

Circular Economy of Plastics in the Automotive Industry

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WHERE RESEARCH MEETS THE FUTURE

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Short Introduction to Polymers

Categories of Polymers



Thermoplast

Elastomer

Duromer



Kunststofftechnik – Einführung und Grundlagen, Christian Bonten, Hanser Verlag, 2016

Polymer Production Worldwide

■ Polymers	380 mio t
■ Thermoplasts	300 mio t
■ Elastomers	30 mio t
■ Duromers	45 mio t
■ Thermoplastic Elastomers	5,8 mio t
■ Biobased Polymers	2,4 mio t

<https://www.statista.com/statistics/282732/global-production-of-plastics-since-1950/>

<https://www.statista.com/statistics/1192886/thermoplastics-production-volume-by-type-globally/>

https://link.springer.com/chapter/10.1007/978-3-642-36591-1_11

<https://www.statista.com/statistics/1109228/global-market-size-elastomers/>

<https://www.smithers.com/resources/2019/apr/global-market-for-thermoplastic-elastomers-to-grow>

<https://www.freedoniagroup.com/industry-study/world-thermoplastic-elastomers-3051.htm>

<https://www.globenewswire.com/news-release/2022/08/11/2496388/28124/en/Global-Bioplastics-and-Biopolymers-Market-Report-2022-Plastics-Production-was-Over-367-Million-Metric-Tons-in-2020-and-Consumption-is-Forecast-to-Double-by-2050.html>

<https://www.bluequarkresearch.com/reports/global-thermoset-market>

<https://www.expertmarketresearch.com/reports/natural-rubber-market>

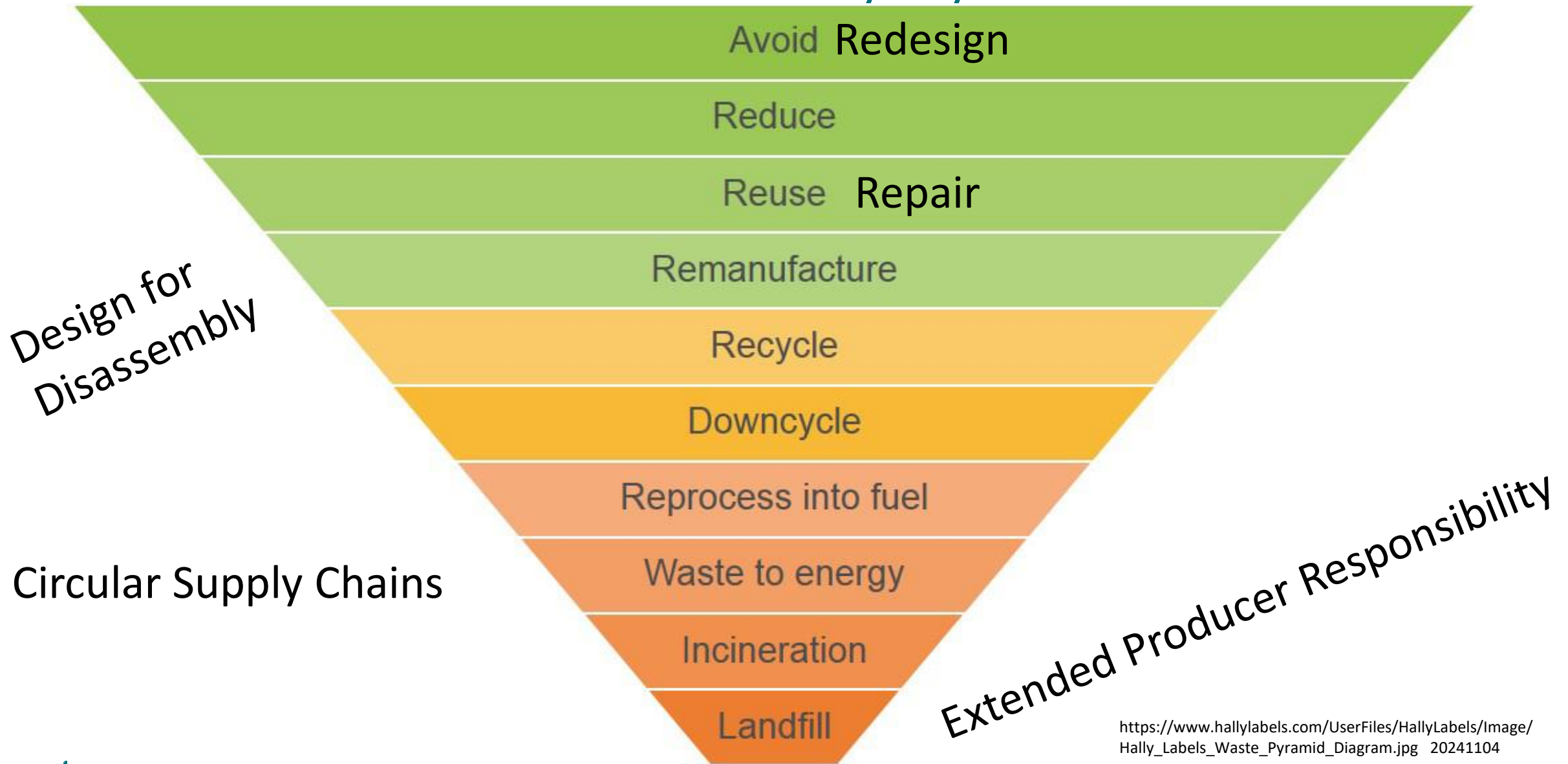
<https://www.bccresearch.com/market-research/chemicals/synthetic-rubber-market.html>

Circular Economy

- Automotive industry has a significant impact on the environment.
- The production and use of vehicles contribute to greenhouse gas emissions, pollution, and resource depletion.
- Previous sustainability efforts in the automotive sector have focused on improving fuel efficiency and reducing emissions.
- The circular economy is a concept that emphasizes the importance of maintaining the value of products and materials for as long as possible.

