CIRCULAR ECONOMY

68

STRENGTHENING THE CIRCULAR ECONOMY

The finite nature of natural resources and the social and environmental consequences of mining raw materials make uncoupling economic growth from resource consumption and the development of a circular economy key sustainability topics. Against this background, there are extensive opportunities for companies to tap into new business models and markets or to give themselves an edge in the competition for limited resources with changed use concepts. At the same time, new legal requirements need to be met. For example, policymakers at international and national level have made it their aim to regulate markets more aggressively in the future in an effort to speed up the transformation towards resource efficiency and a circular economy. One important driver of the circular economy is the ongoing decarbonization of the Volkswagen Group: The growing use of secondary materials and the establishment of closed material loops is helping to significantly reduce our CO_2 emissions.

GROUP-WIDE WORKING STRUCTURES AND STEERING COMMITTEES

Recognizing the importance of this topic, Volkswagen has anchored circular economy as a focus topic in Group Initiative 6 of the NEW AUTO Group Strategy. Cross-divisional and cross-brand working structures have been developed at Group level for managing the topics to be developed. These build on the work of committees such as the Group Steering Committee for the Environment and Energy, the Group Steering Committee for Sustainability, the Group Steering Committee for Product Recycling and the Group Working Committee for Environment Product.

We want to intensify our efforts for a transition to a loop-oriented and resource-conserving way of doing business even further in the future. To achieve this, we rely on alliances and the implementation of joint projects with various partners, such as suppliers, plant manufacturers, the recycling sector and universities.

OUR PATH TO CLOSED MATERIAL LOOPS

Fundamentally, we pursue four lines of action at Group level in the area of circular economy: Firstly, we are already stepping up efforts to use recyclable and reusable materials in our vehicle projects – for example, from production waste. In addition, we want to further improve the supply of circular materials, i.e., secondary materials and renewable raw materials – for example, by buying back end-of-life vehicles – and thus bring valuable materials back into the loop. Another approach is to preserve recyclable materials through reuse and repurposing – for example, in the recycling of high-voltage vehicle batteries in Salzgitter. And last but not least, we are working intensively on developing business models that simplify the recovery of raw materials from our products. The topic of circular economy is also a core element of the "goTOzero" Group environmental mission statement, on which we orient the strategic design of this action area. With this Group mission statement, the Volkswagen Group is setting itself the target of, among other things, further improving its resource efficiency and promoting reuse and recycling approaches in the areas of materials, energy and water. Other topics that contribute to the topic of circular economy are embedded in the "goTOzero – Zero Impact Factory" program. It is guided by the vision of creating a factory that has no adverse environmental impact.

> Environmental Compliance Management

With a circular way of doing business in mind, we aim to minimize our consumption of resources, to live up to extended producer responsibility and to reduce energy consumption. The vehicles already have a long service life: The average age of an end-of-life vehicle is 14 to 20 years according to national authorities in Europe. For the first steps regarding circular economy, we have concentrated on the aspects of batteries, steel, aluminum and plastics. The results obtained from this are used to further develop the overall circular economy strategy and for devising new business models. In geopolitically difficult times, the topic of circular economy is also about strengthening the Group's resilience and minimizing dependencies.

Our approach to waste disposal in production aims to reduce the quantity of waste we produce and to reuse unavoidable waste to create high-quality materials – i.e., to close loops. The focus is on:

- Avoiding waste creation by optimizing production and auxiliary processes and increasing material utilization levels (material efficiency)
- Reducing the quantity of waste produced by processing waste at sites
- Prioritizing the reuse of waste and reducing the quantity of waste that needs to be disposed of

In addition to waste, another focus is on the resource of water. We focus on the following areas of activity in sustainable water management:

- Reduction of freshwater consumption and efficiency in water use, particularly in water stress areas
- Minimization of pollution and no worsening of the environmental and chemical status in the receiving waters (waters into which the treated wastewater is introduced)
- Increased soil and groundwater protection when using water-polluting substances

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MEASURES ALONG THE ENTIRE LIFE CYCLE

The most important measures that we want to take to implement the circular-economy strategy include further clarifying targets and indicators and also realizing circular business models. This applies to the most important components and materials, such as batteries, steel, aluminum or plastics. We are planning to add a specific KPI set for the topic of circular economy to the existing KPIs (DCI, reduction of the environmental impact of production). It will include a description of the use of circular materials at vehicle level and a breakdown by different vehicle projects. The KPI set will also be used in battery production and show the progress in this area. In addition, in the future the Group wants to indicate which revenue we generate through closed-loop circulation.

