

2023
Innovation
China Conference
创新中国国际论坛

中国, 安庆 | Anqing, China
15 • 05 • 2023



Revitalize!
Discover the science behind LOHAS
大健康和可持续发展 **复苏!**

Focus on Sustainability

Christian Neumann
Technology Evangelist, Heraeus



THE HERAEUS GROUP – A FAMILY-OWNED TECHNOLOGY COMPANY

TOTAL REVENUE
29.5 bn. €
(34.9 bn. US\$) in 2021
US\$ calculated with 2021 average exchange rate (1€ = 1.1827 US\$)

Market-oriented distribution
 in **11** GLOBAL
 BUSINESS
 UNITS

6% R&D
 EXPENDITURES

Based on revenues excl. Precious Metals

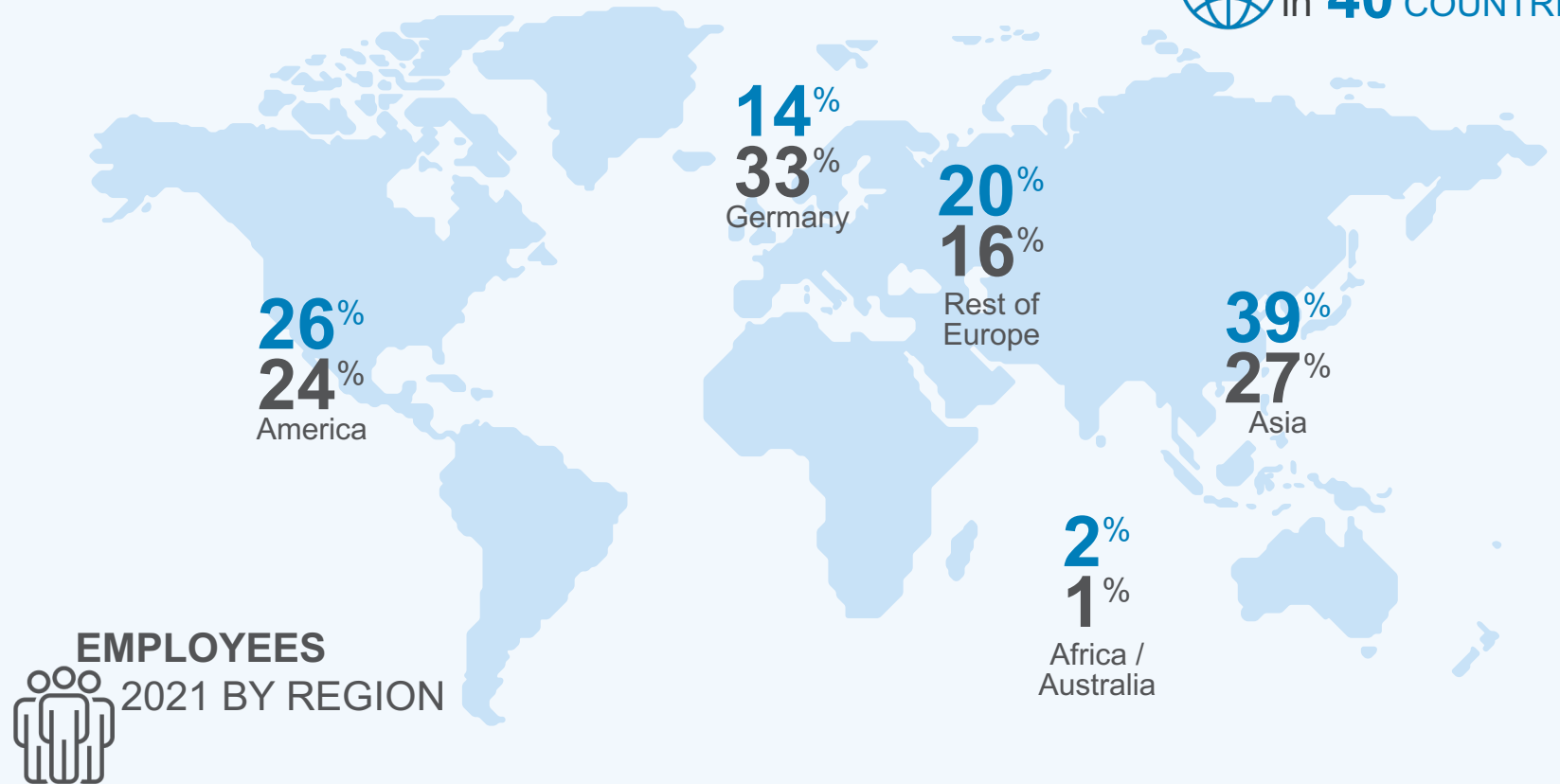
Approx.
16,200
 EMPLOYEES
 worldwide
including staff leasing

