THE STATE OF PLASTIC RECYCLING

Driving Plastic-to-Plastic Circularity

A DEEP DIVE INTO CHEMICAL RECYCLING

Climate Angels
India's Largest Early Stage Climate Focused Angel Fund

ABOUT GOMASSIVE

GoMassive is working towards building a global Climate Innovation Network uniting founders, investors, corporates, government bodies, and policymakers through symbiotic partnerships. It empowers founders to build and scale their ventures with a comprehensive suite of solutions, from fundraising to post-investment management.

what we do?

INVESTMENTS

Climate Angels — SEBI Catogery-1 angel AIF

PORTFOLIO

beco, PRAAN, INDRA EVERYTHING WATER., MATTER, solar square

ACCELERATOR

go massive earth network — Awarding pilots and grants for early-stage Climate Tech startups

PARTNERS

UN environment programme, THE INCUBATION NETWORK, IFC, aws, AMPLUS SOLAR

CSR & GRANT

massive earth foundation — On-ground execution of complex projects in hard to abate sectors

DONORS

ALLIANCE TO END PLASTIC WASTE, giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, TARA

RESEARCH

massive earth foundation — Research in Electric Mobility, Circular Economy and Air Pollution

PARTNERS

agnii, WRI INDIA

EVENTS

massive earth foundation — Massive Earth Summit, Waste NXT, Mobility NXT and NXT by Climate Angels

SPONSORS

Paytm, OSTARA ADVISORS, RUPAREL REALTY, INVEST INDIA, AXIS BANK

ABOUT CLIMATE ANGELS

Climate Angels is a SEBI regulated Cat-1 Angel fund focused on creating a sustainable future by exclusively investing in companies working on Pollution Reduction and Climate Change. We invest in startups working on Agriculture, Clean Mobility, Water, Waste, and Built Environment (Clean & sustainable cities). We have invested in a total of 20 companies till date.

Since its launch in 2021, Climate Angels has invested in 20 climate-tech startups, supporting visionary founders who are building innovative, scalable solutions to combat climate change. Through early-stage capital and strategic guidance, Climate Angels is accelerating the development of breakthrough technologies aimed at addressing the world's most urgent environmental challenges

PORTFOLIO COMPANIES

EMOTORAD
Zero Cow Factory
BECO
Revfin
Smartest, Fastest Electric Vehicle Loans
Kisan Konnect
PRAAN®
MATTER
CLEAN ELECTRIC
Digital Paani
ElectricPe
SHERU
EULER
solar square
exponent
RAS
LUXURY SKINCARE
INDRA
ACE Green Recycling

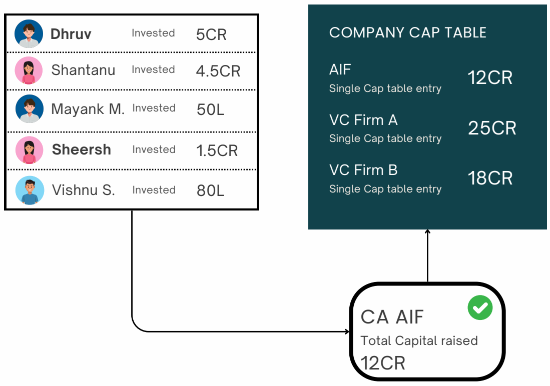
GOMASSIVE SUITE OF SERVICES

GoMassive is working towards building a global Climate Innovation Network uniting founders, investors, corporates, government bodies, and policymakers through symbiotic partnerships.
It empowers founders to build and scale their ventures with a comprehensive suite of solutions, from fundraising to post-investment management.

1. Fundraising Solutions

RUV (Roll up Vehicle)

- As a founder, you can easily create a funding round on the platform and share it with committed investors like friends, family, and angels.
- The deal page is also visible to fund managers and syndicates on the platform for review.
- Through RUV, the entire raise is consolidated into a single cap table entry.



Climate Angels & Syndicate

- Raise through Climate Angel Investors.
- Leverage your proprietary investor network to raise capital, or choose to access the GoMassive capital network, enabling investments through deal-specific special purpose vehicles (SPVs).

GOMASSIVE IB

- Access to a global network of VCs, Corporates and Impact Investors
- Offers end-to-end support across Fundraising (Seed to Growth Stages), Corporate Finance & Structuring, Valuation, Market Strategy, and Investor Relations & Pitch Advisory.

GOMASSIVE SUITE OF SERVICES

2. POST INVESTMENT TOOLS

Captable Management tool

Real-time cap table updates with scenario analysis for future rounds and transparent equity distribution insights.

Employee Stock Option Management

Manage employee stock options with ease and accuracy

MIS Updates to Investors

Share regular updates on company performance with investors

3. ADDITIONAL SERVICES

GoMassive Community

Becoming a part of the GoMassive community, invites to climate events and community programs

Mentor Connect

Guidance and support through 1:1 mentorship sessions while you build your business

Co-Working Spaces

GoMassive partners with leading coworking spaces like WeWork, Springhouse, and 91Springboard to offer the best coworking solutions across India.

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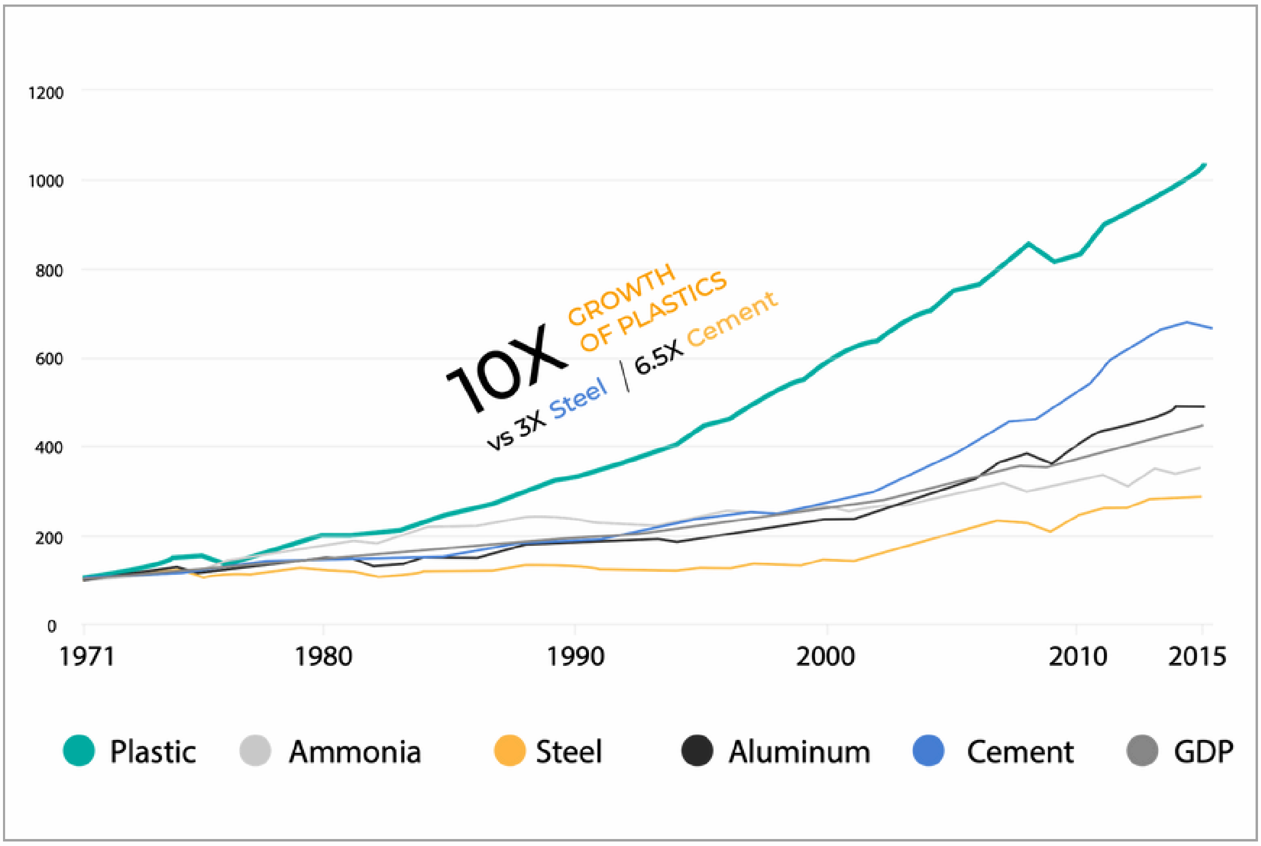
CHAPTERS

DISCLAIMER

CHALLENGES OF WASTE PLASTICS

The demand for plastics in the last 50 years has outpaced all other bulk materials such as steel, cement or aluminum



Global Plastic Production

The global plastic production continues to grow steeply and is expected to double in twenty years and triple by 2060. This surge is driven by the growing use of plastics in packaging, textiles, construction, and mobility — especially in lower- and middle-income economies where per capita consumption is rapidly rising. [1]

Growth Drivers

The increase in plastic consumption is driven by growth in emerging markets, increasing urbanization, and population expansion. With rising incomes and industrial development, demand is shifting from durable goods to short-life, high-volume plastic applications, intensifying pressure on waste and recycling systems.

Petrochemical Role in Oil Demand

Petrochemicals will account for more than one-third of oil demand growth to 2030, outpacing aviation and shipping. As energy transitions reduce fuel-related demand, plastics and chemicals emerge as the largest long-term growth vector for fossil feedstock — reinforcing the need for circular feedstock solutions. [2]

1) *OECD's Global Plastics Outlook to 2060*
2) *Source: IEA (Reaffirmed in public briefings, 2023)*

