



Sector Report

PLASTIC RECYCLING MARKET

About the Authors

PHILIPP V. HOCHBERG is a Managing Partner of Rautenberg & Company and works out of our Frankfurt office.

For more than 20 years, he has advised family-owned companies and their shareholders, private equity houses, entrepreneurs and managers on M&A transactions and financing. His major focus is on transactions in the industrial sector such as Machinery & Equipment and industrial goods as well as in consumer goods/retail.

Philipp holds a graduate degree in economics from the University of Bonn. Alongside his studies in economics, he also studied political and

historical science. As an advisor to principals, Philipp is an entrepreneur himself; for more than 12 years, he was shareholder and Managing Partner of C H Reynolds Corporate Finance AG, which he established with his co-founders in the German M&A market. Earlier positions in his career include Doertenbach & Co. in Frankfurt, Ernst & Young in Berlin.

Philipp co-founded the M&A specialised transaction boutique Bassewitz & Hochberg in Frankfurt who merged with us in 2018.



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BORIS HERZOG is a Partner in our Frankfurt office.

He is an experienced project manager, focusing on market studies, strategy development/execution and the development or evaluation of business cases and value creation plans in a variety of industries, particularly digital infrastructure, tech & media as well as services.

After his studies of computer science and operations management at ESB Reutlingen and ESC Lille, Boris started his professional career in 2007 with Arthur D. Little. Over the course of his six-years tenure, he led

numerous national and international strategy development and performance improvement assignments in diverse industries and conducted various transactions related projects (commercial due diligence, value creation, post merger integration, carve out).

Prior to moving to Rautenberg & Company in May 2014, Boris completed his MBA at IE Business School (Madrid, Spain), where he graduated on the Dean's List honours in 2013.



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He is an experienced expert in strategy development and transformation of mid-sized companies as well as in conducting commercial due diligences in the small and mid-cap segment.

Before joining us, he worked as a project manager at Dr. Wieselhuber & Partner and as an independent consultant, supporting leading SMEs in strategy, transformation, and M&A processes. His sector focus is on

digital business models/IT services as well as on industrial goods (especially mechanical engineering, construction supply, and plastics processing industries).

Sebastian has gained broad experience in the mid-market and corporate environment through various assignments in Germany and abroad. He holds an M.Sc. in Management and a B.A. in Industrial Economics from Friedrich-Alexander University Erlangen-Nuremberg.



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He is a seasoned industry veteran with a strong finance and M&A background and looks back on a corporate career of more than 25 years, primarily in the recycling industry and environmental services. Most recently, he was the Managing Director and CFO of ALBA Services Holding GmbH in Berlin where he was in charge of the Services segment

with more than EUR 700m in revenue. Previously, he served as ALBA Group's Head of Finance, Controlling and M&A. Earlier steps in his career include Bayer Schering Pharma AG in Berlin and Schering AG in Berlin and in New Jersey, U.S.A.

Stefan holds a degree in industrial engineering and business administration from the technical university of Berlin.



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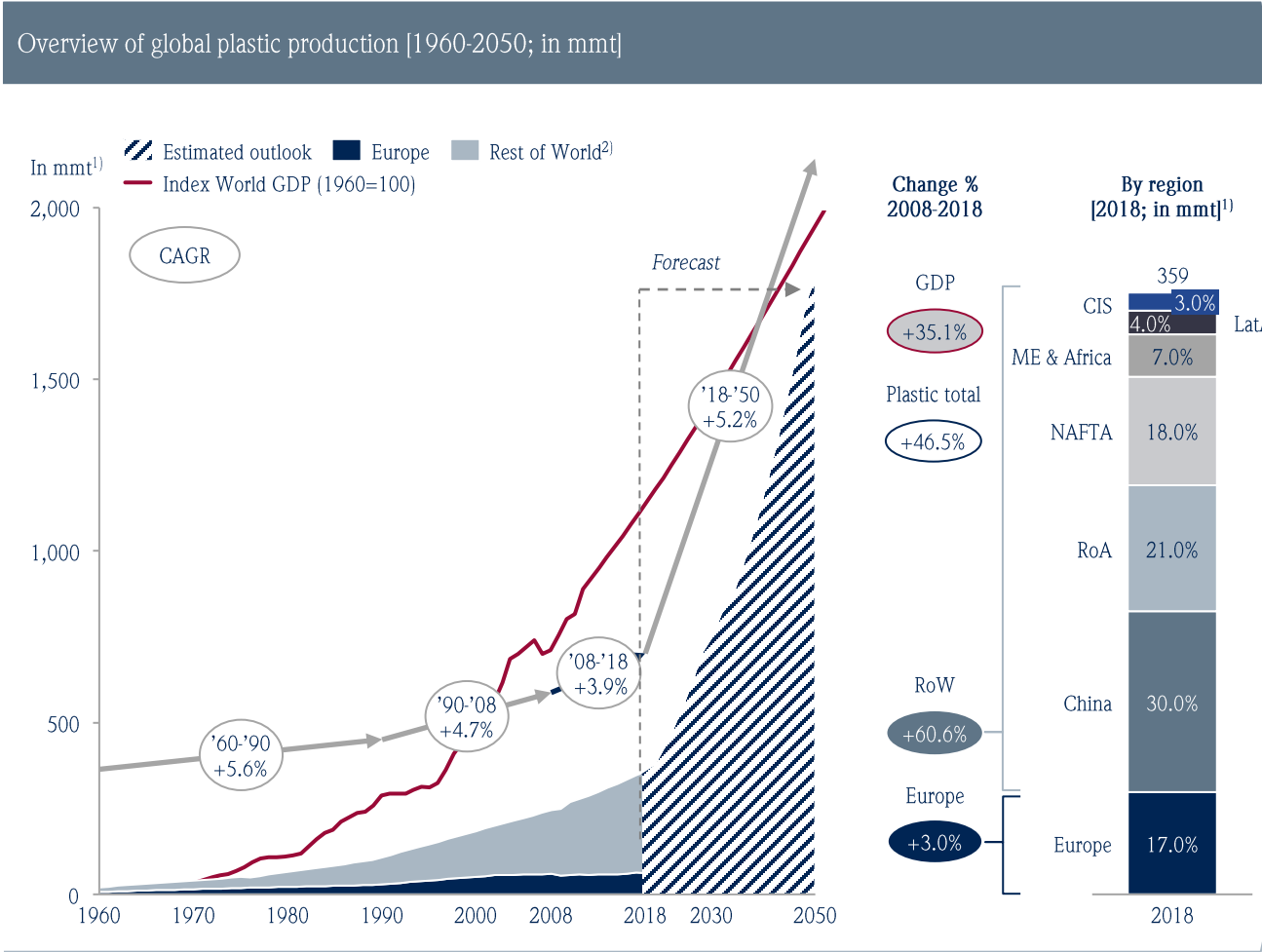
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Plastic production has increased significantly over the last ten years – mainly driven by Asian economies.
Production will increase roughly 4x until 2050.

