



# Battery recycling: Facts and figures about the pilot plant in Salzgitter

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## Battery recycling: Facts and figures about the pilot plant in Salzgitter

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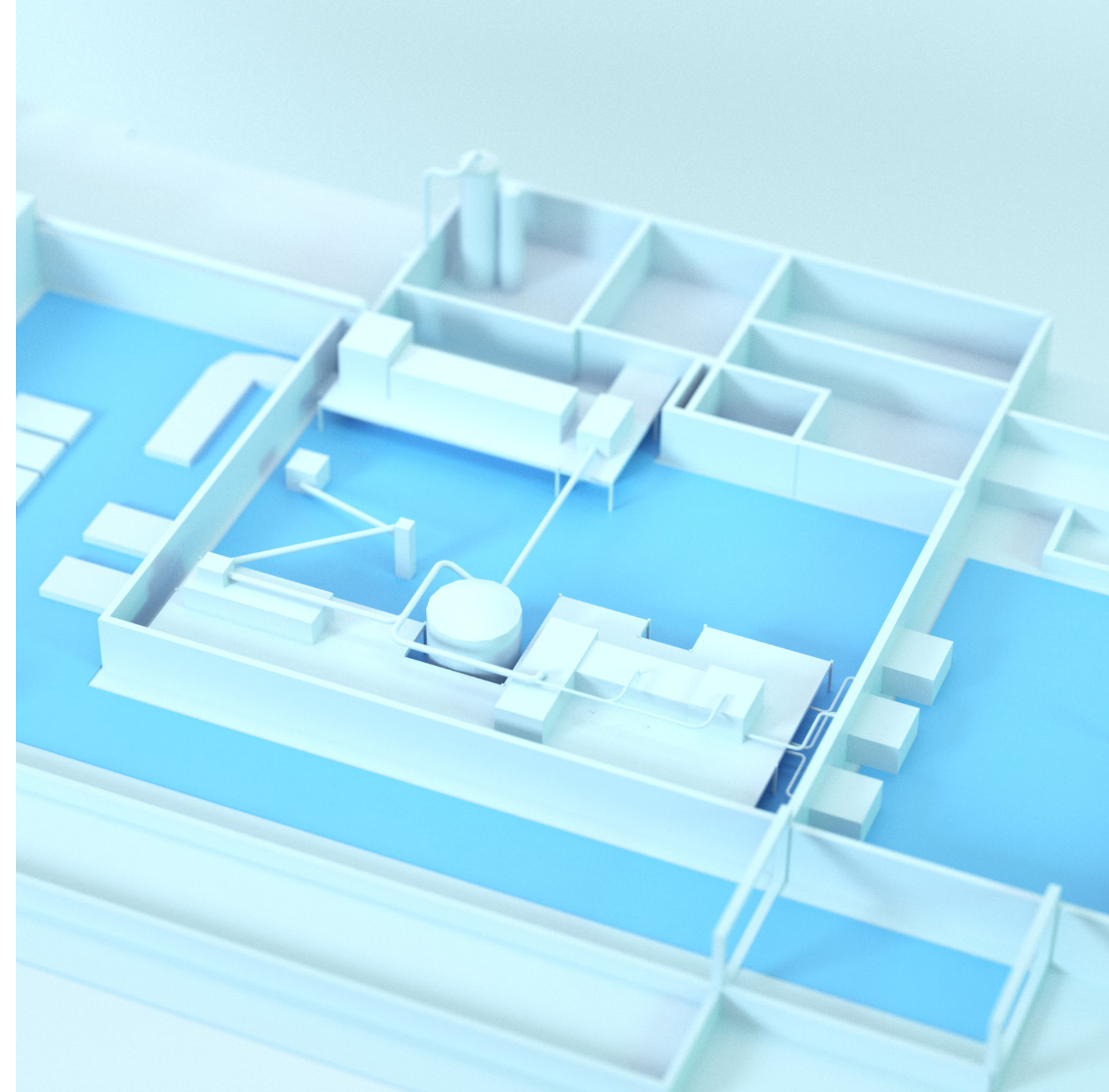
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Battery recycling pilot plant in Salzgitter: The site is playing a key role in the transformation.