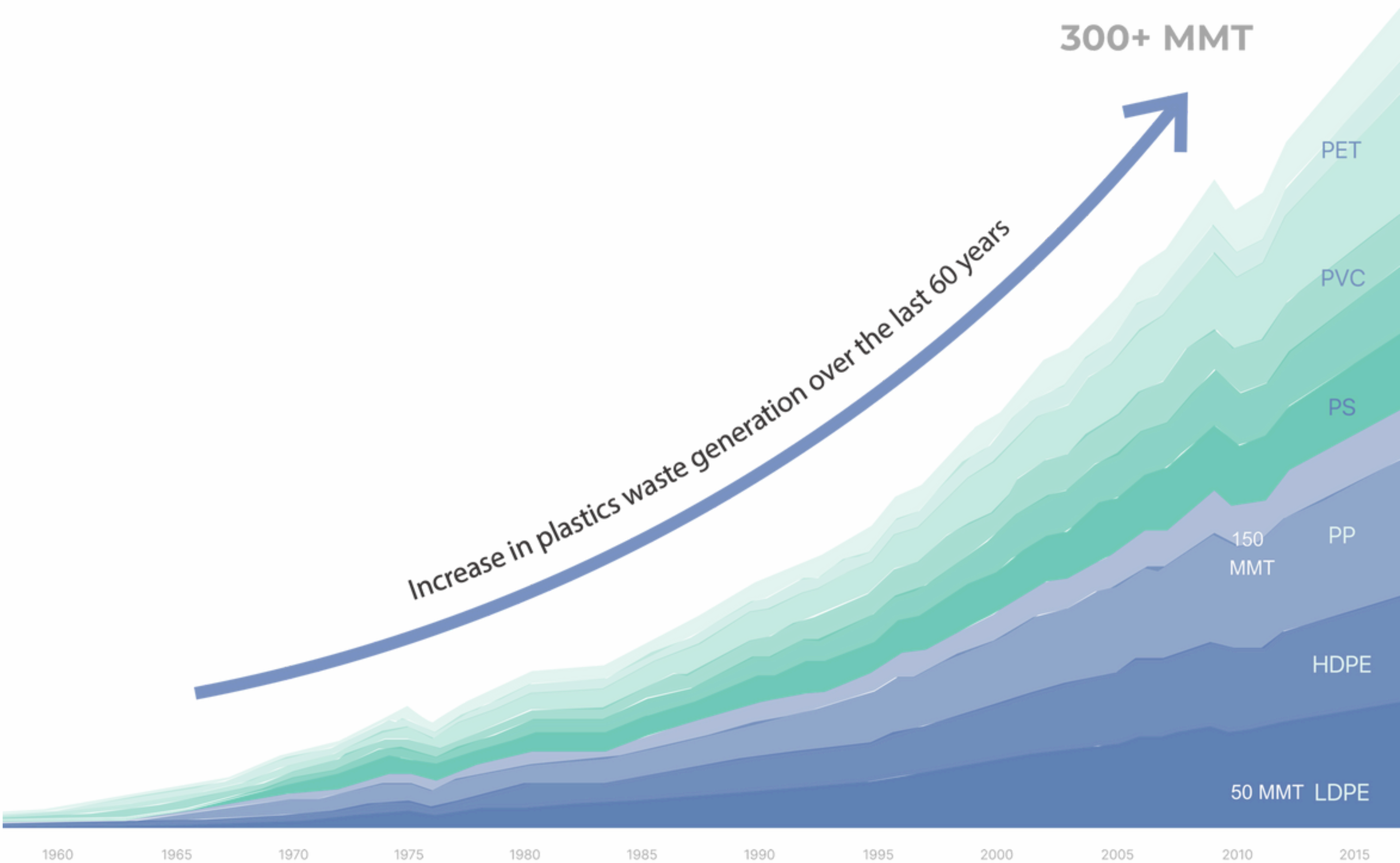
Even as demand for plastics continues to soar, their rate of recycling at end-of-life remains an abysmally low < 12%

Plastic in landfills

An alarming 5.0 billion tons of waste plastics lie accumulated in landfills across the world today.

Limitations of mechanical recycling

Mechanical recycling, the dominant methodology for plastic recycling, works best with clean, single resin streams such as rigid PET and HDPE. It is unable to cope well with plastics from municipal waste streams, as they contain a mix of different polymer types and are contaminated with food residues, labels, glues, mud and dirt.[1]



1) Geyer et all Science Advances, 2017

Given low recycling rates for the material, plastic waste is everywhere today including in the food we eat and the air we breathe.

Plastics in Air, Food
Individual human exposure to microplastics by inhalation has been estimated at 26 to 130 particles a day
Microplastics have been detected in commercial salt, honey, beer, sea food and mineral water

Plastics in Human Gut, Placenta of Babies

Microplastics have been detected in the human intestine and placentas of unborn babies

Microplastics have been detected in the human intestine and placentas of unborn babies

Microplastic pollution has been discovered in snow regions close to Mount Everest, the world's highest mountain

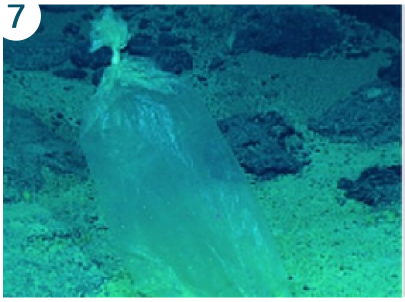
Plastics in Oceans

About 10 to 20 million tonnes of waste plastic ends up in the oceans each year
At current rates, it is expected that by 2050 plastic waste in the ocean shall outweigh fish

Plastics in Antarctica Ice

Micro-plastics have been detected in ice cores drilled in Antarctica

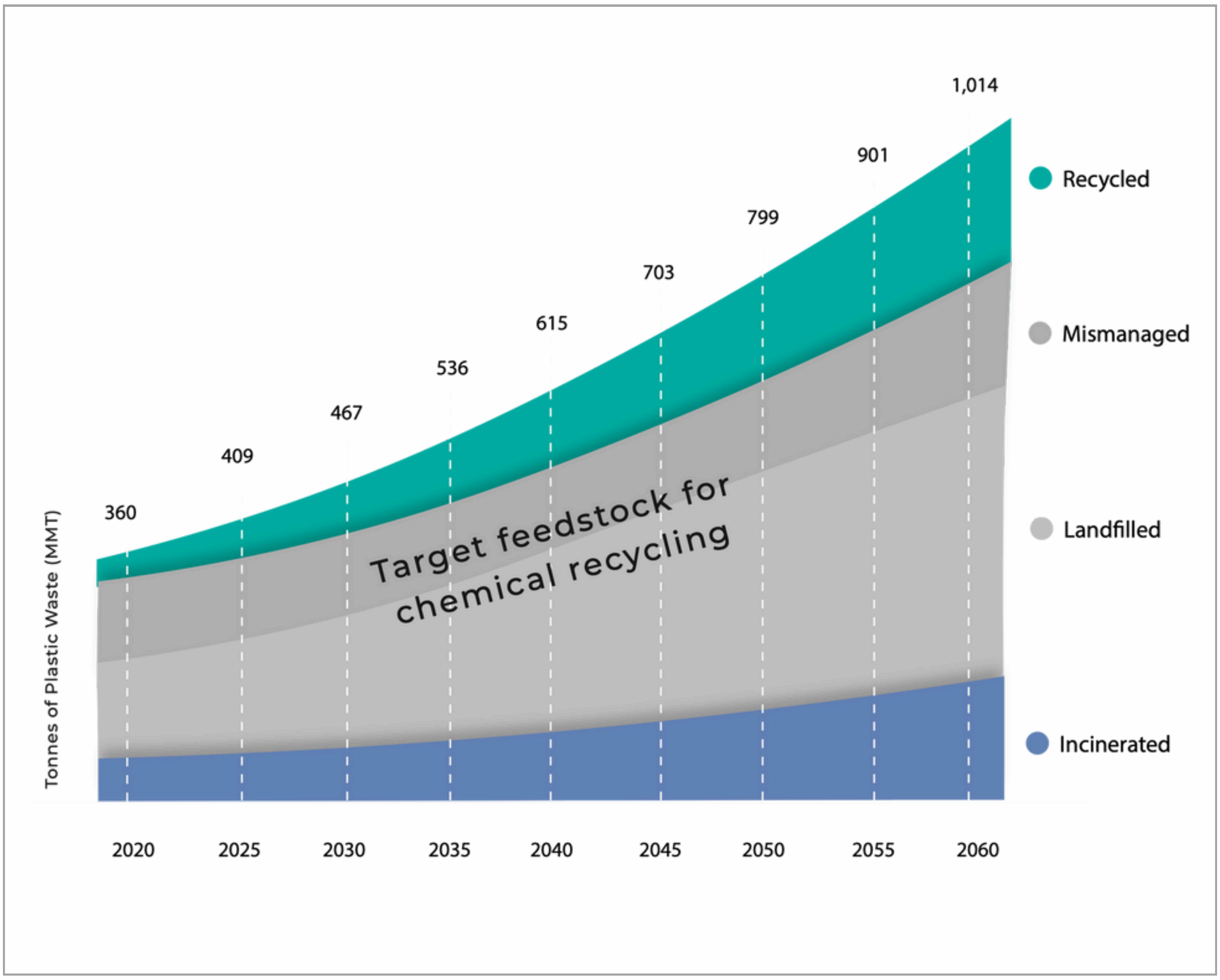
Plastics in the Artic Seafloor
plastic litter on Arctic seafloor continues to increase



Plastics in Mariana Trench
Plastic trash has been found at the deepest point on Earth - the Mariana Trench

The scale of the problem is such that even with a 5X increase in amount of plastics being recycled by 2060, their quantities in landfills would see a 3X increase over current levels [1)]

> By 2060, it is estimated that the amount of plastic waste generated would go up by 3X, the amount of plastics recycled shall go up by 5X and plastics in landfill would also increase by 3X. [2)]

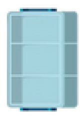
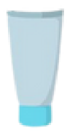


1) and 2) OECD'S Global Plastics Outlook to 2060

OVERVIEW OF PLASTIC RECYCLING PROCESSES

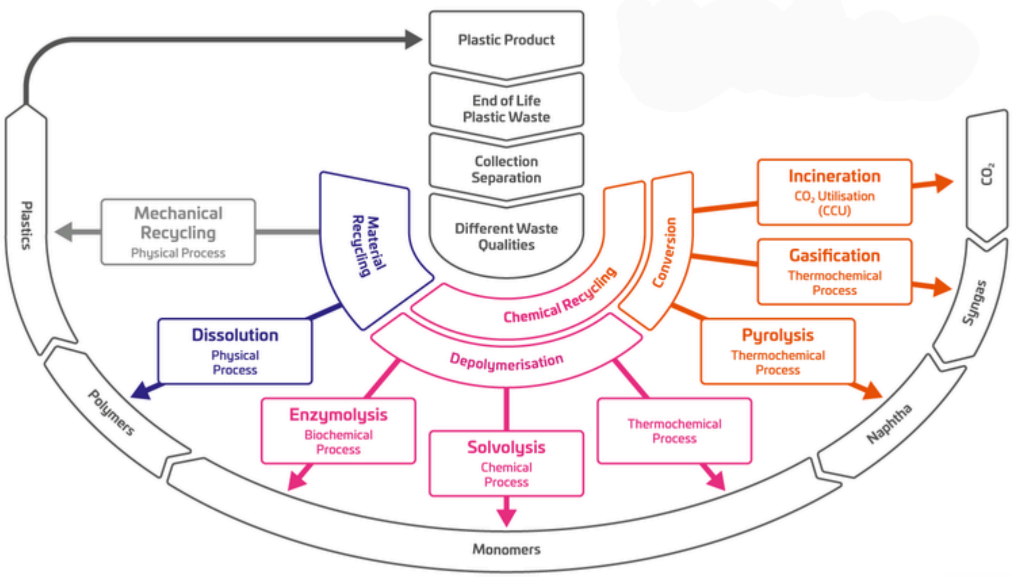
TYPES OF PLASTIC

There are 7 key plastic substrates widely used:

RESIN	CODE	PROPERTY	EXAMPLE	PREFERRED RECYCLING
Polyethylene terephthalate	1 PET	high strength, heat & cold resistant, rigid, lightweight		Mechanical Recycling
High-density polyethylene	2 HDPE	transparent, translucent, tough & solid, long stability		Mechanical Recycling
Polyvinyl chloride	3 PVC	transparent, translucent, tough & solid, long stability		
Low-density polyethylene	LDPE	flexible, light weight, chemical resistant		Chemical Recycling
Polypropylene	5 PP	chemical resistant, tough but flexible		Chemical + Mechanical Recycling
Polystyrene	6 PS	glass-like surface, hard, might get affected by solvents		Chemical Recycling
Other	7 OTHER	hard to recycle & usually has harmful properties		

OVERVIEW OF PLASTIC RECYCLING PROCESS

Plastic recycling sits at the center of global efforts to reduce plastic pollution, decarbonize material use, and build a circular economy. As of 2024, the global plastic recycling market is valued at **USD 45 billion**, with projections ranging from **USD 70–80 billion** by 2030, driven by regulatory mandates and demand for recycled content in packaging, textiles, and automotive applications.[1)]



🌐 **Recycling Routes: Mechanical | Chemical**

Plastic waste flows through two primary recycling routes:

Mechanical recycling (left of the loop)

Mechanical recycling is the most widely adopted method today and typically involves physical processing steps such as sorting, shredding, washing, drying, and re-melting. The process works at an 'article level' and is commonly used for relatively clean, mono-polymer waste streams like PET bottles and HDPE containers.