TOP 10 FAMILY-
 OWNED COMPANIES
 in Germany

Listed in
FORTUNE
 Global 500

REVENUE excl. precious metals
 2021 BY REGION

More than
100 SITES
 in **40** COUNTRIES



THE HERAEUS BUSINESSES – BROADLY DIVERSIFIED

Heraeus Holding

Global Business Units

Heraeus
Comvance



Heraeus
Conamic



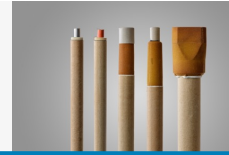
Heraeus
Electronics



Heraeus
Epurio



Heraeus
Electro-Nite



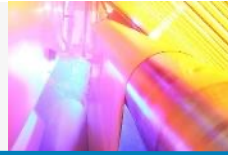
Heraeus
Medical



Heraeus
Medevio



Heraeus
Noblelight



Heraeus
Photovoltaics



Heraeus
Precious
Metals

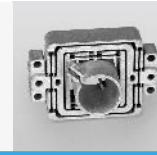


Norwood
Medical

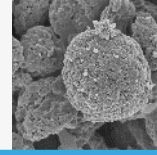


Start-ups

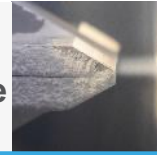
Heraeus
Amloy



Heraeus
Battery
Technology



Heraeus
High
Performance
Coatings



Heraeus
Printed
Electronics



Heraeus
Remloy



Investments

revalyu



Forciot



Mo-Sci



ETS
Technologies



...

SELECTED PARTNERSHIPS AND NETWORKS



Heraeus and the **Fraunhofer Institute IISB** launch **joint master's projects in the field of power electronics**. Two to four master's theses on current research and development topics will be supervised each year.



Heraeus and the **Software & Digital Business Group at TU Darmstadt** work together as partners in **knowledge transfer, exchange of experience** and joint work on **digitization projects**.



Heraeus and **Danfoss Silicon Power** launch a cooperation for the production of **state-of-the-art control modules for electric motors**.



Heraeus and **BASF** establish joint venture for **state-of-the-art precious metals recycling in China**.

Since 2019, the **Heraeus Accelerator Program**



has offered start-ups in the fields of material science, technology and digitalization an opportunity to be supported in their growth phase.

In 2020, Heraeus and **Fudan University in China** agreed on a **research cooperation** for the joint **development of key technologies for the packaging and interconnection of power semiconductors**.



