

(Petro)chemicals Industry's Ambitions & Challenges in EU

From Linear to Circular, the role of regulation, Innovation & Collaboration

February 14th 2023
Webcast - Athens

The Future of Plastics

Frans Stokman – Executive Director Petrochemicals Europe, Cefic

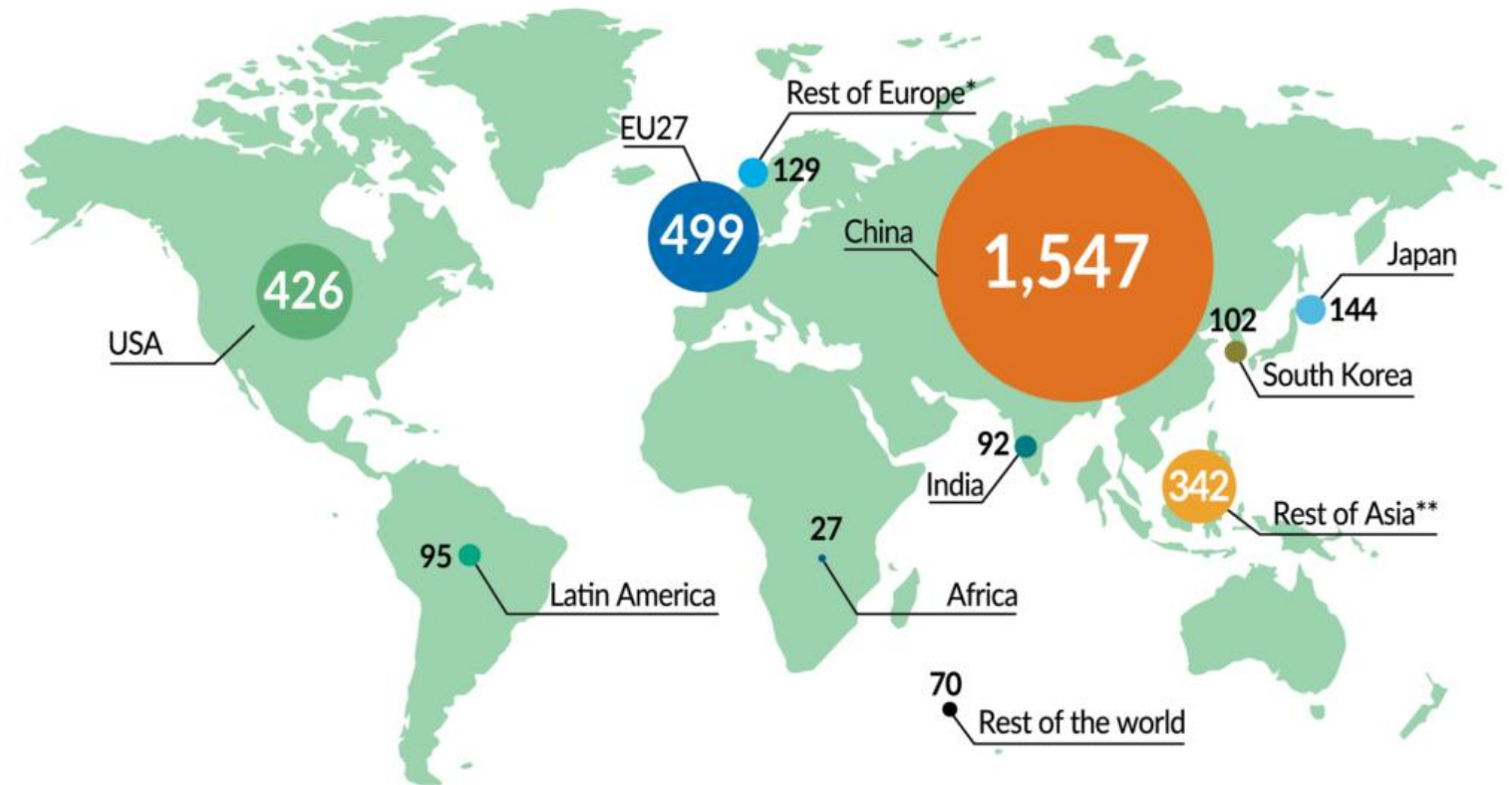
Petrochemicals Europe, an industry group of the European Chemical Industry Council, AISBL
Rue Belliard, 40 - 1040 Brussels – Belgium. Transparency Register n°64879142323-90

**petrochemicals
europe**

Essential materials for a sustainable future

Our EU Chemicals Industry

- **2nd largest chemicals producer** in the world
- **Major importance for economic development and wealth:**
7% of EU27 manufacturing added value
- Employs **1.1 million people**
- + around **three times more indirect jobs**
- A **specialty chemicals** region: 40 billion euros in value