To make our contribution to a circular way of doing business, we are stepping up efforts to use material loops in our production processes. When selecting raw materials, we opt for recycled ones obtained from production waste or end-of-life products. When developing new vehicles, we pay attention to the recyclability of the required materials, using high-quality recycled materials and avoiding pollutants. Under the European Directive on end-of-life vehicles, passenger cars and light commercial vehicles must be 85% recyclable and 95% recoverable at end of life. All our vehicles registered in Europe comply with these standards.

Our Procurement Division has established a Group-wide system for recovering waste materials that can generate income – for example, paper, plastics, wood, electronic components or metal. Under the umbrella of the Zero Impact Factory initiative, we are intensifying our efforts to avoid plastic waste with the Zero Plastic Waste project. This includes the project for recycling plastic waste in diesel tank production, which is described below.

Vehicle Development Measures

We include the circularity of our vehicles in our thinking as early as the development stage. For example, all operating fluids can later be removed from the end-of-life vehicle and parts to be removed are disassembled. Other measures include:

- The use of recycled materials is permitted for many components if they meet the same quality standards as the primary material.
- All components made of plastic are labeled in accordance with international ISO standards so as to be able to later identify them and separate them by type.

Use of Renewable Raw Materials

To reduce our resource consumption, we rely on raw materials from renewable sources when manufacturing our vehicles. Wherever possible, our Group brands use raw materials from renewable resources such as the natural fibers flax, cotton, wood and cellulose. Such materials can be used if they comply with all the technical equirements and perform better than conventional materials over the life cycle. In addition, our sustainability standards apply to our suppliers.

ŠKODA is an example of this. For instance, in collaboration with the Technical University of Liberec and the supplier, the brand has developed a sustainable, ecological material made from sugar beet pulp which can be used in dyed form in the interior of vehicles to create certain design accents. In addition, ŠKODA is working on another material based on the miscanthus reed which will also be used in the interior of models in the future. In addition, the Group is investigating the use of other ecologically sourced materials, such as materials based on cellulose. One flagship project is cooperation with a recycling company. As part of this, a process has been developed to turn painted bumpers into granules. These can then be used for new bumpers.

Use of Recycled Materials in Vehicles

Using the highest possible proportion of recycled materials is very important for us. In the ID. family, for example, ceiling headliners, fabrics, carpets, seats, door trim and decorative inlays are being made from sustainable material. The seat textiles for all lines are partly made of up to 100% recycled PET – these were frequently previously PET bottles. In the Golf 8, 28% of the textiles and 6% of the thermoplastics are made from recycled materials.

In-House Expertise in Battery Recycling

Electric drives are an important step toward low-emission mobility and thus help to protect the climate. At the same time, their production results in different materials entering circulation from the production of conventional vehicles – for example, high-voltage batteries. The raw materials these contain are valuable and it is important for them to remain in circulation for many reasons. For example, the mining and use of these raw materials is associated with emissions and other adverse environmental impacts. If we use battery raw materials multiple times instead, this significantly reduces these impacts and helps us to reduce our carbon footprint. Moreover, making use of materials multiple times also helps to save costs. Volkswagen Group is already working on a recycling concept for batteries. Volkswagen has also entered into strategic partnerships for this, particularly with the recycling group Umicore.

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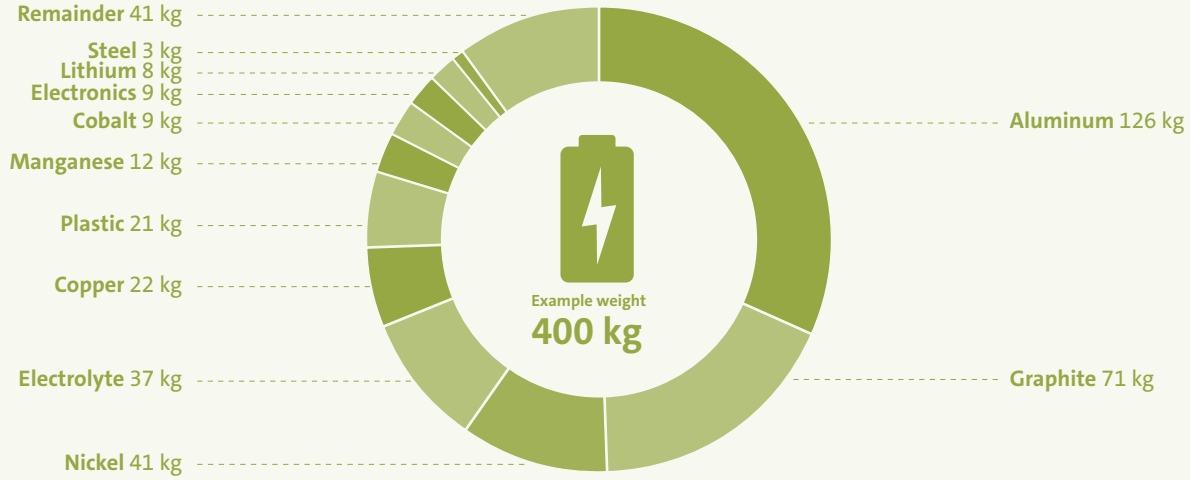
MAKING NEW FROM OLD – THIS IS HOW MANY VALUABLE MATERIALS A BATTERY CONTAINS