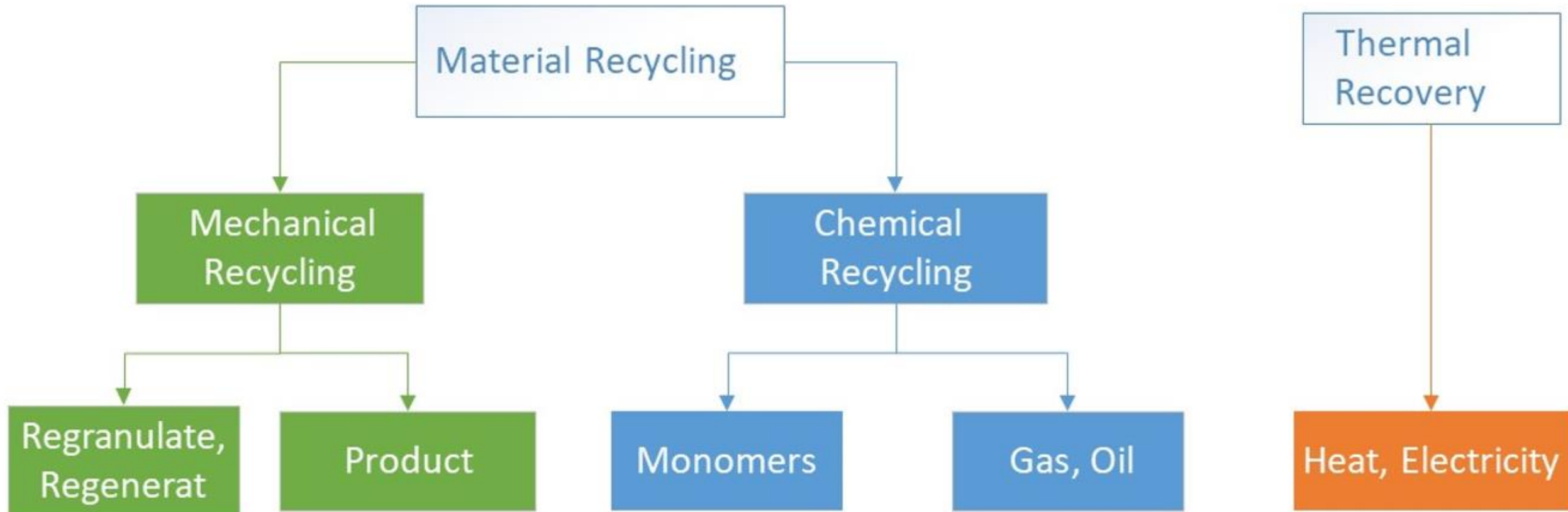
<https://green.org/2024/01/30/the-circular-economy-in-automotive-closing-the-sustainability-loop/> 20241104