Source: Cefic Chemdata International
 * Rest of Europe covers UK, Switzerland, Norway, Turkey, Russia and Ukraine
 ** Asia excluding China, India, Japan and South Korea



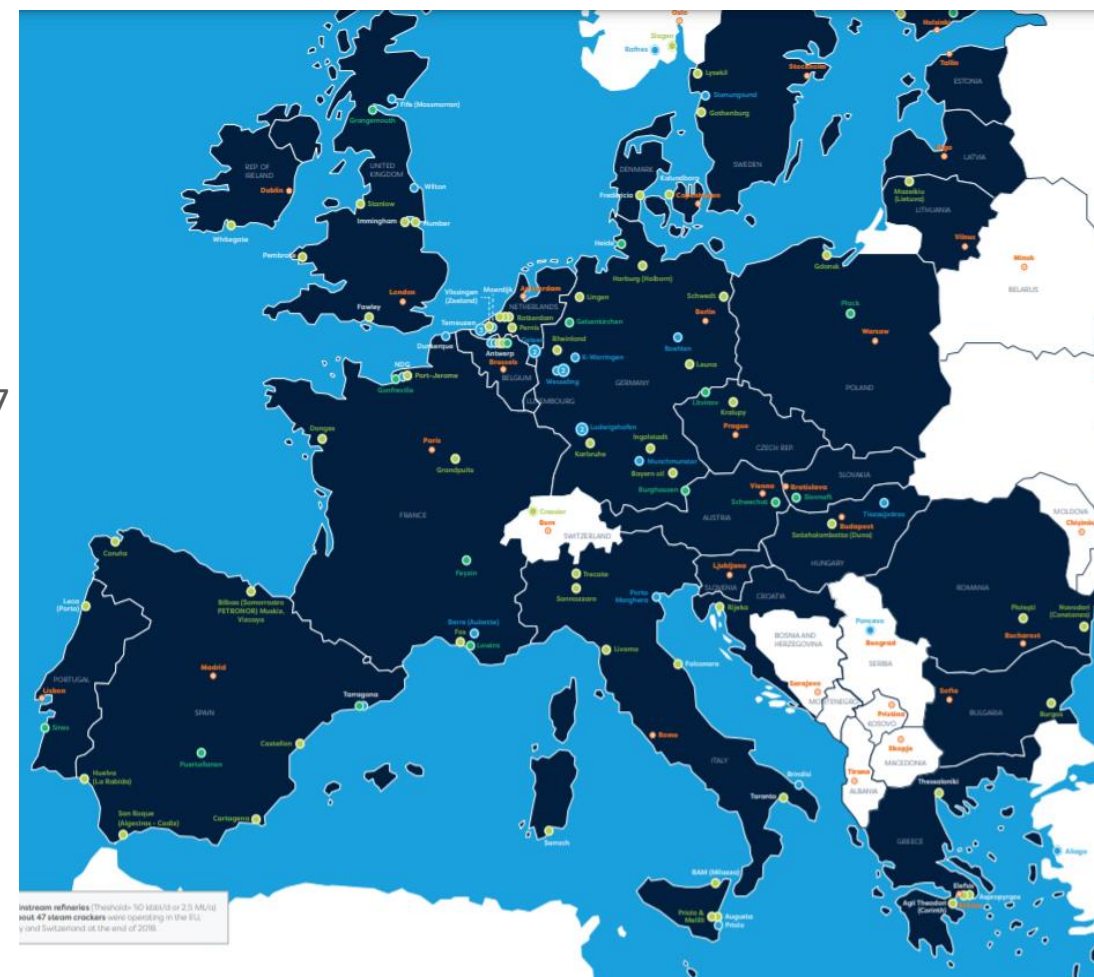
Cefic – the voice of the chemical industry in Europe

Cefic is devoted to promoting a thriving chemical industry that is broadly recognized to provide sustainable, safe and resource-efficient solutions; foster prosperity, growth and investments in Europe, to meet the challenges for future generations”.



Crackers are at the Heart & Start of most global value chains

- **An industry sector of Cefic:**
the European Chemical Industry Council representing manufacturers and National Chemical federations
- **>70 companies**, around 300.000 jobs, 145 billion/a turnover
European producers of base chemicals and derivatives
- **Base chemicals production:**
20 companies operating 40 Naphtha, Ethane & mixed crackers in EU27
- **Infrastructure & Integrated Systems:**
Integrated production sites, connected to pipeline grids active in most value chains
- **Providing essentials materials:**
 - to most industrial ecosystems,
 - one of the most complex global supply chains.
- **An Energy and GHG intense industry**



Source: Petrochemicals Europe/ICIS





Our essential materials are contained in 95% of all manufactured goods



TRANSPORT



COSMETICS



CONSTRUCTION



ELECTRONICS



HEALTH



TEXTILE



PAINTS & COATINGS



HOUSEHOLD



PACKAGING



NEW APPLICATIONS



4 key focus areas for Petrochemicals after safety first...