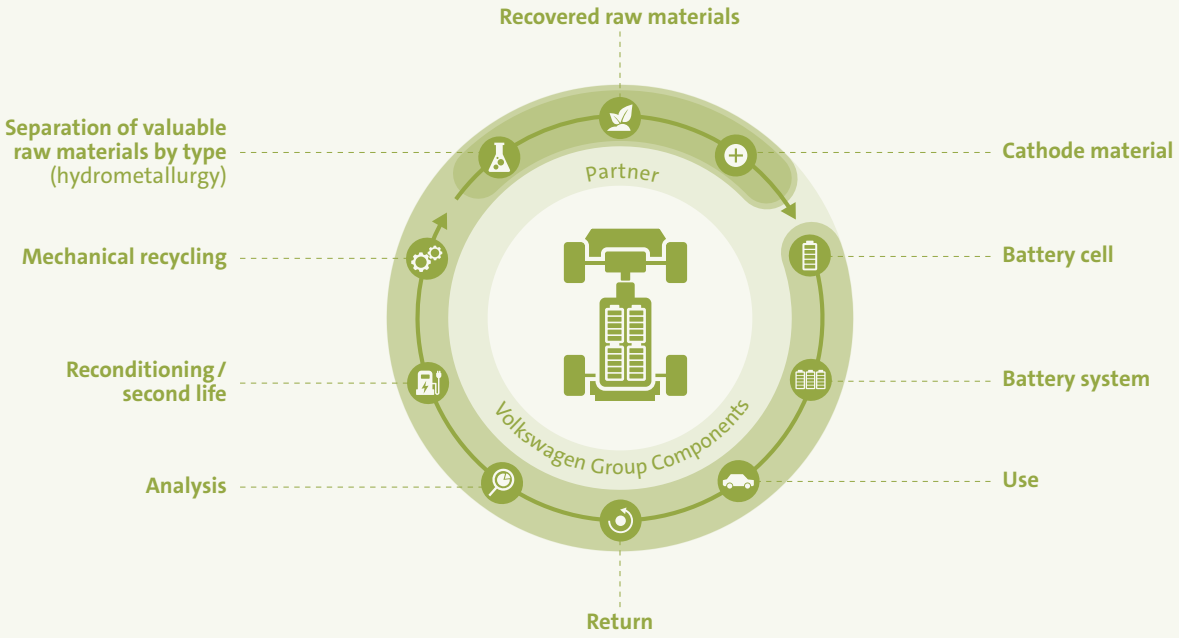


Volkswagen Group Components opened the Group's first pilot facility for recycling high-voltage vehicle batteries at the Salzgitter site at the start of 2021. The objective is industrialized recovery of valuable raw materials such as lithium, nickel, manganese and cobalt in a closed loop and also of aluminum, copper and plastic, with a recycling rate of more than 90% in the future. Batteries are only recycled if they can no longer be used in other ways – for example, in reconditioned form in mobile energy storage systems such as flexible fast-charging stations or charging robots. The facility has been initially designed to recycle up to 3,600 battery systems per year in pilot operation.

The innovative and CO_2-saving recycling process does not require energy-intensive melting in a blast furnace. The used battery systems are delivered, deep discharged and dismantled. The individual parts are ground into granules in the shredder and then dried.