Waste Hierarchy Pyramid

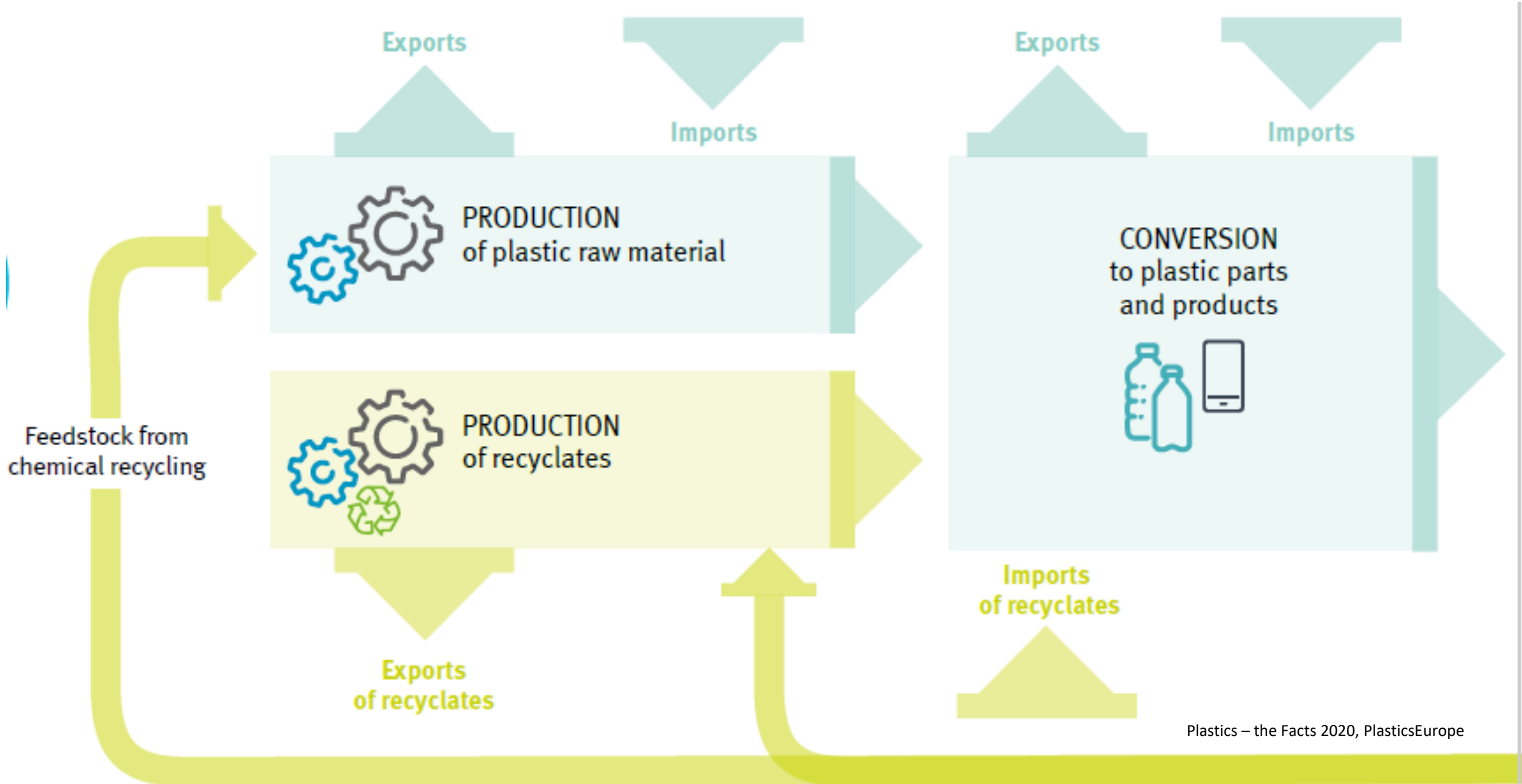


https://www.hallylabels.com/UserFiles/HallyLabels/Image/Hally_Labels_Waste_Pyramid_Diagram.jpg 20241104

