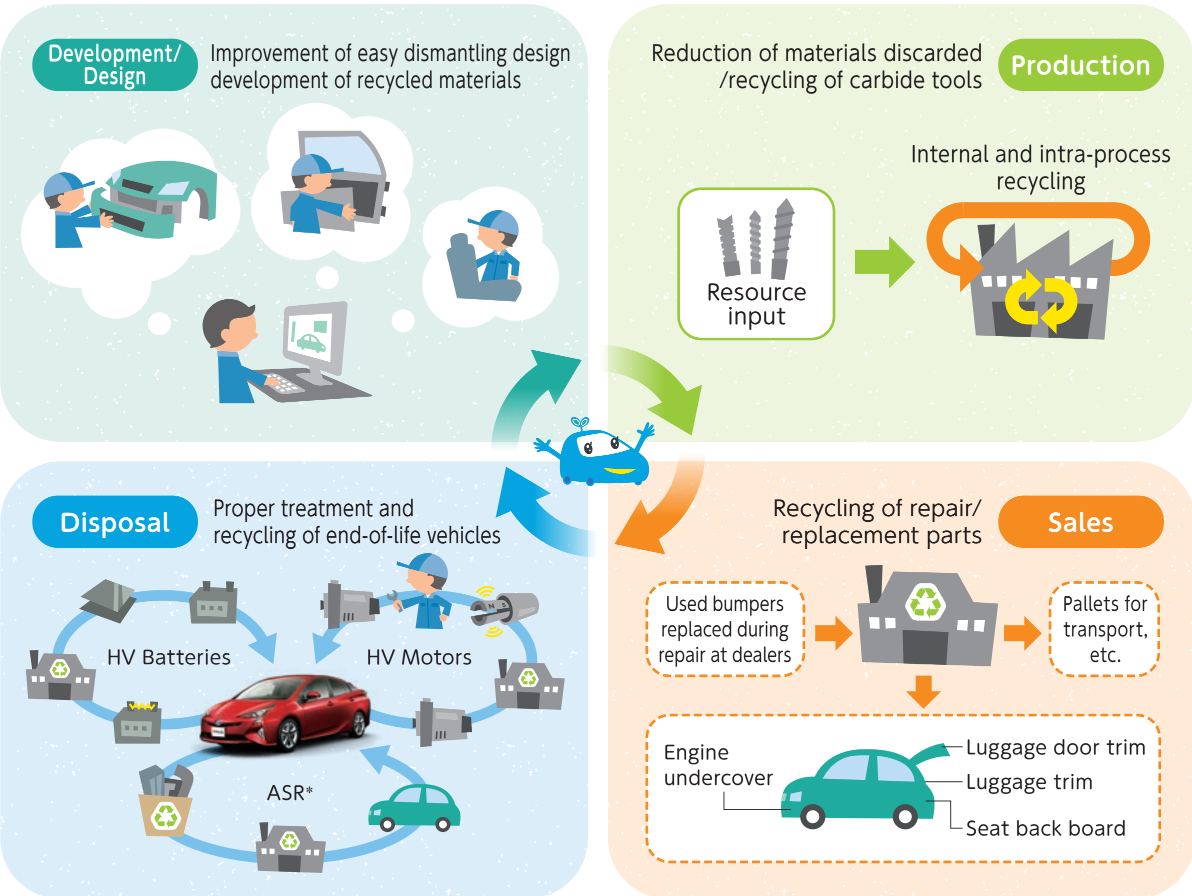


- Reduce the generation of waste.
- Repeatedly use reusable items.
- Recycle waste.



To make more effective use of limited resources, we provide results of these activities into the development and design stages working on creating cars with recycling in mind.

Life cycle of vehicle



＊ ASR : Automobile Shredder Residue.

Specific efforts

Development and Design

Development and design with the environment in mind

In 1998, Toyota was the first in the auto industry to introduce ISO14001*1 in its design and development area. Since then, it has been assessing recyclability in advance, at the vehicle development stage. From 2005, we introduced the "Eco-VAS" *2 a comprehensive environmental assessment system, which is based on the approach of LCA*3 (Life Cycle Assessment), through the entire vehicle development process.

*1 ISO14001 : The international standard for environmental management systems
*2 Eco-VAS : Eco-Vehicle Assessment System
*3 Life Cycle Assessment (LCA) : The product's impact on the environment is assessed in each process from development to disposal as a way of selecting production methods or alternative raw materials, which have lower environmental impacts.
*4 CE : Chief Engineer

Environmental performance

- Fuel economy improvement
- Reduction of exhaust gas, noise, and substances of concern
- Recycle
- LCA

- Customer needs
- Cost
- CE*4 concept

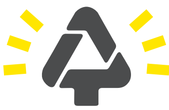
Development and Design

Vehicle structure for easy dismantling

To promote material recycling of end-of-life vehicles, we actively adopt easy to dismantle vehicles and easy to disassemble parts in new cars upon visiting the actual dismantling company.

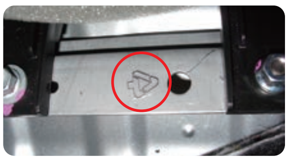
Use of Easy to Dismantle Mark

"Disassembly facilitation marks" are added to show key points for disassembly tasks.



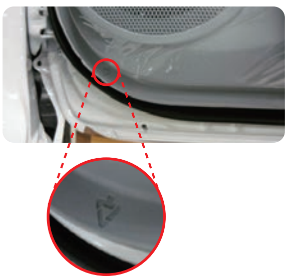
Removal of heavy battery components from hybrid vehicle

The time spent on component removal for the fourth generation Prius was further reduced. A new Easy to Dismantle Mark has been added to assist in hoisting heavy components with good balance.



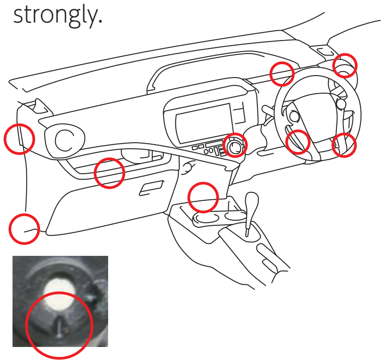
Removal of door trim

The Easy to Dismantle Mark indicates places where the load required for removing the door trim is 30 percent less than usual.

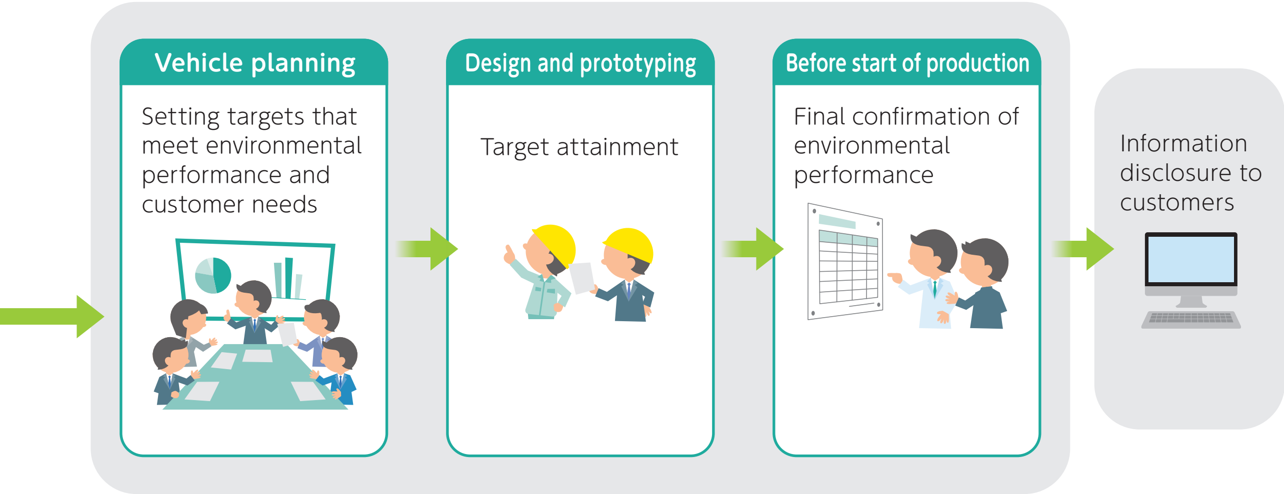


Removal of instrument panel

The positioning of the V grooves makes it easy to remove the instrument panel by pulling it strongly.