In brief

## Statements on battery recycling at the Salzgitter site

**// Volkswagen intends to keep control of the raw material cycle for batteries at all stages. The battery and its raw materials form the foundation for the recycling economy of future mobility.**

Herbert Diess, Chairman of the Board of Management of Volkswagen AG

**// Volkswagen Group Components is urgently addressing the key component of e-mobility with its battery recycling pilot plant, and overcoming another key future issue in the automotive industry.**

Thomas Schmall, Member of the Board of Management of Volkswagen AG, "Technical" Division, and Chairman of the Board of Management of Volkswagen Group Components

**// The pilot project sends out a strong signal to the workforce that the transformation of the Volkswagen Group is continuing to take shape.**

Gunnar Kilian, Member of the Board of Management of Volkswagen AG, "Human Resources" and "Truck & Bus" Divisions

**// Volkswagen has reached another milestone on its way to climate-neutral electric mobility with its battery recycling plant. In addition to generating the electricity required from renewable energy sources, responsible handling of the used batteries has just as critical a role to play.**

Stephan Weil, Minister President of Lower Saxony

**// The recycling plant in Salzgitter is a flagship for business, environmental and employment policy success.**

Bernd Osterloh, Chairman of the General Works Council and Group Works Council of Volkswagen AG

**// This pilot plant represents a major step forward. It shows what is possible today with technical innovation. The intention is also to use these processes at other sites in future.**

Georg Kell, Spokesperson for the Sustainability Council of Volkswagen AG





*Even after a normal car life cycle of 200,000 to 300,000 km, the battery remains by far the most valuable component in the car and will likely be used in stationary storage for a number of years after the car life. Only then will it be recycled – to the greatest extent possible. This creates a sustainable value creation cycle with numerous new business opportunities that we will utilise for Volkswagen.*

Herbert Diess, Chairman of the Board of Management of Volkswagen AG

## Key aspects

# Transformation pioneer: Volkswagen Group Components continues to drive forward the electric offensive with battery recycling

Today, Volkswagen Group Components opened the Group's first plant for recycling electric car batteries in Salzgitter. As pilot operation commences, the Volkswagen Group takes another committed step towards its sustainable end-to-end responsibility for the entire value chain of the e-vehicle battery. With the commissioning of this plant, Volkswagen Components is also highlighting its battery expertise and overcoming yet another major transformation issue in the sector.

### Building know-how, shaping the future

75,000 employees in over 60 global component plants are developing and

manufacturing vehicle components for the Volkswagen Group brands. As a pioneer in the shift to e-mobility, Volkswagen Group Components has been systematically focussing on innovative, competitive and scalable products for the mobility of tomorrow since 2015. At present the business unit's responsibilities include producing key components for the fully electric Volkswagen ID.4 SUV.<sup>1</sup>

With the start of the battery recycling, Volkswagen Group Components is taking a further step towards controlling its entire battery value chain – from battery cell to recycling. →

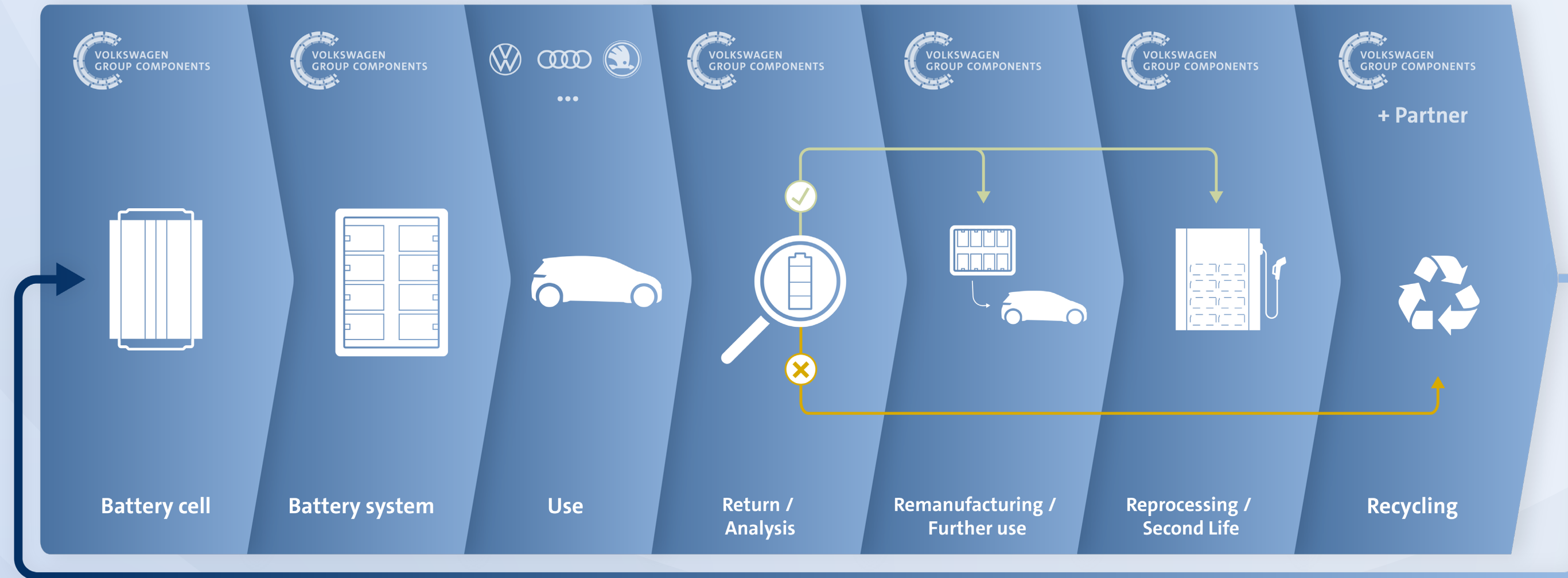
<sup>1</sup> ID.4 - Power consumption in kWh/100 km (NEDC): 16.9-16.2 (combined); CO<sub>2</sub> emissions in g/km: efficiency class: A+.