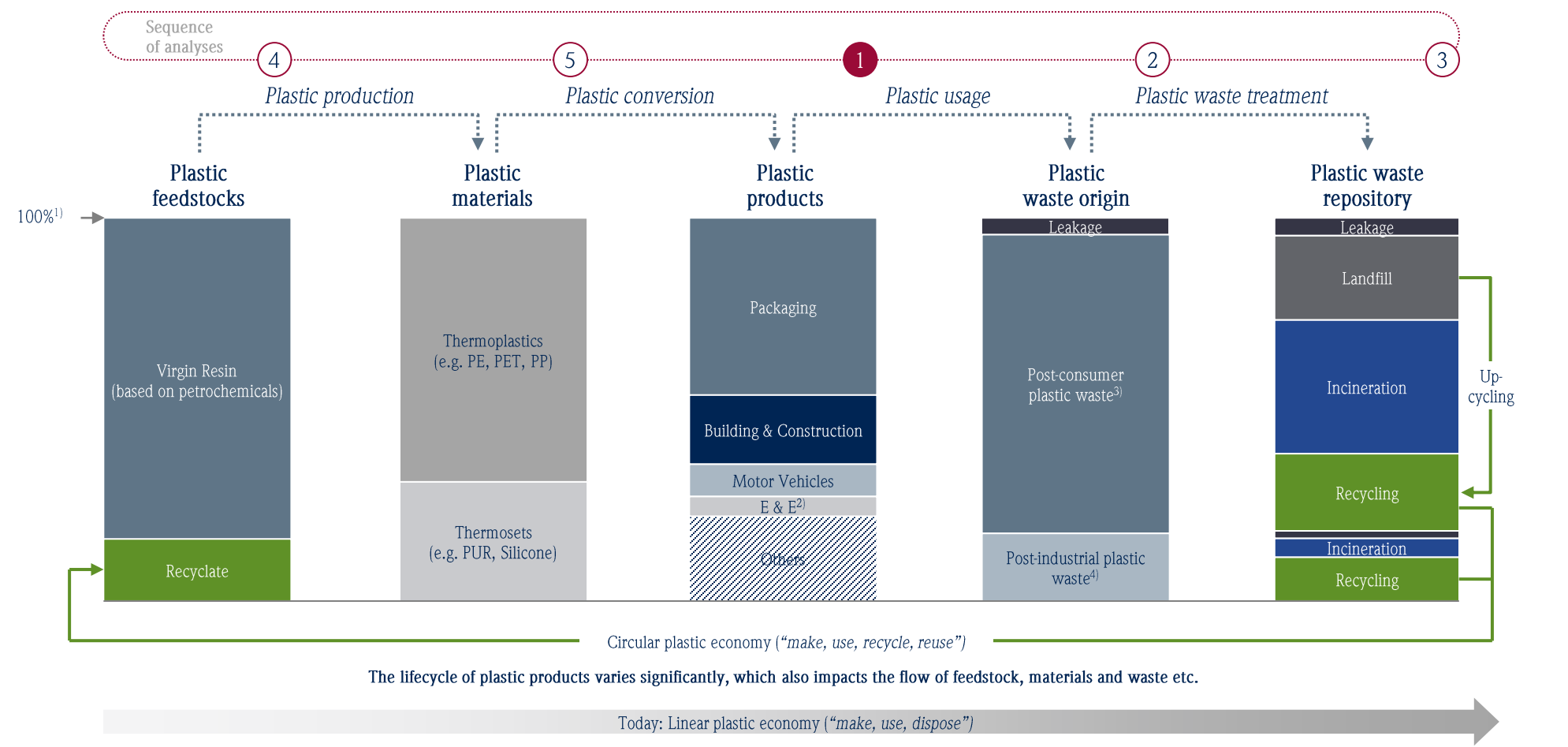
Development of World GDP vs. global plastic production



- Expanding Asian economies, as well as production shifting towards export-oriented China, have been the main drivers for production growth since 1990. Today, **30% of the world's production is taking place in China**
- Whereas historically industrial-focused Europe drove production of plastic until 1980, **the plastic industry has reached a more mature state since 2000**
- The **acceleration of growth until 2050** is primarily driven by **increasing disposable income** and **growing populations** in combination with **lighter products**, **growing expectations for food quality and protection**, and thus, **increased consumption of plastic** and consequently **demand for recycled plastic**

Each of the diverse steps of the plastic lifecycle process involves different stakeholders. The rising circular economy has its own challenging dynamics.

Plastic lifecycle

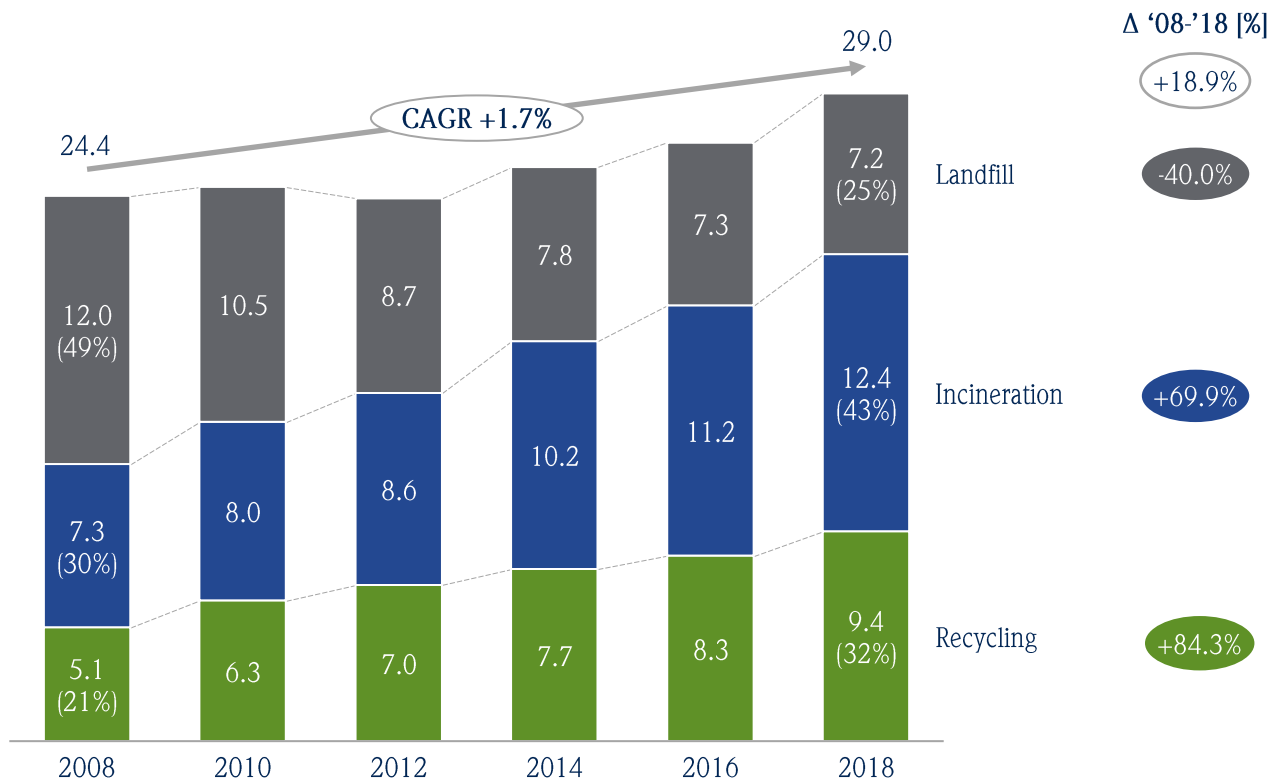


1) The size of the box represents 100% of the category measured in mmt
2) Electrical & Electronics
3) Includes plastic out of municipal solid waste and commercial waste
4) Includes plastic scrap occurring during the manufacturing of plastic products
Source: R&Co analysis

Since 2008, the recycling share of post-consumer plastic waste has increased by 84%, showing strong advancements towards a circular economy.