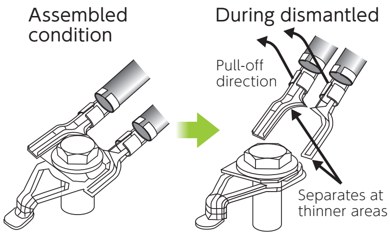


Assessment by Eco-VAS



Use of pull-tab type ground terminal for wiring harness

The ground terminals can be easily removed by pulling them strongly in a procedure similar to that of opening canned food.

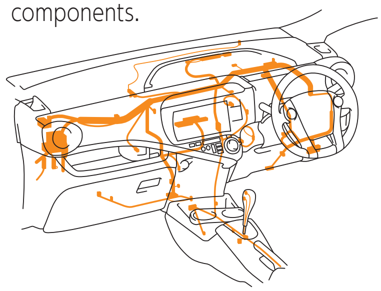


Use of wiring harness visibility improvement tape

By winding recognizable "yellow-green" tape in the vicinity of the place where the wiring harness can be stripped out efficiently, visibility is improved.

Wiring harness layout innovation

The wiring harness can be stripped out without interfering with other components.



Development and Design

CO_2 emissions reduction activity

Development and wider use of plastics derived from plants

Toyota is curbing CO_2 emissions by other methods besides recycling, to prevent global warming.

Petroleum-based plastics

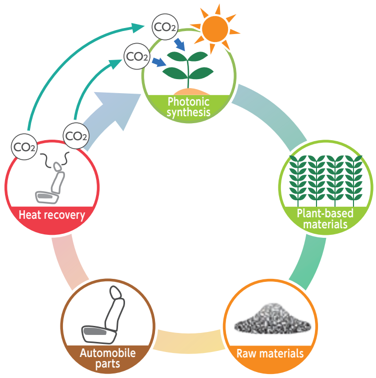
↓

Plant-derived plastics

Toyota researched how to use plastics made from plants in cars!

- Curb CO_2 emissions to prevent global warming
- Contribute to reducing the usage of oil resources

The ecological plastic CO_2 circulation concept



Record of use in cars

Use of ecological plastic in the "Raum" in May 2003	Use of ecological plastic*1 in cars	World first
Use of new ecological plastic in the "CT200h" in Jan. 2011	Bio-PET*2 derived from sugar cane is used in new ecological plastic*3.	World first
Use of new ecological plastic for interior surfaces in the "SAI" in Nov. 2011 Usage has reached **80%** of the surface area of all interior decor components.	Use in components that are difficult with previous ecological plastic Reach the same level of properties, quality, and costs as petroleum-based plastics.	

*1 Ecological plastic : The generic term for plastics developed by Toyota for use in vehicles, which include plants as raw material and achieve better heat resistance, impact resistance, and other properties than general plant-derived plastics

*2 Bio-PET : PET that is manufactured by replacing the monoethylene glycol that is one of the raw materials of polyethylene terephthalate with biological raw material derived from sugar cane

*3 New ecological plastic : Plastic that provides far better heat resistance, durability, expansion and contraction resistance, and other properties than other plant-derived plastics

COLUMN

Pioneering Use of Biosysthetic Rubber in Engine and Drive System Hoses

Toyota became the world's first automaker to use biohydrin rubber,* jointly developed with Zeon Corporation and Sumitomo Riko Co., Ltd., in vacuum sensing hoses (engine and drive system hoses).

Biohydrin rubber is manufactured using plant-derived bio-materials instead of epichlorohydrin, a commonly-used epoxy compound. The first vehicles to use the new vacuum sensing hoses will be produced in May 2016, with usage expected to be rolled out to all models manufactured in Japan by the end of the year. Toyota plans to expand the use of biohydrin to other high performance rubber components, such as brake hoses and fuel line hoses.

*Since plants absorb CO_2 from the atmosphere during their lifespan, such bio-materials achieve an estimated 20 percent reduction in material lifecycle carbon emissions compared to conventional petroleum-based hydrin rubber.


Oil palm as raw material


Bioepichlorohydrin


Biohydrin rubber (polymer)


Vacuum sensing hoses

As biodiesel fuel is produced by chemical processing on oil palm, the raw material of palm oil, bio glycerin is generated as a by-product. The bio glycerin can be used to manufacture bio epichlorohydrin. (Roundtable on Sustainable Biomaterials certification as a plant-derived raw material has been confirmed.)

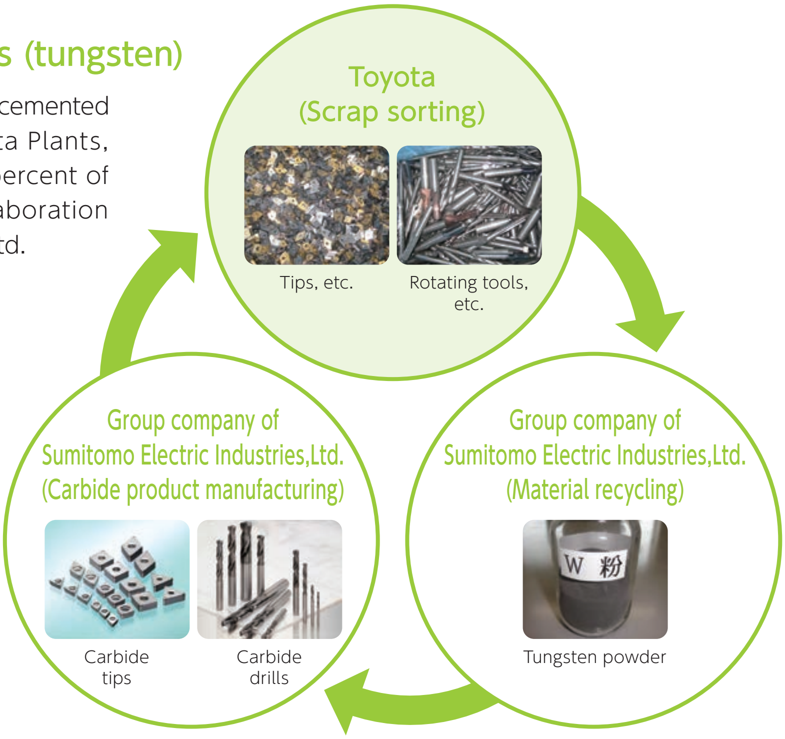
Production

Promotion of effective use of resources

Recycling of carbide tools (tungsten)

By sorting and collecting end-of-life cemented carbide tools generated at Toyota Plants, Toyota recovers and reuses 100 percent of the tungsten they contain in collaboration with Sumitomo Electric Industries Ltd.

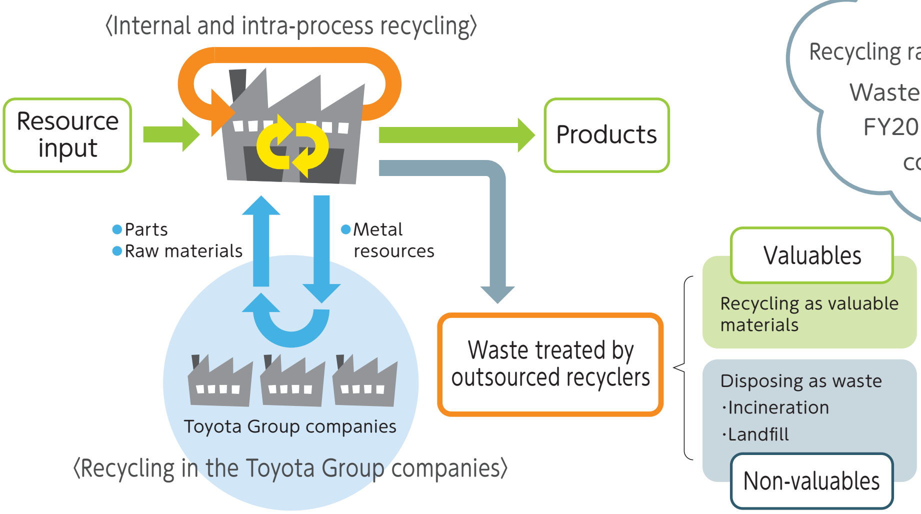
We received an honorable mention for the 1st Rare Metal Recycle Award in "Awards for Resource-Recycling Technologies and Systems" in FY2013.