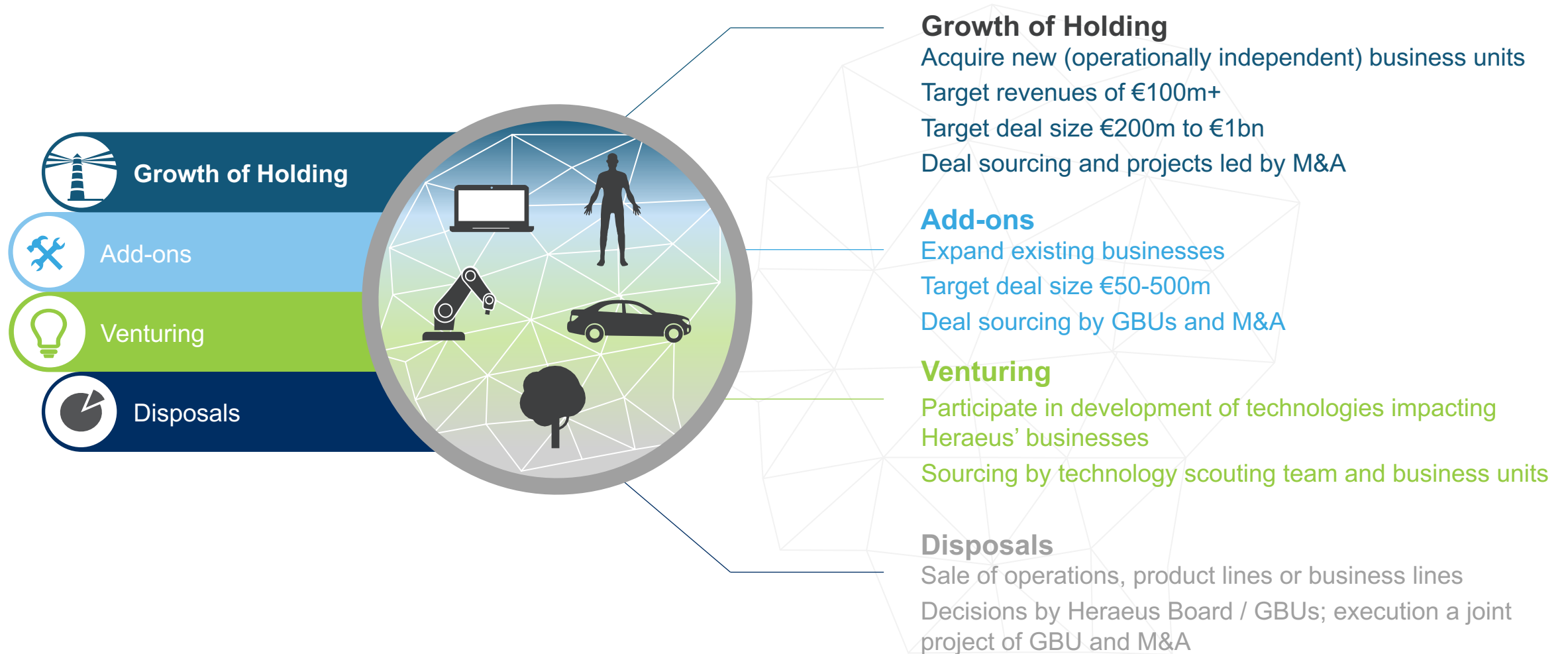
Heraeus cooperates with the start-up **Largentec** to commercialize the innovative **antimicrobial technology AGXX**.

Partnerships with venture capital companies

CM Venture Capital, Shanghai Minority investments in start-ups

Emerald Technology Ventures Minority investments in start-ups in an industrial environment