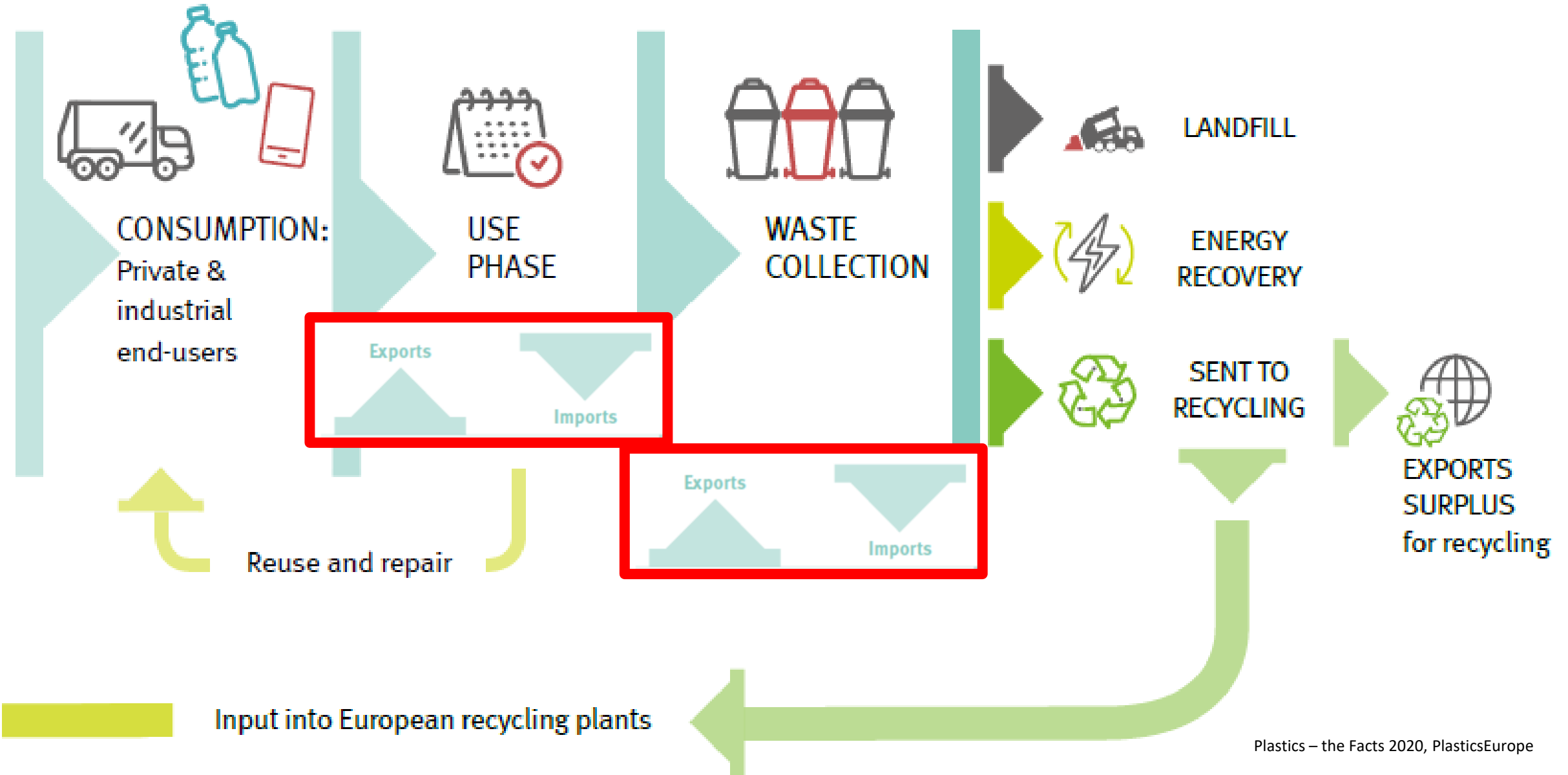
Ways to Recycle



Circularity of Plastics – Broader Picture



Circularity of Plastics – Broader Picture



Where Can We Learn From?

Packaging **Henkel**



Circular Economy of Plastics in Automotive Industry

Plastics in Cars

1



Plastic is the 2nd most used material in vehicles.

2



An average car contains around 177 kg of plastic.

3



By 2030, new cars in the EU must contain at least 25% recycled plastic.

Replacing Oil-based Raw Material

Recycled feedstock



derived from
plastic waste

Renewable feedstock



derived from
organic waste

https://plastics-rubber.basf.com/global/en/performance_polymers/industries/pp_automotive/transportation_sustainability#text-1855025427 20241104

Regulations by EC

- Only 19 % of the plastic fractions recovered after shredding of end-of-life vehicles are currently sent to recycling.
- Around 10 % of total EU plastic demand are new vehicles entering the market.
- In addition to this, the automotive industry employs materials derived from more than 60 raw materials.
- European Commission is proposing mandatory recycled content targets for new cars and vans under 3.5 tonnes.
- This would strengthen the market for recycled plastics and nudge the automotive industry to develop more ambitious recycling practices.
- Such a policy intervention could cut oil use by up to 4 million barrels in 2030.
- This measure would be the first of its kind, as similar requirements have never been proposed before for complex industrial products.

https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/innovative-requirements-could-boost-circular-economy-plastics-and-critical-raw-materials-vehicles-2023-07-13_en 20241104

Design for Circular Economy

- Design thinking is a critical component of circularity.
- A successful transition to circularity in the automotive industry can only be achieved by implementing designs that take into account the proper handling and recovery of ELVs.
- Designing products with circularity in mind is essential for the automotive industry.
- Considering the entire lifecycle of a vehicle.
- Incorporate design strategies that enable easy recycling or reuse.
- Using materials that are recyclable.
- Reducing the number of different materials used.
- Designing components that can be easily disassembled.

Economical Benefits

Benefits of incorporating circular solutions into the automotive industry:

- Generating €1.8 billion net revenue by 2035
- 22'000 jobs created in the EU by 2035
- Enhance the revenue stream in the waste management and recycling industry
- A reduction of 12.8 million tons of CO2 emissions by 2035
- A better valorization of 5.4 million tons of material by 2035
- The demand for recycled plastics in the automotive sector will increase with the implementation of new regulations
- **The EU has set targets to have recycled content of at least 25 % of all the plastic in new cars by 2030, of which 25 % should be recycled from ELVs, and to recycle 30 % of plastics in ELVs.**
- 3.5 million ELVs disappear from EU roads every year (exported or disposed of illegally).

What to do?

- Additive Manufacturing of parts
- adopt circular economy principles
- bio-based materials
- closed-loop recycling
- closing the sustainability loop is crucial to reduce the environmental impact of the industry and ensure a more sustainable future
- designing modular components for easier disassembly and recycling
- designing products for durability, repairability, and recyclability
- implementing closed-loop recycling processes
- minimizing the environmental impact of production and products
- maximize resource efficiency throughout the entire lifecycle designing products with circularity in mind
- minimizing the environmental impact of production and products
- minimize waste
- promoting remanufacturing and refurbishment of parts
- promoting reuse and remanufacturing of materials
- recycle materials
- reduce waste
- using recycled plastics
- utilizing sharing and mobility services

Examples

Redesign

- 10-port water outlet made from Solvay Amodel PPA consolidates multiple metal parts into one plastic part and saves weight.

Credit: Solvay Specialty Polymers



<https://www.automotiveplastics.com/blog/automotive-plastics-drive-sustainable-solutions-on-the-road-to-a-circular-economy/> 20241104