4 major external factors, and counting



GREEN DEAL
2.0 February 2023
October 2019



Recovery Plan for EU
December 2020



REPowerEU: Joint European action for more affordable, secure and sustainable energy
European Commission

March 2022



US Inflation Reduction Act (IRA),
launched in August 2022
+ other global climate initiatives



Feedstocks

- Diversified
- Fossil
- Recycled, Pyrolysis
- Bio
- H2, methanol, ammonia etc.



Energy

- Diversified
- Fossil
- Electrification, capacity, infrastructure
- Efficiency
- Low cost, abundant



Products

- CSS, Reach, Product Stewardship
- Sustainable products, essential materials
- At the start and heart of most value chains
- Carbon Pricing
- Competitiveness, global level playing field
- Recycling



Carbon Management

- Recycling
- Manage the waste
- CCS, CCU
- Net zero, circular
- Innovative technologies
- People, skills

REGULATORY PACKAGES AND POLICIES

Green Deal: CSS (data!), Fit for 55 (e.g., Carbon Pricing/CBAM, ETS/FA), Repower Europe



Pledges heatmap – announced net-zero or carbon reduction commitments

BASF	Sinopec	Dow	Formosa Plastics	ExxonMobil	Ineos	ChemChina	Sabic	Lyondell Basell	Mitsubishi Chemical
Linde	Air Liquide	Bayer	Hongli Petrochem	Nutrien	DuPont	Sherwin-Williams	LG Chem	Toray Industries	Sumitomo Chemicals
Evonik	Shell	Corteva	Rongshen Petrochem	PPG Industries	Reliance Industries	SK Innovation	Covestro	Shin Etsu	Solvay
Ecolab	3M	Yara	Braskem	Lotte Chemical	Indorama Ventures	DSM	PTT Global	Wanhua	Mitsui Chemical
Henkel	AkzoNobel	Arkema	Shanghai Petrochem	Asahi Kasei	Air Products	Mosaic	Sasol	Eastman Chemical	CP Chem
Showa Denko	Lanxess	Westlake Chemical	Hongli Petrochem	Givaudan	Lonza	DIC Corp	Tosoh	Orbia	Eurochem
RPM	Huntsman	Lubrizol	Wacker Chemie	Grupo Alfa	Celanese	Johnson Matthey	Tongkin Group	Teijin	Mitsubishi Gas Chem
Kuraray	IFF	Israel Chemical	Chemours	SCG	Alkerm	Honeywell	Avery Dennison	Imerys	FMC
North Huayin	K+S	Wanhua Group	Clariant	Symrise	Versalis	Sibur	CF Industries	Orca	OxyChem
Daicel	Petronas Chemical	Kaneka	JSR	Avient	Albemarle	Shanghai Huayin	Trinseo	PkN Orient	Sekisui Chemical

