

CLEANSORT – STATE OF THE ART ALLOY-ACCURATE SORTING OF METAL SCRAP WITH HIGH THROUGHPUT

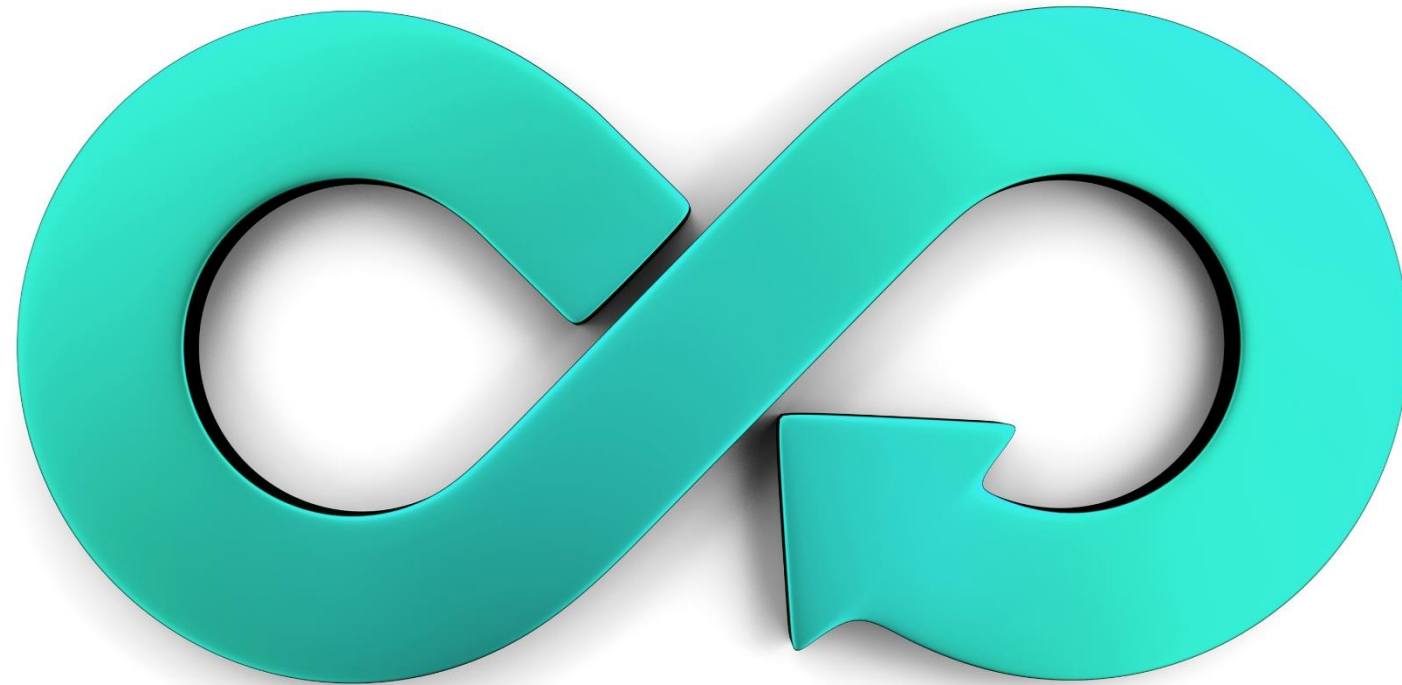
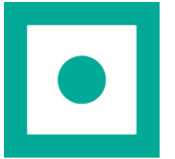
Edwin Büchter, CO-founder and Partner, cleansort
cleansort GmbH

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OUR GOAL

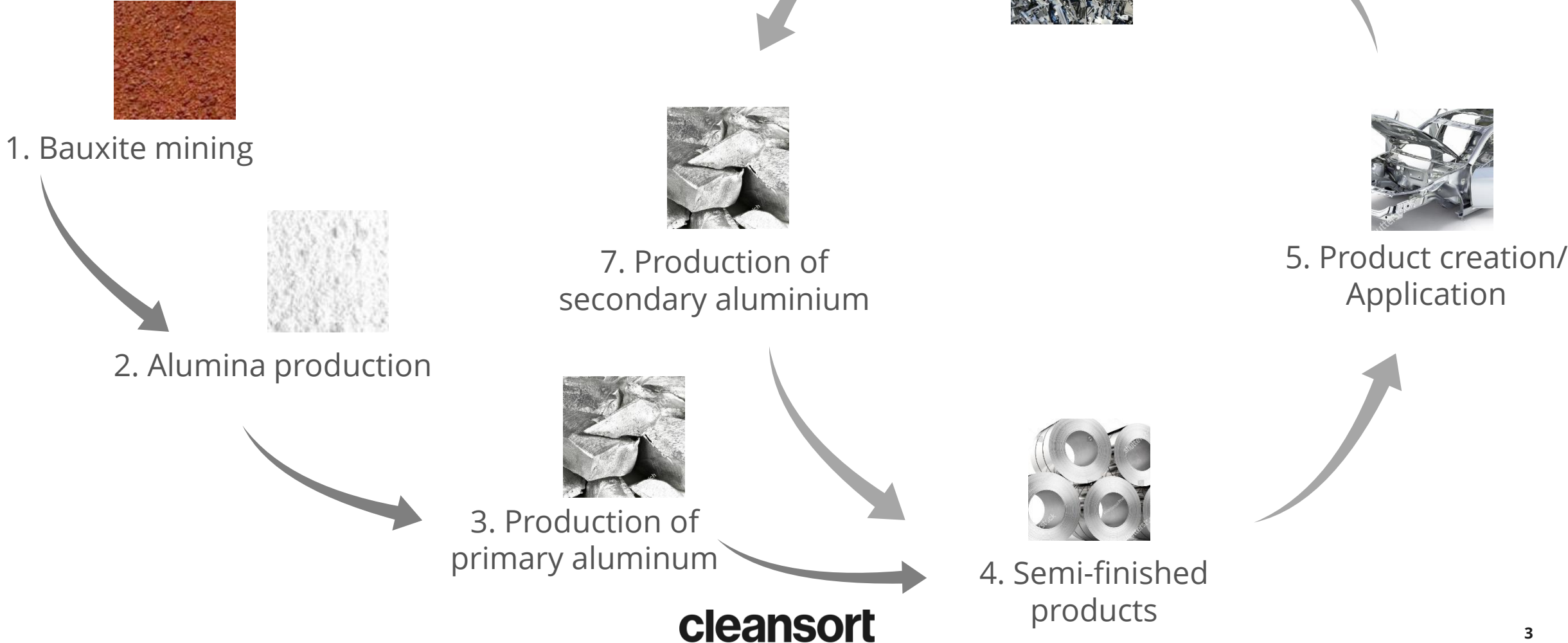
Direct recycling of valuable metal materials