Lightweight

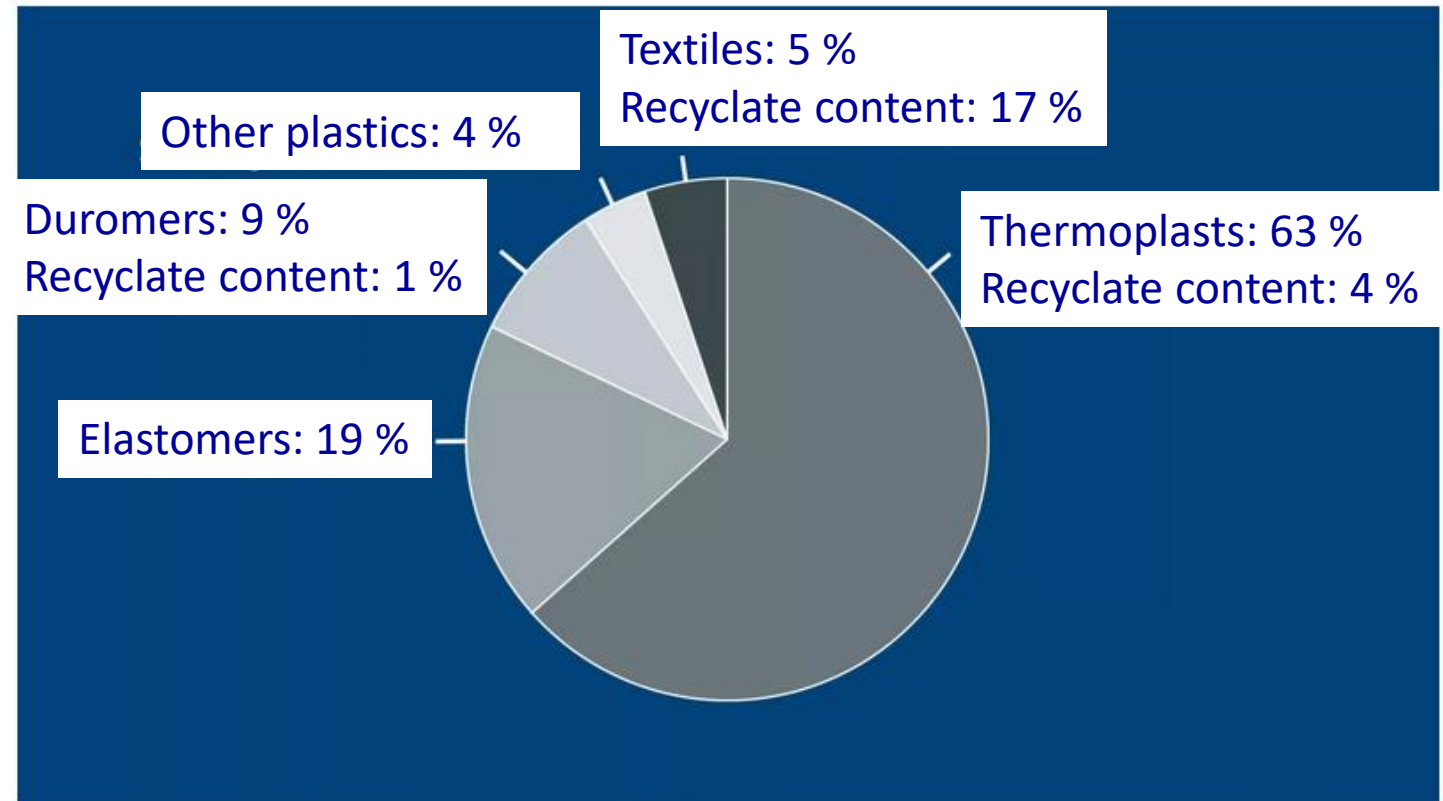
- BASF and Toyota collaborate for lightweighting success
- First-of-its-kind third row free-standing seatbacks
- BASF solution results in 30 % weight reduction and 15 % cost savings
- In the previous model, the third-row seat was comprised of 15 different steel components, making it very heavy.



<https://www.basf.com/us/en/media/news-releases/2020/08/basf-and-toyota-collaborate-for-lightweighting-success-on-2021-s> 20241104