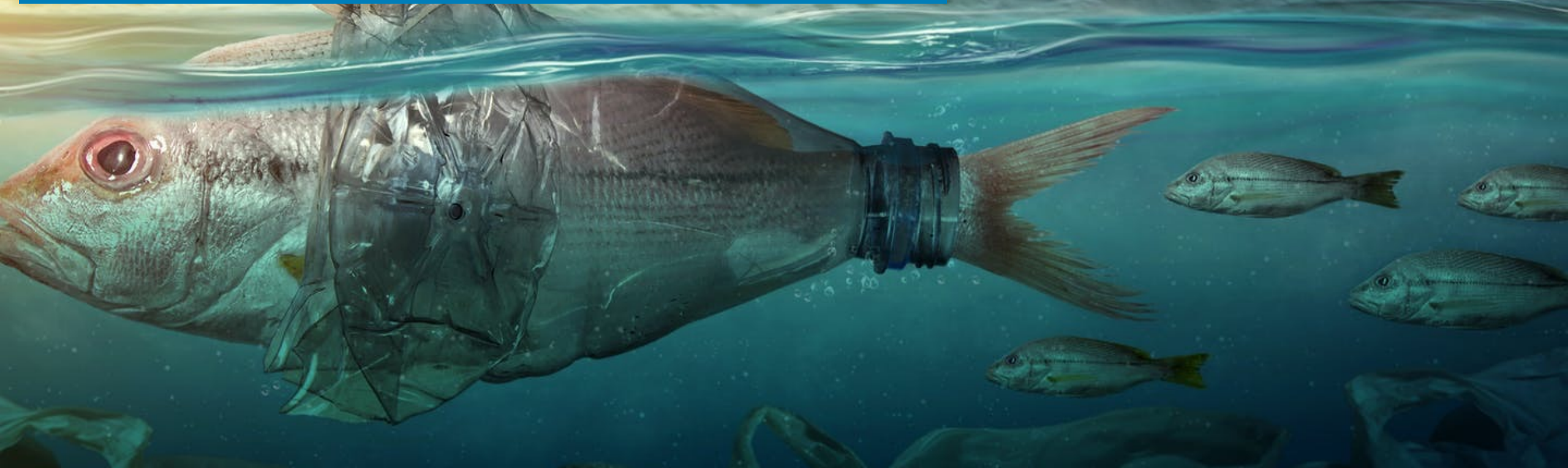
HERAEUS PORTFOLIO MANAGEMENT ACTIVITIES



Heraeus

CIRCULARITY

A CORNERSTONE IN HERAEUS' PORTFOLIO



ESG ASPECTS TODAY DRIVE ALL AREAS OF THE ECONOMY



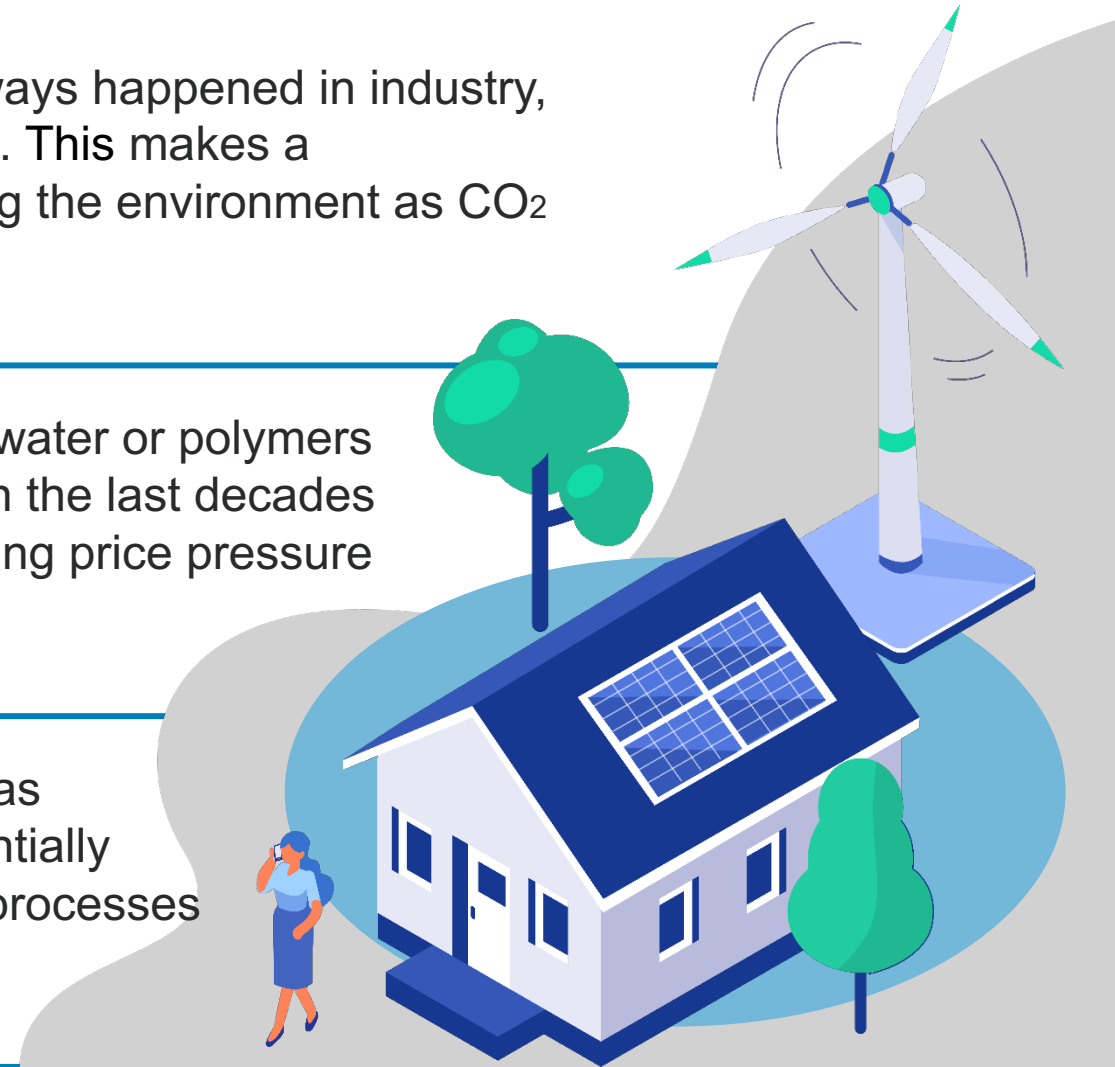
Recycling of Precious metals has always happened in industry, as raw material resources are scarce. This makes a considerable contribution to protecting the environment as CO₂ footprint is substantially lower.



Recycling of abundant materials like water or polymers became increasingly important only in the last decades as these processes generally are facing price pressure from established virgin sources.