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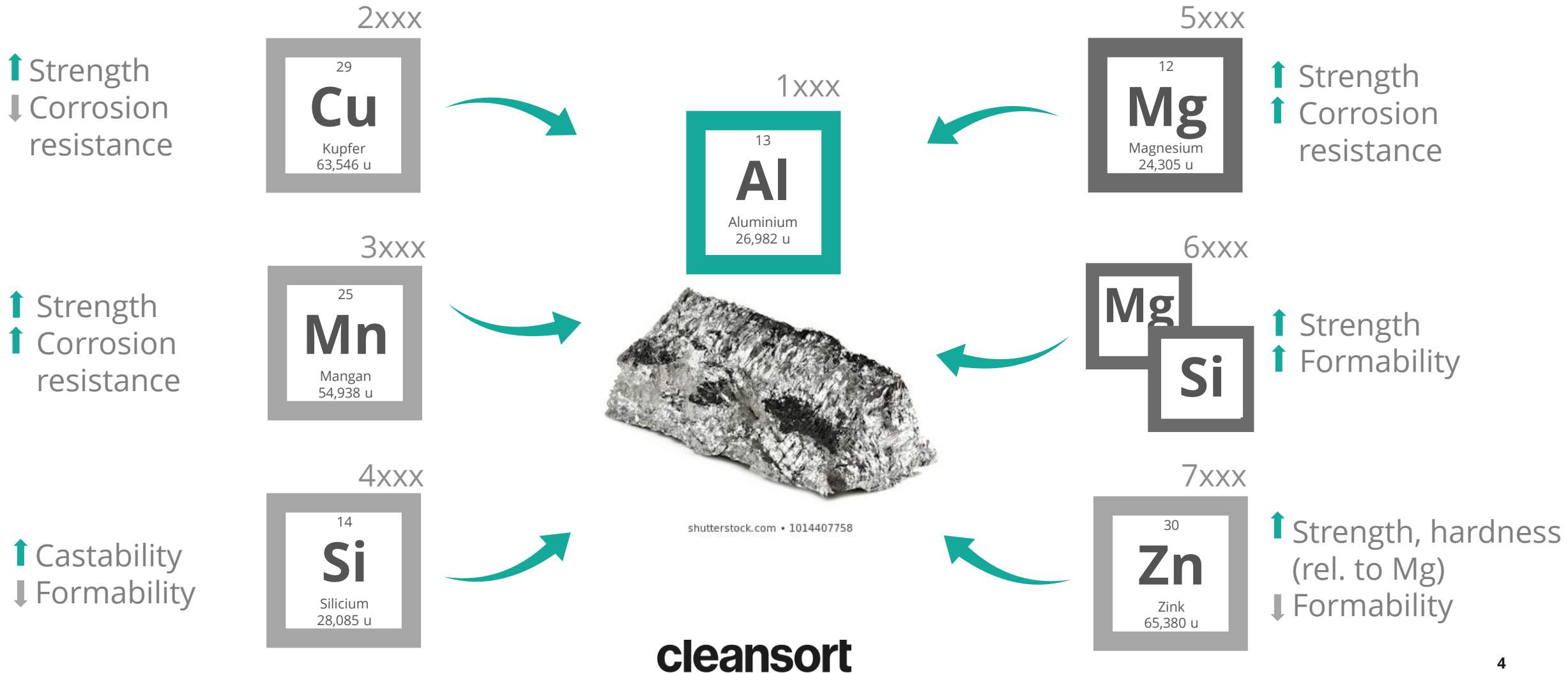
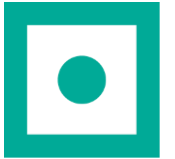
RECYCLING - CIRCUIT