VW – Plastic Recyclates in ID.4

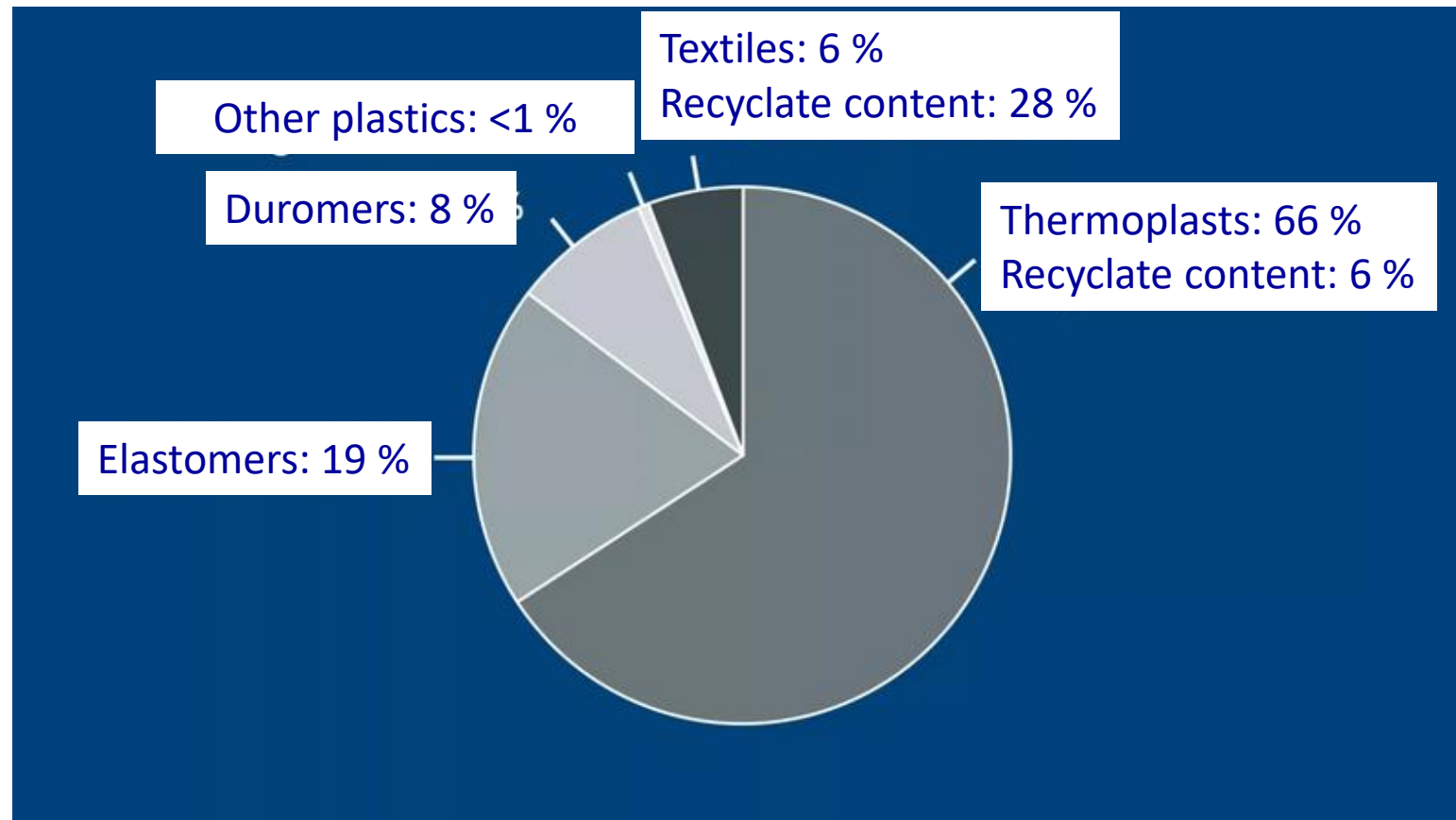
- 17 % of textiles consist of recyclates
- 4 % of thermoplastics consist of recyclates
- 1 % of thermosets consist of recyclates



https://www.volkswagen.at/service-zubehoer/ueber-ihr-auto/umwelt-und-technik/recycling-und-ruecknahme/kunststoff-rezyklate-id4_20241004

VW – Plastic Recyclates in Golf 8

- 28 % of textiles are made from recyclates
- 6 % of thermoplastics consist of recyclates



<https://www.volkswagen.at/service-zubehoer/ueber-ihr-auto/umwelt-und-technik/recycling-und-ruecknahme/kunststoff-rezyklate-golf-8-20241004>

Reusable Spin-on Oil Filter

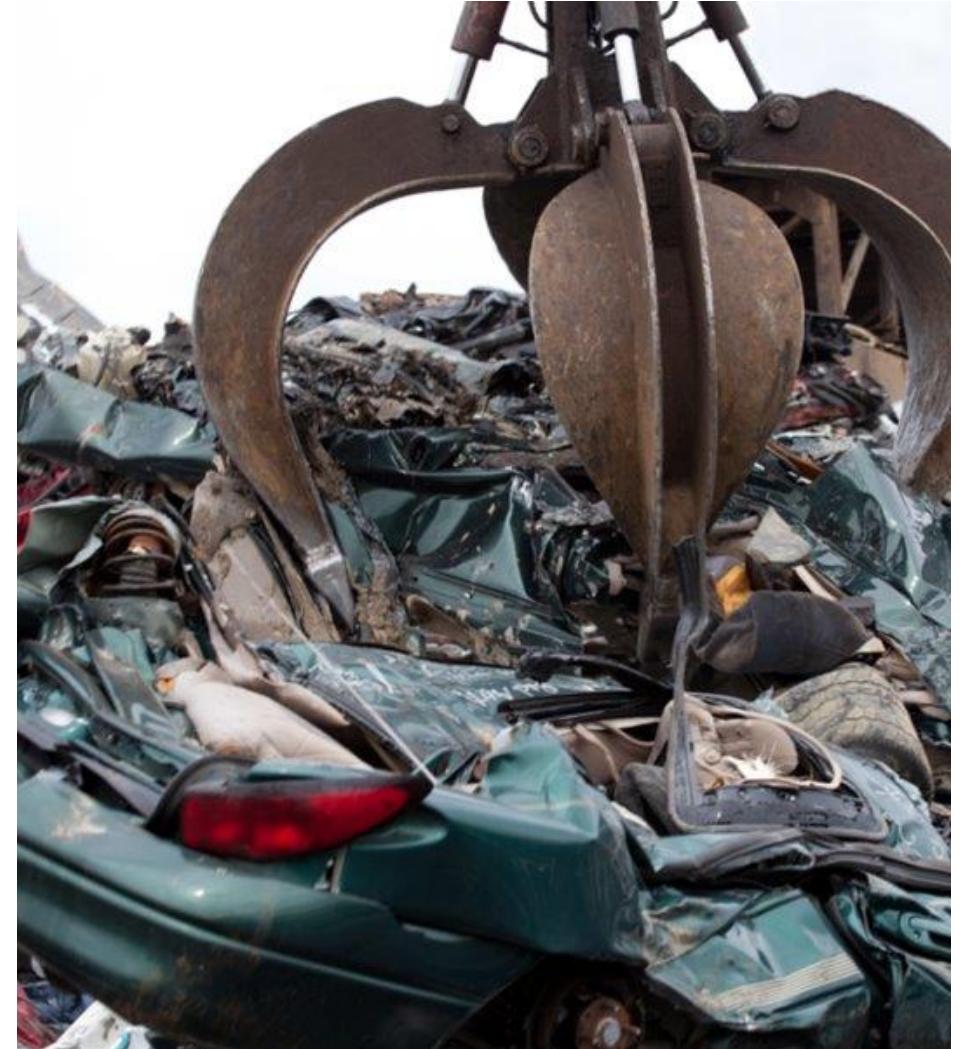
- Reusable, recyclable and lightweight
- World's first reusable plastic spin-on oil filter
- Metal substitution
- Two billion oil filters are replaced and disposed every year
- **Partnership paves the way to success**