## Key aspects

### Volkswagen Group Components responsible for the entire battery value chain

Brand has end-to-end responsibility for the heart of e-mobility



Renewed use of the recovered materials

The Salzgitter site is playing a key role in the transformation: in future, Volkswagen Group Components will manage key parts of the battery value chain itself.

#### Pioneering work for the entire Group

The Centre of Excellence for Battery Cells (CoE) combines development, research, pilot production and quality assurance, and is driving forward the further development of battery technologies across all brands. It is also preparing for the series production of lithium-ion cells.

The recycling of high-voltage batteries is also being continuously developed in the pilot plant and piloted for the Group. The pilot plant will be followed by further recycling plants in future. The aim is to establish a closed-loop material cycle for batteries, which is an essential component of the closed-loop economy of future mobility. ■

## Key aspects

# From raw material to recycling: A cycle for batteries

Nowhere does the issue of transformation have a stronger presence than in Salzgitter. Some 400 employees are researching the battery technologies of the future and innovative recycling processes here. The aim is to achieve a consistently increasing recovery and recycling rate, as well as closed-loop recycling.

### **More recycling, less mining of raw materials**

The Volkswagen Group started researching how raw materials are recovered from batteries over ten years ago. The most valuable recoverable raw materials include

lithium, nickel, manganese, cobalt and graphite. Volkswagen Group Components hopes that the multiple use of these raw materials, in particular, will represent a supreme example of the three pillars of sustainability. Energy-efficient recycling is environmentally sustainable, as it is environmentally friendly and saves CO<sub>2</sub> – around 1.3 tonnes per 62 kWh battery, manufactured from recycled cathode material using green electricity. It is economically sustainable because it saves costs. And it is socially sustainable because it safeguards jobs and creates a fully transparent raw material source. →

*“We have been researching for some time, and now we are getting on and doing things – and so becoming pioneers in the sector with regard to a major future issue.”*

Thomas Schmall, Member of the Board of Management of Volkswagen AG, Technical Division, and Chairman of the Board of Management of Volkswagen Group Components