Activity towards reduction of discarded materials

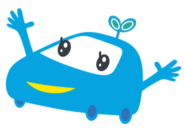
We promote resource loss reduction activities to cut waste from the plants.
In particular, we are tackling yield improvement measures and waste reduction to steadily cut down the amounts of waste treated by outsourced recyclers.

Resource Flow



Recycling rate in FY2015 : **99.6%**

Waste generation amount in FY2015 is reduced by 55% compared to 2001.



Development and Design
Production
Sales
Disposal

Sales

Recycling at the sale stage

Collecting discarded bumpers from dealers and recycling of plastics

Since discarded bumpers are made of polypropylene that allows easy to recycle, we actively collect and recycle them through Toyota dealers nationwide.

We have advanced the technology built up by recycling bumpers, developing recycled material from end-of-life vehicle bumpers as raw material.

- Thorough removal of foreign material, such as grit adhering to bumpers
- Ensure quality through detailed adjustment of constituents
- Start applying to deflectors


Deflector for engine compartment

We also established technologies that allow eco-plastics and recycled plastics to be used for 20% of all plastic components in 2013.
New technology development towards use of recycled plastic materials from discarded bumpers

- Decision of the target components and track of progress
- Removal of coating fragments, which reduce impact resistance

World's highest level

Reuse of used parts

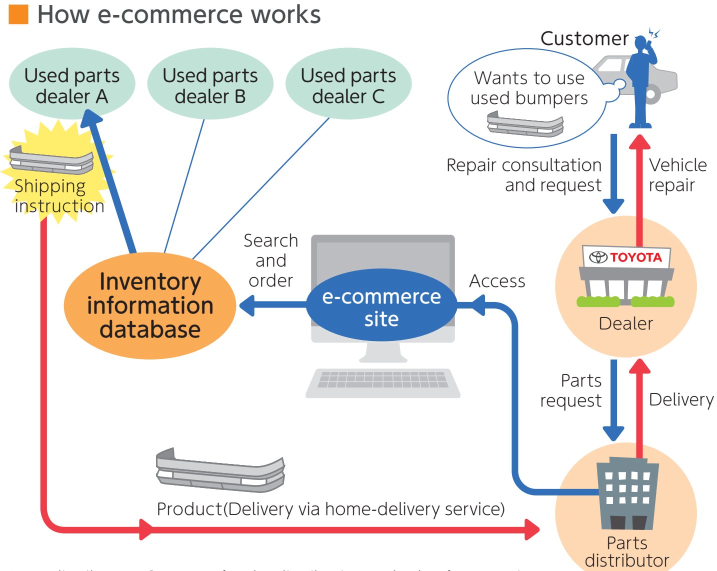
Handling of used parts by e-commerce (electric commercial transactions) began nationwide in 2001 in order to effectively use components through expand use of used parts and supply of remanufactured parts.

Supply of remanufactured parts* and new parts (FY2015)

Part name		No. of parts supplied in FY2015	
		Used parts and remanufactured parts	New parts (reference)
Remanufactured parts	Automatic transmission	2,056	66
	Power steering	4,287	2,288
	Torque converter	1,655	5,070
Used parts		35,498	—

* Remanufactured parts : Disassembled or cleaned parts that have been replaced as equivalent quality of new parts on an as-needed basis

How e-commerce works



Parts distributor : Company for the distribution and sale of car repair parts and accessories, established with joint investment from Toyota Motor Corporation and local dealers. 34 companies nationwide

Activities to Test Recycling of Bumper Covers and Scrap Parts for Waste Reduction

Toyota's North American Parts Operation (NAPO) is working to reduce waste by recycling damaged bumper covers and scrap parts.

Working with business partner Boles Parts Supply (BPS), the program uses a methodology called "National Scrap Program" devised in 2014 to process various kinds of parts that previously could not be reused into plastic pellets of various sizes that can be reused.

The program was first verified at Toyota's two largest parts centers in Ontario, California and Hebron, Kentucky.

In the first 15 months, the program recycled over 40,000 pounds of cloth and foam, two materials that in the past were incinerated or sent to landfills.

The program was then expanded to six parts distribution centers in Cincinnati, Los Angeles, San Francisco, and Portland. This move resulted in the recycling of over 88,000 pounds of parts, accounting for 92 percent of previously non-reusable parts.

BPS has so far succeeded in recycling more than 14 types of waste generated by Toyota. The recycled pellets are also sold to fabric makers and other vendors who manufacture car bumpers, and become part of the materials used to create new vehicle parts.

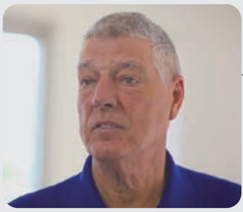
Damaged bumper covers are recycled into plastic pellets.



Juliana Dee, manager of the program at NAPO, states, "We've been enormously pleased with the success of this program. Thanks to our partner BPS, we are giving a second life to things that used to be trash and making a real improvement in our recycling rate. . . It means fewer raw materials are used and less waste is being disposed—a real win-win for the environment."

NAPO confirmed that its overall recycling rate in FY2015 had improved by 3 percent over the previous year and that the parts center in Ontario in particular had improved its recycling rate by an amazing 11 percent.

Toyota is currently reviewing the program for potential rollout to remaining parts distribution centers by the end of FY2017.



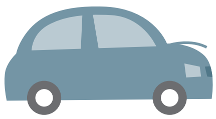
BPS President
Jerry Boles

"Toyota is such an outstanding client, and these guys are truly focused on environmental performance. . . We are very proud of this success."

Disposal

General overview of the recycling

Dismantling company



End-of-life vehicles

Removal of parts

Press

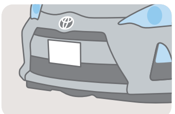
CFC/HFC collection

Freon

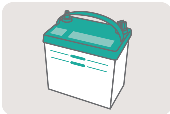
Airbag collection or deployment

Airbag

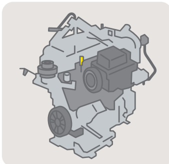
Reuse as used parts, and recycle as ferrous and non-ferrous metals



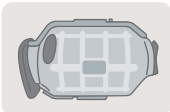
Bumper



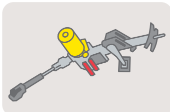
Battery



Engine, transmission



Catalytic converter



Power steering, etc.

Recycling conditions of end-of-life vehicles

Window (Glass)→Raw material for cement

Engine (Steel, aluminum)→
Engines, aluminum products

Wiring harness (Copper)→
Copper products, engines (cast aluminum reinforcement)
Introduced on page 21

Engine oil →
Alternative fuel for boilers and incinerators

Radiator (Copper, aluminum)→
Gunmetal ingots, aluminum products

Coolant (Alcohol)→
Alternative fuel for boilers and incinerators

Bumper (Resin)→Interior parts, tool boxes, etc.