metal recycling using the example of aluminium



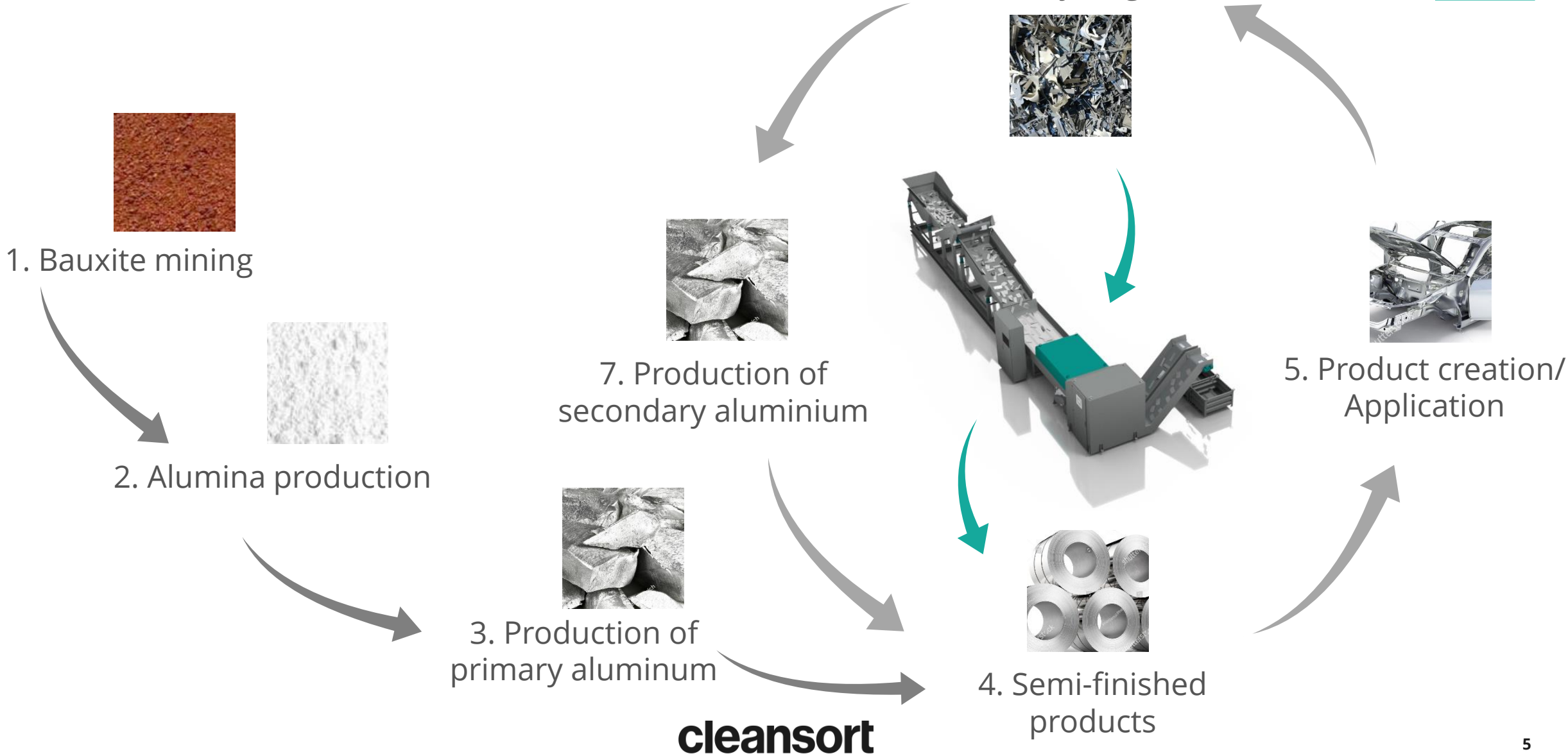
ALLOY SPACE

metal recycling using the example of aluminium – recycling requires stretching

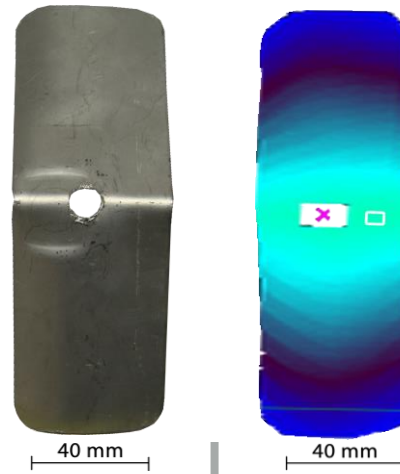


RECYCLING – WITHOUT DOWNSIZING

metal recycling using the example of aluminium



THE IDEA

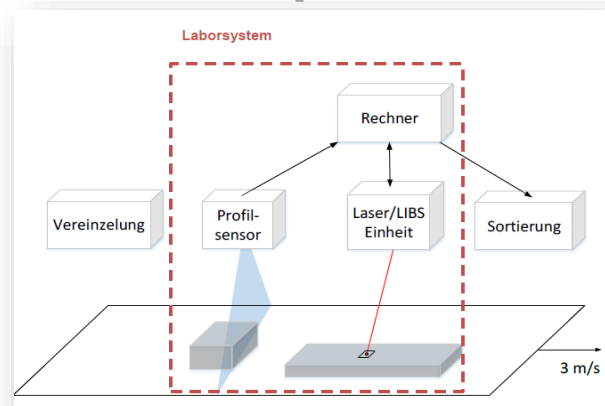


DBU-funded research project 02 - Construction prototype

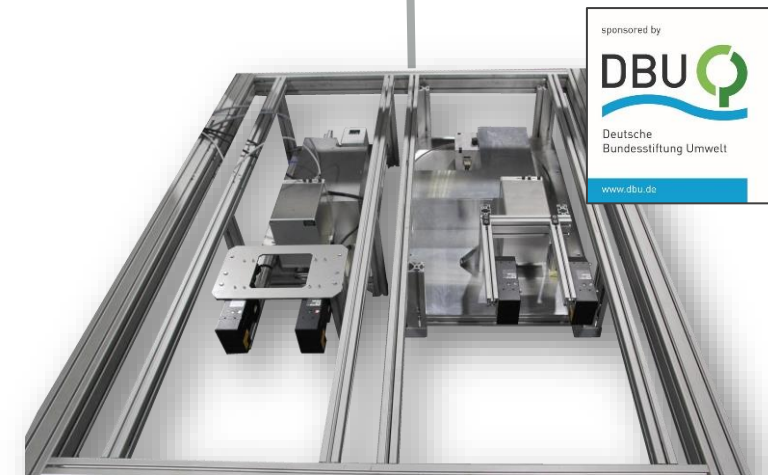
2014

Nov. 2014

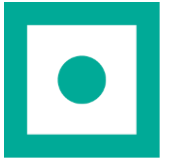
2016



DBU-funded research project 01 - Basic investigation



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Founding

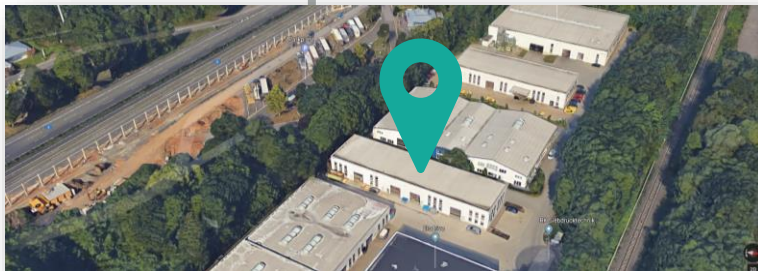


First System in field for
steel sorting

2018

2019-
2021

Summer 2022



Rösrath (near Cologne)