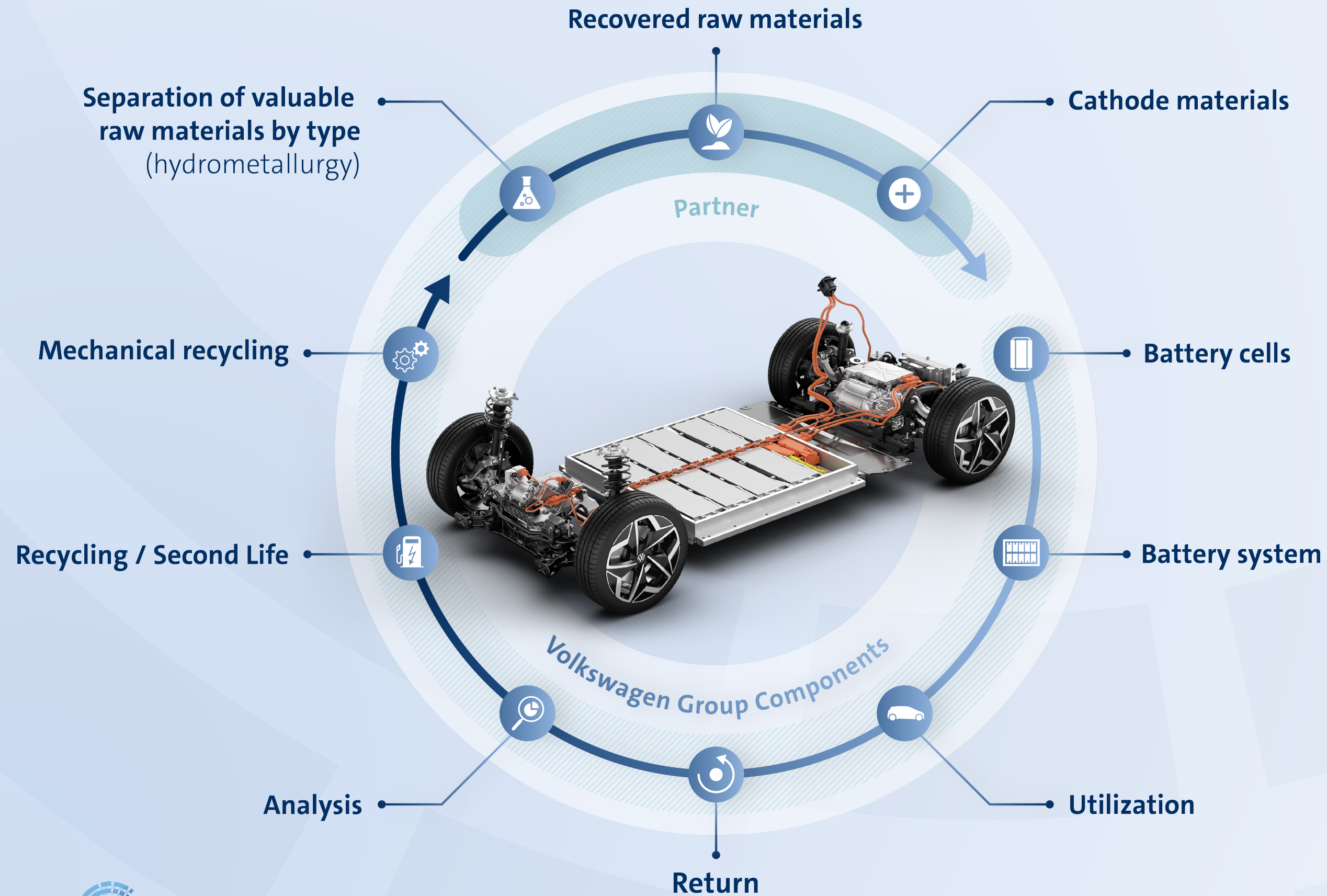




## Key aspects

### After the use is before the use

The battery raw materials cycle



By starting battery recycling, we are also meeting our responsibility to design an essential building block of the resource-conserving closed-loop economy of future mobility in-house. After all: batteries and battery cells are the key components of e-mobility. They represent a significant part of the value added in electric vehicles. That is why Volkswagen Group Components is making battery technology its core competence.

#### Sustainable reusable material cycle with major potential

Over the long term, Volkswagen Group Components wants to return valuable raw materials to the production process chain – by reusing older but intact batteries in what it calls a “second life” or by recycling.

The unique feature of the plant in Salzgitter: It only recycles batteries that can no longer be otherwise used. Beforehand, engineers check whether the battery is still powerful enough to be used as a reconditioned battery – for example in mobile energy storage units, such as the flexible quick-charging columns or charging robots. Only batteries that can no longer be otherwise used are recycled. As raw materials are scarce and expensive, battery recycling becomes the basis for batteries using recycled raw materials. And the demand for cathode material from recycled batteries increases with every new electric vehicle. ■



*“We know from many years of research that recycled battery raw materials are just as efficient as new ones. We plan to support our cell production in future with the material we have recovered. We really use every gram of recovered material as the demand for batteries rises sharply.”*

Mark Möller, Head of Technical Development & E-Mobility Business Unit

## Key aspects

# Salzgitter: Blueprint for the battery recycling of tomorrow

The battery recycling pilot plant in Salzgitter will initially process 3,600 battery systems per year – equivalent to around 1,500 tonnes. Subsequently, the innovative process can be scaled to any volumes – for example, when larger numbers of batteries return from the market at the end of the 2020s. Today the plant is already capable of handling up to 15 battery systems a day in a three-shift operation.