Chemical recycling (right of the loop)

Chemical recycling — also referred to as advanced recycling — includes pyrolysis, gasification, solvolysis and depolymerization technologies. These processes break plastic waste into monomers or hydrocarbon intermediates, allowing for the production of virgin-equivalent resins and high-purity chemical feedstocks.

1) Roland Berger Report

MECHANICAL RECYCLING

Today, plastics are recycled primarily using mechanical recycling — a mature, physical processing method where plastic waste is sorted, washed, shredded, dried, and re-melted to produce recycled plastic pellets. These pellets are then extruded or molded into new products.

STRENGTHS

✅ Proven and Widely Deployed

Mechanical recycling is a mature, commercially established process with broad global infrastructure. It is especially effective for clean, single-polymer waste streams such as PET bottles or HDPE containers and remains the backbone of global plastic recycling infrastructure.

✅ Lower Energy Use and Emissions

Compared to virgin plastic production or chemical recycling, mechanical recycling has a lower energy footprint and generates fewer greenhouse gas emissions — making it environmentally preferable when the feedstock is suitable.

✅ Simpler Operations and Maintenance

The technology is relatively simple, well understood, and does not require advanced chemical handling or reactor systems, making it more accessible for small recyclers and regional processing hubs.

CHALLENGES

❌ Less Suitable for Mixed Waste

The majority of municipal plastic waste is heterogeneous, containing a mix of polymer types (e.g. LDPE, PP, PVC), additives, inks, food residues, and laminates. Mechanical recycling systems are not configured to process these complex, contaminated streams effectively.

❌ Low-Quality, Low-Value Output Limitations

Recyclates produced through mechanical recycling are often of lower quality and cannot meet food-grade or pharma-grade standards, restricting their reuse in high-value packaging applications.

❌ Quality Degradation Over Time

Each reprocessing cycle reduces polymer quality due to thermal and mechanical degradation. This limits the number of times a material can be recycled before it becomes unusable.

CHEMICAL RECYCLING

Chemical recycling is an advanced process that transforms plastic waste back into its fundamental chemical components, enabling the creation of new **virgin quality plastics, low-carbon fuels and renewable chemicals.**

Chemical recycling employs processes like **pyrolysis or depolymerization** to break plastics down into their original monomers or hydrocarbon building blocks. These intermediates are then purified and repolymerized to produce new plastics that are **chemically identical to virgin fossil-based resins**, with no loss in material performance, even after repeated recycling cycles.

This molecular-level reset makes chemical recycling uniquely suited for high-purity applications such as **food-grade packaging**, where even trace level contaminants may be unacceptable.

By addressing waste streams that are mixed and contaminated chemical recycling unlocks circularity for plastics that mechanical recycling cannot process. It is thus emerging as a critical enabler for scaling **plastic-to-plastic circularity** in alignment with EPR mandates, recycled content regulations, and corporate sustainability targets.

CHEMICAL RECYCLING

Comparison of Key Chemical Recycling Technologies

Parameter	Pyrolysis	Solvolysis	Dissolution
Definition	Thermal or thermo-chemical decomposition of plastic waste in the absence of oxygen to produce pyrolysis oils, off-gas, and solid residues (carbon char).	Chemical process using solvents (e.g., methanol, glycol, water) to break polymers into monomers or oligomers.	A physical process using solvents to dissolve plastic, separating it from additives and impurities.
Main Output	Pyrolysis oils as chemical feedstocks, process offgas, and carbon char.	Monomers or oligomers, which can be re-polymerized into new plastics.	Purified polymer ready for reuse, separated from dyes, fillers, and additives.
Operating Temperature	400–600°C	150–300°C	50–200°C
End Products	Virgin-quality plastics, renewable chemicals, sustainable fuels.	High-purity recycled polymer (with quality similar to virgin plastic).	High-purity recycled polymer (with quality similar to virgin plastic).
Suitable Plastics	Polyolefins - mixed and dirty PE and PP and PS	PET (glycolysis), PU (hydrolysis), PLA (methanolysis), etc.	Mostly high-value, single-polymer plastics like PET and PS.
Circularity	Highly circular - key pathway to drive true plastic-to-plastic circularity	Highly circular - breaks plastic into monomers that can be reused.	Highly circular - breaks plastic into monomers that can be reused.
Carbon Emissions	40% plus GHG emission saving, compared to plastics made from fossil fuels and incinerated at end-of-life.	Lower GHG emissions than pyrolysis	Lower GHG emissions than pyrolysis
Commercial Viability	50% + EBITDA margins, driven by high prices of pyrolysis oils as circular feedstocks.	Growing adoption, especially for PET and PU recycling.	Emerging technology, most suitable for pure plastic waste streams.
Challenges	Fewer technologies demonstrated at commercial scale, most at TRL 4-7, complex oil purification.	Requires pure polymer streams for efficiency.	Limited to certain plastics and dependent on solvent efficiency.

CHEMICAL RECYCLING

Chemical recycling technologies, such as pyrolysis are designed to handle hard-to-recycle, municipal plastic waste streams.

Chemical Recycling via Pyrolysis

- Converts low-grade, hard-to-recycle waste plastics into chemical feedstocks for **new food-grade plastics**, renewable fuels, and sustainable chemicals.
- Enables true circularity by breaking down polymers to the molecular level and allowing repeated recycling **without loss of quality.**
- Enable compliance with **recycled content mandates** enshrined in EPRs in different regions of the world.
  - **EU**: 10–35% by 2030; 50–65% by 2040
  - **India**: 10-30% starting 2025-26; 20-60% starting 2028-29

Market and Investment Trends

Global chemical recycling capacity is expected to grow rapidly:

- From < 1- 2 MT today to **70 MT by 2050 (35% CAGR)**
- Demand driven by brand commitments, regulations, and the need for food-contact grade recyclates

💰 Over **USD 130 billion** in CAPEX will be required globally by 2050 to build the necessary infrastructure — making this one of the largest industrial transitions in plastics manufacturing.[1]

1) Roland Berger Report

CHEMICAL RECYCLING

AT INFLECTION POINT ?

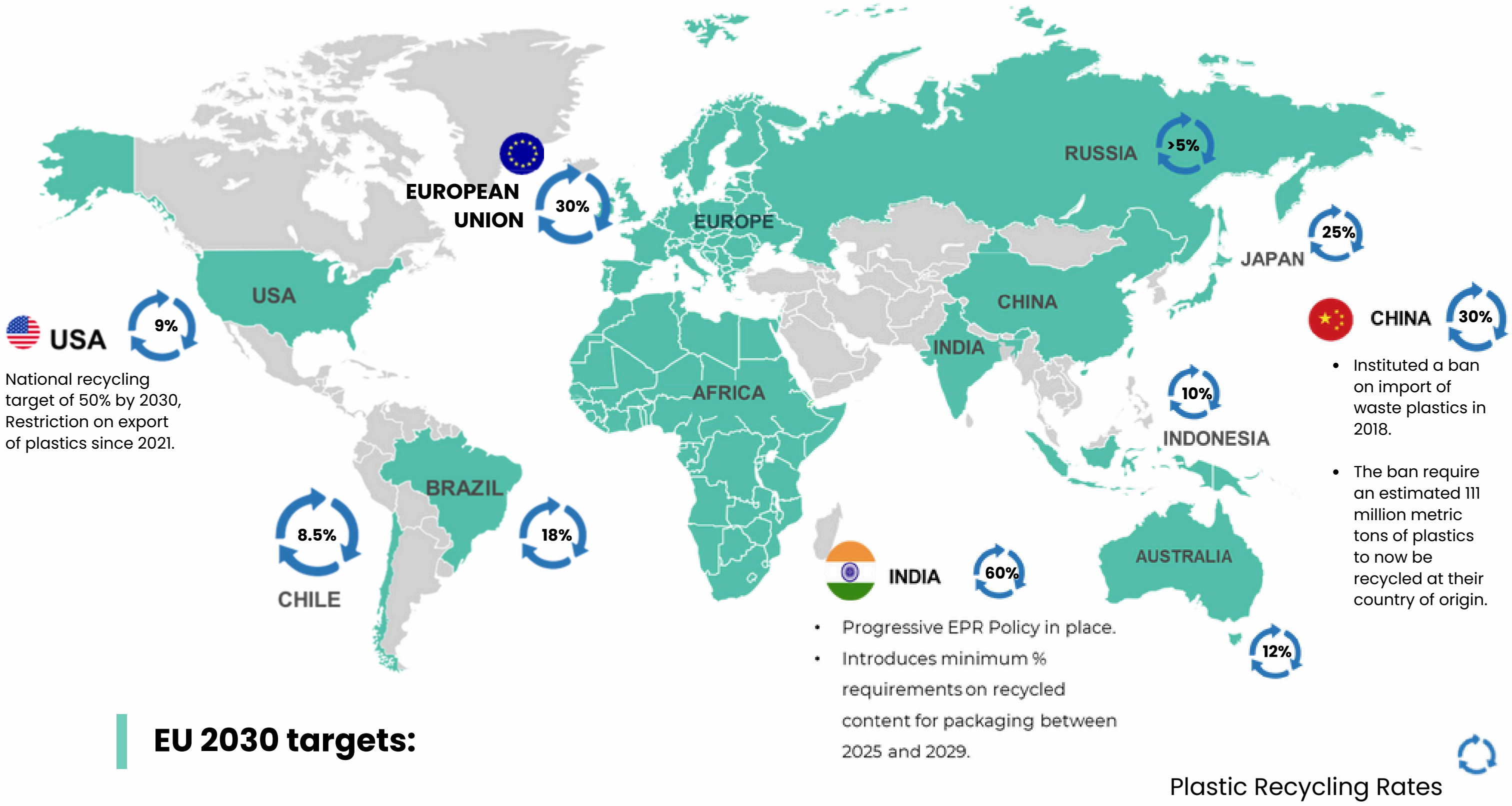
WHY IS CHEMICAL RECYCLING GAINING MOMENTUM?