Successful completion
of three lighthouse
projects



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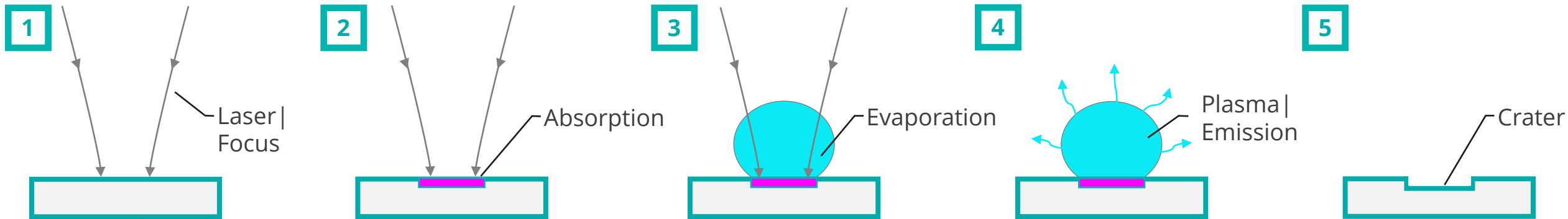
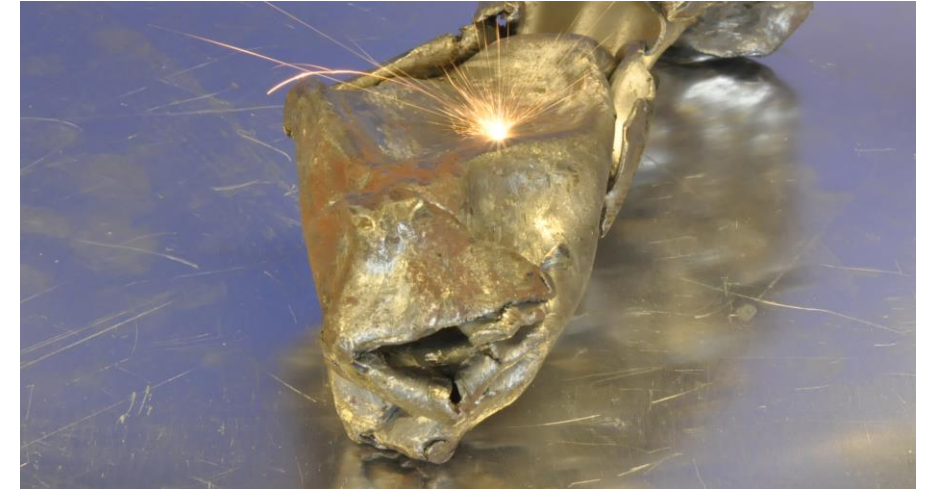
LASER-INDUCED BREAKDOWN SPECTROSCOPY (LIBS)

Working principle

Technique for quantitative elemental analysis of solids, liquids and even gases.



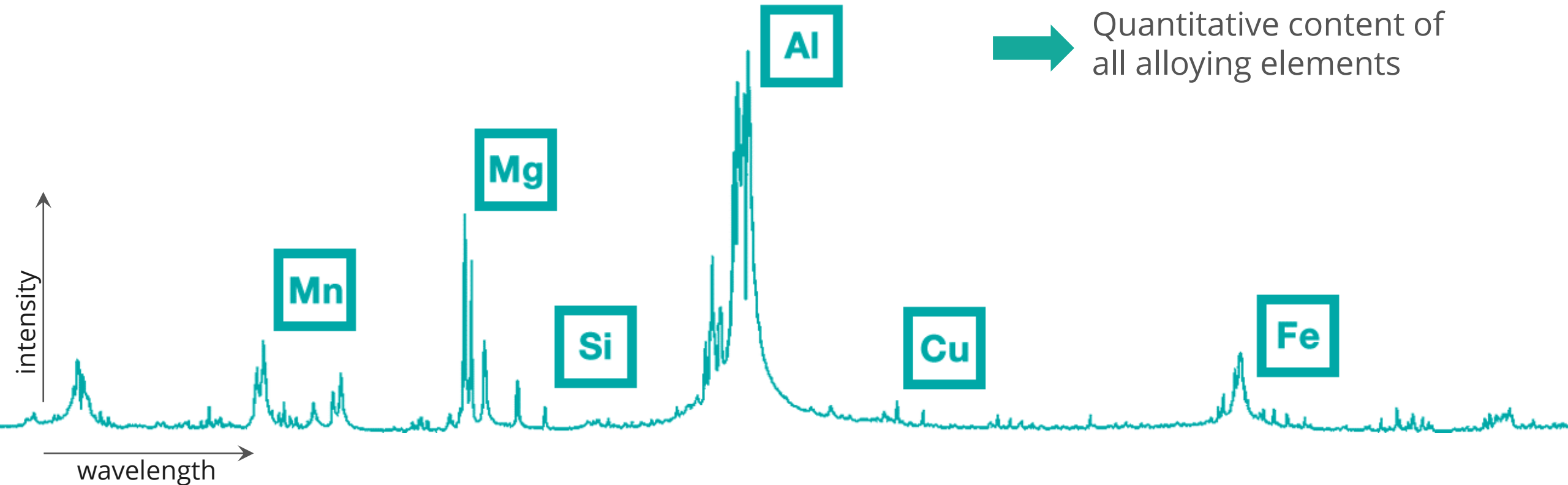
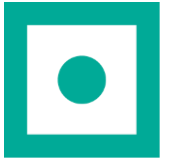
clean2sort module made by cleanLASER



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SPECTRAL ANALYSIS OF PLASMA EMISSION LIGHT

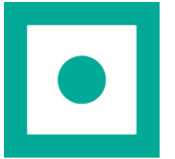
Quantitative analysis after calibration – example aluminium