■ Net-zero by 2050
 ■ 2030 reduction commitment
 ■ No announced commitments

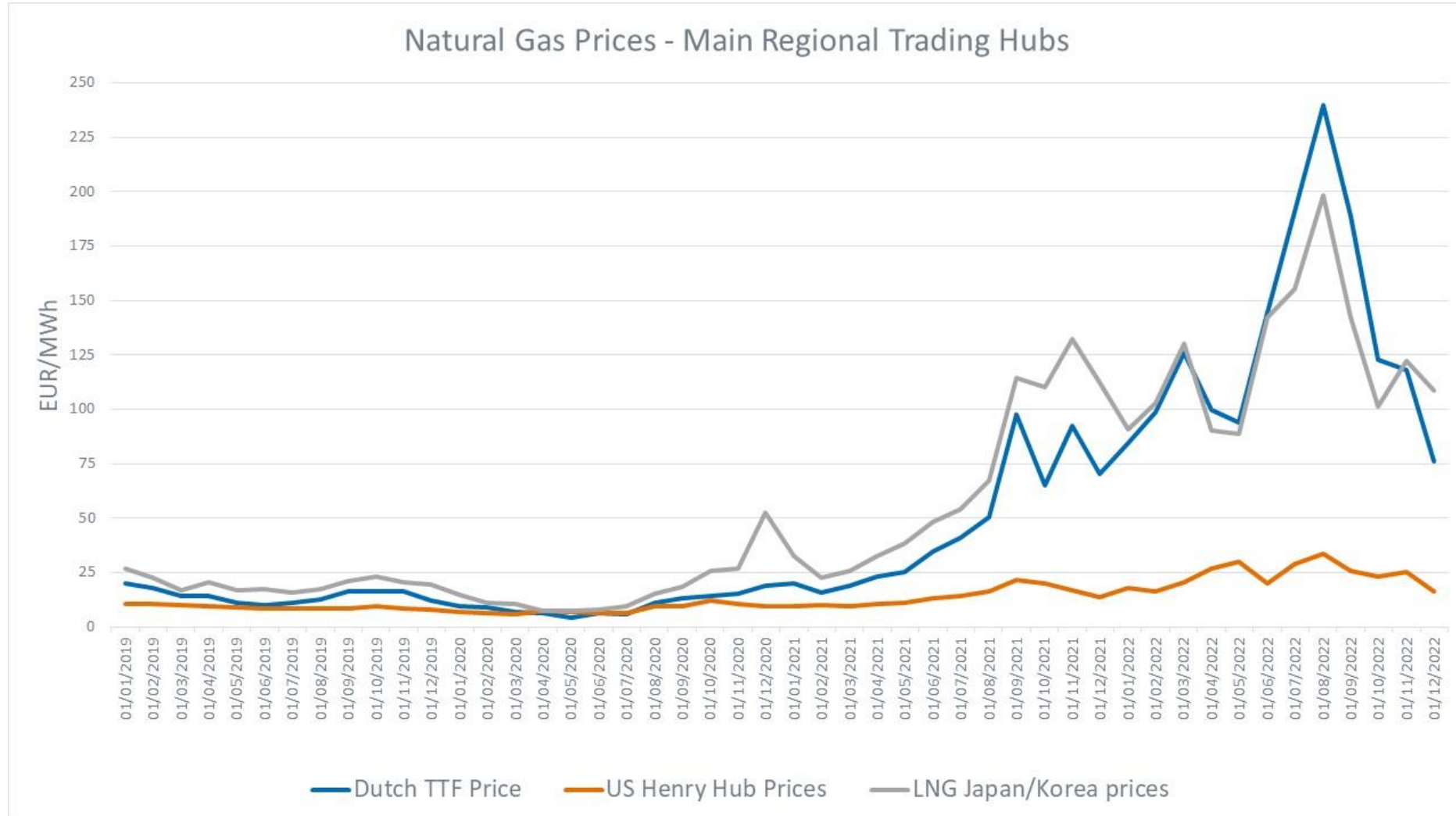
The EU chemical industry has the ambition to become climate neutral by 2050.

A few challenges added these days...



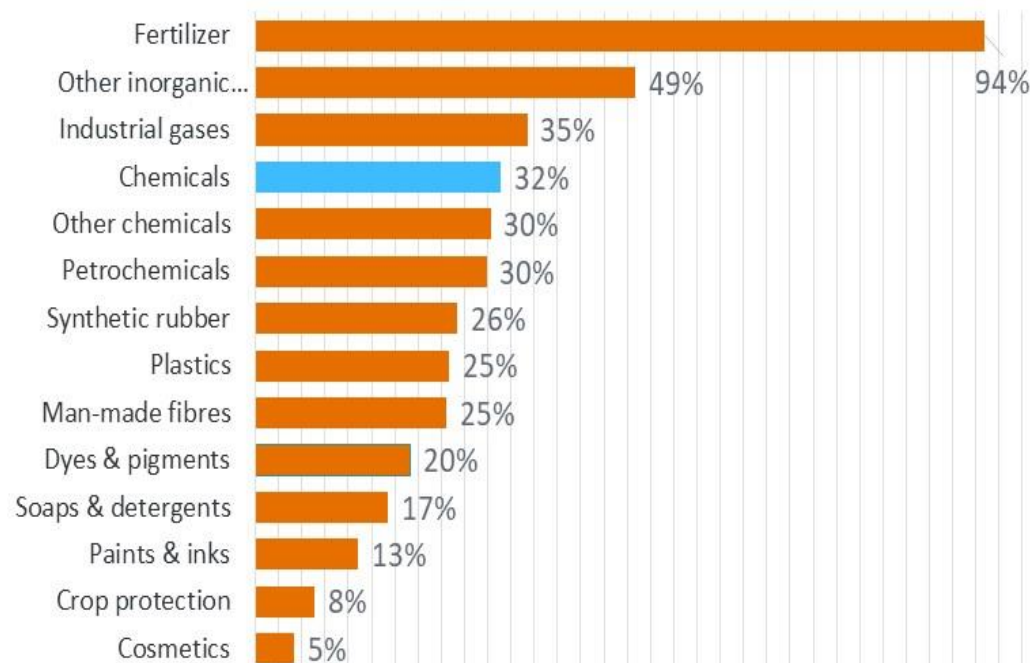


Natural gas prices in Europe: deep decline since Aug-22 but still 4.6 time higher than in the US