### **Innovative raw material recovery**

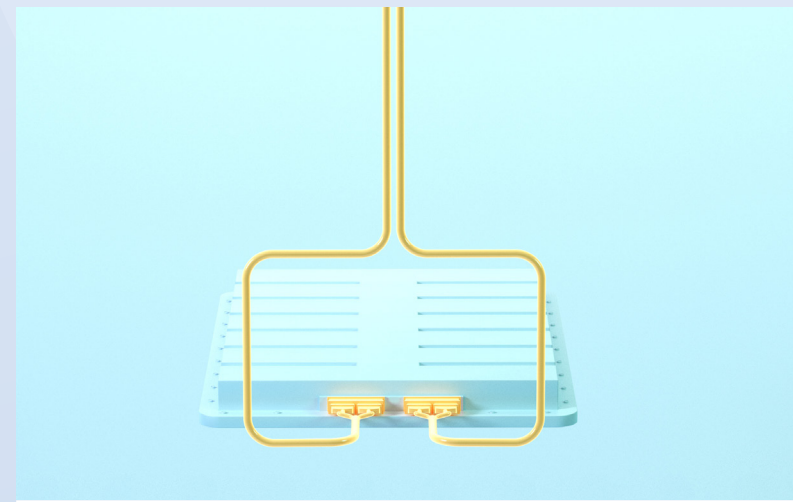
Volkswagen does not smelt metals in a blast furnace, as significantly higher temperatures and more energy are used in established pyrometallurgy. The objective is highly effective recycling and the reuse of valuable raw materials, such as nickel, manganese, cobalt, copper, steel and aluminium – a process that is also environmentally and economically sustainable. →



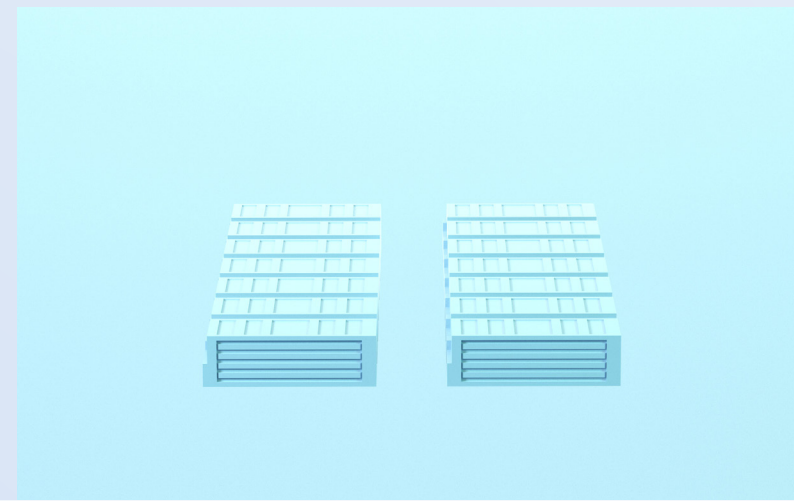
## Key aspects

### How does the recycling process work?

The innovative and CO<sub>2</sub>-saving recycling process consists of several stages:



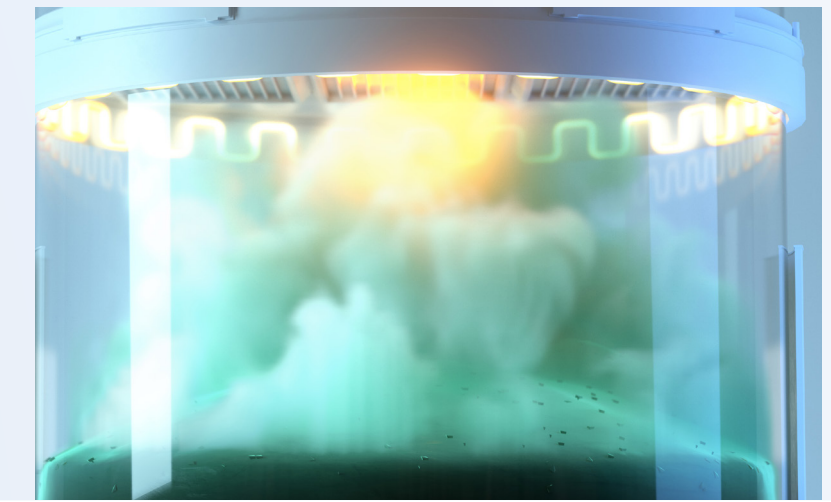
Arriving battery systems are tested and depleted. Efficient performing batteries are reused.



