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— Inventing circularity, together —

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Plastic consumption is causing adverse environmental effects. Regulations are being introduced and brands have made commitments to resolve the matter.

Pledges and regulations on plastics, by region[1]

Sustainability momentum Low High

	Types of pledges and regulations			
	CPG[2] commitments and focus	Taxes and extended producer responsibility (EPR)	Single-use plastics (SUP) regulation	Recycling regulations
China	Recycled content	EPR in implementation	Requires biodegradable for bags and food-service plastics	Waste import ban
North America	Packaging recyclability, recycled content	CA: Province-level EPR US: State-level EPR in process	CA: 2022 ban US: State-level bag bans	CA: RB[5] 100% by 2030 US: State-level regulations
Developed Asia and Australia	PET[3] bottles, waste reduction	EPR schemes widespread	Bag ban in Japan, parts of Australia	JP and KR: RR[6] 60–70% by 2030 AU: RC[7] 20%, RR 70%, and RB 100% by 2025
Europe	Recycled content, reducing virgin plastics	EU: Plastic tax (€800 per metric ton),[4] carbon taxes, EPR	EU: SUP ban on 10 items	EU: RC 30%, RR 55%, and RB 100% for plastic packaging by 2030
Rest of world	Varies	EPR schemes	India: State-level regulations	Turkey: RR targets Brazil: RC 75% (proposed) Indonesia: 70% reduction in marine plastic by 2025

[1] Country abbreviations are as follows: AU = Australia, CA = Canada, JP = Japan, KR = South Korea, US = United States.
[2] Consumer packaged goods.
[3] Polyethylene terephthalate.
[4] Metric tons: 1 metric ton = 2,205 pounds.
[5] Recyclability.
[6] Recycling rate.
[7] Recycled content.
Source: McKinsey analysis

What progress are top FMCGs making on plastic packaging?

2018 Baseline year
2021 2025 target

	TOTAL WEIGHT of plastic packaging in metric tonnes in 2021	DECREASE VIRGIN PLASTIC USE Weight of virgin plastic packaging in metric tonnes	INCREASE THE SHARE OF POST-CONSUMER RECYCLED (PCR) CONTENT % of PCR content weight in total plastic packaging	ENSURE 100% OF PLASTIC PACKAGING IS REUSABLE, RECYCLABLE, OR COMPOSTABLE (RRC) % of total plastic packaging weight that is reusable, recyclable, or compostable	MOVE FROM SINGLE-USE TOWARDS REUSE MODELS % of total plastic packaging weight that is reusable
Nestlé Food	920k	-33%; 2018 950k, 2021 878k; -8%	30%; 0.2% 4.6%; +4.4	100%; 49% 45%; -4	=0; 1% 1%
Procter & Gamble	Not a Global Commitment Signatory				
PepsiCo Beverages	2,500k	-5%; 2020 2,233k, 2021 2,343k; +5%	25%; 3% 6.3%; +3.3	100%; 77% 76.1%; -0.9	Not reported
AB InBev	Not a Global Commitment Signatory				
Unilever* Household and Personal Care	713k	-50%; 2018 701k, 2021 587k; -16%	25%; 0.7% 17.7%; +17	100%; 50% 53%; +3	0.1%
JBS	Not a Global Commitment Signatory				
Tyson Foods	Not a Global Commitment Signatory				
The Coca-Cola Company** Beverages	3,224k	-20%; 2019 2,692k, 2021 2,786k; +3%	25%; 9% 13.6%; +4.6	100%; 99% 99.9%; +0.9	4% 1.3%; -2.7
Mars, Incorporated Food	204k	-25%; 2019 183k, 2021 204k; +11%	30%; 0% 0%; =0	100%; 23% 20%; -3	0% 0%; =0
L'Oréal Cosmetics	144k	-33%; 2019 121k, 2021 114k; -5%	50%; 4.7% 21%; +16.3	100%; 30.3% 39.1%; +8.8	0.4% 1%; +0.6

Notes:
a) Signatories are ranked according to their revenues as of the beginning of the Global Commitment in 2018.
b) 2018 data reported in this table might differ from previous reports as companies might have updated previous years' data.
c) Year-on-year growth is calculated in percentage for virgin weight and using percentage points for all other metrics.
d) All quantitative data are provided for the latest year reported, in most cases for the relevant company's financial year ending 2021. Details of the reporting timeframe for each signatory are provided in their individual reports online.
e) To find more information about individual plastic reduction targets, baseline years, and baseline weight, please look at the online reports.
* Reporting scope is limited to primary and secondary plastic packaging in 27 markets representing 82% of turnover.
** Reporting scope is limited to PET primary plastic packaging.