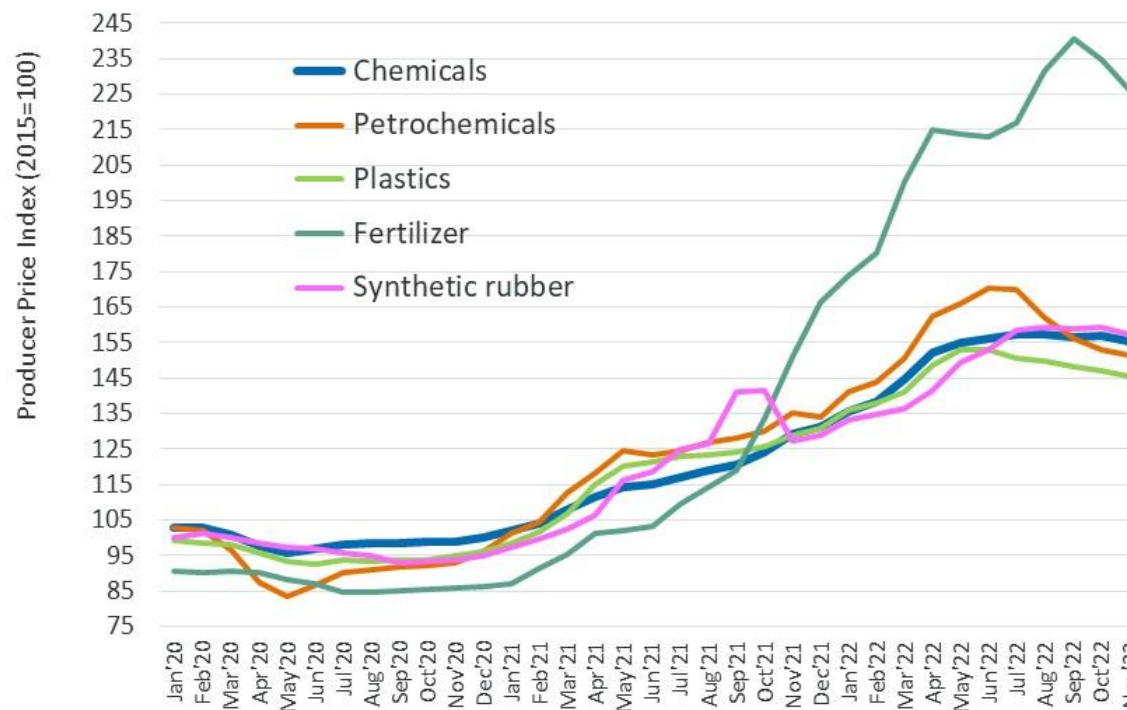


Chemical selling prices far above the historical levels

EU27 Producer prices: Jan-Nov 2022 (y-o-y)