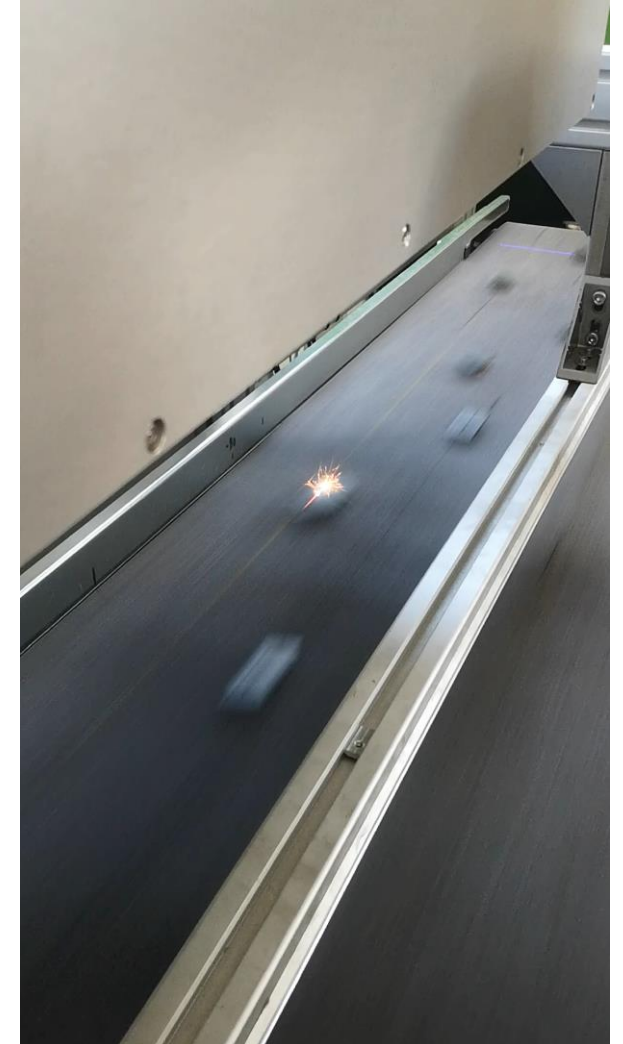
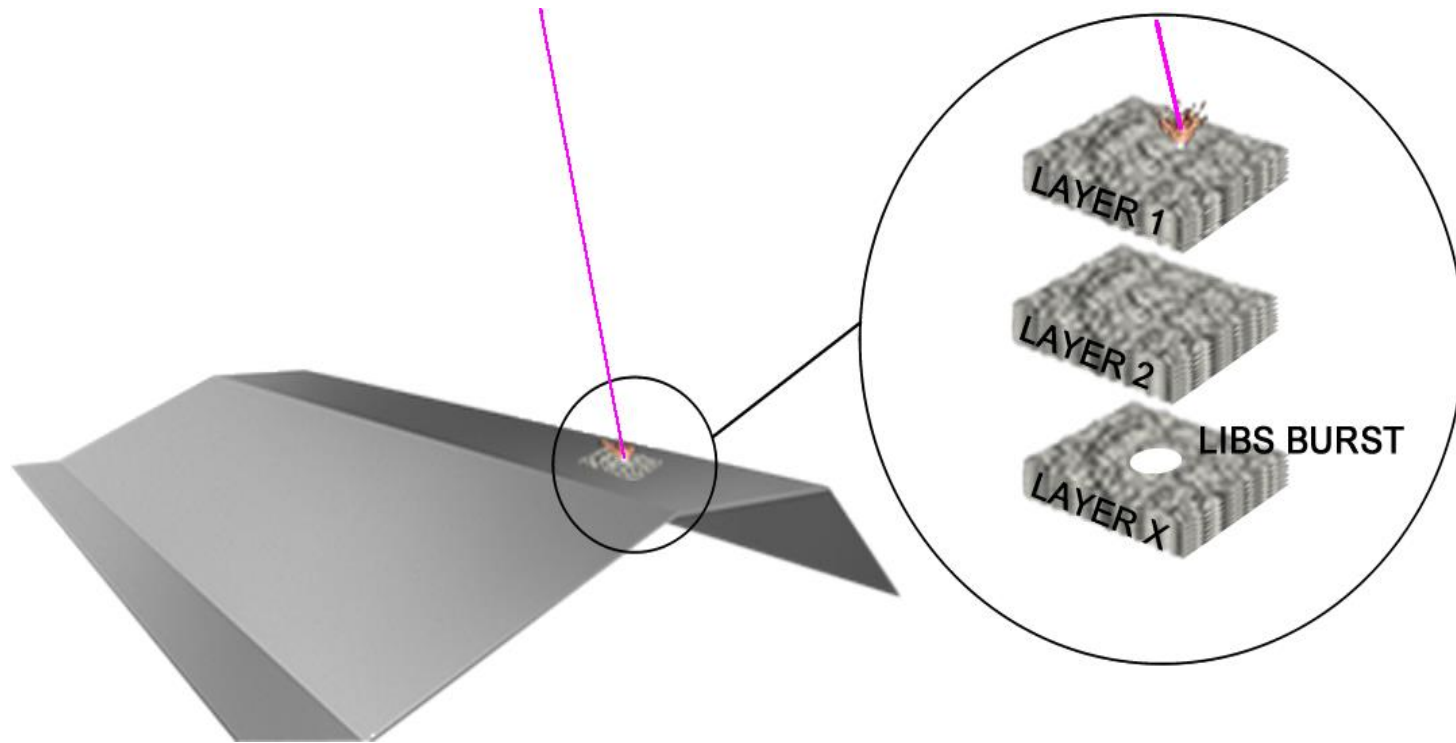
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THE MEASUREMENT PRINCIPLE

A two-step process: Laser preablation & LIBS



Measurement procedure must be really fast! ←

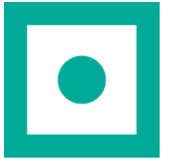


Conveyor belt speed : 3 m/s

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THE CHALLENGE

The physiognomy of recyclables



- Galvanized steel
- Oil on new aluminum scrap
- Soot layers on metals from waste incineration plants
- Material segregation in castings
- Surface coatings and hydrate layers on non-ferrous metals
- Painted end of life materials



Cleaning of parts prior to measurement is essential!



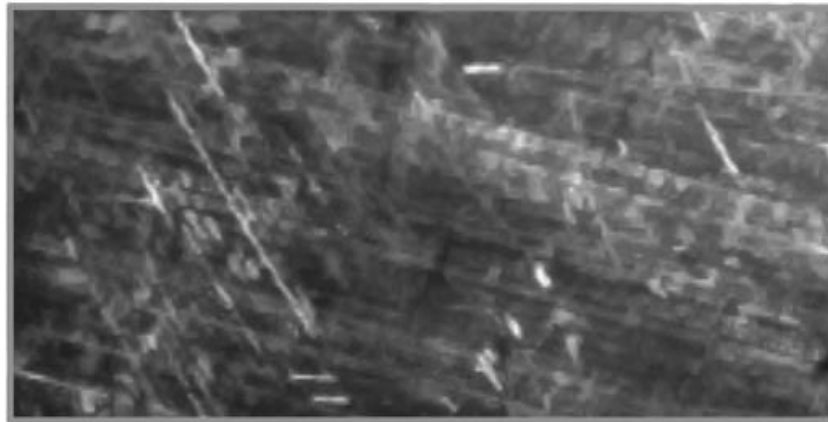
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INLINE PREABLATION AND CLEANING