Further reading

Our world in data - Plastic pollution, Ellen Macarthur foundation – Global Commitment

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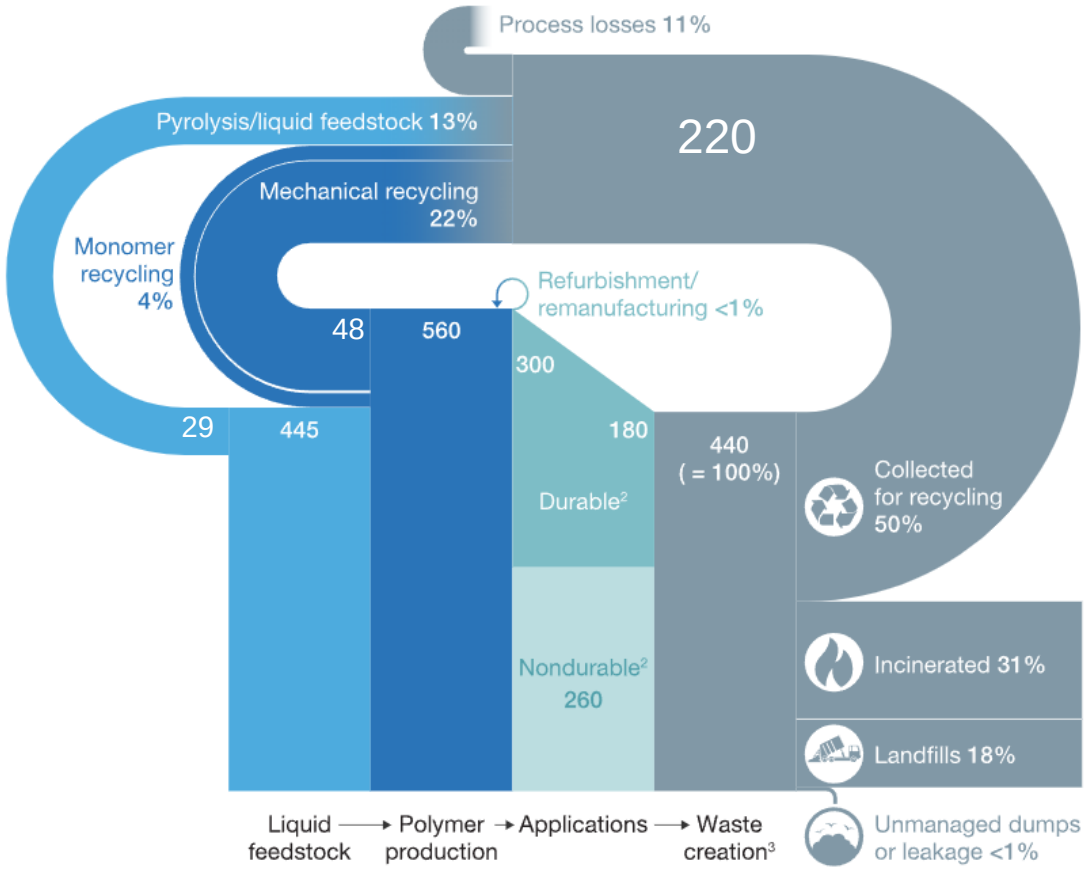
Advanced recycling promises to unlock recycling to its full potential

Global waste polymer flows 2030, millions of metric tons per annum[1]



[1]Scenario based on a multi-stakeholder push to boost recycling, regulatory measures to encourage recycling, consistent progress on technologies, and $75-per-barrel oil price.
[2]Durable applications with an average lifetime >1 year will end up as waste only in later years, while nondurable applications go straight to waste.
[3]260 million metric tons mixed plastic waste from nondurable applications that end up as waste in same year plus 180 million metric tons of mixed plastic waste from production in previous years.