Factor	Mechanical Recycling	Chemical Recycling
Reduction of Plastic Pollution	Works well for clean, sorted **mono-materials** (e.g. PET, HDPE); struggles with mixed or contaminated plastics	Can handle **70–90% of plastic waste,** including mixed and contaminated plastics, reducing landfill and ocean pollution.
Recycling Efficiency	Polymer **degrades with each cycle**; typically recyclable only 2–3 times before quality loss.	Breaks polymers into monomers/base chemicals, enabling **infinite recycling** with **virgin-like quality**.
Energy Consumption	**Low energy use** (~0.8–1.5 MWh/ton), but depends heavily on precise sorting to stay viable.	**Higher energy intensity**, but allows recovery of high-value, high-purity materials.
Output Quality	Produces recyclates that are **inferior to virgin plastics** and and unsuitable for food, pharma, or high-performance use.	Enables pathway for generation of **virgin-quality polymers** suitable for **food-grade** and high-performance plastics.
Circularity Potential	Supports limited re-use; recyclates are downcycled into lower-value products.	Enables **closed-loop, plastic-to-plastic circular economy**, irrespective of number of cycles.

Plastic Waste Recycling: A Chemical Recycling Perspective" – ACS Sustainable Chemistry & Engineering
Life Cycle Environmental Impacts of Chemical Recycling via Pyrolysis" – Science of The Total Environment
Carbon Footprint of Mechanical Recycling of Post-Industrial Plastic Waste" – MDPI

A mix of regulatory drivers, minimum recycling mandates, levies and carbon taxes all over the world are driving greater circularity for plastics and decarbonization

Over the past decade, **731 regulations** that curb plastic pollution have been introduced worldwide



EU 2030 targets:

- Up to 30% recycled content mandate on plastic packaging by 2030 [1]
- Recycling of municipal waste **60%**
- Recycling of packaging waste **70%**
- Recycling all plastics **55%**
- MSW permitted for landfill (max): **10%**

Tax/levy on non-recycled plastic packaging

- **EU-Wide: €800/ton** on non-recycled plastic packaging waste
- **Spain**: **€450/ton** on non-recycled plastic in non-reusable packaging
- **Italy**: **€450/ton** on virgin plastic in single-use packaging (effective July 2026)
- **UK: £200/ton** on plastic packaging with <30% recycled content

Key drivers of investments in chemical recycling :

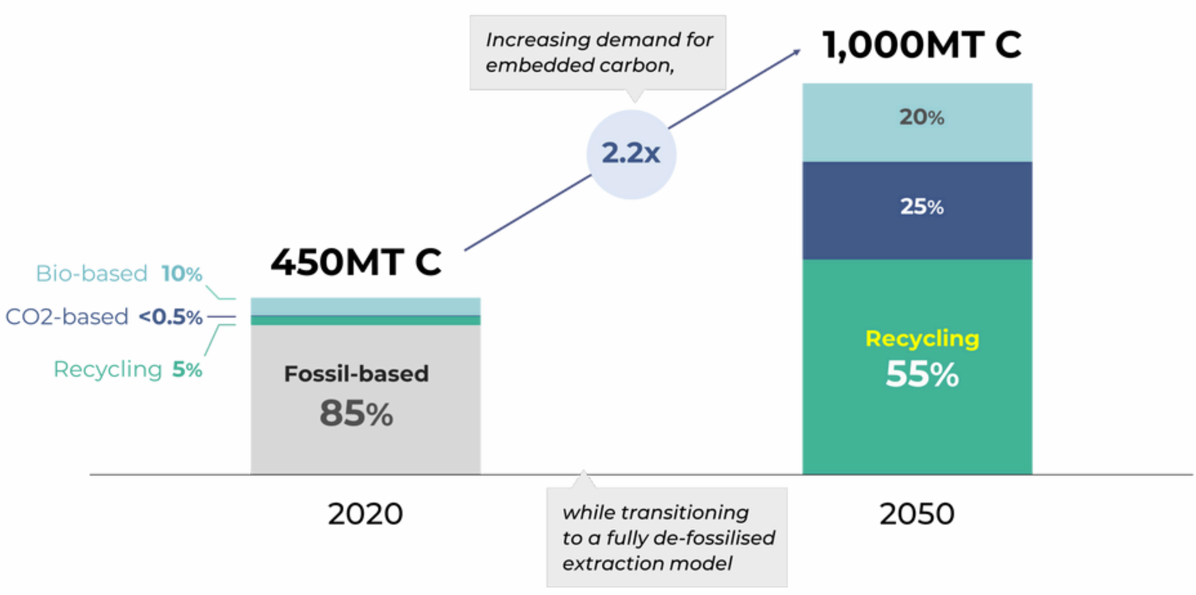
- **$130B+ global CAPEX** projected by 2050 for chemical recycling infrastructure . [2]
- EPR mandates: Strong mandates for **recycled content**, across geographies like EU, India.
- Global EPR mandates and plastic taxes accelerating compliance.
- **Strategic entry by majors**: Dow, BASF, Lyondell Bassell, SABIC, KBR, Sulzer Chemtech, Technip, NextChem etc. are all investing in circular polymer value chains.

1) EU legislation on Packaging and Packaging Waste Regulation (PPWR)
2) Roland Berger Report

Chemical Recycling of plastics is also emerging as a crucial lever in the hydrocarbon industry's transition from fossil-based to renewable feedstocks

Global Carbon Demand for Chemicals and Derived Materials

in million tonnes of embedded Carbon



nova-institute.eu/

2.2× increase in embedded carbon demand by 2050, driven by petrochemicals, plastics, and advanced materials

🏭 Strategic Role of Chemical Recycling

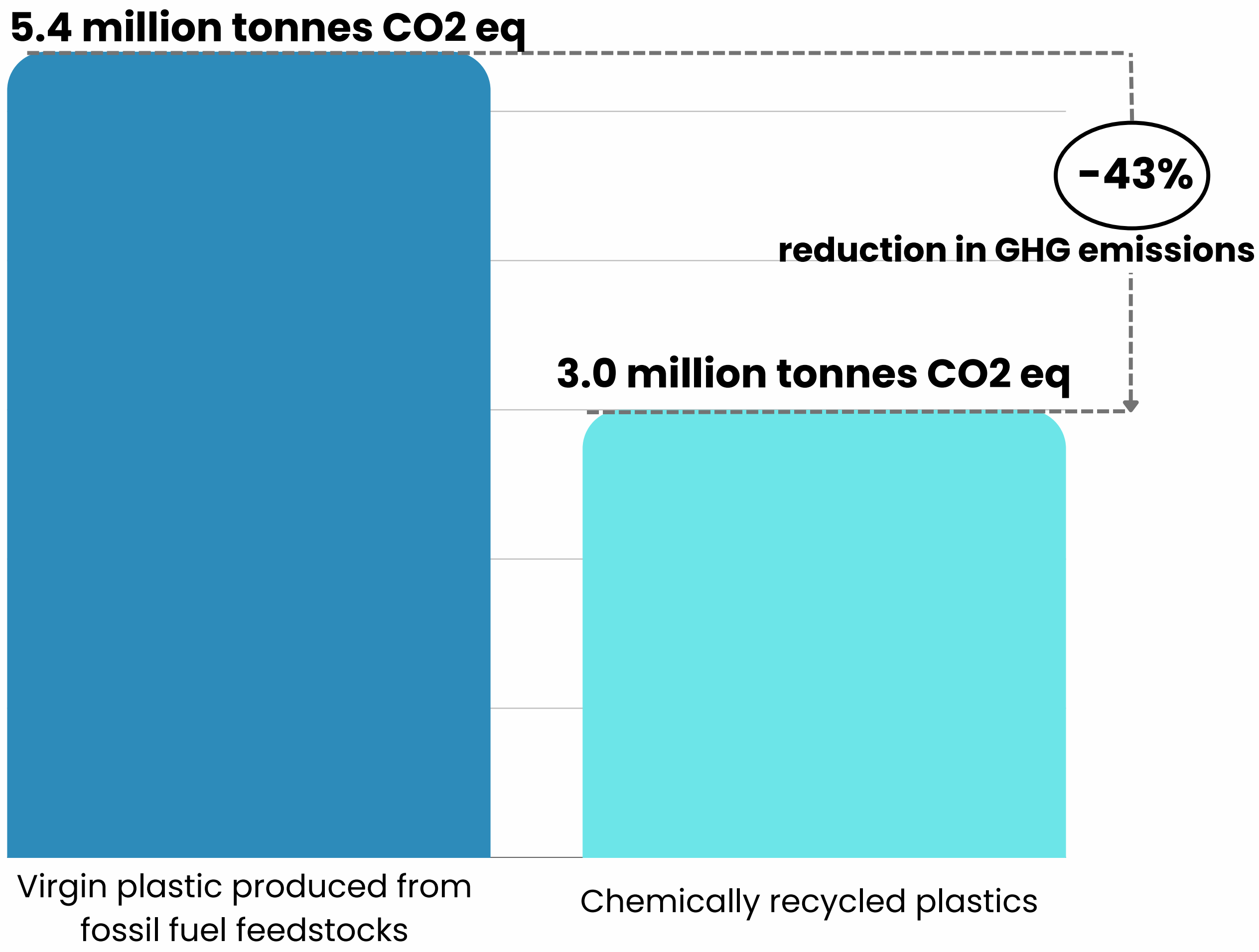
- Targets the 60–70% of low-grade plastic waste, which are mismanaged, going to landfills or being incinerated.
- Converts low-grade plastics to hydrocarbon oils, that feed into pre-existing petrochemical infrastructure, reducing the need for virgin naphtha and fossil derived feedstocks.
- Enables generation of virgin-quality recycled content for high-performance applications, including food-grade and pharma-grade materials

Plastic Waste Recycling: A Chemical Recycling Perspective" – ACS Sustainable Chemistry & Engineering
Life Cycle Environmental Impacts of Chemical Recycling via Pyrolysis" – Science of The Total Environment
Carbon Footprint of Mechanical Recycling of Post-Industrial Plastic Waste" – MDPI

CHEMICAL RECYCLING

Life Cycle Environmental Impact of Pyrolysis

Plastics produced using chemical recycling provide **43% decrease** in CO_2e emissions compared to the plastics produced from fossil feedstock (5.4 tons vs 3.0 tons of CO_2e) that are incinerated for energy recovery.



Source: The Consumer Goods Forum's Coalition of Action on Plastic Waste[1)]

Reduction of fossil resource usage
By 75-90%, by continuously re-using the carbon embedded in plastics. [2)]

Global Warming Potential (GWP) Ranking
Incineration >> Chemical Recycling > Mechanical Recycling. [3)]

1) TCGF LCA Study, 2022
2) BASF Sphera LCA, 2020
3) BASF–Sphera Global Review, 2023
(meta-analysis of 15 studies across 20 years)

CHEMICAL RECYCLING

A BLUE OCEAN INVESTMENT OPPORTUNITY

Massive Market Opportunity

- **Global plastic crisis:** More than 400 million tonnes of plastic are produced annually, yet less than 12% is recycled. The majority is discarded into landfills, burned, or leaks into marine and bio-ecosystems.
- **Rising demand from global majors:** Leading FMCG and petrochemical companies (e.g., PepsiCo, Unilever, Nestlé, Coca-Cola) have committed to ambitious sustainability targets— like decreasing use of virgin plastics and using 10–50% recycled content — driving a surging demand for food-grade plastics, which mechanical recycling methods struggle to deliver.