<https://www.basf.com/global/en/media/news-releases/2020/03/p-20-145> 20241104

Cascade Recycling

- BMW and ALBA Group, expanding the circular economy
- First: components removed for mechanically recycling
- Remaining plastic parts are then shredded together with the vehicles
- Shredder residue: as many materials as possible separated that can also be mechanically recycled
- Remaining plastic mix used in chemical recycling
- Raw material for pyrolysis oil
- This oil is set to replace fossil raw materials
- Used to produce plastics with the same quality as new plastics



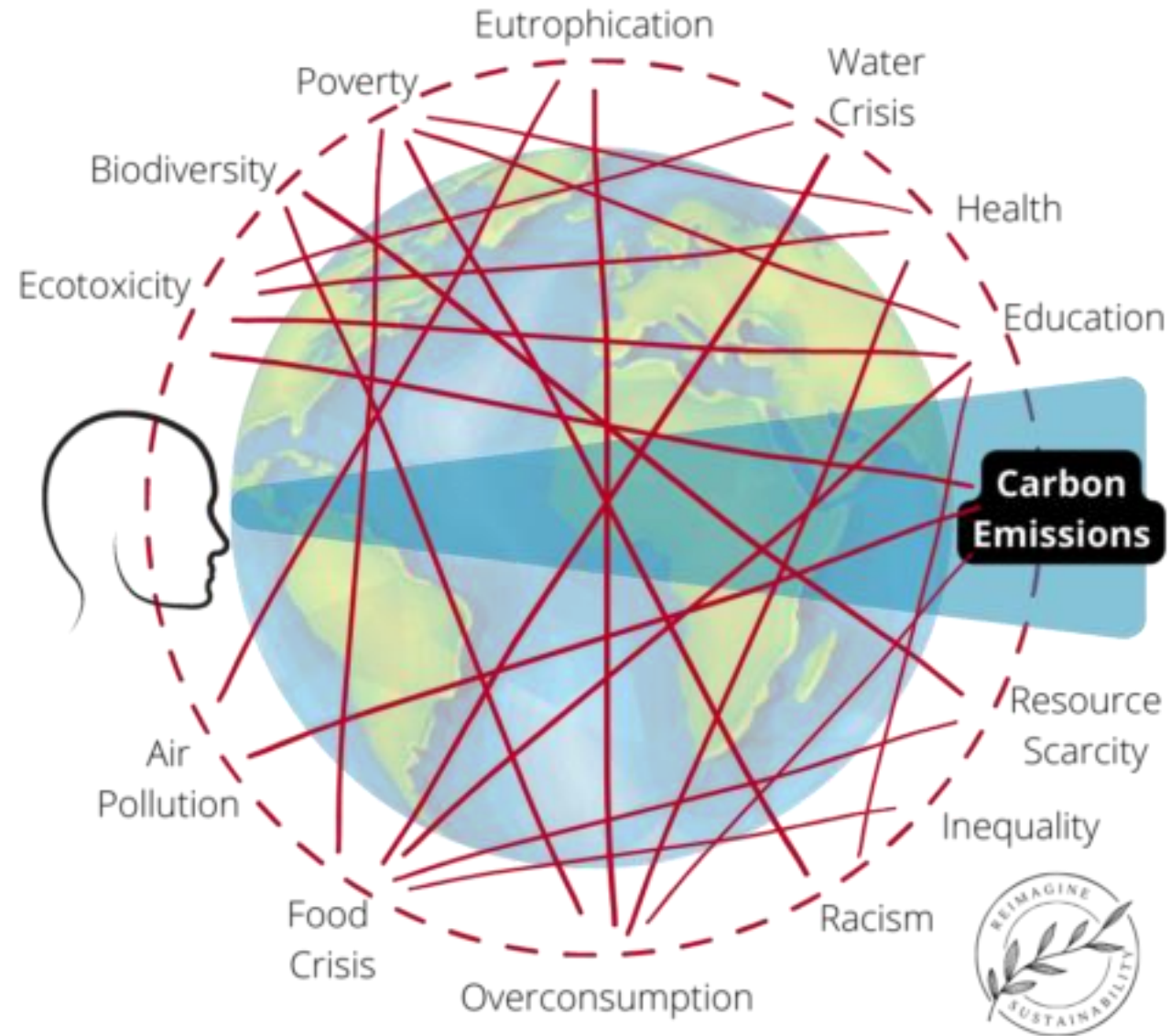
https://plastics-rubber.basf.com/global/en/performance_polymers/news-events/stories/recycling_projects 20241104

Reduction of CO₂

- How can I reduce CO₂ upstream and in the production phase?
- How can I reduce CO₂ in the use phase?
- How do I meet ambitious recycling targets?
- How can I substitute fossil resources by renewable resources?
- How can I quantify the carbon footprint of my products?
- How can we drive forward sustainability together?