Plastic waste repository

EU post-consumer plastic waste treatment from collected waste [2008-2018; mmt]

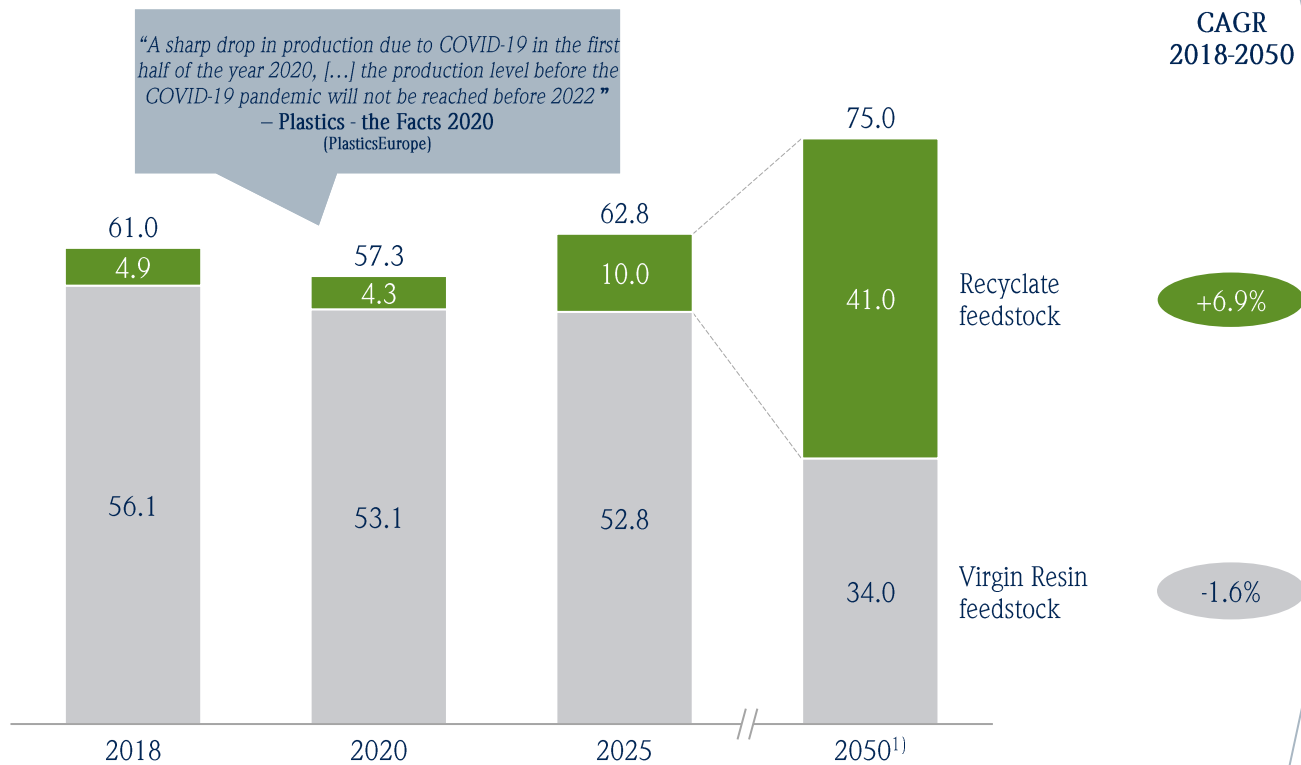


- In 2018, around **29 mmt** of plastic waste were collected in Europe for further treatment, representing a c. **~19% increase from 2008**
- Most notably, the **recycling treatment share has increased** significantly from **~21% to ~32%** indicating strong **advancements towards a circular economy**
- Apart from this, c. **20% (2018) were recycled outside the EU** (mainly Asia)
- With new EU regulations coming into effect in 2015, **imposed bans on landfill have further decreased landfill rates** and fostered recycling
- Import restrictions from Asia (e.g. 2017 plastic ban in China; “National Sword”) **are forcing the EU to find further environmentally friendly ways to treat post-consumer waste besides incineration**

While Recyclate today only accounts for a small amount of feedstock material for production, its share is expected to increase to c. 50% of plastic production in 2050.

Plastic production/feedstocks

European plastic production forecast by feedstock[2018-2050; mmt]

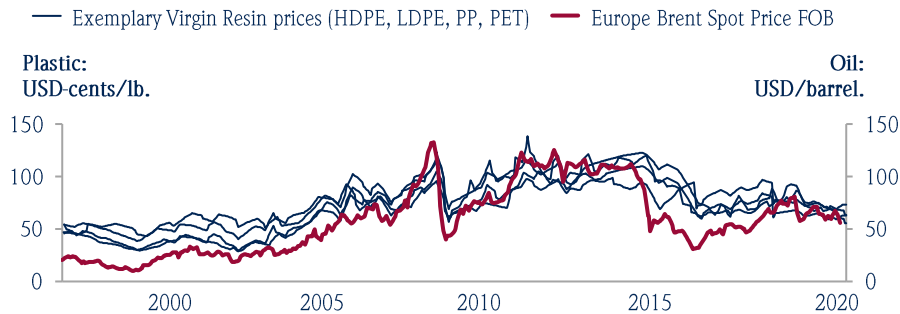


- In general, **by 2050 c. 50%** of the plastic production **world-wide** could be based on **plastic reuse and recycling**. A similar figure will accordingly apply to the EU
- The **Circular Plastics Alliance** aims to increase the European **market for Recyclate feedstock to 10 mmt by 2025**
- In the future, c. **25-30% of the Recyclate material** will be reprocessed by means of **mechanical recycling**
- c. **25-30%** of the polymer material will be recovered by **chemical technologies** e.g. pyrolysis
- Yet domestically available waste **will not be sufficient to cover the increasing demand for adequate feedstock**:
 - Consequently, the ‘transformation’ from waste to Recyclate will need to become significantly more efficient (e.g. via improved collecting and sorting)
 - New sources of waste need to be uncovered (e.g. re-opening of landfill sites, re-direction of plastic waste from incineration or increasing waste imports)

Price of Recyclate has been above Virgin prices recently, the latter mainly driven by lower oil and gas prices due to COVID-19 impact.