Strong Regulatory Tailwinds

- **Powerful Policy Push:** The EU Green Deal, PPWR Framework, Single Use Plastic Directive, EPR frameworks of several regions including Europe and India are all accelerating the shift toward circular plastics.
- **Demand for Recycled Content:** Several regions now require minimum recycled content in packaging, creating high-value demand for chemically recycled materials that meet stringent quality standards.

Drives Plastic-to-Plastic Circular Economy

- **No Downcycling:** Unlike mechanical recycling, which downcycles material, chemical recycling offers a pathway for infinite closed-loop recycling of waste plastics, without loss of performance.
- **Planetary Benefits:** By turning waste back into virgin-equivalent feedstocks, chemical recycling helps create a closed-loop economy, reducing dependence on fossil-based inputs.

Technology Advancing Rapidly

- **Technology Innovation**: Over the last decade, technologies like pyrolysis, hydrothermal liquefaction and depolymerization have significantly matured and moved closer to commercial readiness.
- **Growing Ecosystem**: A wave of innovators—such as Mura, Braven Environmental, Pryme, Purecycle, PolyCycl, Plastic Energy — are scaling up, attracting investment, and gaining industry validation.

Solves for Limitations of Mechanical Recycling

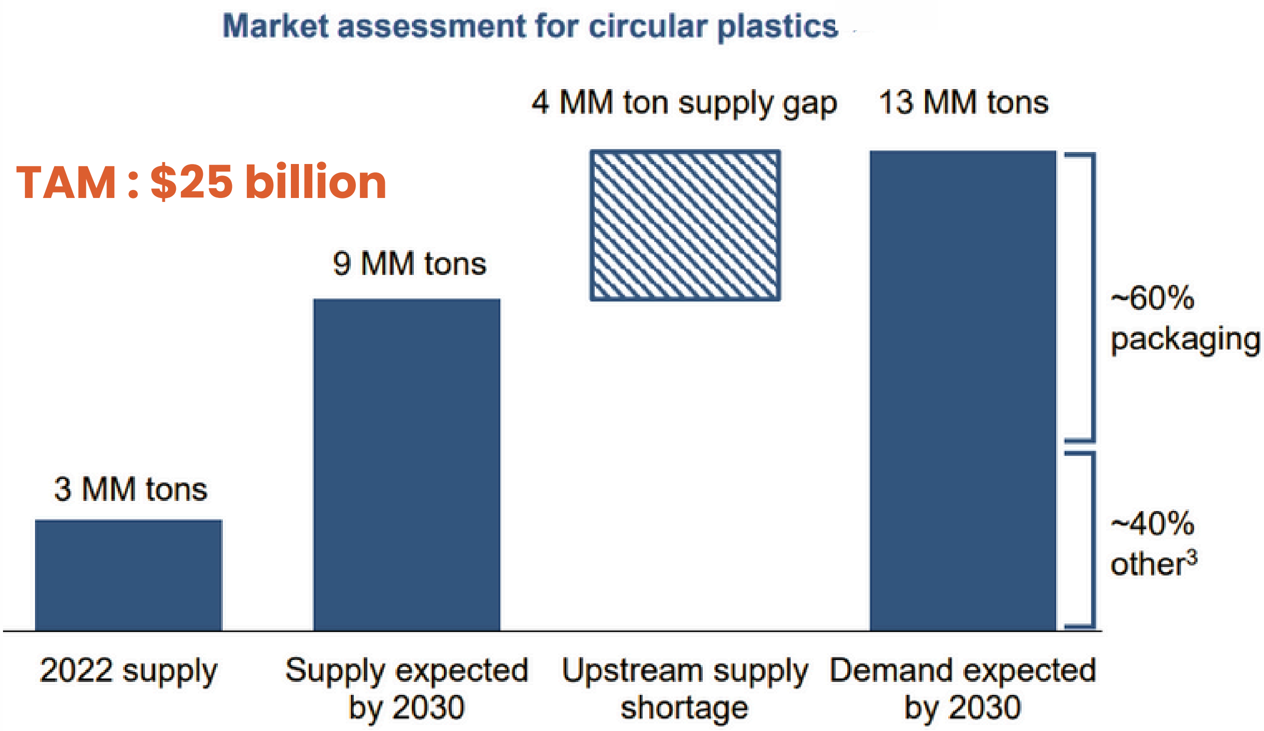
- **Overcomes Feedstock Challenges**: Chemical recycling can process mixed, contaminated municipal plastics that mechanical methods cannot handle — including single-use plastics and flexible packaging films.
- **Delivers High-Quality Outputs :** By breaking plastics down to their molecular building blocks, it enables production of virgin-quality resins, suitable for food-grade and premium applications.

CHEMICAL RECYCLING

MARKET SIGNALS – 3 CASE STUDIES

CASE STUDY – I
LYONDELLBASELL

LyondellBasell is Europe's largest producer of Polyethylene and polypropylene.
In 2023, it marketed 123 kilotons of recycled and renewable-based polymers, reinforcing its global push toward circular and low-carbon materials.



LyondellBasell Sustainability Report for Investors, Nov 2024

Structural Supply-Demand Gap

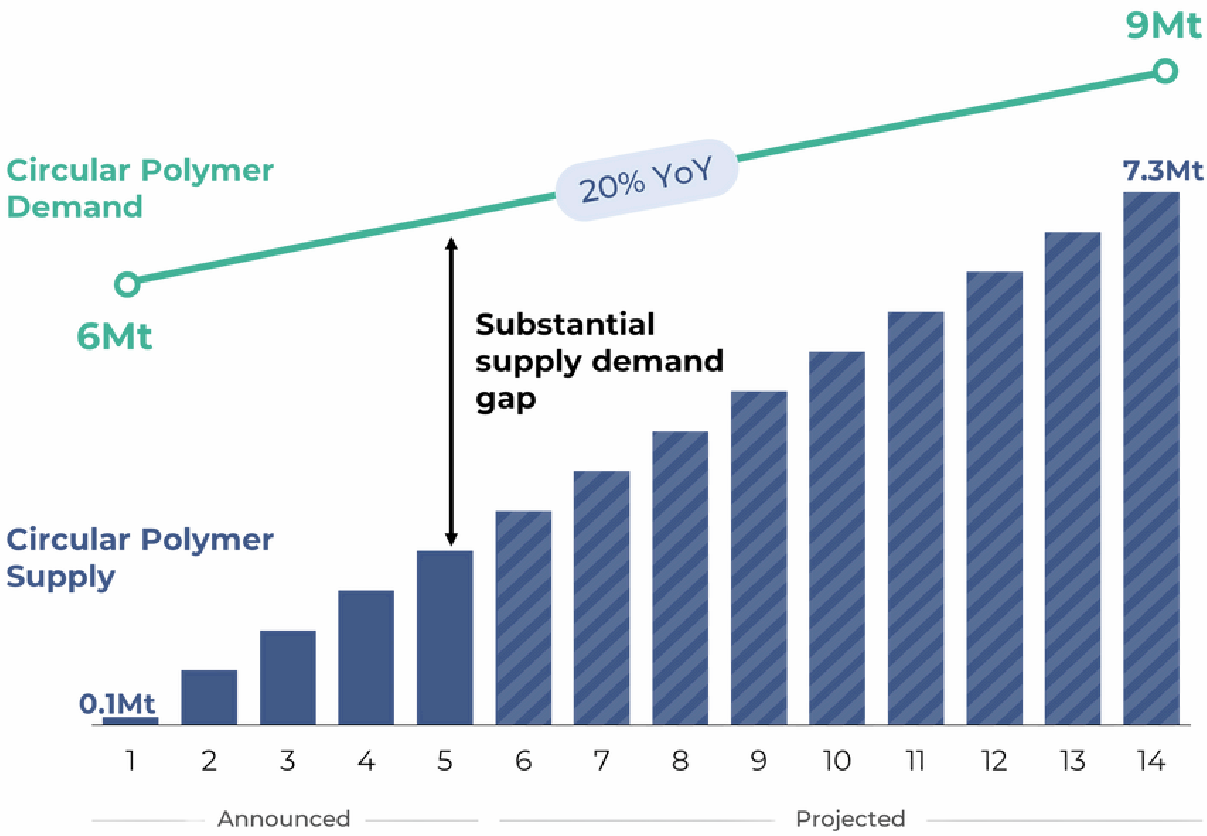
- Circular plastics demand is expected to rise from 3 million tons in 2022 to **13 million tons** by 2030, across just North America and Europe.
- Only 9 million tons of supply is projected by 2030 — leaving a 4 million ton upstream demand gap.
- This represents a **$25 billion total addressable market**, with greenfield capacity urgently needed to meet demand.

Recycled Content Driving Demand

- More than **50%** of the total demand growth for PE/PP plastics is now driven by recycled and renewable-based content.
- Consumer packaging accounts for **~65%** of this demand and has the fastest growth in recycled content requirements.

CASE STUDY – II
DOW CHEMICALS AND QENOS

The demand-supply gap shall continue to persist, with supply-side controlling a favourable "green premium"



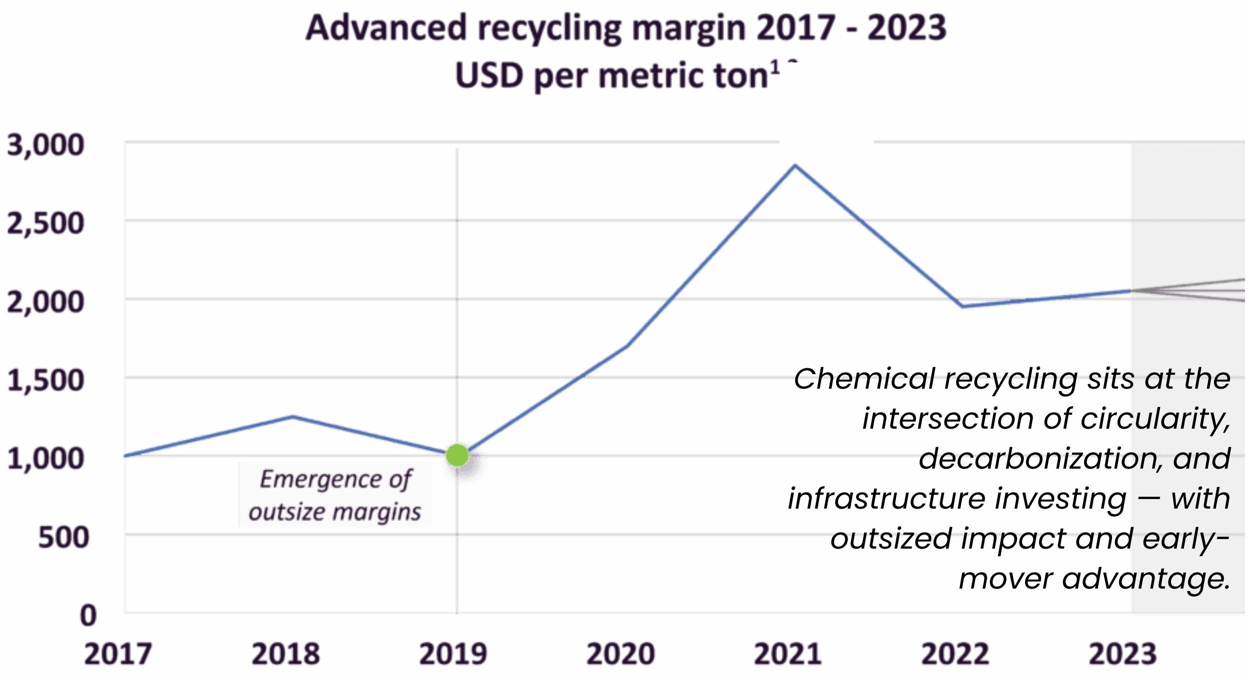
" Most of our brand owners have 30% post consumer recycled content targets by 2030.