Prior to the spectral analysis



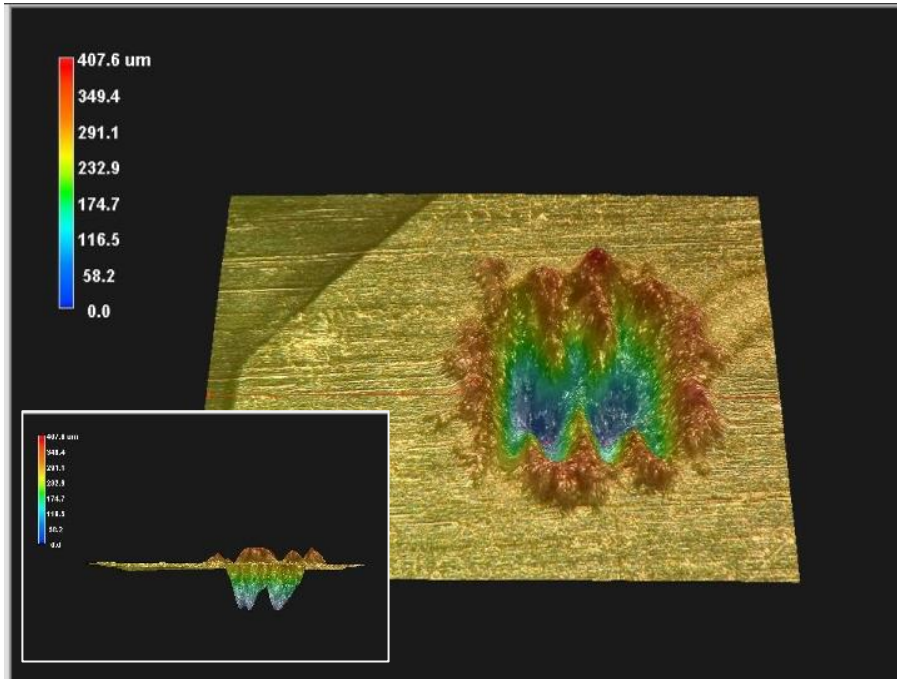
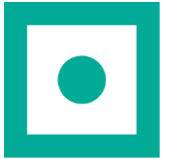
➔ Ultra-fast cleaning of scrap parts



Cascade of multiple clean2sort modules to cover wide conveyor belts

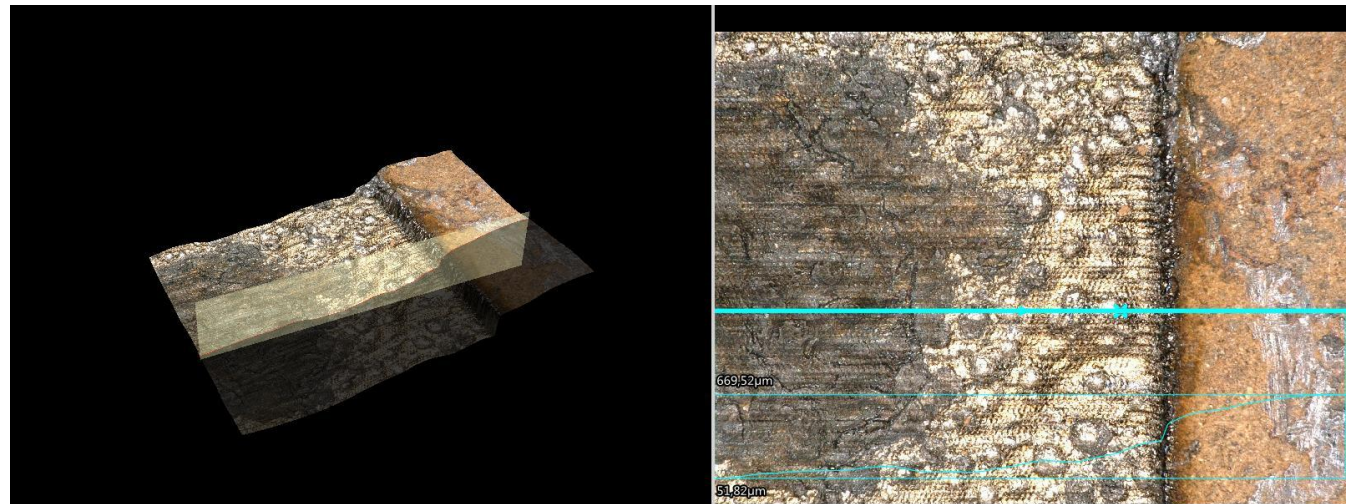
PERFORMANCE OF PREABLATION

Even thick layers and coatings can be removed



- Ablation depth per pass approx. 40-70 μm
- Time required for one ablation pass:
4.85 ms (corresponds to 14.55 mm at $v = 3 \text{ m/s}$)
- Measurement time <1,4ms

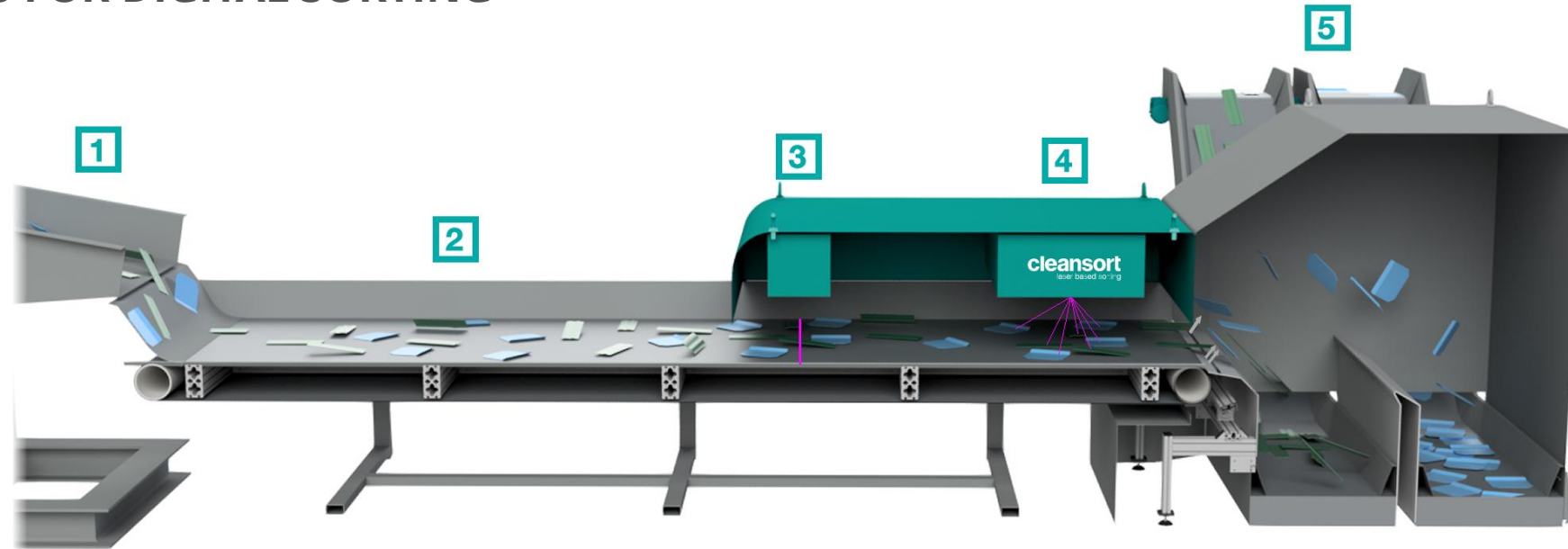
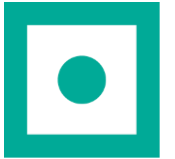
Up to 20 measurements
within a blink of an eye!