Battery (Lead)→Batteries

Transmission (Steel, aluminum)→
General steel products, aluminum products

Body (Steel)→
Vehicle parts, general steel products

Seat (Urethane foam, fabric)→
Raw material for cement and heat source

HV*1 battery→
Batteries, rechargeable batteries
Introduced on pages 19 and 20

HV motor magnet→Magnets, catalysts
Introduced on page 21

Catalytic converter (Rare metal)→
Catalytic converters

Suspension (Steel, aluminum)→General steel products, aluminum products

Wheel (Steel, aluminum)→Vehicle parts, general steel products, aluminum products

Tire (Rubber)→Raw material for cement and heat source

*1 HV : Hybrid Vehicle

Shredding company

Shredder

Sort into three

Ferrous

Non-ferrous metals

Shredder residue (ASR)

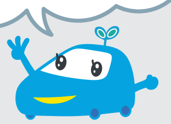
Recycle as ferrous and non-ferrous metals

ASR Recycling company

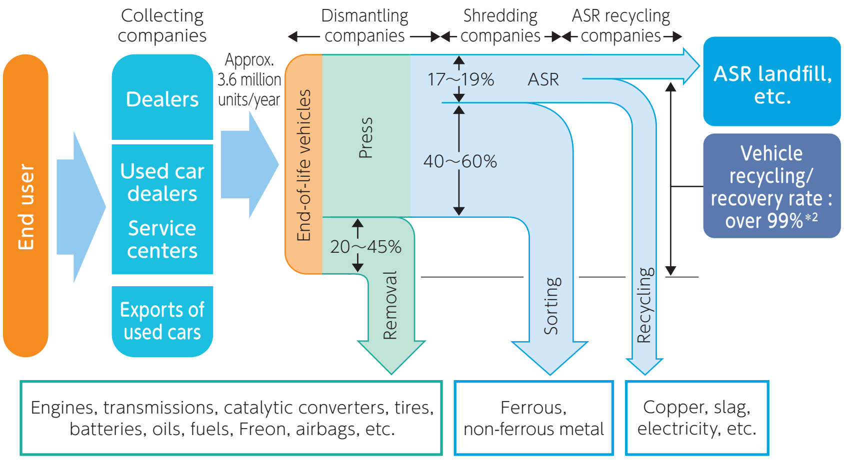
Recycle as materials

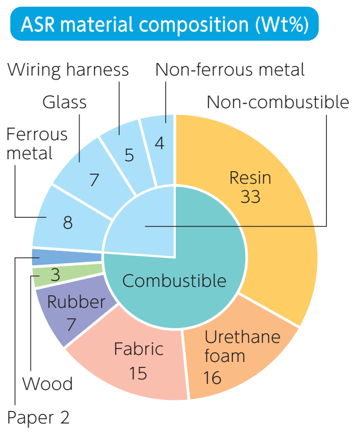
Recover as thermal energy

★Star-marked three items are required to be taken back by vehicle manufacturers under the Automobile Recycling Law!



■ Recycling/recovery route for end-of-life vehicles (Japan)





*2 Recycling/recovery rate : Weight sent for recycling divided by the total weight of end-of-life vehicles

Disposal

Efforts for proper treatment

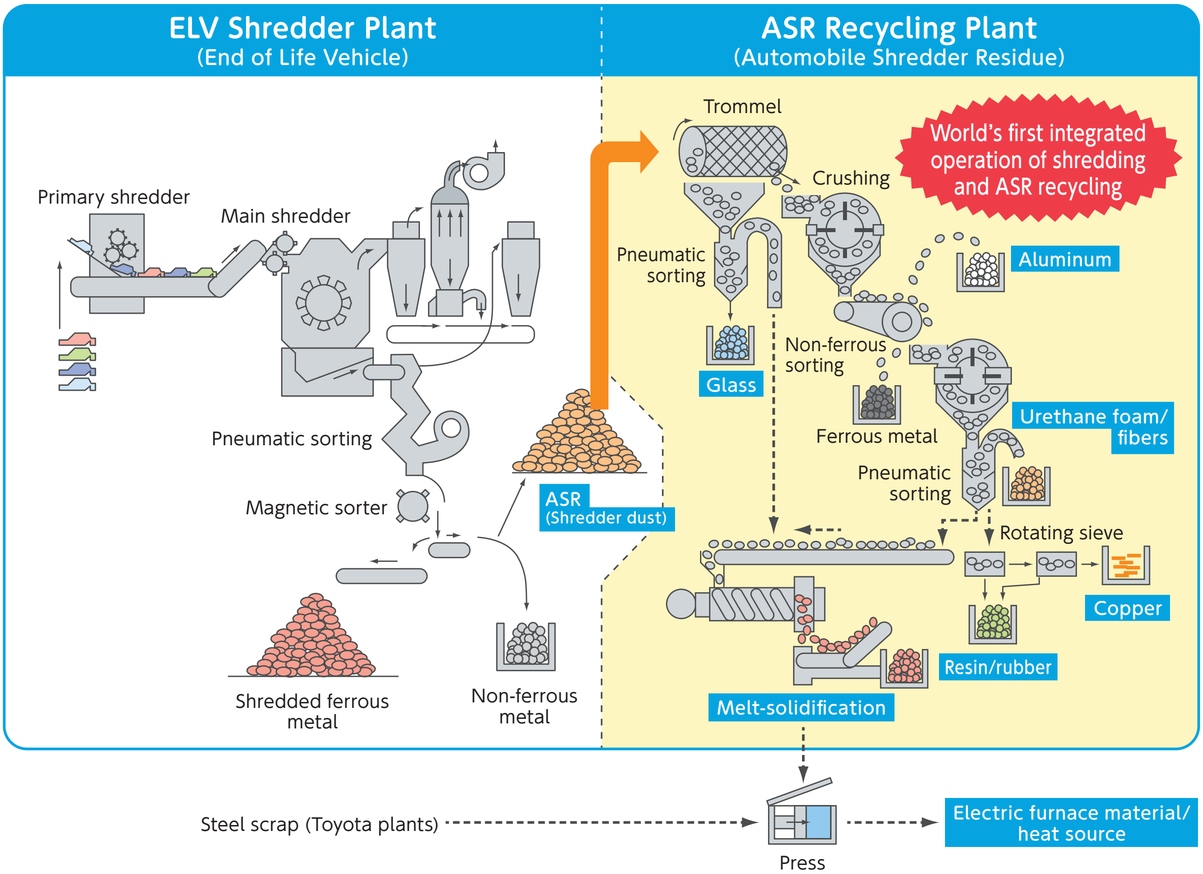
Proper treatment of Automobile Shredder Residue (ASR)

In 1993, Toyota started working jointly with Toyota Metal Co., Ltd. to develop ASR recycling technology. We started operating a unique recycling plant in August 1998, recycling on a mass production basis (capacity: approximately 2,000 tons of ASR per month).

Toyota Metal Co., Ltd.

Development and utilization of ASR sorting technology

In order to use automobile shredder residue completely, it is necessary to recycle it into the basic materials of products.
Since separation of constituents is required to raise their purity, we developed special sorting technologies for ASR recycling plants using wind and magnetism to make shredder residue reusable.



Use of resin as a heat source for electric steel furnaces

Electric steel furnaces use heat sources and carbon additives when they melt steel scrap to turn it into steel products.

By adding an appropriate amount of the resin sorted out from ASR, it has become possible to use the resin as an alternative to heat sources and carbon additives.

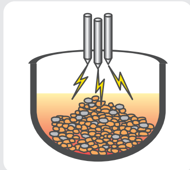
The Automobile Recycling Law calls for the ASR recycling/recovery rate to be raised to 70% by FY2015, but Toyota already reached that target in FY2007.

Joint technical development with Aichi Steel Corporation in Jan. 2005

Resin in ASR

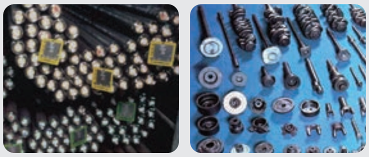
Substitution for heat sources and carbon additives

Steel scrap



Electric steel furnace

Dissolution



Steel and components for vehicles

This technology enables effective use of light materials with low calorific value, such as mixed resin, which was previously considered difficult to recycle.

ASR material recycling

With the aim of the material recycling of resin and proceeding with the material recycling of ASR-based resin, Toyota implemented a sorting device with the use of water for the first time in 2015. We also started working on copper and aluminum removal of non-ferrous metals in impurities mixed in resins and rubbers, and using them as a recycled resin base material.

Sorting process of recycled resin raw material

Recycled resin base material after sorting

Removed aluminum

Removed copper

Proper treatment of HV batteries

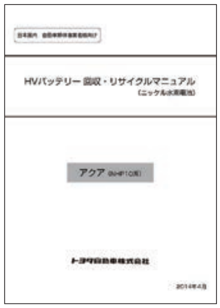
We provide information on end-of-life HV batteries so that they can be removed from vehicles safely, and collect them through a collection network to perform proper treatment.

Safe removal

Precautions for safe removal of batteries from vehicles by dismantling companies are available on the following website.