The sales of products containing recycled content are increasing dramatically. Compared to the fossil fuel and virgin alternative, such products from Chemical Recycling materials are commanding a **premium of $1500 per metric ton.**

Jim Fitterlang
CEO (2022)

Mckinsey , Qenos March 2023

CASE STUDY – III
MCKINSEY ANALYSIS



1) McKinsey | Beyond the bottle: Solutions for recycling challenging plastics (November 2022);
2) McKinsey | A unique moment in time: Scaling plastics circularity (August 2023)

Accesses High-Value, Underserved Markets
Chemical recycling produces virgin-quality output suitable for high-purity applications. McKinsey identifies this as **the only viable route** to meet demand from sectors like food & pharma, where mechanical recyclates fall short.

Compelling Economic Opportunity
Pricing premiums for circular content, combined with supply constraints and regulatory tailwinds, are likely to support **margin durability over the long term** — making chemical recycling not just an environmental imperative, but also a compelling economic opportunity.

Investor Momentum and Capital Need
Chemical recycling can unlock an additional **20–25 million tons** of circular plastics capacity. Achieving circularity at scale requires $80–120 billion in global investments.

Circular plastics manufactured using chemical recycling command an outsized market margin of USD 1500 - 3000 per ton.

PLASTIC RECYCLING

INVESTMENTS

INVESTMENTS: GLOBAL

KEY STATISTICS

206 Companies

12 Acquisitions

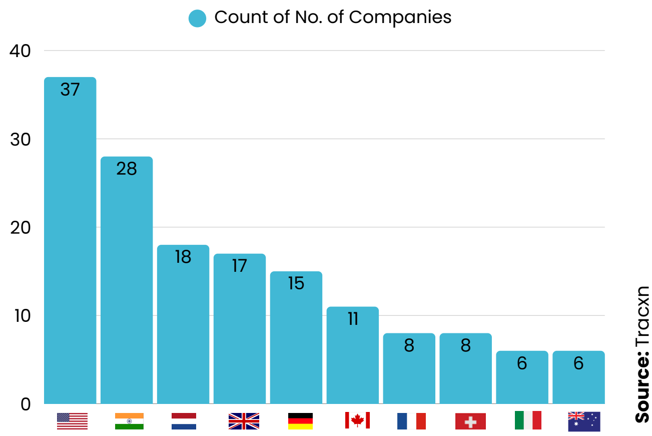
$1.03B Total Funding

$24M Median Valuation

0 Active Unicorns

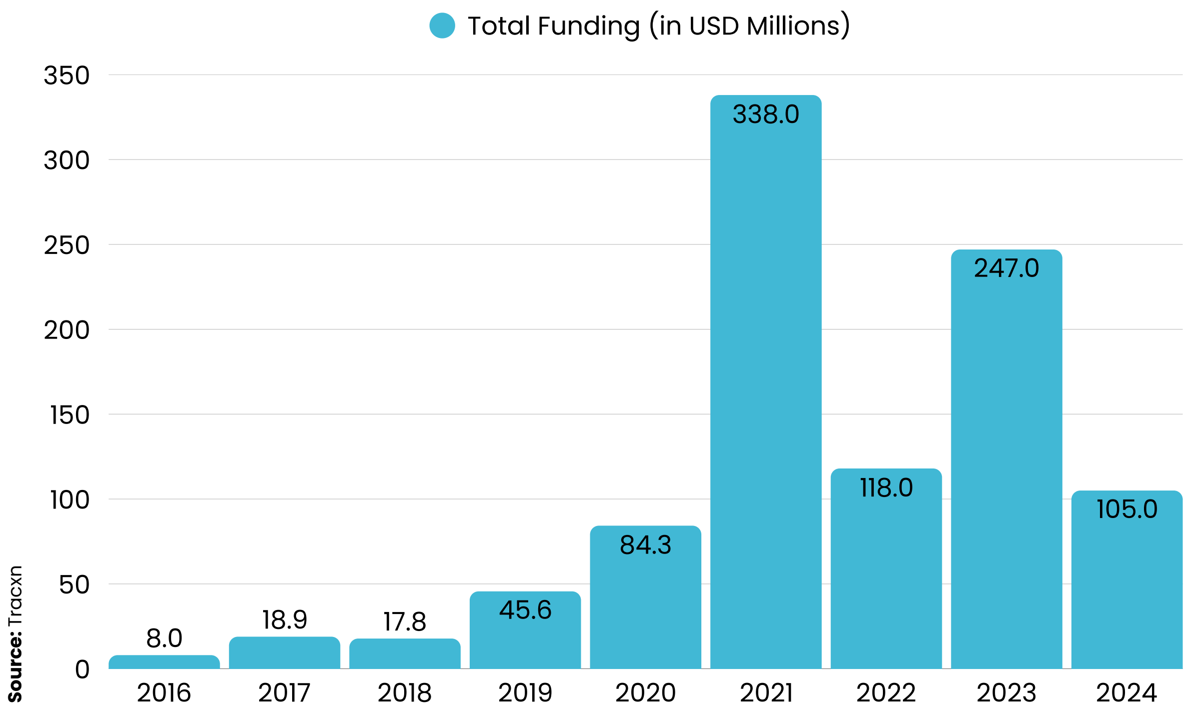
$1.12M Median Round Size

TOP GEOGRAPHIES



Note: *The data represents the total number of companies registered in the plastic recycling sector without any specific distribution based on the type of recycling they undertake. It is important to note that the majority of these companies primarily engage in mechanical recycling of plastic.*

TOTAL FUNDING



INVESTORS

CIRCULATE CAPITAL

European Innovation Council Fund

Cycle Capital

INFINITY RECYCLING

ARCTERN VENTURES

MAIN SEQUENCE

BATTELLE

European Union European Social Fund

SOSV THE ACCELERATOR VC

INVESTMENTS: INDIA

KEY STATISTICS

28 Companies

18 Funded Companies

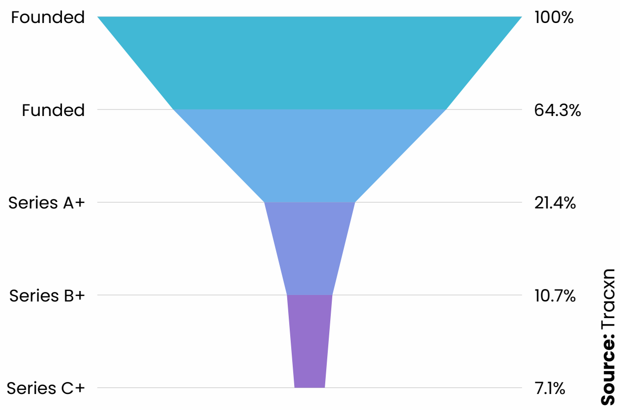
$69.7M Total Funding

$34.6M Funding in Last 2 Years

0 Active Unicorns

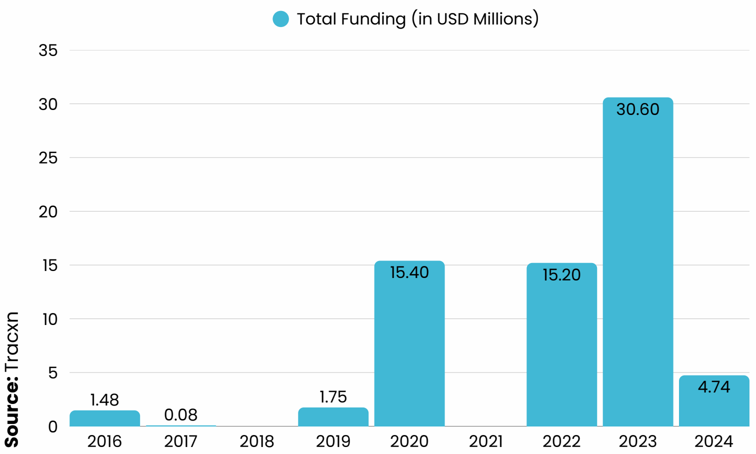
$676K Median Round Size

COMPANIES BY CURRENT STAGE



Note: *The data represents the total number of companies registered in the plastic recycling sector without any specific distribution based on the type of recycling they undertake. It is important to note that the majority of these companies primarily engage in mechanical recycling of plastic.*

TOTAL FUNDING



INVESTORS

SOCIAL alpha

Flipkart Leap

ELCID INVESTMENTS LIMITED

Mumbai Angels

Venture Catalysts++ A 360 ONE Company India's 1st Multi-Stage VC

LetsVenture

CHEMICAL RECYCLING

NOTABLE INVESTMENTS

CASE STUDY - I PLASTIC ENERGY

Plastic Energy | UK & Spain

Pyrolysis of mixed plastic waste

Plastic Energy is one of the earliest commercial pioneers in chemical recycling, specializing in the pyrolysis of hard-to-recycle plastic waste. Headquartered in the UK and Spain, it has developed a proprietary batch-based process to convert mixed and contaminated plastics into TACOIL™ — a synthetic oil used in the production of circular polymers.

Its operational track record and backing by global petrochemical players has positioned it with a high-valuation of **$2.4 billion** (Dec 2024)

> *Plastic Energy's valuation growth demonstrates how operational traction in chemical recycling can drive disproportionate investor interest — especially in a structurally undersupplied circular plastics market.*

1. Technology & Output

- Batch pyrolysis of mixed, flexible, contaminated plastics
- Produces pyrolysis oil (TACOIL) for circular polymer feedstock

2. Commercial Status

- 2 operational plants (5 KTA each); 4 larger scale projects in pipeline
- Early-mover advantage in commercial deployment
- Reported $3M revenue (UK entity, FY2023)

3. Investor Highlights

- Proven tech, real-world assets, strategic offtakes
- Batch design though, results in higher capital cost intensity per KTA (kilo-ton annum) of feedstock processed.

4. Valuation & Funding

- Raised $169M (2021) at $652M pre-money
- Valuation in Dec 2024 : $2.4B
- Strong investor confidence, backed by petrochemical majors

Source : Pitchbook, company financial disclosures, other publications.

CASE STUDY – II

Braven Environmental | USA
Pyrolysis of mixed plastic waste

Braven Environmental is a U.S.-based chemical recycling company that uses a proprietary pyrolysis technology to convert mixed plastic waste into circular-grade pyrolysis oil.

Braven's first commercial-scale plant in North Carolina was commissioned in 2020, positioning Braven as one of the earliest operational players in North America.

Braven has offtake agreements with majors like Chevron Phillips and BASF and significant investor attention — reflected in its pre-commercial valuation of $550 million in March 2018 and more recently, between **$800 -1200 million** in Dec 2023, when the company raised a round of $200 million.