Highlights

- This paper uses prospective material flow analysis (MFA) to investigate plastic recycling in Europe in 2030.
- Implementation of mechanical and chemical recycling would improve plastic recycling rate up to 80%.
- The MFA clearly distinguish the quantity of plastic-to-plastic recycling from plastic-to-chemicals and plastic-to-fuel.
- The highest achievable plastic-to-plastic recycling is 61%.
- Implementation of chemical recycling can help to reach recycled content target in 2030.

Further reading

McKinsey How plastics waste recycling could transform the chemical industry

How much can chemical recycling contribute to plastic waste recycling in Europe?

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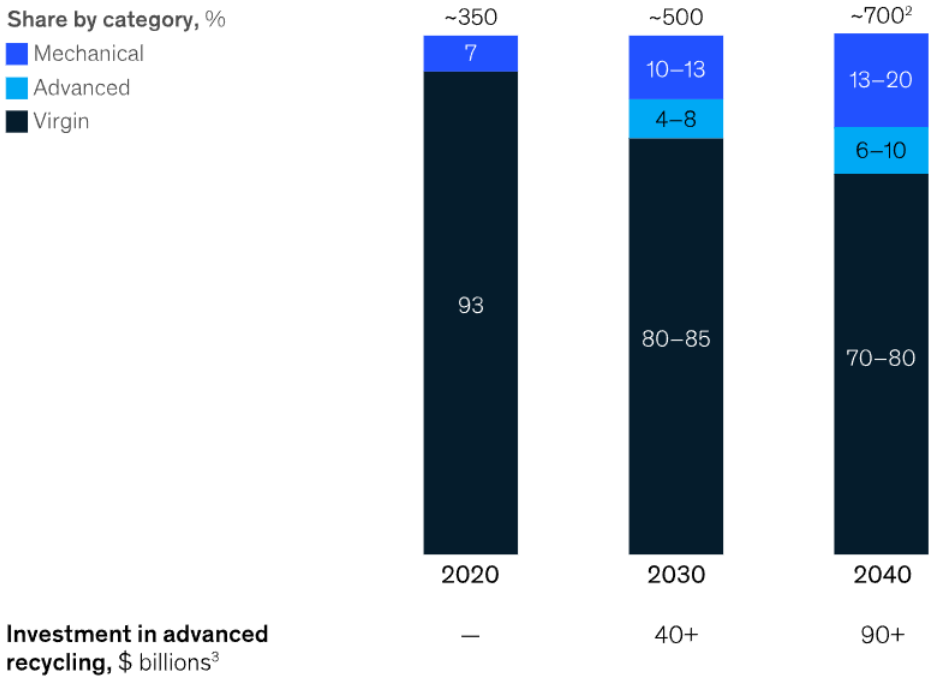
Advanced recycling estimated to become a $36bn market by 2030

Advanced recycling could grow to 20 to 40 million metric tons, or 4 to 8 percent of the total plastics supply by 2030, requiring more than $40 billion of total investment.

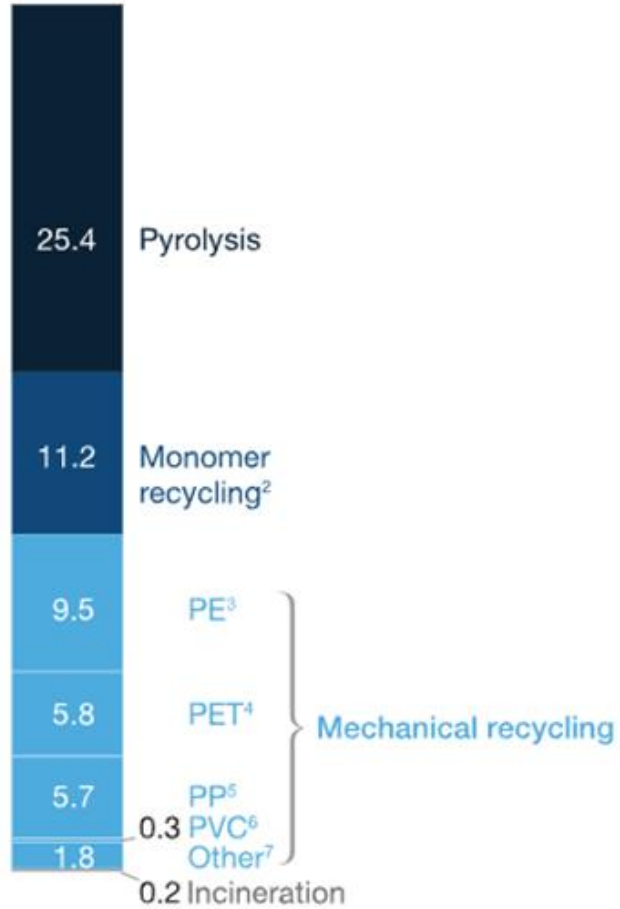
Global polymer demand 2020–2040,[1] million metric tons per year