Toyota Motor Corporation Official Corporate Site

http://www.toyota.co.jp/jpn/sustainability/environment/challenge5/battery-recycle/index.html#title02

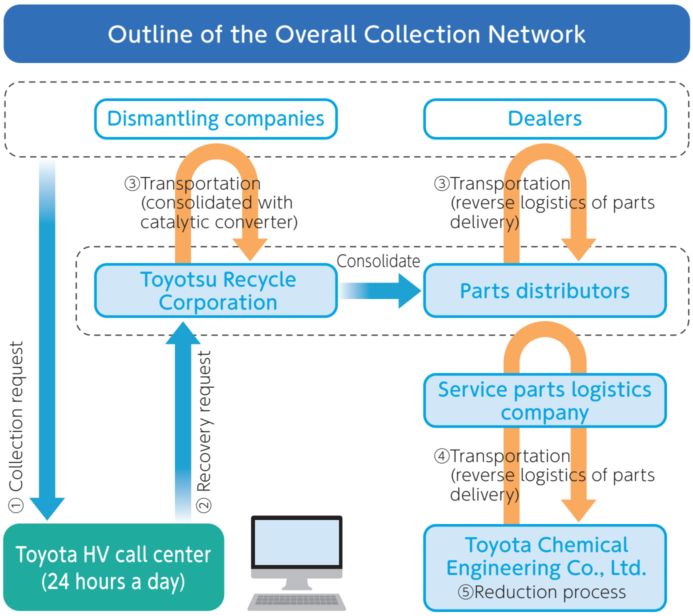


Battery Collection and Recycling Manual

Collection system

For end-of-life battery collection in Japan, Toyota has built a unique network, and the Toyota HV Call Center receives collection requests nationwide via the Internet.
This collection network also uses returning delivery trucks of Toyota service parts to reduce CO_2 emissions.

■ Battery collection network in Japan

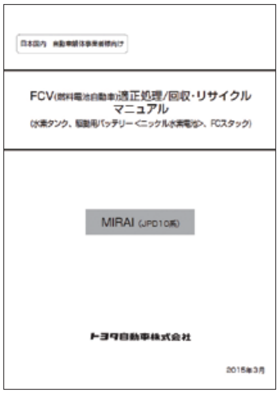


Proper treatment

In Japan, reduction process is applied to the collected batteries to achieve zero voltage and harmless electrolytes. We are also considering a proper treatment method for lithium-ion batteries.

Proper treatment of FCV (Fuel-Cell Vehicle)

Toyota’s FCV, MIRAI, can travel with its motor alone with use of electric power both FC stack (fuel cell battery) and HV battery.
It is an environment-friendly and zero emission vehicle that only generates water during traveling and using hydrogen gas as fuel.



MIRAI uses two tanks made of carbon fiber reinforced plastic (CFRP) that store high-pressure hydrogen gas at a charging pressure of 70 MPa (equivalent to 700 atmospheric pressure).

When dismantling FCV, it is required to dispose the remaining hydrogen gas in the tank, and process (scrap) the tank so it cannot be reused (High Pressure Gas Safety Act).

Along with launching MIRAI, Toyota created an operation manual to roll out various precautions, including releasing gas from the hydrogen tank and scrapping, removal of the HV battery and FC stack, and recovery procedures.

Start of Recycling of MIRAI Hydrogen Tanks in Europe

Leasing of the MIRAI has also begun in Europe. Therefore, it is imperative to properly dispose end-of-life hydrogen tanks. Toward commercialization of a recycling operation, Toyota conducted a pilot program in Europe, and the program recently reached the point of ensuring proper recycling of end-of-life hydrogen tanks, resulting in Toyota's decision to sign a subcontracted recycling agreement with a local company. From now on, the hydrogen tanks from the MIRAI that reach their end of life in Europe will be locally recycled. For example, carbon-fiber-reinforced plastic (CFRP) will be removed from these tanks and reused as a recycled material.


CFRP hydrogen tank


Pyrolysis process

Disposal

Efforts for recycle/reuse

Necessity for recycling rare metals and rare earths

In recent years, vehicles have come to use numerous motors and circuit boards.
Compared to conventional vehicles, hybrid vehicles, in particular, have increasing numbers of components, such as batteries and motors that use rare metals*1 and rare earths*2.

Toyota is working on rare metals to provide its customers with stable supply of good vehicles

Procurement risks

- The potential extraction period*3 is short.
- Production is concentrated in a few countries.
- Procurement is easily affected by economic and political changes.
- Prices are extremely volatile.

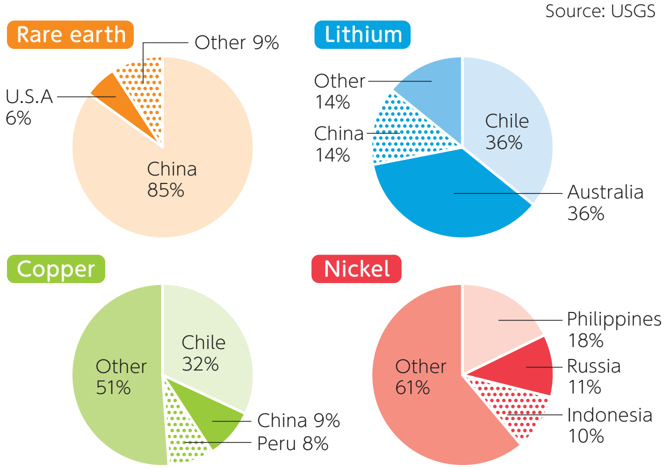
This is one of the factors that can have a major impact on the vehicle production and sales in the future

Countermeasures

①Recycle resources from urban mining.
②Develop the technology both alternative materials and reduce the quantities of materials.
③Stabilize procurement by opening up new routes.

■ Leading producing countries of non-ferrous metal resources (2015)

Source: USGS



*1 Rare metal : Metals difficult to obtain. Lithium, cobalt, nickel, etc.
*2 Rare earth : 17 metals of similar chemical properties, included in the rare metals
*3 Extraction period : An index to show the remaining underground reserve: how soon resources will deplete if they are kept producing at the current pace.

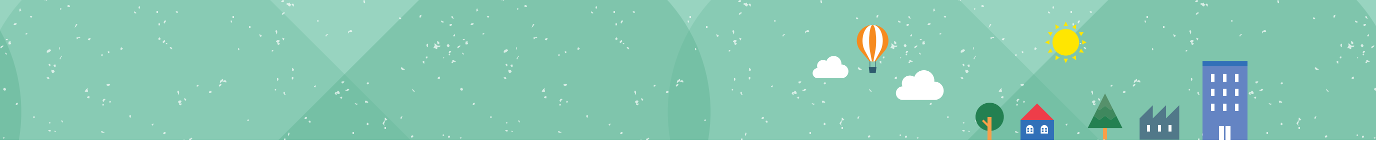
COFFEE BREAK

Periodic table of the elements

(Period) \ (Group)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen																	2 He Helium
2	3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
3	11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
4	19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
5	37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
6	55 Cs Cesium	56 Ba Barium	57~71 Lanthanide Series	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
7	87 Fr Francium	88 Rg Radium	89~103 Actinide Series															