Braven demonstrates how early operational deployment, even at small scale, can unlock premium valuations — especially when paired with strong offtake partnerships and efficient execution.

1. Technology & Output
- Proprietary continuous pyrolysis of mixed, post-consumer plastic waste
- Produces pyrolysis oil suitable for use in circular polymers

2. Commercial Status
- 12 KTA (~30–36 TPD) demonstration plant in North Carolina - commissioning completed in 2020
- Signed offtake agreements with Chevron Phillips and BASF
- Pursuing development of a 67 KTA commercial facility in Texas.

3. Valuation & Funding
- Raised $50M in Mar 2018 at a $550M pre-money valuation
- Latest funding (2023): $200M, bringing EV to $800M–$1.2B

Source : Pitchbook, company financial disclosures, other publications.

CASE STUDY – III agilyx

Agilyx | United States

Depolymerization of polystyrene and PMMA

Agilyx is a U.S.-based chemical recycling company with a enterprise value of **USD 310 million (June 2025)**. It specializes in the depolymerization of polystyrene (PS) and PMMA (acrylic) into high-purity monomers for reuse in plastics manufacturing.

As an early mover in the sector, Agilyx has helped shape the narrative around monomer-based circularity. While its Oregon facility experienced operational challenges, the company has strengthened its upstream capabilities through its affiliate Cyclyx, focused on waste sourcing and aggregation.

Agilyx also achieved a notable commercial milestone with a 10 TPD plant in Japan, operated by Toyo Styrene. With infrastructure-scale projects underway and strong investor backing, Agilyx remains a key player in the maturing chemical recycling landscape.

Agilyx was among the first chemical recycling companies to go public, listing on the Euronext Growth Oslo exchange. Despite facing challenges in commercializing its depolymerization technology at scale, the company has continued to enjoy investor confidence and market support—underscoring the long-term belief in monomer-based circularity and its role in future plastics infrastructure.

1. Technology & Output

- Proprietary depolymerization of polystyrene and PMMA into monomers
- Currently focused on polystyrene; feedstock-specific technology

2. Commercial Status

- 10 TPD plant operational in Chiba, Japan (with Toyo Styrene)
- Prior Oregon demo facility decommissioned due to challenges
- Strong focus on feedstock aggregation through Cyclyx Circularity Centers
- Two large-scale Cyclyx hubs under development (>$120M capex each)

3. Valuation & Funding

- Raised $33M in Sep 2020, pre-money valuation $144M. Enterprise value: ~$310M as of June 2025
- Investors backing both tech platform and Cyclyx expansion

Source : Pitchbook, company financial disclosures, other publications.

CASE STUDY – IV

Mura Technology | United Kingdom
Hydrothermal liquefaction of mixed plastics

Mura Technology is a UK-based chemical recycling company pioneering the HydroPRS™ process — a supercritical water-based method to convert mixed plastic waste into oils and waxes.

With a global licensing partnership with KBR and projects underway across the UK, Germany, the U.S., and Asia, Mura has adopted a replicable model.

The company commands an estimated enterprise value between **$400–600 million** driven by investor confidence in its scalability, technology, and alignment with circular economy goals.

Mura exemplifies how IP-rich, licensing-first models in chemical recycling can attract high valuations — even pre-revenue — by leveraging partnerships, global replication potential, and infrastructure-aligned strategies.

1. Technology & Output

- Hydrothermal liquefaction using supercritical water (220–250 bar)
- Converts mixed plastic waste into hydrocarbon oils and waxes
- High pressure = greater system complexity and higher capital cost, however company claims this also allows them to handle a broad feedstock.

2. Commercial Status

- 20 KTA UK plant under construction; full-commissioning expected in late 2025.
- Global licensing partnership with KBR; projects underway in Germany, U.S., and Asia
- Strategy focused on modular replication

3. Valuation & Funding

- Raised $16M in Mar 2021 at $133M pre-money
- Follow-on round in Oct 2022 valued Mura at $465M (pre-money)
- Current EV (2025): Estimated between $400–600M (dealroom.co), even as first plant coming online at full capacity.
- Investor base includes strategic, institutional, and EPC-aligned capital

Source : Pitchbook, company financial disclosures, other publications.

CASE STUDY - V PURECYCLE

PureCycle Technologies | United States
Solvent-based purification of polypropylene (PP)

PureCycle is a U.S.-based chemical recycling company focused exclusively on the purification and decontamination of waste **polypropylene**.

Using a solvent-based extraction process originally developed by P&G, PureCycle produces ultra-pure recycled PP that is odorless, colorless, and food-grade compliant.

PureCycle is publicly listed (NASDAQ: PCT) and despite delays and cost overruns at its flagship Ironton, Ohio plant, it commands an enterprise value of **~$950M – 1.1 billion** reflecting investor belief in its feedstock focus, IP ownership, and circular brand partnerships.

PureCycle demonstrates the potential of scaling single-resin, high-purity recycling technologies — and how brand alignment, public listing and feedstock specialization can attract and sustain investor confidence.

1. Technology & Output
- Solvent-based purification of waste PP
- Removes colorants, odor, additives to yield virgin or near-virgin grade recycled PP
- Output suitable for food-grade, pharma, and consumer goods applications

2. Commercial Status
- 59 KTA Ironton, Ohio plant under commissioning after delays.
- Next-gen facilities under planning in Georgia, South Korea, and Europe.
- Partnerships with Milliken, L'Oréal, and TotalEnergies

3. Valuation & Funding
- Publicly listed (NASDAQ: PCT) via SPAC merger in 2021
- Peaked at ~$8.4B valuation (2021); corrected to EV ~$950M–1.1B (2025)
- Raised over $900M in equity and project finance to date
- Backed by strategic CPG and institutional investors

Source : Pitchbook, company financial disclosures, other publications.

CASE STUDY – VI

Aduro Clean Technologies | Canada

Catalytic hydroconversion of plastics, biomass and heavy oil (Hydrochemolytic™ Tech)

Aduro is a Canadian chemical recycling company developing a novel water-based, low-temperature catalytic process — Hydrochemolytic™ Technology (HCT) — to convert waste plastics, biomass, and heavy crude into higher-value products.

Though still pre-commercial, the company is publicly traded and valued at an estimated enterprise value of **USD 270 million** (June 2025), based largely on IP promise and early pilot development.

Aduro's valuation reflects growing investor appetite for circularity-enabling platforms — even at early pilot stages — as capital increasingly seeks exposure to scalable solutions aligned with future recycled content and decarbonization mandates.

1. Technology & Output

- Water-assisted catalytic conversion
- Targets polyolefins (PE, PP), biomass, and petroleum residues
- Produces lighter hydrocarbon fuels and chemical precursors

2. Commercial Status

- No commercial plant yet; pilot-scale validation ongoing (Canada)
- Tech validated in lab and early demonstrations
- IP portfolio expanding to cover multiple verticals (plastics, bitumen, biomass)

3. Valuation & Funding

- Publicly traded on Canadian Securities Exchange (CSE: ACT)
- Raised ~$4M since 2021 via equity placements
- Current EV (June 2025): ~$330 Mil
- Attracting interest from innovation-aligned cleantech and VC funds

Source : Pitchbook, company financial disclosures, other publications.

CASE STUDY – VII

PolyCycl | India
Patented, cost-effective pyrolysis of low-grade plastic waste

PolyCycl is an **India-based** chemical recycling company focused on converting contaminated waste plastics into circular chemical feedstocks. Backed by over **10+ years of R&D,** the company's patented technology integrates several proprietary modules that optimize for high yield, improved pyrolysis oil purity and safe operability.

PolyCycl operates a **6th-generation** conversion plant (TRL-7) and has established key strategic partnerships with waste management and EPCm companies.

PolyCycl's journey reflects a patient, technology-first approach to solving tough problems in plastic circularity — with a focus on cost-efficiency, engineering reliability and practical integration with petrochemical infrastructure.

1. Technology & Output
- Cost-efficient, **fully-continuous** technology, focused on conversion of municipal plastics to circular feedstocks.
- Proprietary **PyOilClean™** module purifies generated pyrolysis oils without use of cost-intensive hydrogenation.
- **CapEx: < 1.0 million per KTA** — amongst the most efficient globally.
- 8 international patents.

2. Commercial Status
- **6th-generation,** TRL-7 pilot plant operational for several years.
- Generated pyrolysis oils qualified by global petchem companies across Europe and SE Asia.
- Collaboration with Re Sustainability - India's largest waste management co.
- Exclusive engineering tie-up with leading EPCm firm (undisclosed)
- Modular design: with each line capable of processing up to **100 TPD** of waste plastic feedstock.

3. Valuation & Funding
- Privately held, with capital raised from Spectrum Impact, SuperMorpheus, Milestone Gears and various HNIs

Source : Pitchbook, company financial disclosures, other publications.

CHEMICAL RECYCLING

Other Technology Companies

Startup	Technology	Country	End Product
novoloop	ATOD: Accelerated Thermal Oxidative Decomposition	USA	Lifecycled TPU (thermoplastic polyurethane)
nexus CIRCULAR Advanced Recycling. Acce	Pyrolysis with continuous feed & advanced control systems	USA	Circular naphtha, waxes
Paterson Energy	Pyrolysis	India	Fuels, energy recovery
ITERO	Thermal cracking + fractional condensation	UK	Hydrocarbon fractions for polymer production
PATPERT	Catalytic Pyrolysis	India	Pyrolysis Oil
JEPLAN	BRING Technology system (polyester recycling)	Japan	Recycled PET resin
Pryme making plastics circular	Proprietary pyrolysis process	Netherlands	Circular feedstocks

CHEMICAL RECYCLING

KEY CHALLENGES

KEY CHALLENGES

Challenges in Chemical Recycling

Practical considerations shaping technology readiness and commercial deployment.

1) Feedstock Consistency and Compatibility

Chemical recycling technologies are generally optimized for specific polymer types such as polyolefins or polystyrene. In contrast, municipal waste streams tend to be mixed and inconsistent, often containing multilayer materials and trace contaminants. Navigating this variability is central to effective process design. Some technology providers have developed capabilities in segregating and pre-processing target plastics, improving feedstock quality and system reliability.

2) Product Quality and Purification

To qualify for circular polymer production, chemical recycling outputs must meet purity requirements — particularly with respect to halogens, metals, and other contaminants. While advances in purification are steadily improving oil quality and downstream compatibility, it remains a critical step in the overall value chain and an area of active innovation.

3) Scaling and System Integration

Demonstrating that a technology works reliably at commercial scale — and can integrate smoothly with petrochemical operations — is essential for adoption. This requires alignment across engineering, permitting, quality assurance, and offtake partnerships. Execution capabilities are becoming just as important as technical innovation in shaping investor confidence.

4) Evolving Regulatory Clarity

While regulatory frameworks around mass balance, recycled content attribution, and product classification (e.g. pyrolysis oil as feedstock vs. fuel) are advancing, further clarity is still needed in several jurisdictions. As policies evolve, clearer definitions and certification pathways will play a key role in supporting commercial scale-up and market confidence.

CORPORATES AND SUSTAINABILITY

SUSTAINABILITY INITIATIVES

Amazon

INITIATIVES

Amazon's initiatives are focused on increasing recycled packaging material for delivery purposes. They are eliminating plastic straws and polystyrene from brick-and-mortar store locations.