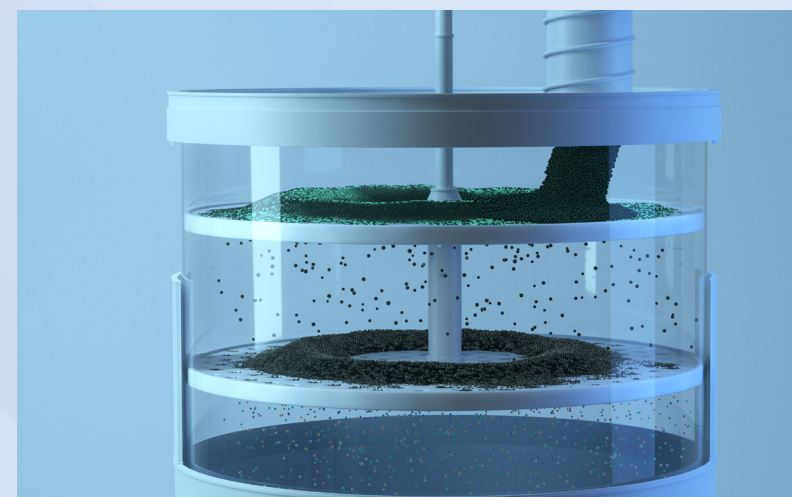
Casings and attachments are removed and the battery system is dismantled into individual modules.



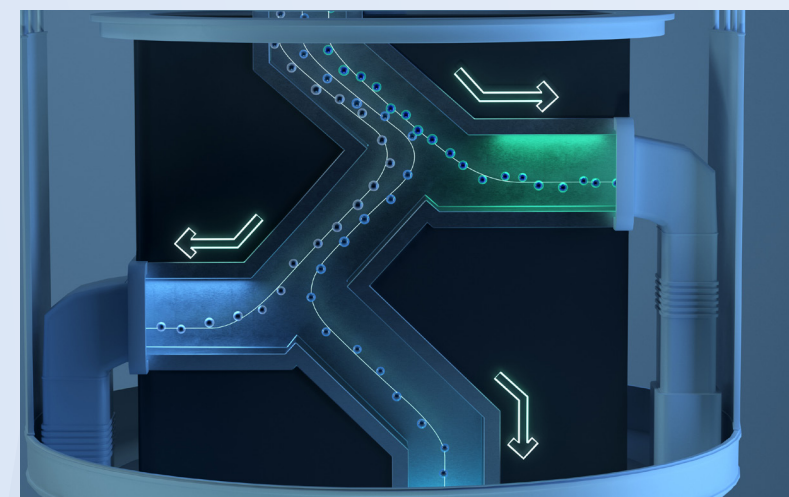
The battery modules are mechanically pulverised into granules in a grinder.



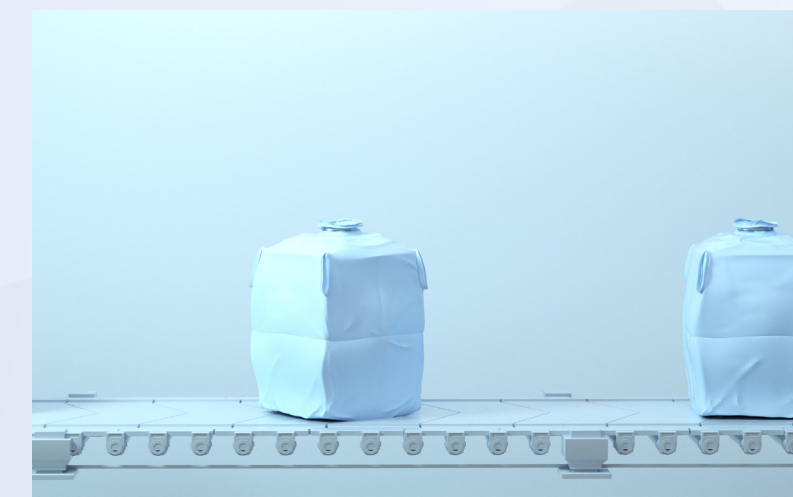
To be able to further utilise the material the granulate is dried and wet electrolyte components are evaporated.



The dried granulate is sieved, obtaining valuable "black powder". The mixture of lithium, nickel, manganese, cobalt and graphite can be used for the production of new battery cells.