Successful technologies in these areas therefore also have to have a substantially lower carbon footprint against virgin processes which directly translate into cost.



CONSUMER BRANDS ALREADY SET THEIR ESG GOALS FOR POLYMERS

adidas

- 2021: ca. 60% rPET
- Using 100% recycled polyester by 2024
- Be climate neutral until 2050

Puma

- 75% recycled polyester by 2025 (apparel & accessoires)

Nike

- 2019: 27,000 MT of recycled polyester (20%)
- 2030: reduce carbon footprint by 65% in owned or operated spaces and by 30% across extended supply chain

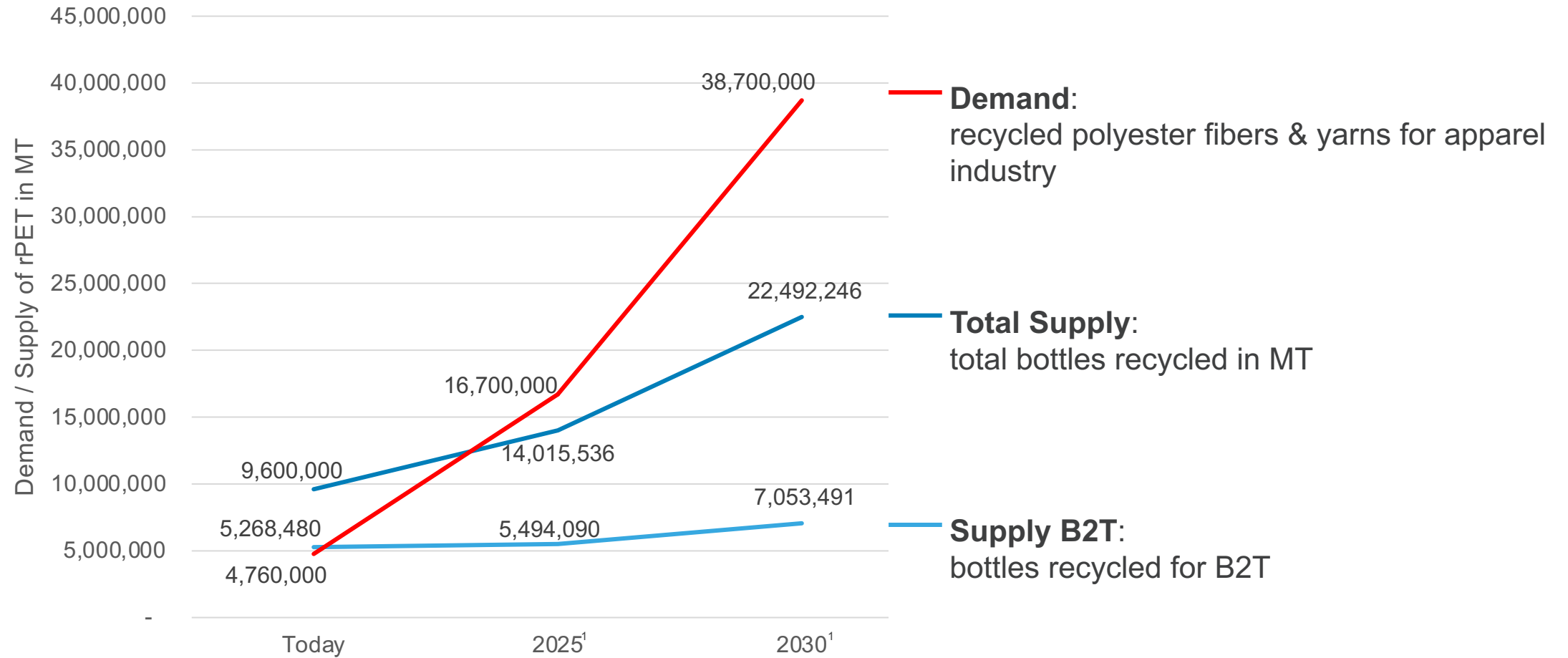
H&M

- 100% recycled polyester by 2025

IKEA

- Using 100% recycled polymers by 2030

THE SUPPLY GAP FOR RECYCLED FIBERS WILL INTENSIFY



revalyu's Full Scale Industrial Continuous Manufacturing Plant

📍 Nashik, India



Recycling more than 4 million bottles a day into high quality sustainable recycled (poly)ester.