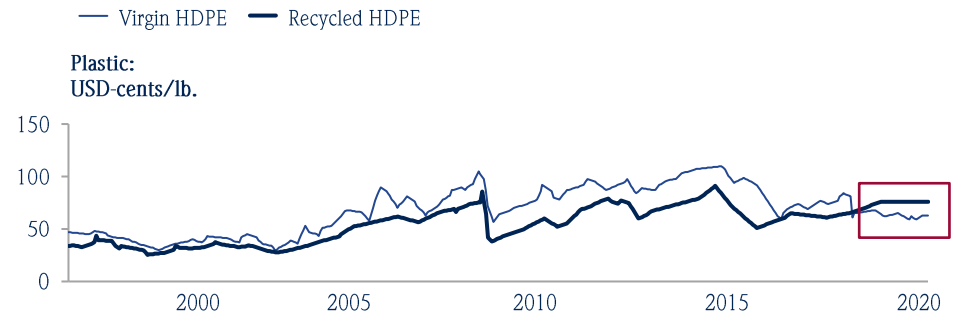
Plastic price

Virgin Resin dependency on oil price
[1996-2020; USD-cents per lb./USD per barrel]



- Virgin Resin is derived from crude oil, natural gas liquids, liquid petroleum gases, and natural gas – as a result, plastic prices depend on the price of oil and gas
- Prices for oil and gas are volatile and have plummeted time and time again for reasons like advances in the methods of extraction (e.g. fracking), political turmoil between OPEC countries, Russia and the U.S., or the COVID-19 pandemic, resulting in a drop in Virgin Resin prices
- Petrochemicals are set to be the largest driver for the world's oil demand until 2030 – with possible reverse influence on oil and gas prices

Comparison of exemplary Virgin Resin and Recyclate prices
[1996-2020; USD-cents per lb.]



- Prices for recycled plastic feedstock have been lower than for Virgin plastic for a long time, but the former have become more expensive recently – up to the same price level or even more expensive than Virgin plastic; drivers were:
 - Increasing demand for recycled plastic, mainly due to regulation and higher environmental consciousness among consumers/converters (ongoing)
 - Falling oil prices and thus decreasing prices for Virgin Resin, making it relatively more attractive for converters
- China's import restrictions led to lower prices for plastic waste bales in Europe (i.e. lower procurement costs for Recycling Players), at the same time lowering average waste quality and making sorting more complex
- Processual and technical improvements in the recycling process offer a big lever to lower recyclers' costs in general, potentially reducing Recyclate prices

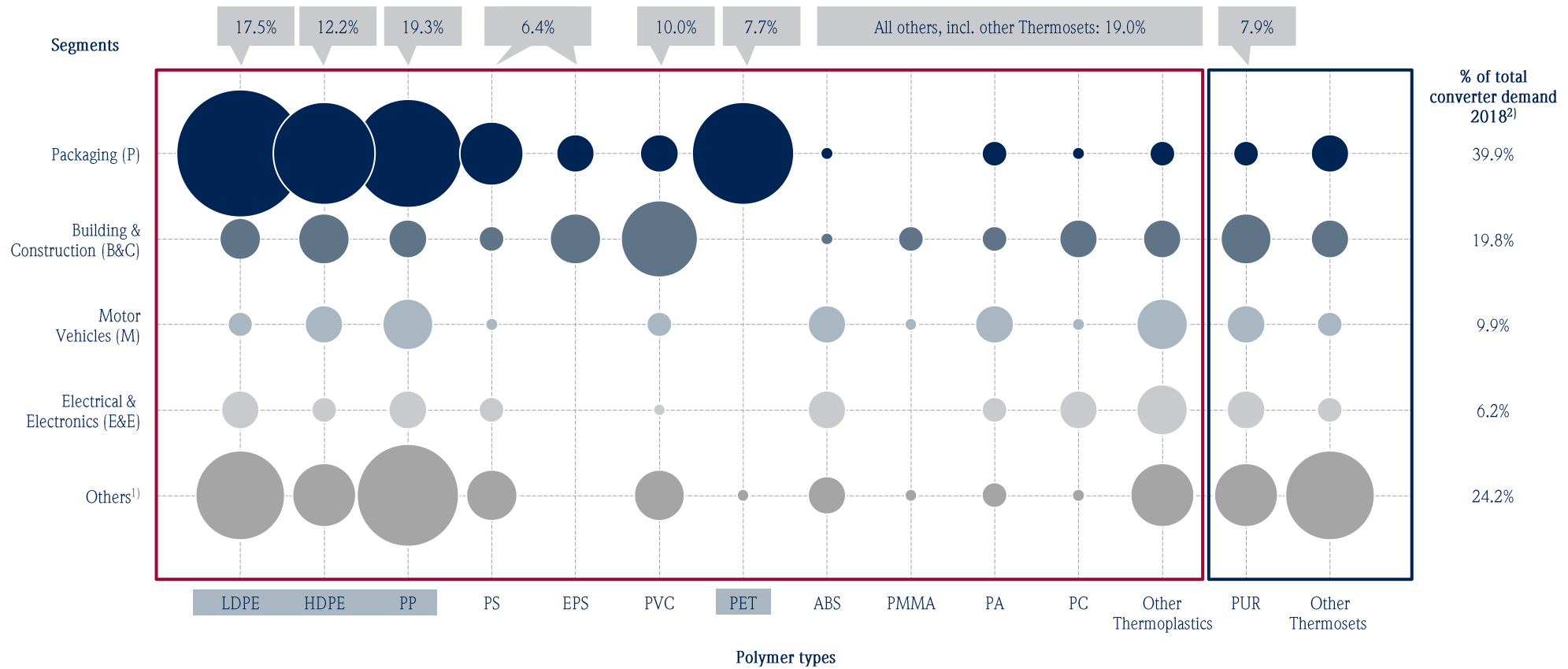
- As a result of the recent COVID-19 situation, industry experts expect lower plastic recycling volumes due to challenges in the waste management supply chain and, together with the oil price shock, converters to increasingly favor Virgin plastic in the short-term
- Regulations regarding recycling quotas will not to be relaxed as the consumer products industry is likely to stand by their commitments of using a higher share of Recyclate in production out of fear of reputational damage¹⁾

1) E.g. Unilever and Henkel signalled that their robust sustainability plans remain unchanged in the face of the recent, relatively high price of recycled plastic recently
Source: EIA, Eco-Business, IASS Potsdam, McKinsey, Plastics News, Recycling Magazine, U.S. Bureau of Labor Statistics, R&Co analysis

Polyethylene (PE) and Polypropylene (PP) are the relevant polymers regarding converter demand.
Packaging (P) is most significant for recycling purposes.