A strong magnet filters out all magnetic components from the granulate – mainly iron and steel. Non-magnetic metal is separated from plastic particles.

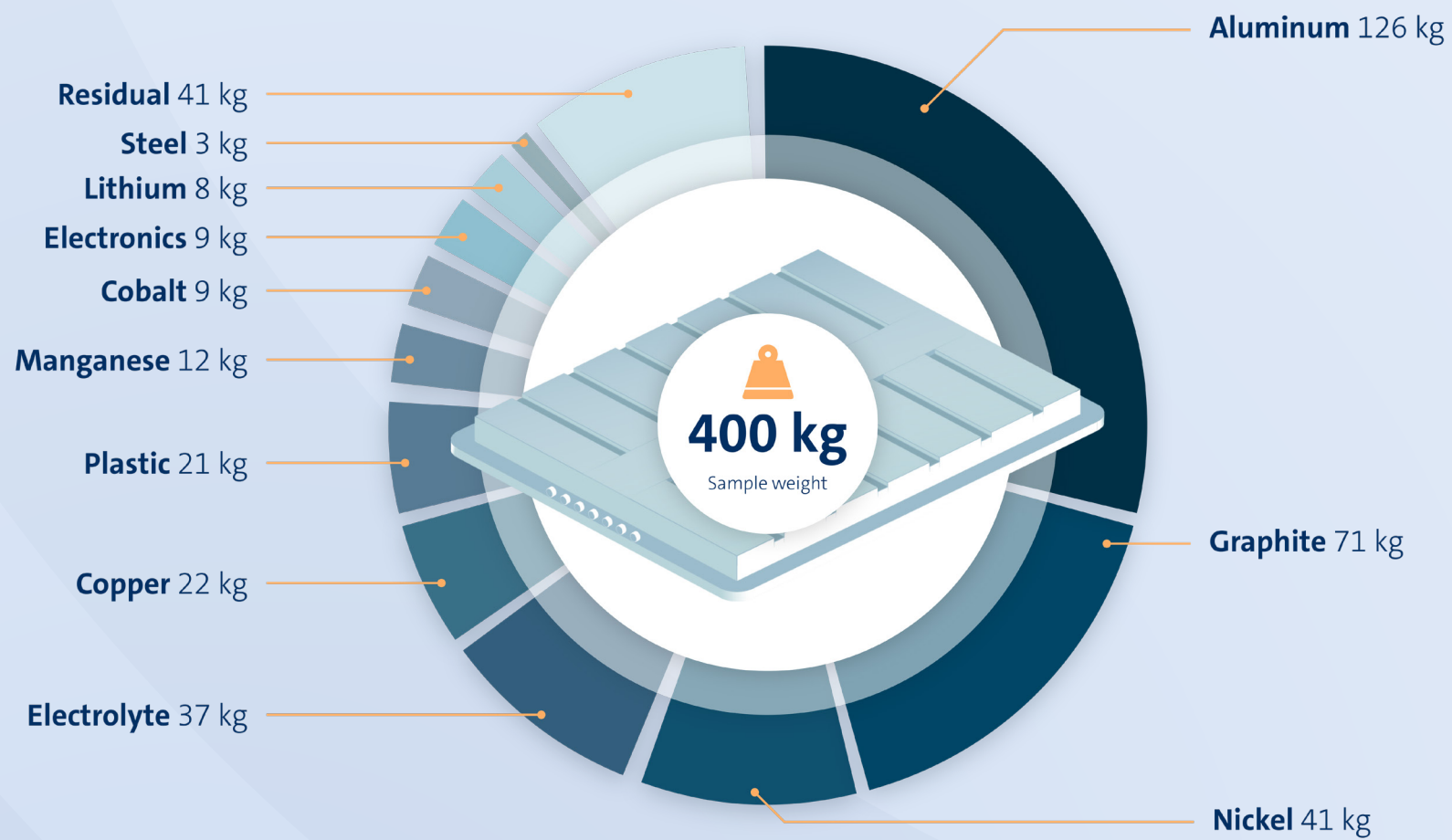


The most important materials are filled separately into Big Bags – "black powder", aluminium, copper and plastic. The "black powder" is then transported to partners for separation of the individual raw materials.