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THE SORTING SYSTEM

MODULES FOR DIGITAL SORTING



1&2

SEPARATION

- Separation by vibrating feeders
- Conveying speed 3 m/s

3

OBJECT DETECTION

- 3D analysis via laser profile sensors

4

PREABLATION AND LIBS-ANALYSIS

- Scanning measurement systems incl. high-performance preablation

5

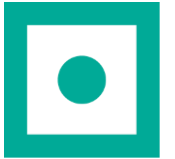
SORTING

- Two-fraction sorting using air-pulse technology

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APPLICATION

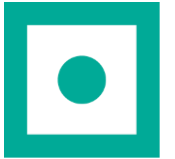
LIBS-based sorting of scrap



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EXEMPLARY SORTING RESULTS

Validation tests for internal research purpose



AL STAMPING SCRAP (new)

Part sizes ~	30-800	mm
Throughput ~	4-6	t/h
Yield ~	85	%
Purity* ~	96	%



EOL-SHREDDING SCRAP

Part sizes ~	50-250	mm
Throughput ~	5-7	t/h
Yield ~	85	%
Purity* ~	92	%



AL-SHREDDING SCRAP

Part sizes ~	40-120	mm
Throughput ~	6	t/h
Yield ~	90	%
Purity* ~	97	%

RESEARCH PROJECT – GREEN AL LIGHT – DIGITALIZED RECYCLING

DEVELOPING TARGET SORTING TECHNOLOGY

Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages



JOINT PROJECT:



SORTING ON TARKET ALLOYS AT THE TOUCH OF
THE BUTTON

- EOL-Scrap with a wide size variation
- First melt pot results show 100% applicability of the technical concept

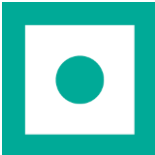


Stakeholders along the process-chain:

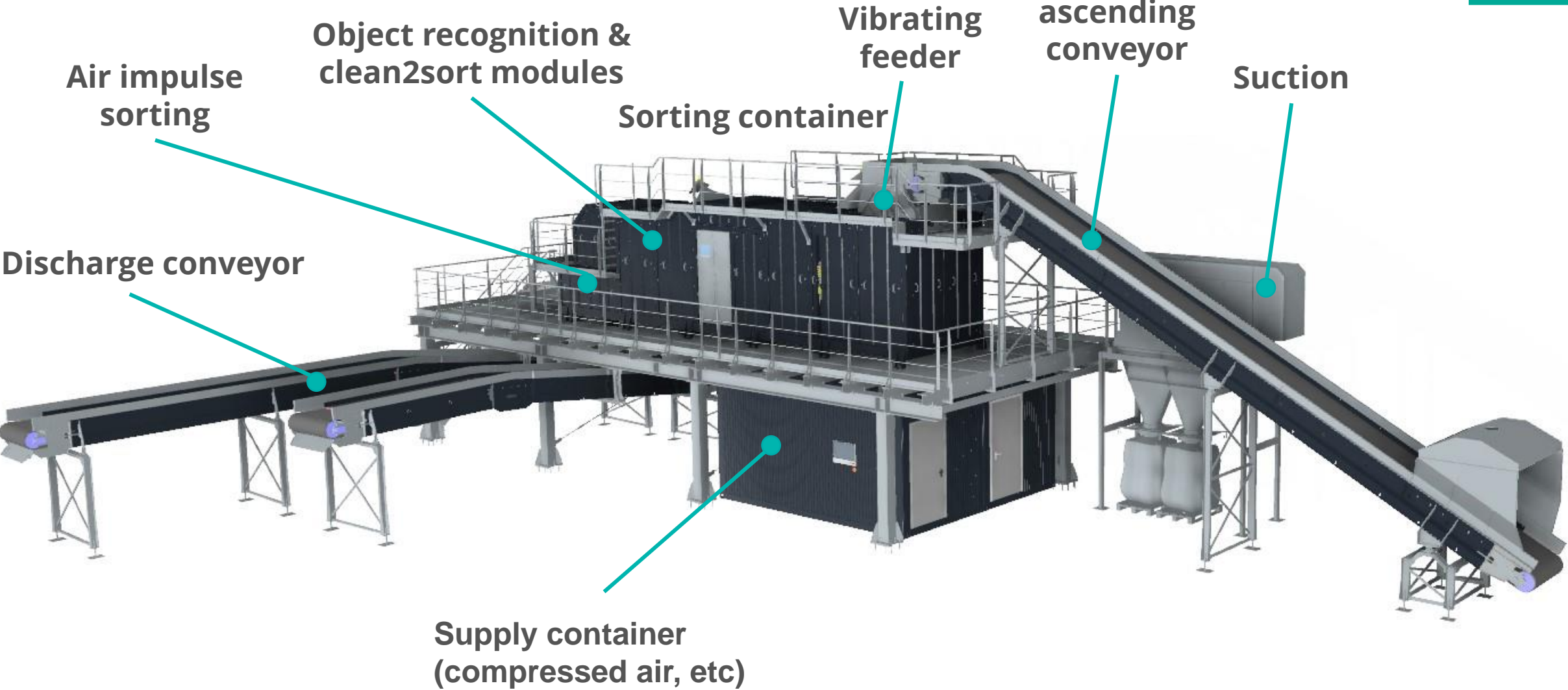


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INDUSTRIALISATION STATUS: CLEANSORT R1200



Complete turn-key sorting system



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FIRST RUNNING INDUSTRIAL MACHINE IN FIELD!