Plastic materials – European converter demand by polymer types and segments

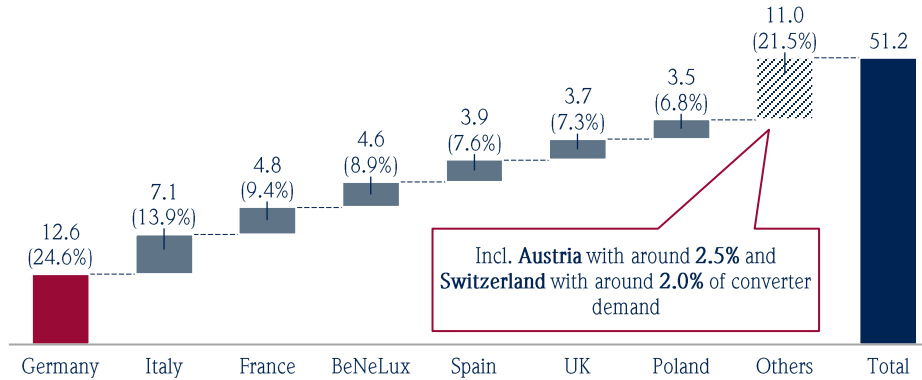
Indicative



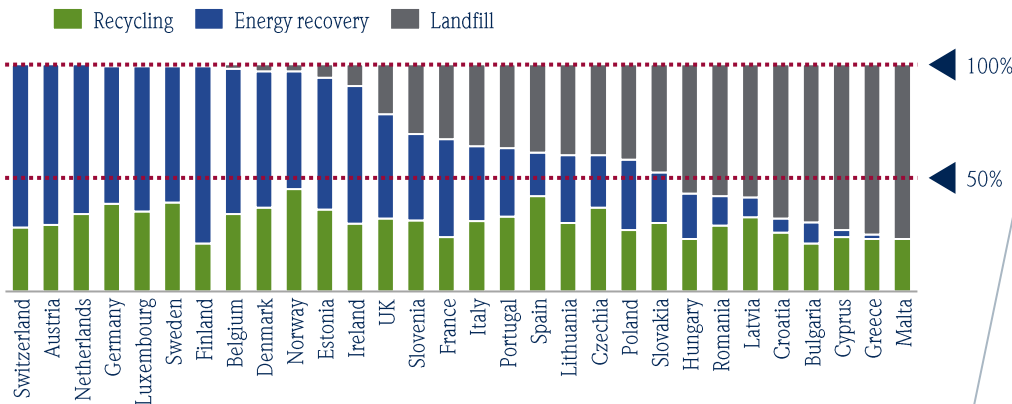
Recycling rates are already high; but as a result of regulation and commitments, recycling capacity will require extensive build-up. DACH region covers ~30% of EU-28 demand.

Plastic converter demand, waste treatment & recycling capacity

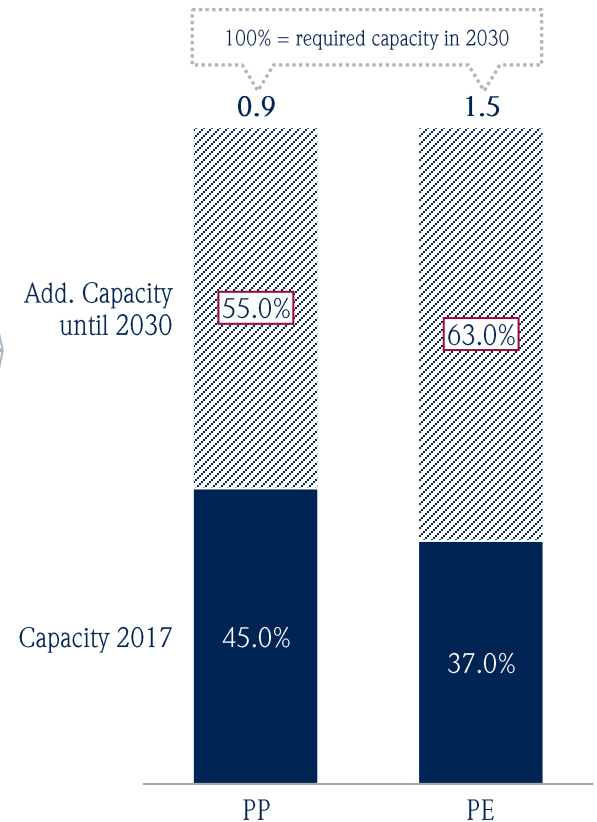
Plastic converter demand by country in EU-28 [2018, mmt/%]¹⁾



EU post-consumer plastic waste treatment by country [2018, %]



Recycling production capacity [2017-2030; DE; mmt]



The regional waste availability will determine the technology opted for. Mechanical recycling cannot handle all types of waste but will be best addressing production costs, capex and environmental aspects.

Mechanical vs. chemical recycling overview

	Feedstock	Output	Decontamination	Ability to treat mixed plastic	Process maturity
Mechanical recycling	PE, PET, PP, PS	Plastic (made of one/more polymers)	Yes- (based on sorting, washing capabilities)	Yes	Industrial scale
(Solvent-based) purification	PVC, PS, PE, PP	Polymers	Yes	No	Pilot stage
Chemical decomposition	PET, PU, PA, PLA, PC, PHA, PEF	Monomers	Yes	No	Existing pilot plants for PET, PU, PA
Thermal decomposition	PMMA, PS	Monomers	Yes	No	Pilot stage
Conversion/ thermal cracking (pyrolysis and gasification)	Plastic mix (Multi-layered & unsorted materials)	Hydro-carbon mix	Yes	Yes	Small scale so far

FOCUS

Chemical recycling

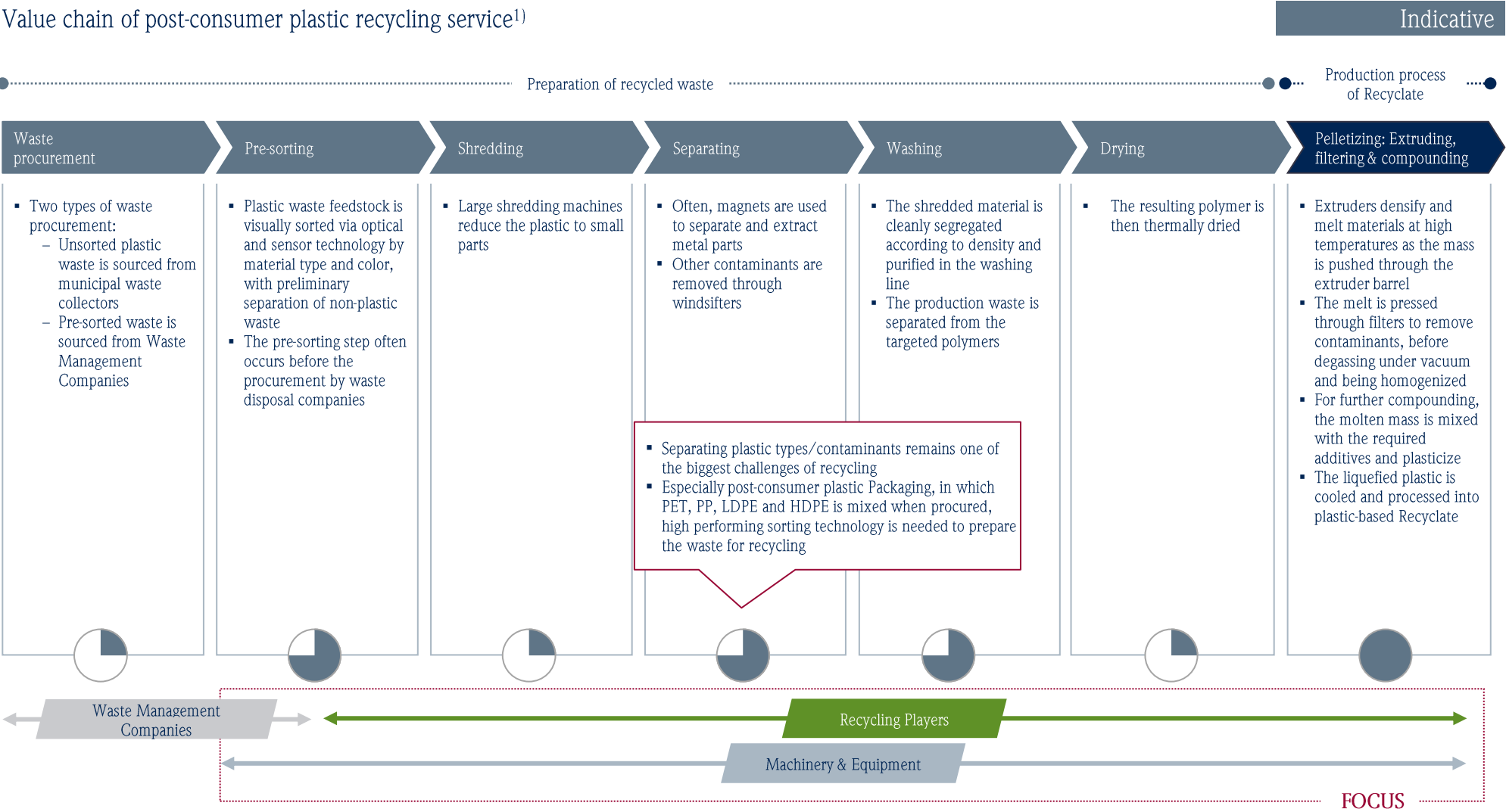
In 2050, **nearly 50-60%** of plastic demand could be covered by plastic reuse and recycling