In addition to aluminum, copper and plastics, the process mainly yields valuable "black powder" containing lithium, nickel, manganese, cobalt and graphite, which are important raw materials for batteries. The separation and processing of the individual substances by hydrometallurgical processes – using water and chemical agents – is subsequently carried out by specialized partners. As a consequence,

AFTER USE IS BEFORE USE – THE LOOP FOR BATTERY RAW MATERIALS



GRI 306-2

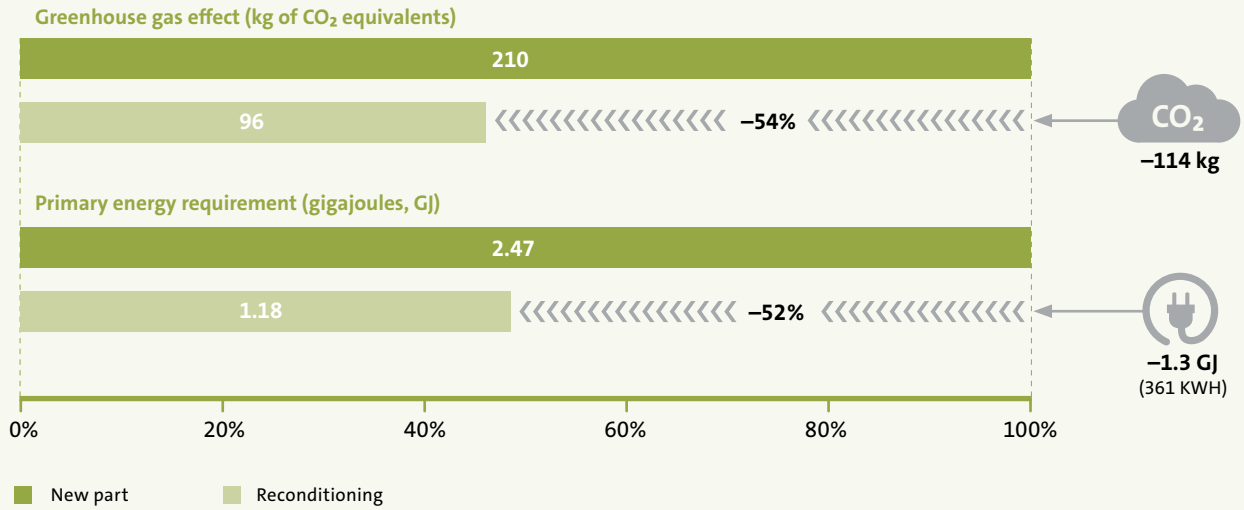
essential components of old battery cells can be used to produce new cathode material. The material recovered can be used to support battery cell production at Volkswagen in the future. The CO_2 savings are calculated to be approximately 1.3 metric tons per 62-kWh battery manufactured using cathodes made from recycled material and green electricity.

Recycling of Vehicle Parts and Tools

The aim of our focus on high quality with a low need for repair is to give our vehicles long lives in the use phase, thus making an important contribution to resource efficiency. If a part nevertheless fails, we additionally offer new parts through the Exchange Parts program of the Group's after sales segment and its brands. The worldwide return of used parts from the workshops and their subsequent industrial reconditioning are a key component of the replacement program. By means of our development skills and structured quality standards and processes, we make the part ready to be used again for another life cycle in the vehicle's use phase. Cross-brand uniform standards and structures are created from within the Group's after sales segment to jointly implement new circular economy projects in a targeted and efficient way. If customers choose the reconditioned part as an alternative to a new part, they are actively supporting sustainable resource conservation and the reduction of energy requirements and CO_2 emissions.

The environmental impact of a brand-new gearbox has been compared with that of its reconditioned equivalent in a certified environmental impact study. Ultimately, a 54% reduction in CO_2 emissions and a 52% decrease in primary energy requirements can be achieved through reconditioning. The amount of energy this saves per reconditioned gearbox is 1.3 gigajoules, which is equivalent to the range of an electric car of more than 2,200 km (ID.3 on the basis of WLTP).

ENVIRONMENTAL IMPACT OF GEARBOX RECONDITIONING



Currently, the product range includes around 8,300 parts for central vehicle components, such as motors, gearboxes or electronic components. In 2022, we took back around 407,000 used parts from 67 countries in the central used parts warehouse through our return process. This is equivalent to a return rate of 97%.

Furthermore, it is not just vehicle parts that are reconditioned at Volkswagen but also production tools. This is what, for instance, the center of excellence for tools at the Salzgitter site is for. An average of 160,000 tools have been processed here each year since 2009 to make them suitable to return to use.