# Key aspects

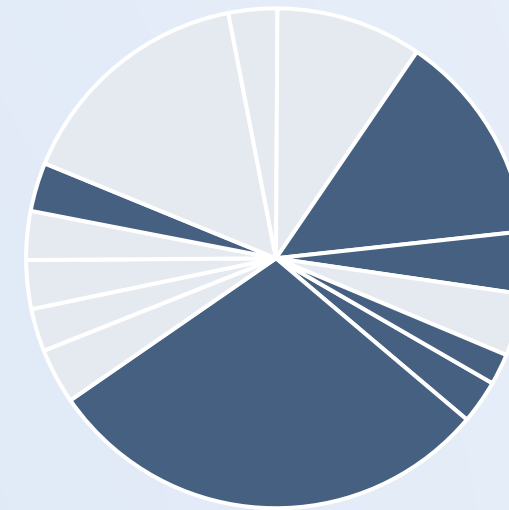
## Battery materials



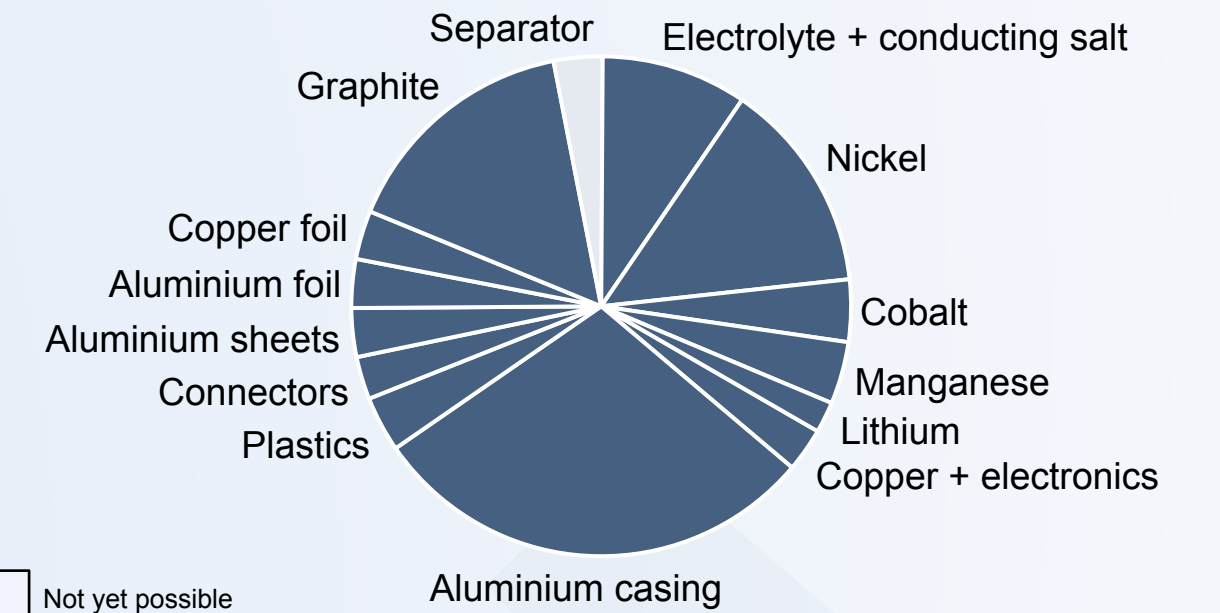
With a 400 kg battery, the recovered raw materials add up to over 100 kg of aluminium, over 100 kg of electrode material (including lithium, nickel, manganese, cobalt and graphite) and over 20 kg of copper. Energy-efficient recycling can reduce the primary raw material demand and new electrode material is produced from a 100% transparent source, saving CO<sub>2</sub>.

## A comparison of material recovery processes

State of the art: Pyrometallurgy  
 > 50 % material recovery



Our approach: Mechanical preparation and hydrometallurgy  
 > 95 % material recovery



Legend: ■ Currently possible ■ Not yet possible

Data is based on battery weight

**Pyrometallurgy:** Smelting in a blast furnace associated with high energy consumption – focus on nickel and cobalt

**Mechanical preparation and hydrometallurgy:** Volkswagen Group Components produces “black powder” containing lithium, nickel, manganese, cobalt and graphite, which is then separated into the individual raw materials by a partner company

The Salzgitter plant is small but does its job well – Volkswagen Group Components will continue to optimise it and scale the volume as the numbers of returned batteries rise. With its first step into industrialised battery recycling, Volkswagen Group Components is improving its security of supply and embarking on a climate-friendly, sustainable closed-loop electric mobility economy.





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