- Mechanical recycling** (25-30% of plastic demand 2050)
- Waste materials are recycled into “new” (secondary) raw materials without changing the basic structure of the material
 - Waste materials are washed, (pre-)sorted, shredded, separated and eventually re-melted and extruded into new secondary raw materials – with the disadvantage that materials “degrade” after each re-cycle and can eventually only be used for lower-quality products

- Chemical recycling** (25-30% of plastic demand 2050)
- Chemical recycling refers to several different processes – purification, decomposition and conversion – with different output grades. Conversion outputs are often liquid/gaseous hydrocarbons similar to products derived from petroleum refining which are used as raw input for plastic production
 - The closer the processes return the material outputs to its hydrocarbon/petrochemical state, the higher the required energy and the less efficient the processes

As chemical recycling processes are still in an early stage and not implemented on an industrial scale, the focus of the subsequent analyses is on mechanical recycling

Mechanical recycling process: The particular quality of plastic Recyclate depends on the type of plastic waste and the technical capabilities of pre-sorting, washing and extrusion technologies.

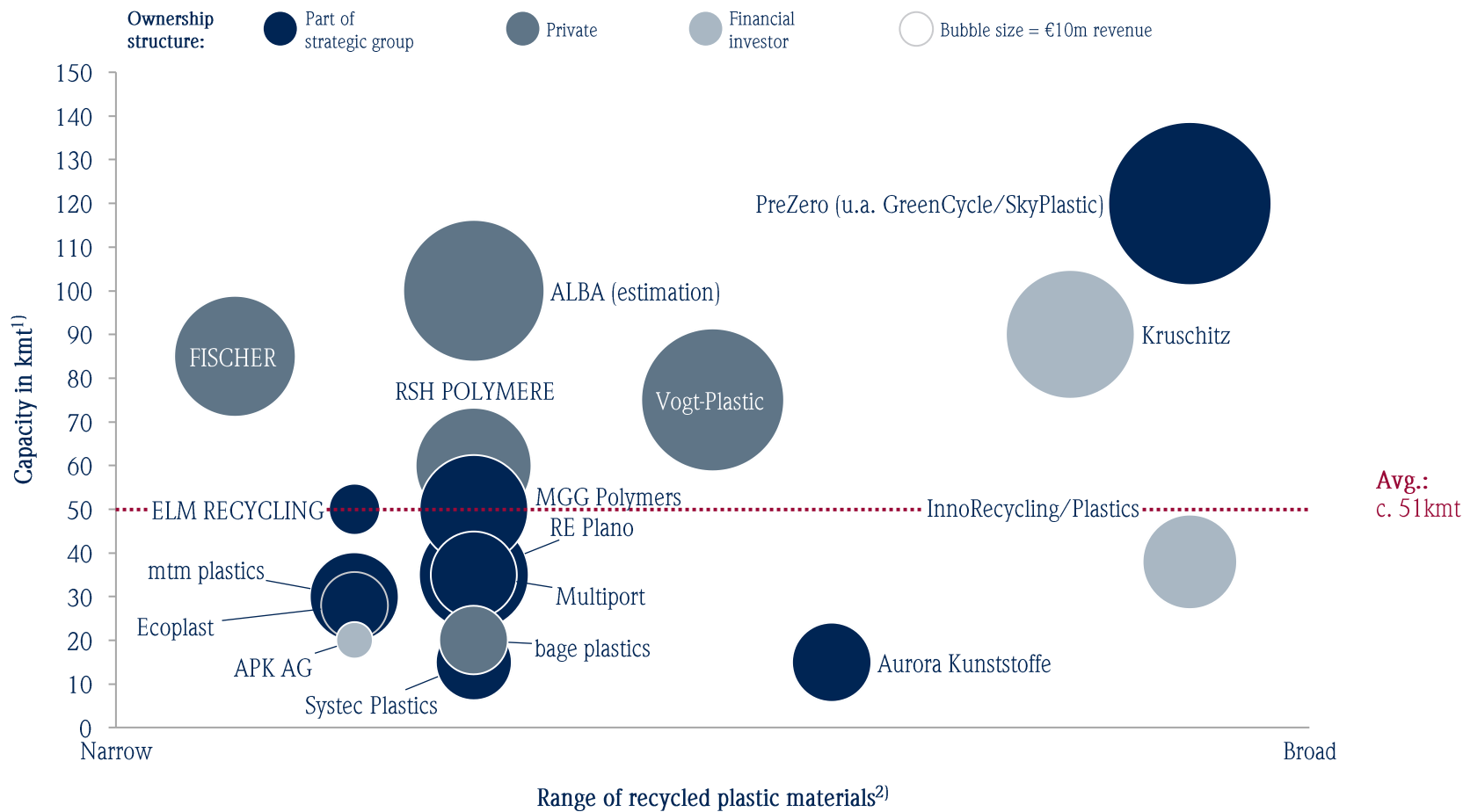


The DACH market for plastic Recycling Players remains very fragmented with an annual average capacity of around 40,000 metric tons per Player.

Recycling Players in the DACH region (1/2)

Indicative

Segmentation
of selected
Recycling Players
in the DACH
region [latest
available year;
kmt/€m]¹⁾



The fragmented plastic Recycling Players universe offers the opportunity to consolidate and industrialize (scale/optimize) operations.