GRI 306-2

Recovery of Precious Metals from Catalytic Converters and Particulate Filters

The Exchange Parts program also makes a contribution to the circular economy through taking back used catalytic converters and particulate filters. The recovery of the precious metals platinum, palladium and rhodium, which are contained in them, is achieved through cross-brand processes. Around 80,000 catalytic converters and particulate filters are taken back from the Group brands' workshops each year. In addition, catalytic converters from engine testing facilities and production batches are also fed into the recycling process. In this way, more than 600 kg of precious metals are recovered as raw materials and are available to the Group as secondary material. The recovered raw materials are used in the production of new exhaust systems for Group vehicles, with the result that materials loops are closed and the need for new precious metals can be reduced.

Aluminum Closed Loop at Audi

A closed loop for aluminum was achieved for the first time beyond Company boundaries in the Neckarsulm plant in 2017 with the Aluminum Closed Loop Project. The waste from aluminum sheet-metal parts from the press shop is delivered directly back to the suppliers, who can recycle the scrap and use it to produce new material that Audi then uses again in the press shop. Compared with using primary aluminum, recycling aluminum waste can save up to 95% of the energy used in manufacturing. In this way, Audi avoids CO_2 emissions and reduces the quantity of primary raw materials needed. In addition to the plant in Neckarsulm, the Audi plants in Ingolstadt and Győr have now also joined the Aluminum Closed Loop process. The process itself and the resultant net CO_2 savings of more than 633,881 metric tons of CO_2 since 2017 have been verified by independent third parties. The calculation of the CO_2 savings from the Aluminum Closed Loop Project was updated compared with the prior year because the press shop offcuts were reassessed.

633,881 metric tons of CO_2

have been saved since 2017 through the Aluminum Closed Loop process.

Recycling Production Waste

Waste with recyclable content generated in production is also being increasingly systematically included in our closed-loop processes. For example, in the Volkswagen Group Components foundry in Kassel, all aluminum chips generated on the site are returned to the casting process. Around 20 metric tons of aluminum chips are produced here each day and melted down in the plant. According to forecasts, this alternative to regular aluminum production reduces the energy requirements by around 3,250 MWh per year and reduces CO_2 emissions by more than 1,400 metric tons per year. In the medium term, the foundry wants to melt down a further 40 metric tons of material from other European Volkswagen plants per day. In the long term, the quantity is set to rise to up to 80 metric tons of chips per day.

At the Volkswagen plant in Wolfsburg, plastic waste produced in the process of manufacturing gasoline tanks (co-extrusion) is prepared and used again for the production of diesel tanks (mono-extrusion). As a result, around 1,600 metric tons of material that would otherwise be disposed of can be used in plastic tanks in this way each year. This can save the plant 2,500 metric tons of CO_2 and €2 million in costs of materials each year.

Responsible Use of Water

We want to use the resource of water as sparingly as possible. The supply chain, in particular obtaining and processing raw materials, is responsible for the greater part of our water use. Because we cannot influence these aspects directly – despite our sustainability requirements for suppliers – we concentrate on our production sites. Of all freshwater that we use for manufacturing passenger cars and light commercial vehicles, 50.3% (around 15.9 million m^3) is used by sites in risk zones. These are regions with water shortages, such as Mexico. The closed-loop circulation or recirculation of cooling and process water mean the need for freshwater and the quantity of wastewater can be reduced considerably. The San José Chiapa (Mexico) Audi site, which can be considered a wastewater-free site due to closed-loop circulation, provides a good example of this.

We manage water-saving processes at all our Group's locations during production in line with Group-wide specifications. In addition, Volkswagen supports the Water Disclosure Project (WDP), which was launched by the Carbon Disclosure Project (CDP), through the transparency of its water management. In 2022, we were given the top grade of A in the WDP ranking for our sustainable water management and are thus back in the leadership index. Given our growing production figures and the integration of new sites, our Group's absolute freshwater use has increased in recent years. From 2010 to 2022, the quantity of freshwater used for the manufacture of passenger cars and light commercial vehicles decreased by 17.4% per vehicle thanks to a wide range of recycling measures and the introduction of manufacturing processes requiring little water. The amount of wastewater produced is in line with the amount of freshwater that we use. Differences in quantities between fresh and wastewater are the result of, for example, evaporation in cooling towers and during the manufacturing process.

GRI 303-3

CIRCULAR ECONOMY KPIS

KPI	Unit	2022	2021	Notes and comments
CO_2 avoided since 2017 through the Aluminum Closed Loop Project	in metric tons of CO_2	633,881	467,671	The calculation of the CO_2 savings from the Aluminum Closed Loop was updated compared with the prior year because the press shop offcuts were reassessed.
Proportion of freshwater needed at sites in risk zones	in million m^3/year	15.9	15.8	Passenger cars and light commercial vehicles