[1] Polymer demand includes fibers (polyesters and polyamide), excludes rubbers and intermediates.
[2] Figures may not sum to 100%, because of rounding.
[3] Assumes capital intensity range of $1,500 to $3,000 per ton.
Source: CI Circular; McKinsey analysis

McKinsey & Company

Growth in profit pool, $ billion, 2016 to 2030[1]



Further reading

McKinsey advanced recycling opportunities

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On spec naphtha production and olefin yield maximization are possible with our process

H_2

7 OTHER

05 PP

2 PE

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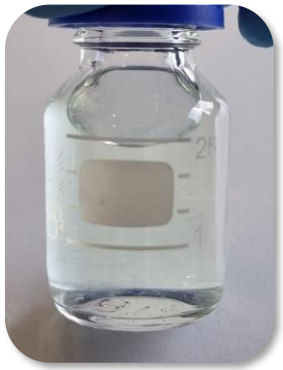

- Ethylene
- Propylene
- Butylene

Post consumer waste | **Patented process** | **Naphtha** | **Cracker** | **Monomers for plastic production**

Further reading

Cell Reports Physical Science, Nature communications

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We produce better quality products while requiring less energy

Hydrocracking

- Controlled specs via catalysis
- “Drop-in” possible in cracker
- Yield 80-90%
- Catalytic process, ~400°C
- Exothermic reaction
- Better energy efficiency, lower emissions
- TRL 5-6

Pyrolysis

- Large variation between processes
- Upgrading required (Hydrotreating)
- Yield 40-70%
- Thermal process, ~600°C
- Endothermic reaction
- Burns off-gas to fuel the process
- TRL 7-9

LCIA comparison between pyrolysis and hydrocracking

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The pilot unit operations will start in June 2023 (Lausanne, Switzerland)

2018 – 2020 | *2021 – 2024* | *2024 -2027* | *2027-2030*

Discovery
Batch
0.1 L vessel

Prototype
Semi-batch
0.6 L vessel

Pilot
Continuous
10 L vessel
4 kg/h

Demo
10 $kt_{naphtha}/y$

Commercial
50 $kt_{naphtha}/y$

Investment opportunity

EPFL WISSENSCHAFT. BEWEGEN GEBERT RÜF STIFTUNG

FIT fondation pour l'innovation technologique

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

VAUD

SWITZERLAND INNOVATION

DOW

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The project team has a strong scientific background and has the support of a board of directors with a track record in business

Martin Hedman
Finances
- +20 yrs as CFO, CEO of SMEs owned by listed companies

Dr. Antoine van Muyden
CTO
- PhD in biomass catalysis
- Process design
- Founder

Dr. Felix Bobbink
CEO, Chairman
- PhD in CO_2 catalysis
- Founder

Management

Brigitte Baumann
Board member (Indep.)
- +20 yrs as board member
- Angel investor
- Advisor to startups

Christophe Marche
Board member (DOW)
- Global business dev at Dow

Board

Dr. Wei-Tse Lee
Engineer
- PhD in plastic hydrocracking
- Design of catalyst for polymer hydrocracking
- Founder

Dr. Christopher Hunston
Engineer
- PhD in waste sludge catalysis
- Catalyst deactivation expert
- Operation of continuous rigs

Dr. Maneka Roger
Engineer (June 23)
- PhD in exhaust gas catalysis
- Extension of catalyst lifetime
- Spectroscopy expert

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IMD

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eit Climate-KIC
Climate-KIC is supported by the EIT, a body of the European Union

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