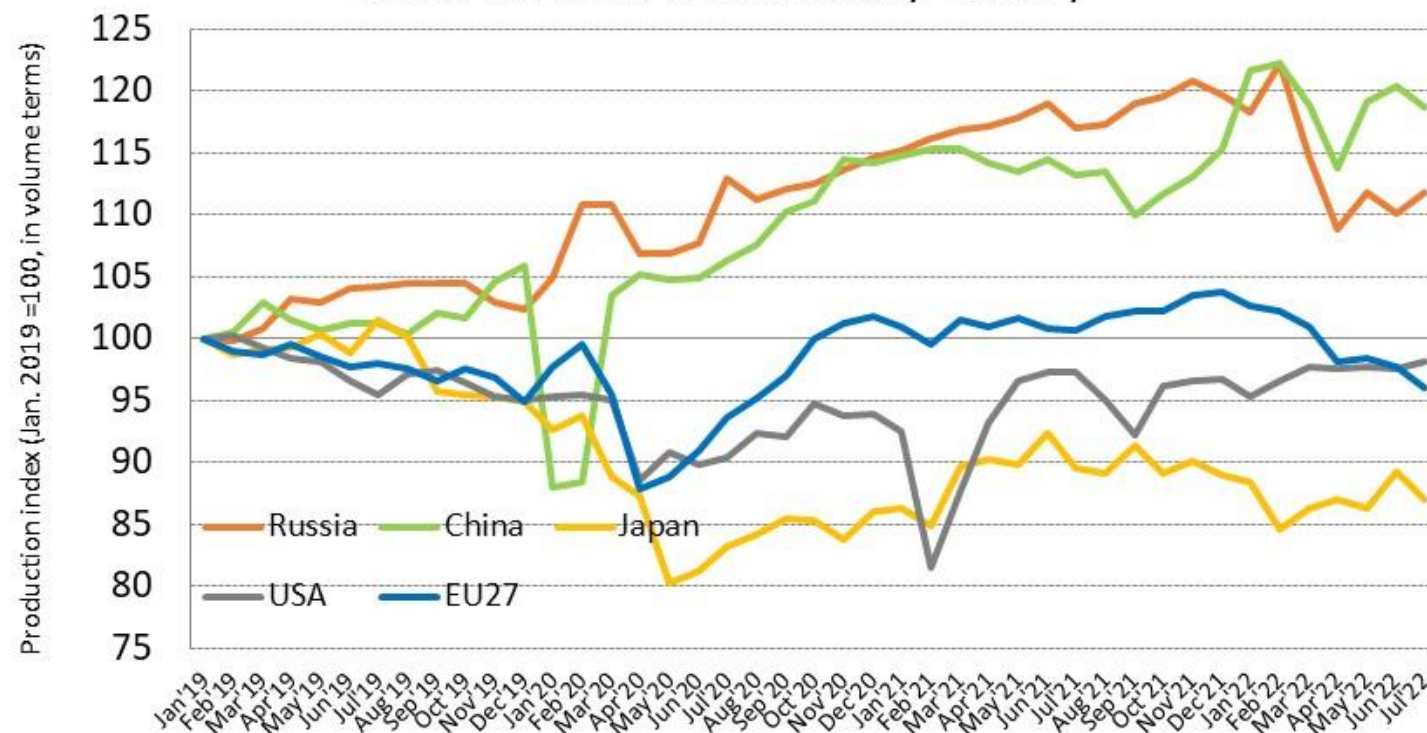
EU27 Producer prices in the chemicals industry



Chemical production development by country

	2021 (Jan- July)	2022 (Jan- July)	Changes
South Korea	100,9	97,9	-2,9%
Russia	116,8	113,8	-2,6%
Japan	89,2	87,2	-2,2%
EU27	100,9	99,4	-1,4%
Latin America	103,5	104,8	1,3%
World	106,1	108,6	2,4%
China	114,4	119,2	4,2%
India	104,7	110,0	5,0%
USA	92,3	97,2	5,3%