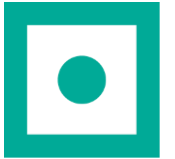
Focus on steel scrap sorting



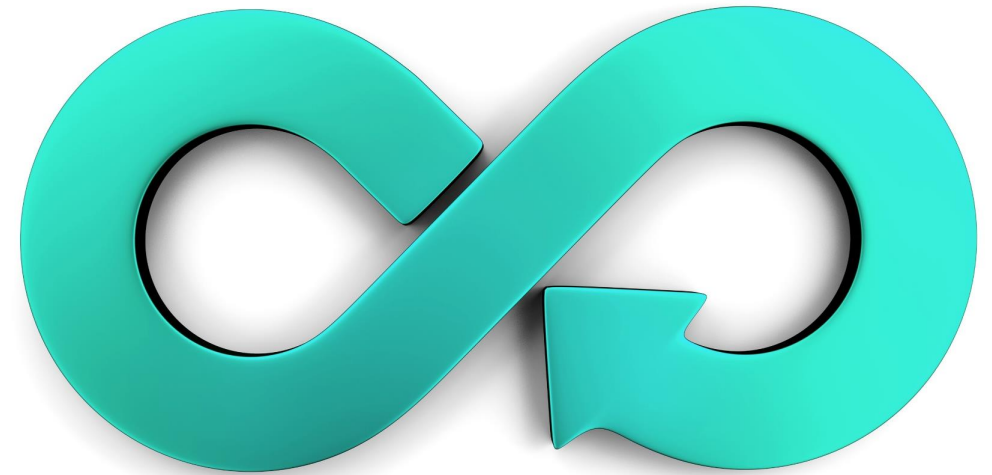
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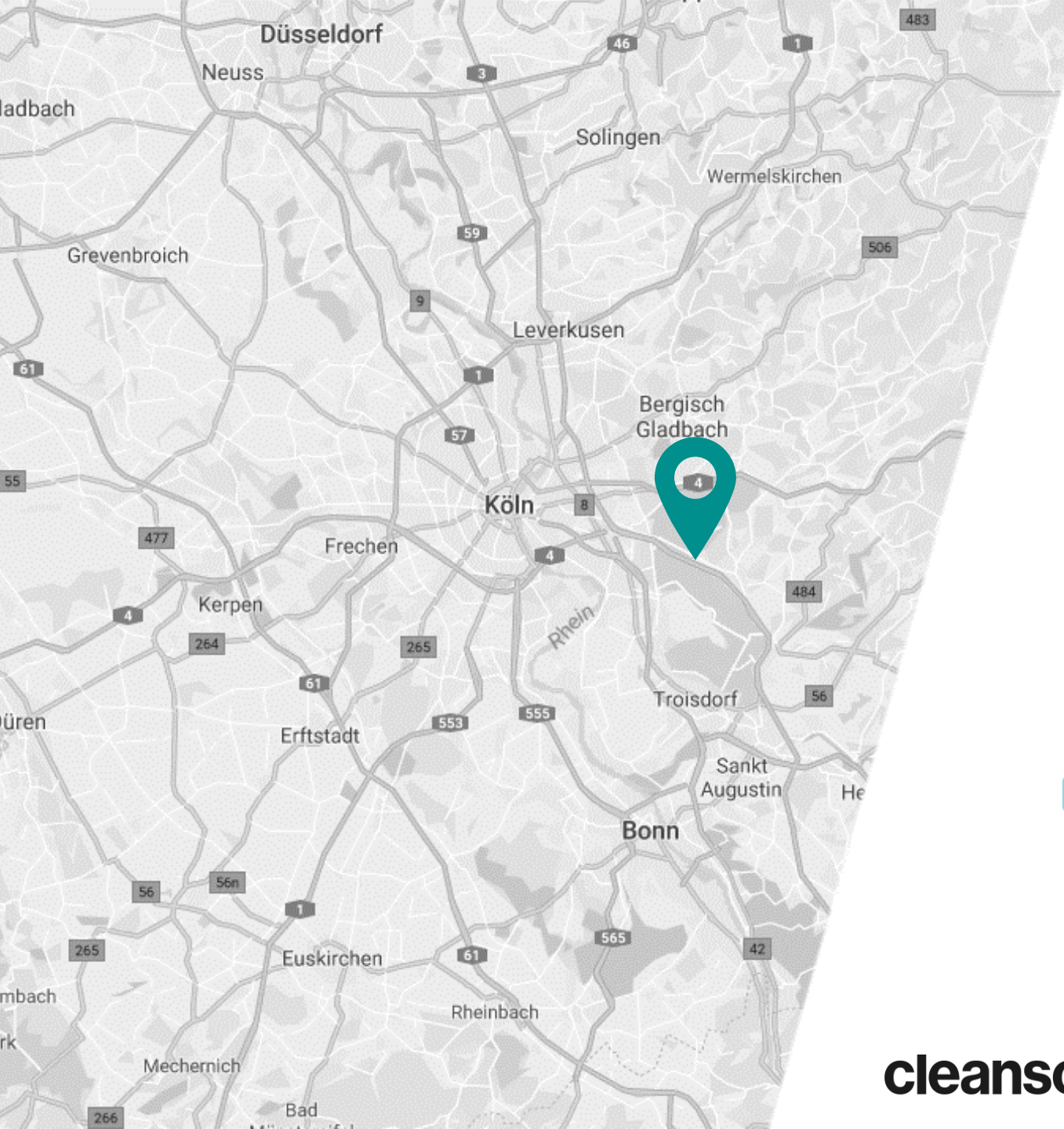
SUMMARY

DIGITAL SORTING IS AVAILABLE!



- Goal: Enable real recycling (no downcycling) of metals via sorting of different alloy classes
- Laser-based quantification of alloy elements (LIBS)
- Technological key advantage:
Cleaning of measurement surface with the same laser
- High sorting efficiency and accuracy
- In principle adaptable to various types of materials (Aluminium)
- First running industrial plant (throughput ~ 8 t/h), second one is currently set up





CONTACT



Nussbaumweg 27,
51503 Rösrath



+49 (0)2205 901 002 – 100



edwin.buechter@cleansort.de



www.cleansort.de
www.cleanlaser.de

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