Recycling Players – M&A perspectives

Indicative

Consolidation

- “Green” plastic products, and the build-up and expansion of recycling infrastructure drive growth and consolidation in Europe
- Plastic recycling companies often lack industrial scale, standardization and operational excellence – which is reflected in the composition of the sector. It is still characterized by small, entrepreneurial companies with legacy operations/machinery and limited capex capabilities
- Sector potential by using scale effects – e.g. combining plastic waste from several pre-sorting operations and recycling with efficient state-of-the-art technologies
- Most recent transactions focus on enhancing capacity and thus scale, alongside the value chain (collecting, sorting), which strengthens recyclers’ procurement position and cost structures ultimately affecting margins positively

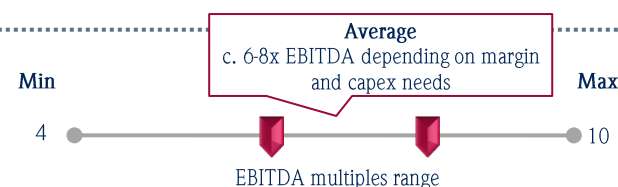
Horizontal integration/diversification

- Forward integration: Waste Management Companies (e.g. Remondis) use M&A as means to further internalize recycling capacities to secure attractive value pockets
- Backward integration: Food retail Players (e.g. Schwarz-Gruppe) focus on preventing, reducing and recycling plastic waste, thus strongly building up their own recycling capacities and collection services
- Diversification (medium-term): Petrochemical companies will start to build up their own Recyclate operations as a partial alternative to Virgin polymers production (Borealis, BASF)

RM&Co M&A outlook for the next 5 years



- The current state of the recycling industry is highly fragmented with ample room for improvement and growth
- This offers a unique investment opportunity to consolidate and industrialize, which will strongly drive M&A activity in the upcoming years



Rationale for financial sponsors



- Discover promising themed trends like impact investments, sustainability, green technologies etc.
- Leverage the buy and build experience (from target search to execution to post-merger integration) to drive the consolidation
- Realize size premium through focused M&A strategy as strategic investors will be willing to pay a high(er) price for upscaled Recycling Players; in addition, potential to realize multiple arbitrage at exit for private equity firms

Accordingly, Machinery & Equipment Players are usually specialized in either plastic recycling preparation or the Recyclate production process steps.

















Selected DACH plastic recycling Machinery & Equipment Players and their recycling technology offerings

Selection

Archetypes:

Production process specialists

Preparation process specialists

Company	HQ	Revenue ¹⁾ [€m]	Employees ¹⁾	Pre- sorting	Shredding	Separating	Washing	Drying	Extruding, filtering and compounding
Bühler Group		3,030	13,165						
Vecoplan		120	450						
Binder + Co		113	383						
Steinert		86	350						
Lindner Recyclingtech		74	300						
Sesotec		68	540						
Sutco ²⁾		55	380						
Herbold Meckesheim		47	170						
STP ²⁾		24	82						
Trennso ²⁾		24	70						
B+B Anlagenbau		13	n/a						
Hamos ²⁾		8	33						
Starlinger Group ³⁾		290	1,100						
EREMA Group		205	650						
NGR ²⁾		80	250						
Gneuß		24	c. 130						

- Besides offering single recycling machinery, some of the Players also design and engineer (turnkey) recycling production lines and plants
- The global market leaders primarily originate from the DACH region
- Selected Players in the preparation process part of the value chain also address non-plastic customers/segments
- Increased number of strategic partnerships between recycling and M&E Players to accelerate the transition to a circular economy e.g. EREMA with Borealis and Lindner

1) Latest available year

2) Sutco Recyclingtechnik; STF Maschinen- und Anlagenbau; TRENN- und Sortiertechnik; Trenn- und Sortiertechnik; Hamos Separationstechnik; Next Generation Recyclingmaschinen

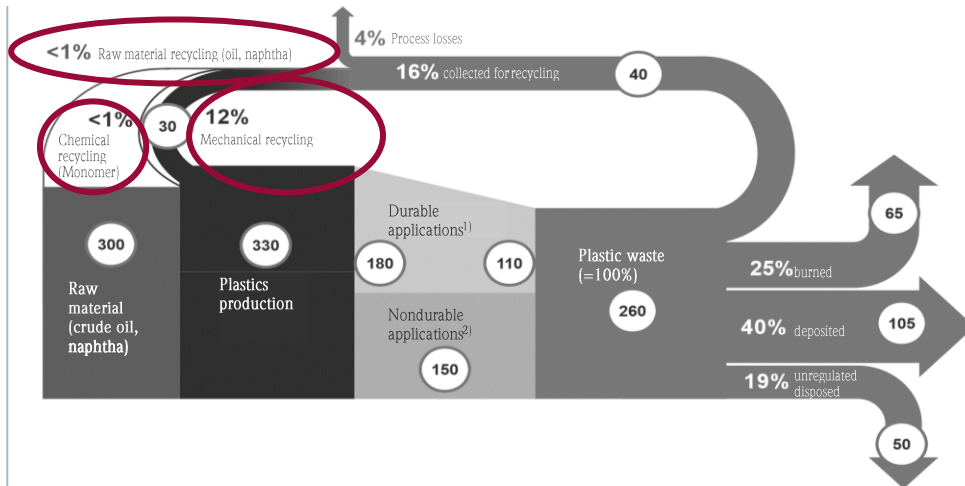
3) Thereof recycling equipment: €130m

Source: Company websites & publications, BvD Markus, Capital IQ, R&Co analysis

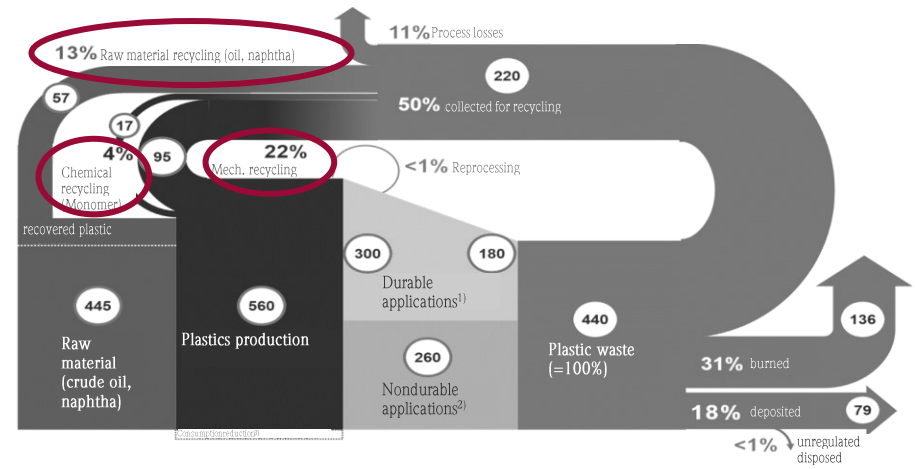
The recycling market will experience much stronger growth than plastic production, recycling machine manufacturers should prepare for significantly increasing demand.

Solution to a fundamental problem

Plastic and plastic waste production 2016
in millions of tons



Plastic and plastic waste production 2030F
in millions of tons



Now is the time to act!

- The material collected for recycling is growing disproportionately to plastic and waste production; in 2030, 39% of all plastic waste is already expected to be recycled, up from about 12% in 2016
- To improve the yield of collected material, the importance of alt. Recycling methods (esp. chemical recycling), a closed-loop economy can only be created by combining all methods
- Achieving long-term goals requires capital to realize economies of scale and to develop new technologies or to further develop existing technologies

1) Durable applications with an average lifetime >1 year

2) 150 mio metric tons (260 mio metric tons in 2030F) of mixed plastic waste from nondurable applications that end up as waste in the same year + 110 mio metric tons (180 mio metric tons in 2030F) from the previous year

3) Scenario based on multi-stakeholder push

Quelle: McKinsey, R&Co Analyse

Leveraging buy-and-build in order to expand the business model and driving operational excellence will be an attractive value lever within the recycling machinery industry.