Global Chemical Production by Country





Carbon Price Development EU- tipping €100/t

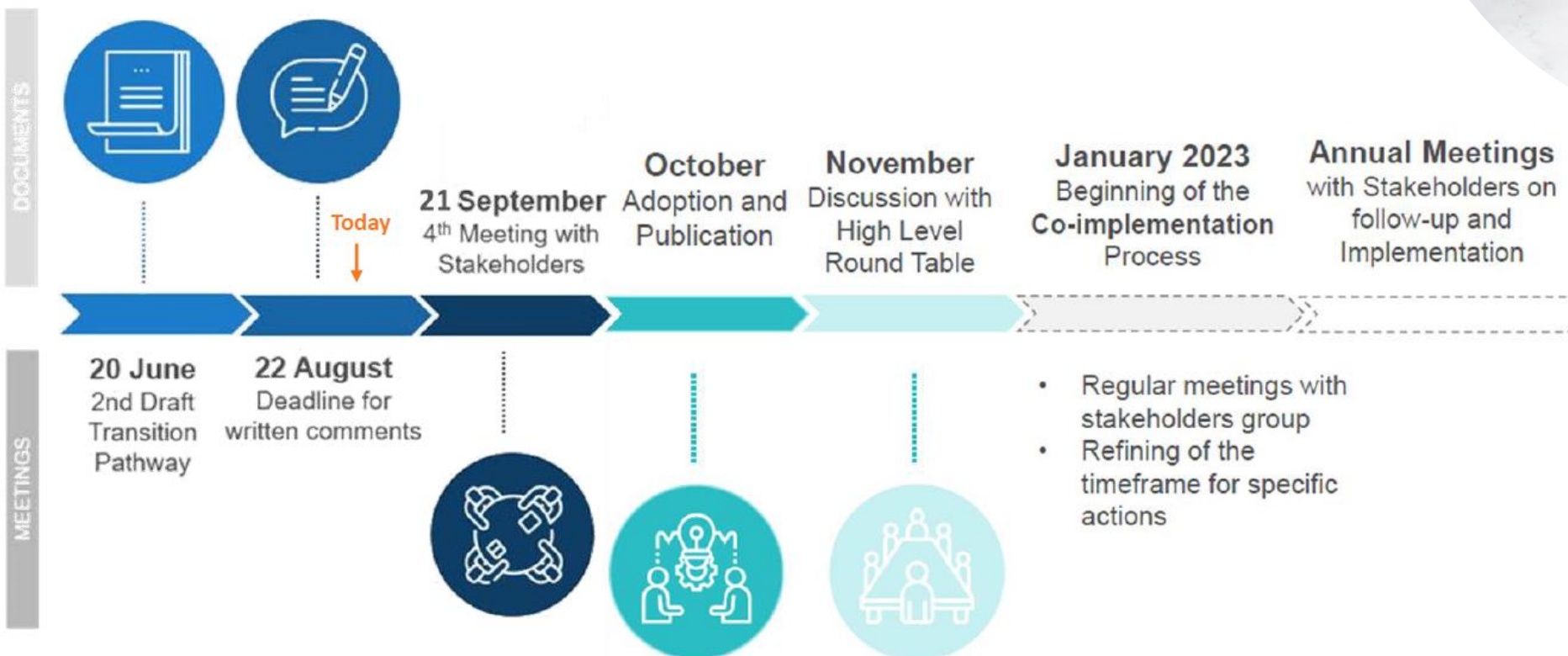


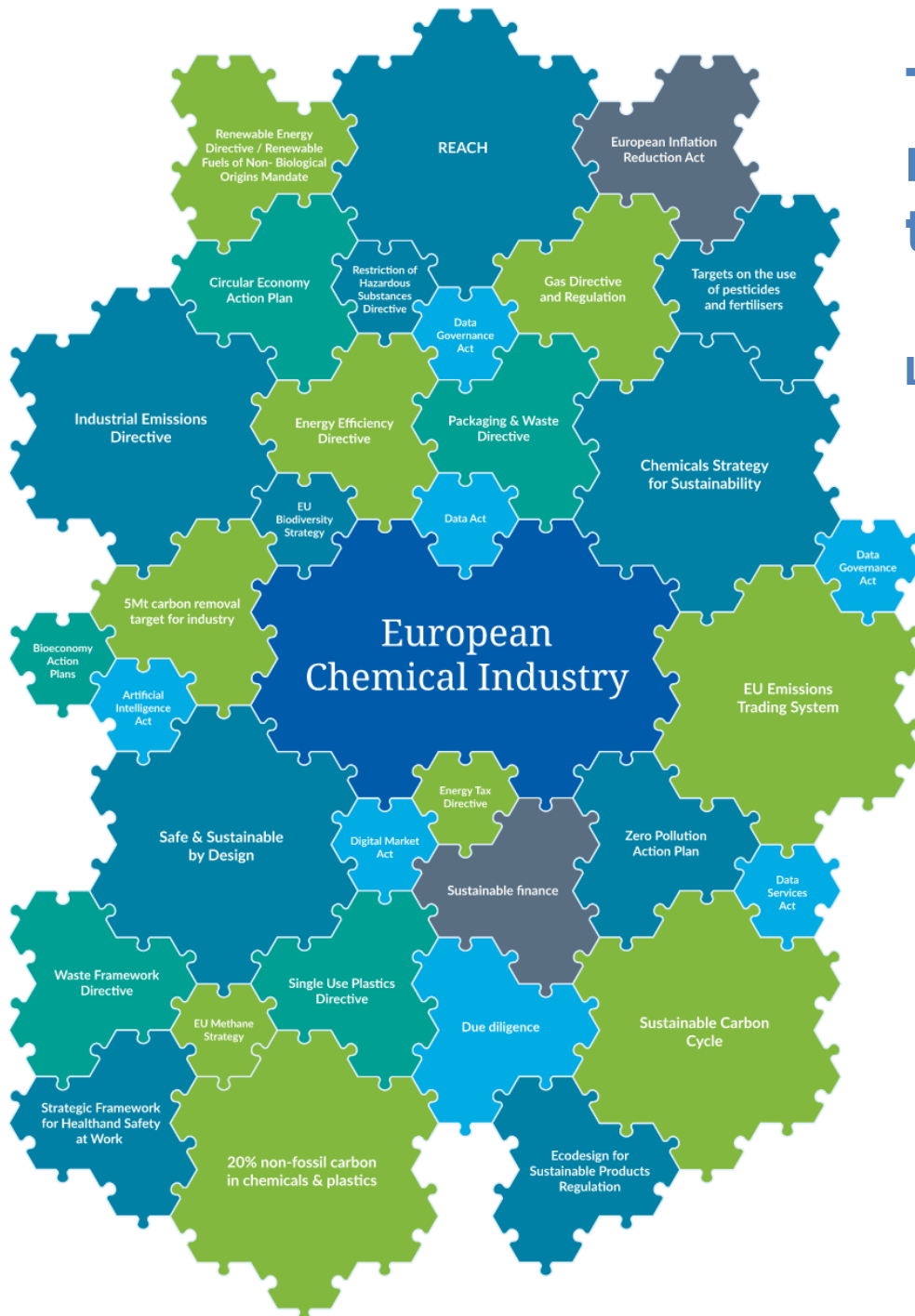
Source: <https://tradingeconomics.com/commodity/carbon>





Chemicals Industry sector co-creating pathways document with EU Commission





The Transition Pathway provides a concrete roadmap which puts together all the pieces of the EU legislative agenda.