The company set targets to raise the recycled content in plastic film bags from 25% to 50% and in plastic padded bags from 15% to over 40%, with these improvements expected to save over 25,000 metric tons of new plastic annually. Additionally, in North America, Amazon redesigned rotisserie chicken containers to use 70% less plastic, reducing plastic usage by 2 million pounds per year.

Procter & Gamble

INITIATIVES

The multinational corporation is looking to reduce plastic usage by innovating on product packaging, focusing on refillable products and product weight reduction.

P&G reduced plastic by redesigning diapers and packaging, saving 8,000 kg annually, and introduced refillable containers and cardboard Tide packs, cutting plastic use by 60%. It targets a 50% cut in virgin plastic and 100% recyclable or reusable packaging by 2030.

Pepsico

INITIATIVES

PepsiCo's innovations centre on sustainable packaging made from non-plastic materials such as aluminium cans, glass bottles and recyclable PET (polyethylene terephthalate) material.
PepsiCo is reducing plastic use by developing recyclable paper bottles, switching to aluminum cans, and phasing out virgin plastics in Europe—saving 70,000 tonnes and cutting emissions by 40%. By 2030, it aims to cut virgin plastic use by 50% per serving and use 50% recycled content in packaging.

Unilever

INITIATIVES

Unilever seeks to shift to mono-material packaging and reusable spray bottles. They also want to integrate more post-consumer resin into their packaging.

Unilever is cutting virgin plastic by using refill packs with 75% less plastic and increasing recycled content in products like Persil, saving 650 tonnes annually. It targets a 30% cut by 2026 and 40% by 2028, with all packaging reusable, recyclable, or compostable by 2030–2035.

Source- "Innovation in Plastics"-Marico Foundation

CHEMICAL RECYCLING

INDUSTRY ANNOUNCEMENTS

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Key Announcements in Indian Market

- **Re Sustainability–Aarti Circularity JV** (2025) : Joint venture announced between Aarti Circularity and Re Sustainability to develop chemical and mechanical recycling based Plastic Material Recycling Facilities across India, starting with Hyderabad, targeting 500 TPD capacity by 2030.
- **PolyCycl Launches Gen VI Platform** (2025) **:** PolyCycl unveiled its 6th-generation ContiFlow Cracker™, a modular, continuous pyrolysis system for converting low-grade plastics into circular oil. Its PyOilClean™ module enables purification without hydrogenation.
- **Revalyu–PET Expansion** (2024–25, India): $100M scale-up to process 20M PET bottles/day into recycled polyester chips.
- **PolyCycl–Re Sustainability Collaboration** (2024) : PolyCycl partnered with Re Sustainability to set up feedstock preparation facilities across India to process post-consumer polyolefins for chemical recycling applications.
- **Re Sustainability Circularity Hub Launch** (2024): Re Sustainability launched a 32,000 TPA plastics circularity hub in partnership with Sharrp Ventures, focused on recovering and upgrading polyolefins into recycled materials and feedstock.
- **Reliance Industries – ISCC+ Circular Polymer Launch** (2023) : RIL became the first Indian company to produce ISCC+ certified circular polymers from pyrolysis oil at its Jamnagar refinery, branded as CircuRepol™ and CircuRelene™.

INDUSTRY ANNOUNCEMENTS

🌍 International Announcements

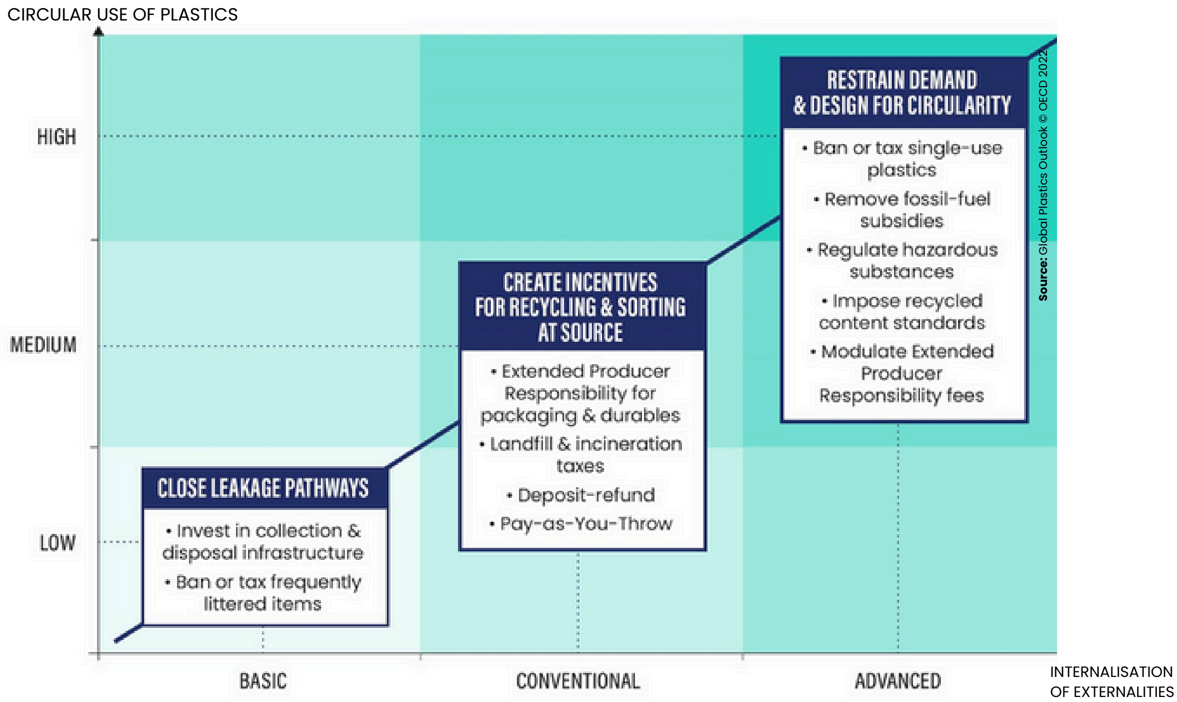
- **OMV–ReOil® Start-up** (2025, Austria): 16 KTA advanced recycling plant operational at Schwechat for plastic-to-oil conversion.
- **France–€500M State Aid for Chem Recycling** (2025): EU-approved funding to boost national plastic recycling capacity.
- **Pryme Netherlands** (2025): Adjusted expected annual capacity of its Pryme One plant to 16,700 tonnes of pyrolysis oil due to technical challenges. Produced 154 tonnes of pyrolysis oil in March 2025
- **Lux Research Outlook** (2025): Global advanced recycling capacity nears 1M TPA; investor interest remains strong.
- **ExxonMobil–Baytown Expansion** (2024, U.S.): $200M investment to scale recycling capacity to 1 billion lbs/year by 2027.
- **Braven–Texas Pyrolysis Project** (2024, U.S.): 250K TPA facility announced to produce 50M gallons/year of pyrolysis oil.
- **Mura–KBR Licensing** (2021–24): Global rollout of HydroPRS™ tech with projects in UK, Germany, U.S., Asia.
- **ExxonMobil–Baytown Start-up** (2023, U.S.): 40 KTA advanced recycling unit now operational in Texas.
- **Plastic Energy–Freepoint JV** (2023, U.S.): 33 KTA pyrolysis plant in Texas to produce TACOIL™ from mixed plastic waste.
- **Agilyx–Toyo Styrene** (2023, Japan): 10 TPD polystyrene depolymerization plant operational, producing circular styrene.
- **PureCycle–Ironton Start-up** (2023, U.S.): 59 KTA solvent-based PP purification plant launched in Ohio.
- **Total–Honeywell** (2022, Spain): 30 KTA pyrolysis plant planned using UpCycle™ technology.

RECOMMENDATIONS

FOR STAKEHOLDERS

RECOMMENDATIONS

Policy Roadmap for Circular Plastic Use



Lessons From The World on Circularity

COUNTRY	POLICY MEASURES	DESCRIPTION
France	€500M State Aid Scheme (2025)	EU-approved package to co-fund chemical recycling infrastructure, supporting depolymerization and pyrolysis-based projects nationwide.
United Kingdom	Plastic Packaging Tax (2022–)	£200/tonne tax on packaging with <30% recycled content—driving demand for chemically recycled feedstocks where mechanical solutions fall short.
Italy	Tax on Virgin Plastics (2026)	€450/tonne tax on virgin plastics in single-use packaging, starting July 2026—creating strong financial incentives for chemically recycled content.
Japan	Biotech & Chemical Plastic Strategy	National strategy targets replacement of 2.5–3M TPA of conventional plastics with bio- or chemically recycled alternatives by 2030.

STRATEGIC TAKEAWAYS AND KEY INDUSTRY LEARNINGS

Strong ROI Fundamentals[1)]

With capital costs in the range of USD 0.5 mil - 3.0 mil per kilo-ton of feedstock processed per annum, leading projects in the chemical recycling space target 2-7 year payback periods with IRRs in the 12-40% range. Eastman's Kingsport plant expects $30-50 million annual EBITDA, delivering approximately 20% simple ROI on their $250 million investment.

Strategic Market Positioning[2)]

Early movers gain significant competitive advantages. Companies like PureCycle command premium pricing for recycled polypropylene, with projected EBITDA margins exceeding 40%. As regulatory pressure for recycled content intensifies and corporate sustainability commitments expand, first-mover facilities will capture disproportionate value from supply-constrained markets.

Technology Licensing Opportunities[3)]

Beyond plant ownership, the sector offers high-margin licensing revenue streams. Companies like Mura, PolyCycl, Agilyx, Aduro Cleantech, Loop Industries, Licella, Plastic Energy monetize intellectual property through royalty models, avoiding heavy capital requirements while generating returns from global deployment of their technologies.

Learning from Setbacks: Smarter, Not Larger Deployments

Teething challenges have contributed valuable lessons to the industry's evolution. Pryme (Netherlands) recently scaled down its flagship plant's capacity from 40 kTA to 16.7 kTA due to technical bottlenecks. Similarly, Quantafuel's 16 kTA Denmark plant and Recycling Technologies' 7 kTA UK facility struggled to sustain operations.

Rather than defaulting to mega-scale, companies like UK-based Greenback and India's PolyCycl advocate for moderate-sized initial plants that balance capital efficiency with strong project economics. These models can deliver EBITDA margins exceeding 50%, without the high capex burden of infrastructure.

Multiple Revenue Streams Enhance Competitive Position

Smart chemical recycling projects have been leveraging dual revenue models unavailable to virgin producers. European facilities earning $100+ per ton in tipping fees through landfill tax avoidance effectively subsidize feedstock costs while generating product revenue. This creates a $600+ per ton advantage in optimal regulatory environments, transforming marginal projects into highly profitable ventures. PlasticsToday analysis shows how government mandates enable recyclers to charge premium disposal fees while commanding higher product prices.

1) 3) Bain & Company, "The Circularity Gap for Plastics," 2023
2) PureCycle Technologies investor presentations and SEC filings

CONTRIBUTORS

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Shailesh has 20 years of experience with 11 years in Venture Capital investing and 9 years in Operations with strong domain knowledge of consumer internet, technology and manufacturing space.

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