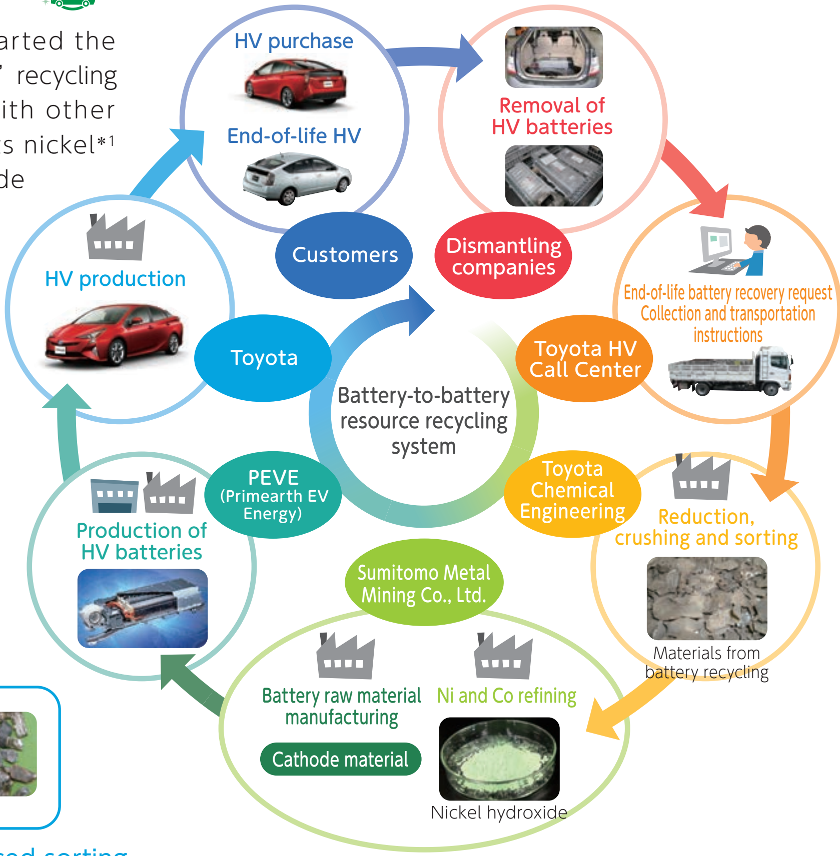
Lanthanide Series	57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium

Rare metal
Rare earth



Recycling of HV batteries

In October 2010, Toyota started the world's first 'battery-to-battery' recycling operation in partnership with other related companies. It extracts nickel*1 from used nickel-metal hydride batteries and recycles it as a raw material for batteries.
In other words, complete recycling of rare metals has moved into the final validation phase*2.



Until now

Recycled as scrap for raw material for stainless steel.


Stainless

Development of advanced sorting and extraction technologies

In future

Recycle as raw materials for new batteries.
Extract Nickel and Cobalt*3.


Nickel

*1 Nickel : Rare metal
*2 Validation phase : Studying the problems of a newly-developed product or technology by using it in real situations for practical use
*3 Cobalt : Rare metal

COLUMN

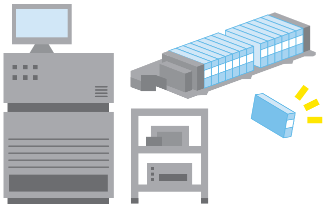
Recycling of lithium-ion batteries

Compared to nickel metal hydride (NiMH) batteries, lithium-ion batteries use less metal resources to produce the same capacity.
Toyota is developing technologies to recycle rare metals and non-ferrous metals from lithium-ion batteries same as NiMH batteries.


Lithium-ion batteries

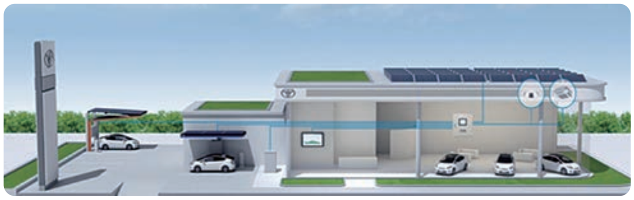
Remanufacturing/reuse of HV batteries

Toyota inspects and remanufactures end-of-life NiMH batteries removed from hybrid vehicles. We have been reusing them as stationary rechargeable batteries since 2013, and as supply batteries for vehicles since 2014 for the ecological renewable energy.
After reuse, the material is recycled and used for new batteries again.



- Remanufactured and sold as supply batteries for vehicles after inspection (the second generation Prius) **since 2014**

- Remanufactured and sold as stationary rechargeable batteries (firstly, shop use…dozens of units have already been installed) **since 2013**



Sustainable energy business in Yellowstone National Park

In June 2014, the partnership among Toyota, Indy Power Systems, Sharp USA SolarWorld, Patriot Solar, National Park Service, and Yellowstone Park Foundation, end-of-life Toyota Camry Hybrid nickel-metal hydride battery packs that store energy generated by solar panels in the distributed energy system started operation in Yellowstone National Park.
Renewable electricity that was generated by solar panels is stored in the 208 used Camry Hybrid NiMH battery packs (with a capacity of 85kWh), and is used as emergency power supply for lodges in the park.

Yellowstone National Park

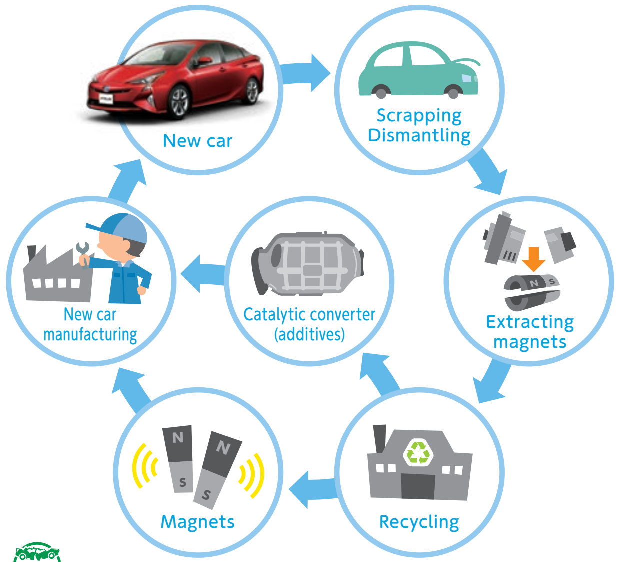
Solar panels for solar power generation

NiMH battery storage system

Recycling of magnets

Magnets used in HV motors include two types of rare earths elements, neodymium and dysprosium*. Toyota is working on the research and development of motors that use as little rare earths as possible, and it recycles the extracted neodymium and dysprosium into new magnets in cooperation with Shin-Etsu Chemical Co., Ltd.
Furthermore, we have started Car-to-Car recycling system that enables magnets to be recycled into additives for catalysts in collaboration with Sanwa-yuka Industry Corporation.

* Neodymium and dysprosium : Rare earth elements used in the production of powerful permanent magnets

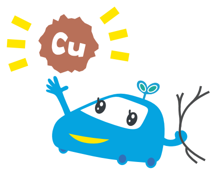


Recycling of wiring harness (copper)

Mineable copper used in power transmission and wiring is expected to last roughly 40 years. On the other hand, large amounts of copper are loaded and used in the next-generation vehicles such as hybrid vehicles, which become increasingly popular in the years to come.
Toyota has therefore been developing Car-to-Car recycling technology in cooperation with affiliated companies. Recycled copper trial production started in the HQ plant from 2013. After a three-year trial production, we completed development of technology to separate less refining copper from 99.96% purity copper.


Wiring harness

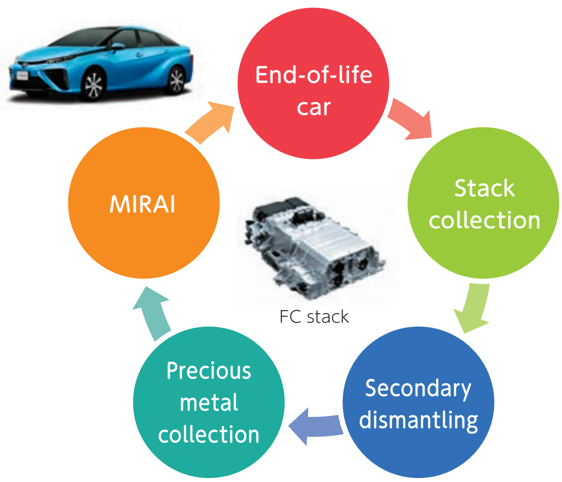

Recycled copper



Recycling of FC stack

The FC stack (fuel-cell battery) loaded in the MIRAI initiates chemical reaction by hydrogen gas supplied from the hydrogen tank and oxygen in the air taken from outside the vehicle, and produces a high voltage of over 300 volts.

FC stack uses metals of high scarcity value. Along with the sales launch of MIRAI, Toyota has established the world's first FC stack collection and recycling system.



Disposal

R&D on resource recycling

Research into efficient removal and recovery technologies

We are conducting research on efficient dismantling technologies for wide use of heavy dismantling equipment and vehicle structure for easy dismantling.