Plastic recycling Machinery & Equipment manufacturers – M&A considerations

Indicative

Trend to down- or upstream integration

- Very few initial plastic recycling Machinery & Equipment manufacturers are now the technology leaders followed by related technology providers (e.g. extrusion)
- The relevant Machinery & Equipment manufacturers are mainly characterized by medium-sized family businesses focusing primarily on specific areas of the process chain; the world-market leaders are located in the DACH region
- New concepts are formed out of neighboring processes in order to control critical process steps (e.g. acquisition of BritAS by NGR, Plasmac by EREMA)
- Potential trend for turnkey approaches will demand strong technology offerings alongside the process itself, and corresponding financing services

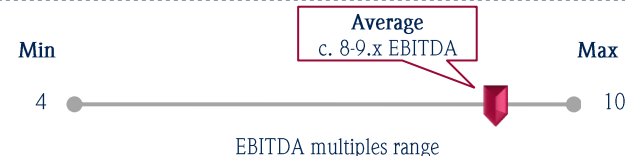
Strategic Players and private equity

- Bigger plastic machinery suppliers are trying to step into the recycling segment through in-house developments based on neighboring technologies and through acquisitions of technologies
- In Europe, very few private equity firms have supported plastic recycling Machinery & Equipment manufacturers (e.g. VTC Industriebeteiligungen) as the Machinery & Equipment sector is generally not in the current sweet spot
- Most of the relevant Players are family-owned and in a financially strong position
- Some “impact” investors (family offices) are starting to invest in growth projects of plastic recycling Machinery & Equipment Players

RM&Co M&A outlook for the next 5 years



- Due to the complexity of the separate recycling steps, synergies between the consecutive process steps are prominent
- Market leaders can show EBITDA-margins above 12-15% and growth rates > 10% p.a. with corresponding high multiples >10x EBITDA



Rationale for financial sponsors

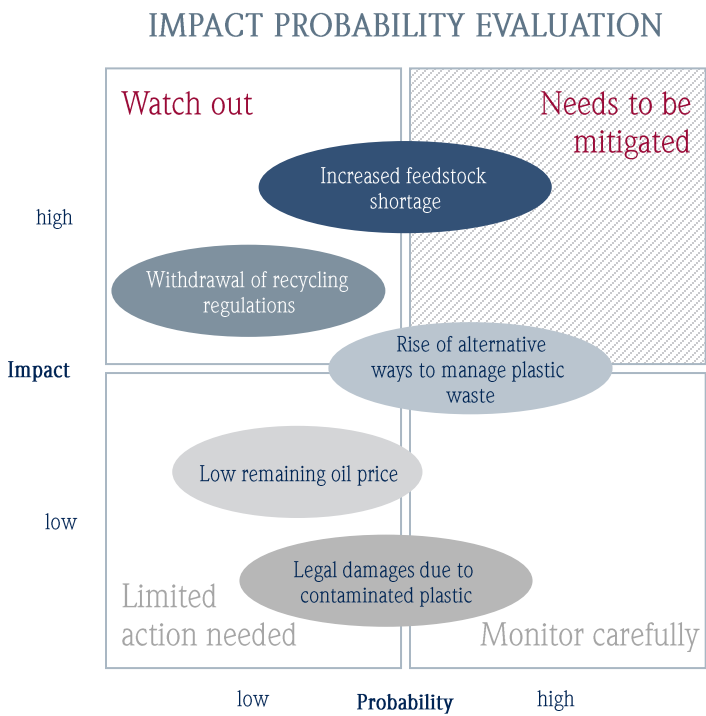


- Support of plastic recycling Machinery & Equipment manufacturers with expansion plans will continue to be an attractive value lever
- Leverage buy-and-build experience to realize synergies in specific parts of the process chain; prior industry expertise and a suitable approach to family-owned businesses is required in order to be successful

Several risk factors for market participants have been identified, yet these appear manageable.

Selected investment risks

Hypotheses	RM&Co implication assessment for recycling companies
1 Increasing demand for plastic Recyclate will increase feedstock shortage resulting in increasing purchase prices	Overall risk is medium as: <ul style="list-style-type: none"> Future close-the-loop economies have to secure the procurement of plastic waste by: <ul style="list-style-type: none"> Re-direction of plastic waste from incineration Increased imports Re-opening of land fill-sites
2 Governments and institutions withdraw from adopted recycling regulations (e.g. EC recycling quota, import bans)	Overall risk is considered low as: <ul style="list-style-type: none"> Customers and corporates have changed their behavior towards more sustainable production/products Contradicts global trends such as fighting climate change
3 Alternative ways to manage plastic waste e.g. Mechanical recycling will become available on an industrial scale	Overall risk is low as: <ul style="list-style-type: none"> It would potentially increase prices of plastic waste and thus squeeze margins But would require significant capex and time to build-up a functioning infrastructure It will complement rather than replace existing technologies
4 The oil price will remain low making it more attractive for plastic converters to use Virgin plastic instead of recycled plastic	Overall risk appears low as: <ul style="list-style-type: none"> Certain share of plastic production has to be covered via recycling as a demand by consumer goods industry and regulations Technology innovations are increasing recycling efficiencies resulting in increased competitive pricing Oil price is expected to recover form its all-time low in midterm
5 Toxic substances , which are part of recycled plastic, contaminate customers (e.g. within food and health care industry), and thus cause legal and reputational consequences	Overall risk is deemed low as: <ul style="list-style-type: none"> Institutions such as EFSA¹⁾ approve recycling processes to provide legal certainty Also provides competitive edge for recycling and technology innovations which are enabling the treatment of complex types of post-consumer waste



Who is Rautenberg & Company?

Rautenberg & Company is an integrated strategy and corporate finance advisory firm that is built on sector expertise, senior level experience and attention and high-quality execution across the full range of client solutions.

Over the last 8 years, Rautenberg & Company has experienced a great improvement in competitive position, rising from being a small advisory boutique in 2014, to being a 25+ professionals advisory firm today, with offices in Duesseldorf, Frankfurt/Main and London.

Over the past 8 years, Rautenberg & Company has advised on +50 transactions.

How Rautenberg & Company can help?

How we can help with our Corporate Finance/M&A Advice?

In our Mergers & Acquisitions Advisory business, we support buyers or sellers with the preparation and execution of corporate transactions or participations. A dedicated senior team with +80 years of transaction experience can secure balanced and thoughtful advice, offering credibility/influence on senior decision-makers of potential buyers or sellers and investors. Our particular focus is advice on the sale of companies, as well as the carve-out of single business units and assets. We also provide advice on mergers and strategic partnerships. On the buy-side, we develop customized acquisition strategies, identify suitable target companies and assist in the execution of the transaction.

How we can help with our Strategy & Value Creation Advice?

In our Strategy & Value Creation Advisory business, we support our clients and their portfolio companies in strategy and growth, with digitization and all other aspects of value creation and operational improvement. This includes exit readiness programs, commercial due diligences on the buy-side and sell-side, value creation plans and post-merger integration programs.

CAPITAL INTELLIGENCE – Rautenberg & Company has close relationships with many of the top Private Equity, Venture Capital and Infrastructure investors in Europe. We are happy to make introductions where appropriate. The team also covers local family offices and wealth managers to connect clients to the local investment community as they look to potentially raise money from within the DACH region.

CORPORATE ACCESS – Rautenberg & Company has a profound knowledge of the Plastic & Rubber industry, especially in related Machinery & Equipment manufacturing, with a broad network and relationships with companies, shareholders and investors in the DACH region.