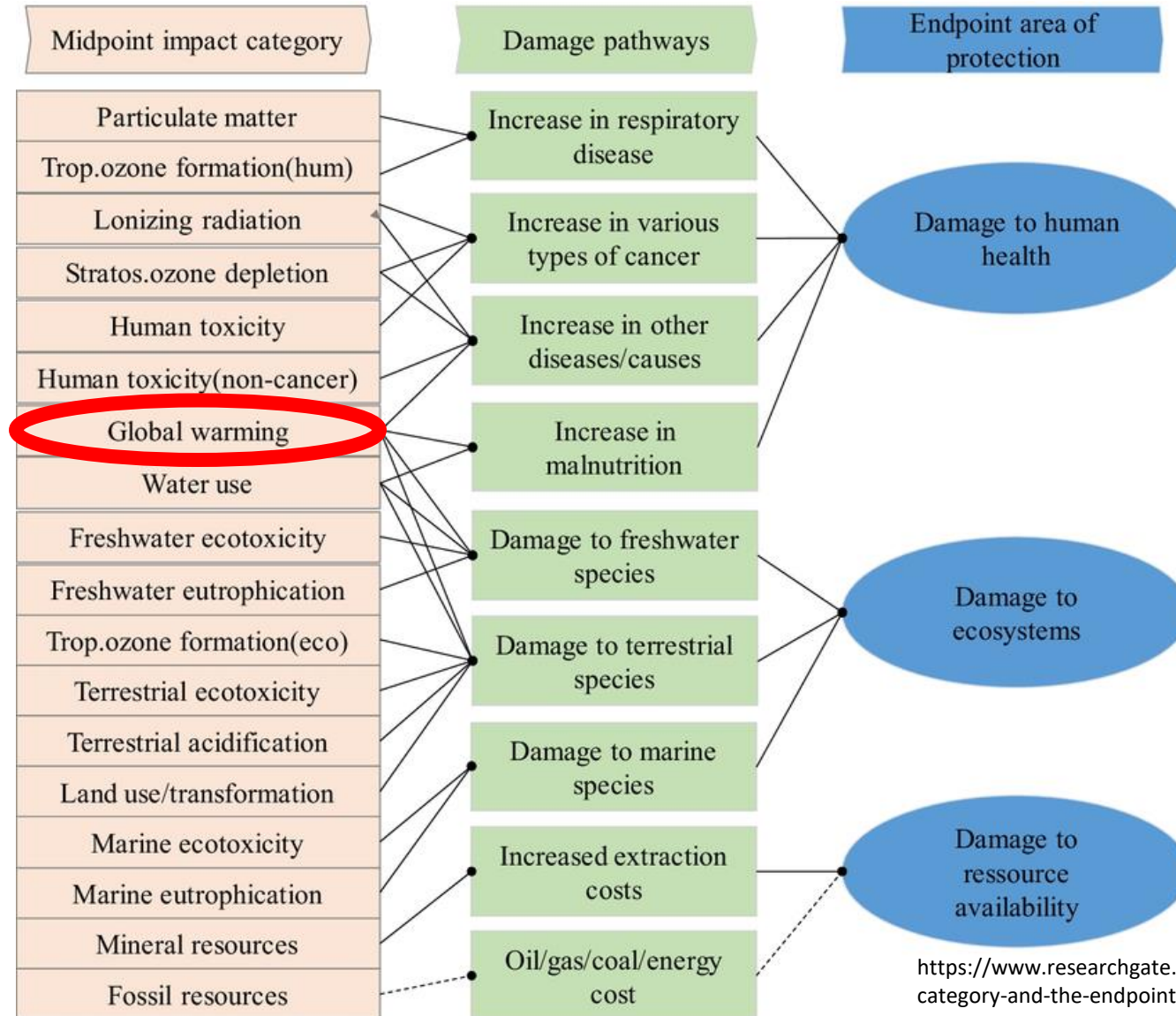
https://plastics-rubber.basf.com/global/en/performance_polymers/industries/pp_automotive/transportation_sustainability#text-1855025427 20241104

Carbon Tunnel Vision



<https://reimaginesustainability.com/from-a-carbon-tunnel-vision-to-a-holistic-collaboration-approach/20241104>

More Than CO₂eq!



https://www.researchgate.net/figure/The-relations-between-the-midpoint-impact-category-and-the-endpoint-area-of-production_fig2_361961361 20241104

Summing Up

Summing Up

- Technically everything is possible
- Many possible strategies
- Clear hierarchy for Circular Economy
- Design for recycling
- Stable market for recyclates
- **Partnership paves the way to success**

Key Success Factors

- Learn the language of each other
- Cooperation necessary between various partners
- Science – transfer – application / innovation

- **In addition to interdisciplinarity –
appropriate education of future professionals!**

Fast Cars – Sustainable?

Top speed 440 km/h

but only for 1 country in the world???



<https://luxurylaunches.com/transport/the-bugatti-chiron-super-sport-300-is-the-worlds-first-production-300mph-car.php> 20241104



Thanks for your attention

Questions? Remarks?

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