Heavy dismantling equipment


Removal of a wiring harness with heavy dismantling equipment

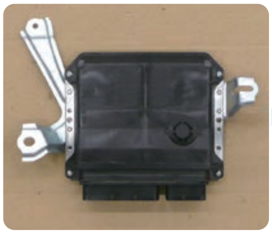

Motor removal


Motor disassembly

Research into technologies for disassembling parts that use precious metals

We are conducting research on technologies for the efficient disassembly of electronic circuit boards and sensors, which are considered as urban mining* resources, and technologies for the removal of components containing precious metals.

Engine ECU


Before disassemble


After disassemble

O2 sensor


Before disassemble


After disassemble

* Urban mining : The process of reclaiming compounds and elements from end-of-life vehicles, batteries and electric devices which would otherwise be left to decompose as landfill

Research on resin recycling

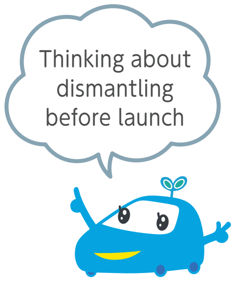
We are considering the possibility of reusing resin vehicle parts recovered from end-of-life vehicles, as a way of promoting the further recycling of resin.

e.g.) Bumper material from end-of-life vehicles→ Reused in resin body components

We are also working on R&D towards realizing of bumper-to-bumper recycling in the future.

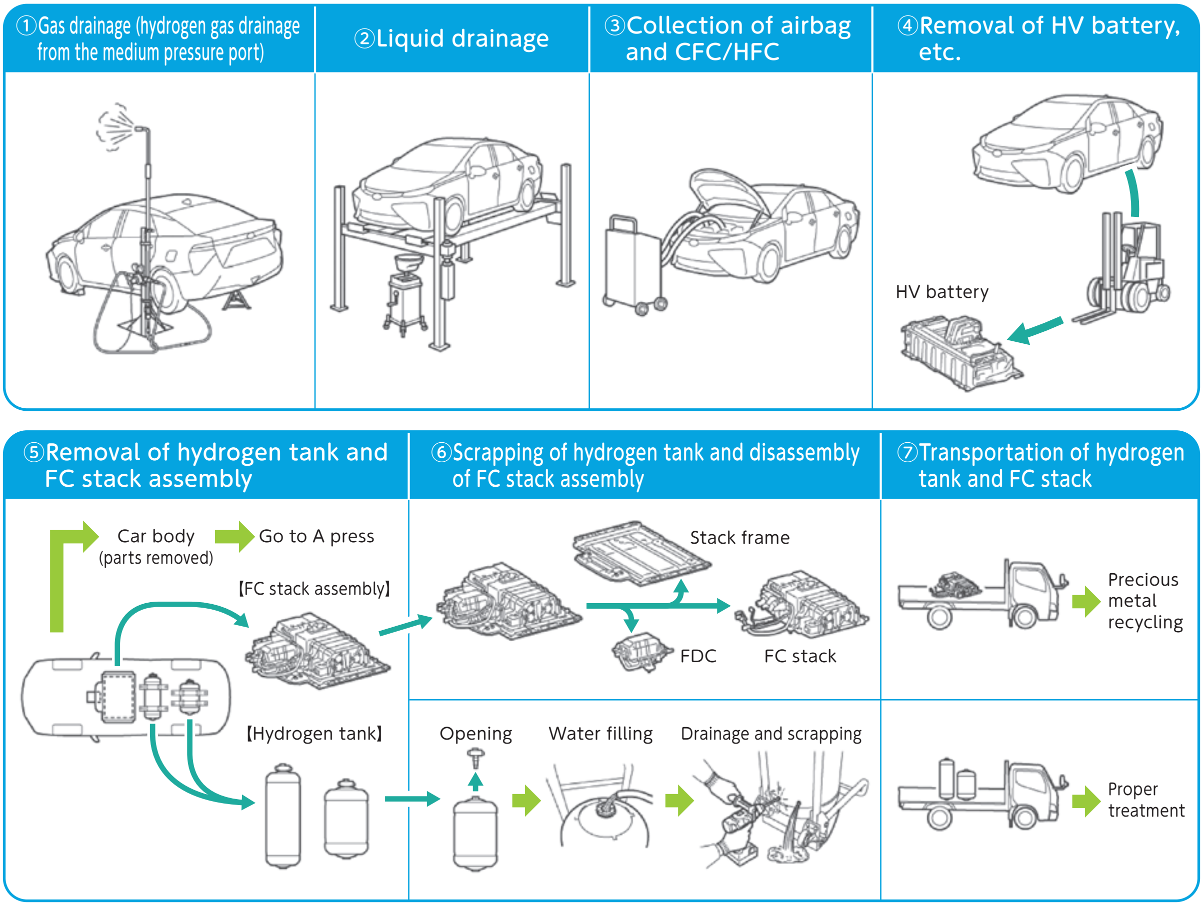

Vehicle resin parts

Development of FCV dismantling technologies



Assuming the occurrence of end-of-life FCVs in the future, Toyota started considering the operation procedures and construction methods of dismantling a few years prior to sales launch.
Furthermore, a dismantling demonstration was performed for Japan ELV Recycle Association in view of Article 3 of the Automobile Recycling Law: "Provide Information of Automobile Structure".

Flow of the FCV dismantling operation (standard pattern)



Dismantling demonstration


Gas drainage


Unloading tank and stack

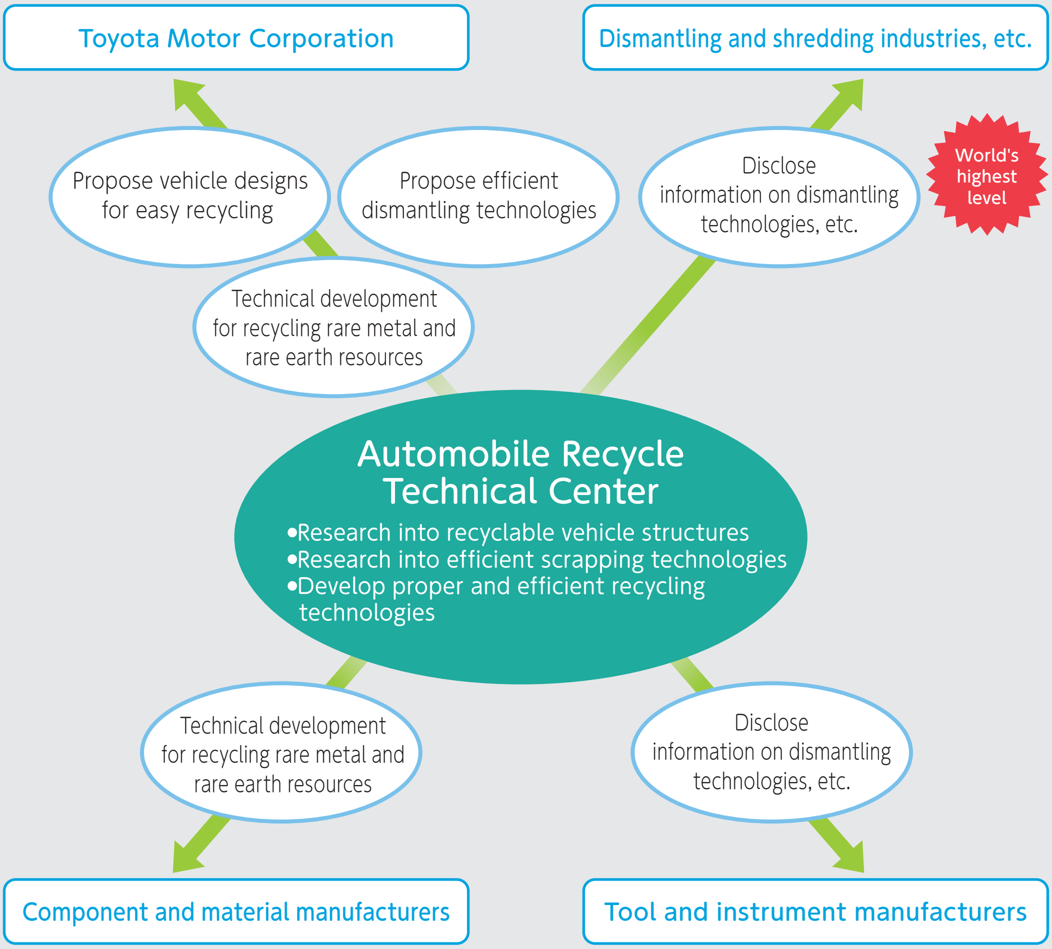
Recycling research site for end-of-life vehicles

Toyota has conducted extensive research to enhance the dismantlability of end-of-life vehicles and the recyclability of parts.