Capacity:
15.000
tons per year

ISO 9001
ISO 14001
ISO 45001
BUREAU VERITAS
Certification



OEKO-TEX®
CONFIDENCE IN TEXTILES
STANDARD 100
12.HIN.10572 HOHENSTEIN HTTI
Tested for harmful substances.
www.oeko-tex.com/standard100



REACH
224 SVHC
list compliance



OVERVIEW OF PET RECYCLING TECHNOLOGIES

Collection and pre-processing

- › Bottles are collected, sorted, cleaned (incl. label removal) and crushed into flakes
- › This process is essentially identical for mechanical and chemical recycling
- › Large mechanical recyclers often perform pre-processing in-house

Mechanical recycling

- › Currently **standard process**
- › (Ultra-) clean flakes are melted and subsequently filtered mechanically using standard machinery
- › Liquid paste can then be processed into chips (to be mixed with virgin PET) or directly extruded, e.g. into bottles or yarn
- › Method with several **drawbacks**:
 - › Melted PET can only be filtered on macro level, therefore demands clean input which adds to cost

Chemical recycling

- › Fundamental idea to **depolymerize** PET into constituent molecules and after filtering of microscopic contaminants **re-polymerize to (almost) virgin-level qualities**
- › Competing processes dissolve pre-processed flakes in different types of solvents

Methanolysis

- › Dissolves PET with methanol which needs to be crystallized again - energy usage drives up cost
- › Product DMT only compatible to outdated polymerization equipment

Glycolysis

- › Solvent ethylene glycol – energy-efficient production of oligomers without catalysts
- › Several competitors developing glycolysis processes and intend to recycle non-bottle PET waste
- › **revalyu's process is favorable due to low temperature and low energy and chemicals consumption achieving product quality that is comparable to virgin**
- › **revalyu has far more experience in large-scale production than other glycolysis competitors**

Other chemical processes

- › Other chemical processes (ammonolysis, hydrolysis) used in mixed-processes or only on lab scale
- › Bacteria-derived enzymes (PETase) as alternative, but not yet mature

Revalyu: Heraeus Funding & Guidance



Currently building a recycling plant in the US with a capacity of **100 metric tonnes** (225,000 pounds) of recycled PET chips per day. In a further planned expansion, the plant will have a capacity of up to **200 metric tonnes** (450,000 pounds per day).



Currently building 2 additional plants in India with a combined capacity of **200 metric tonnes** per day.



Helped in filing **20 technology patents** (filed and/or granted)

HERAEUS PORTFOLIO MANAGEMENT ACTIVITIES SINCE 2010

Geographic growth / consolidation

2022	BASF Joint Venture	CN
2021	HS Advanced Materials	KR
2019	ShreeRam Industries	IN
2018	JunCheng	CN
2017	Argor	CH
2017	TROT	CN
2015	CPP	IN
2013	Ferro PV	US
2012	Minco	US
2012	Minco	CN
2012	Biomain	SWE
2012	Fusion	US
2011	Bio Medi-Face	CH
2010	Ferro PC	US
2010	Huden	KR

New technologies / new markets

2022	Erbas	CH
2022	mimiX Biotherapeutics	CH
2021	Electroniks	US
2021	Norwood	US
2021	Banyan Nation	IN
2021	Mo-Sci and ETS	US
2021	Nextsense	US
2021	AMS	GER
2020	revalyu	IN
2020	Pulse Systems	US
2020	Contract Medical	GER
2019	Via Biomedical	US
2018	Evergreen	US
2017	Biotectix	US
2017	Graphite Machining	US
2016	Vino	GER
2015	OCC	GER
2015	Neometrics	US
2014	Vulcan	US
2012	Daychem	US
2010	Clevios	GER

Venturing

2021	Hightech Gründerfond	GER
2021	CM Ventures	CN
2019	Forciot	FIN
2015	Ankasa	US
2014	Locate	GB

Disposals

2020	GMSI's assets to: Applied Materials	US
2018	MDS assets to: Sino-platinum	CN
2018	Fabrication Business to: LTD Material	US
2017	Sputter targets to: Materion	GER / TW
2015	Vectra to: PGM Tech.	BR
2014	Danyang to: GCEPMM	CN
2013	Dental (Kulzer) to: Mitsui	GER
2010	Indian catalysts to: Evonik	IN

CO₂ FOOTPRINT: HERAEUS INVESTS GLOBALLY INTO PV SITES

 20 of our global sites are already using PV generated energy or are about to do so