To further advance dismantling and recycling technologies and commercialize and incorporate them in vehicle designs based on the technologies and expertise gained from this research. Toyota established the Automobile Recycle Technical Center in Toyota Metal Co., Ltd. in 2001.

Automobile Recycle Technical Center

Positioning of the Automobile Recycle Technical Center



Compliance with the Automobile Recycling Law

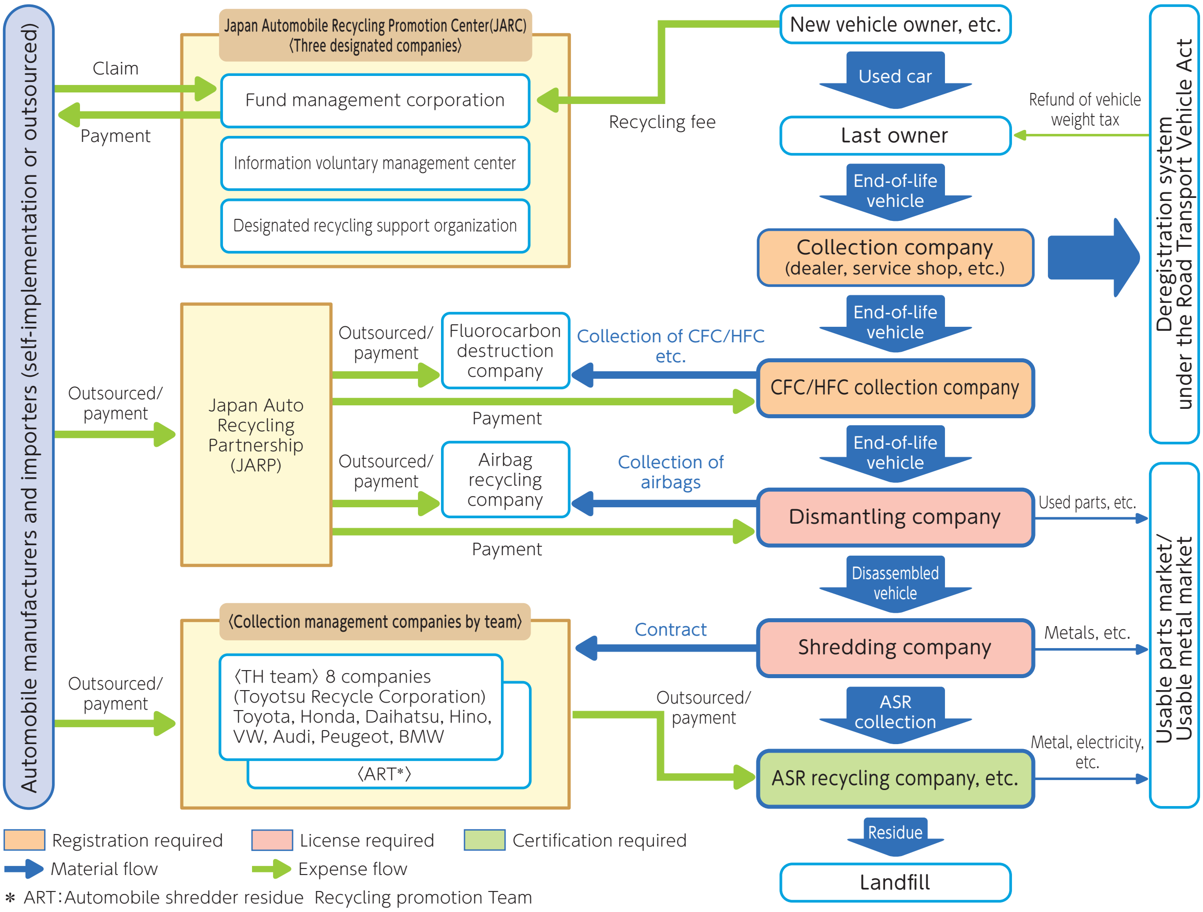
The Automobile Recycling Law, which came into effect in January 2005, mandates an appropriate roles and responsibilities between automobile manufacturers and other involved parties, to promote the recycling and proper treatment of end-of-life vehicles.
Under the Automobile Recycling Law, Toyota collects CFC/HFC, airbags and ASR from end-of-life vehicles, and actively promote recycling or proper treatment.

Outline of the law for recycling of end-of-life vehicles (Automobile Recycling Law)

(As of January 1, 2005)

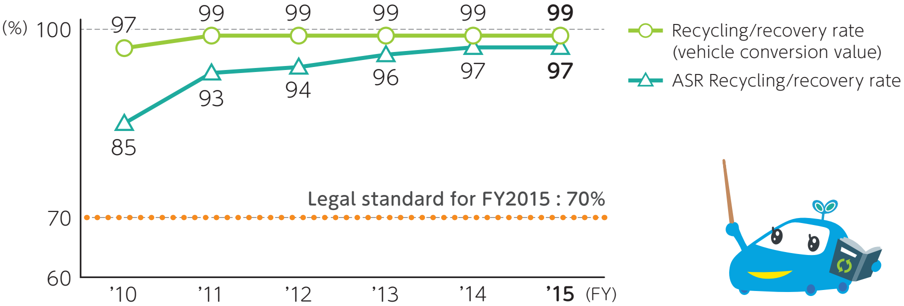
System for collection and recycling under the Automobile Recycling Law

Targets: 4-wheel passenger vehicles (including mini-vehicles) and 4-wheel commercial vehicles (standard, small, mini-trucks and buses)



＊ ART:Automobile shredder residue Recycling promotion Team

Transition in Toyota's recycling/recovery rate and ASR recycling/recovery rate



Recycling in changing times and Toyota's action

Changing times

1970~

From mass production and consumption to energy-saving and recycling

1990~

Recognize environmental problems and start addressing them on a global scale

2000~

Escalation of global environmental problems

Towards establishment of a recycling-based society

Toyota's action

★1970~ Established Toyota Metal Co., Ltd.

★1998~ Started ASR operations P12

★2001 Established Recycle Technical Center P14

★2007 Formulated scenarios for recycling technologies in 2020

★2008 Established the Resource Recycling Committee

Recyclable design (Easy to dismantle design)

Various recyclable design items were applied to new vehicles after Raum

Recyclable design efforts based on recycling technology scenarios

Promotion of bio plastics 2003 -

Compliance with the Automobile Recycling Law

More advanced resource recycling (rare earths, rare metals, etc.)

Toyota Metal Co., Ltd.
(Handa City, Aichi Prefecture)

Recycle Technical Center
(in Toyota Metal Co., Ltd.)

ASR Recycle Plant
(in Toyota Metal Co., Ltd.)

Raum

Prius

2010	2011	2012	2013	2014	2015	2016

Getting complicated of balancing recycling-based society with
low carbon society related problems

Towards establishment of a low-carbon society

★2011

Achieved 99% of ELV Recycling/recovery rate

★2013

Achieved 20% usage of ecological plastic and recycled resin material

★2013

Prime Minister's Award for ongoing efforts to promote a sustainable society by reducing, reusing and recycling resources (3R) in FY2013

Received the 1st Rare Metal Recycle Award for Resource-Recycling Technologies and Systems in FY2013

★2015

Formulated Environmental Challenge 2050

P2

★2015

Received the Global Environment Award

HV battery collection recycling system commences 2009 - World first

Carbide tool tungsten collection recycling system commences 2010 - World first

HV motor magnet recycling commences 2012 - World first

HV battery remanufacturing and reuse operations commences 2013 - World first

MIRAI FC tank and stack collection system operation commences

SAI

MIRAI

Worldwide
Olympic Partner

Worldwide
Paralympic Partner

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