Launched by the Commission on January 27th 2023



The four dimensions of the Transition

We are facing the biggest transformation in our industry's history as we go climate neutral, circular, digital while shifting to safe and sustainable chemicals

- Going circular
- Going digital
- Going climate neutral
- Shifting to safer and more sustainable chemicals

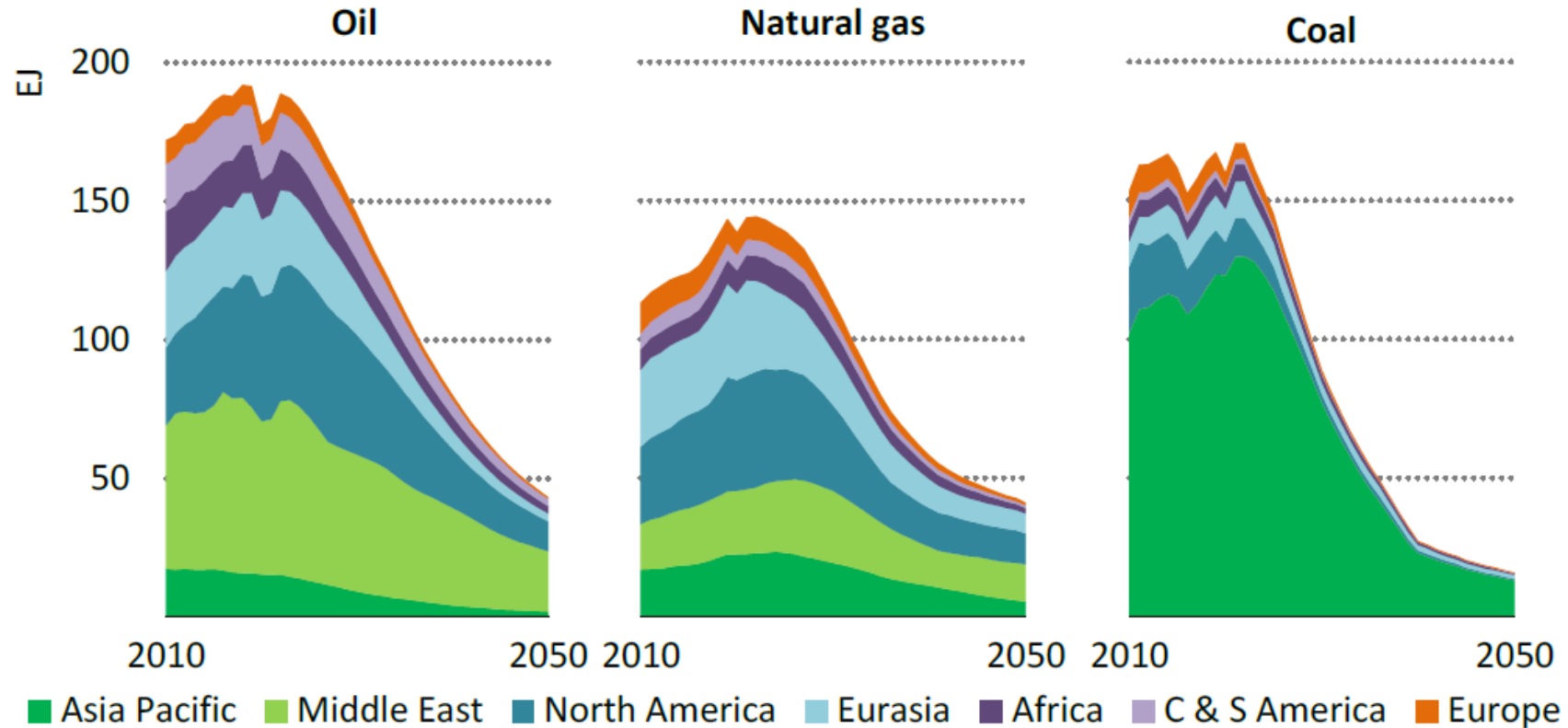
A few Illustrations of progress on Projects & Investments:

- Electrification
- CCS
- Recycling, Pyrolysis





Oil, Natural Gas & Coals supply by region (NZE scenario)

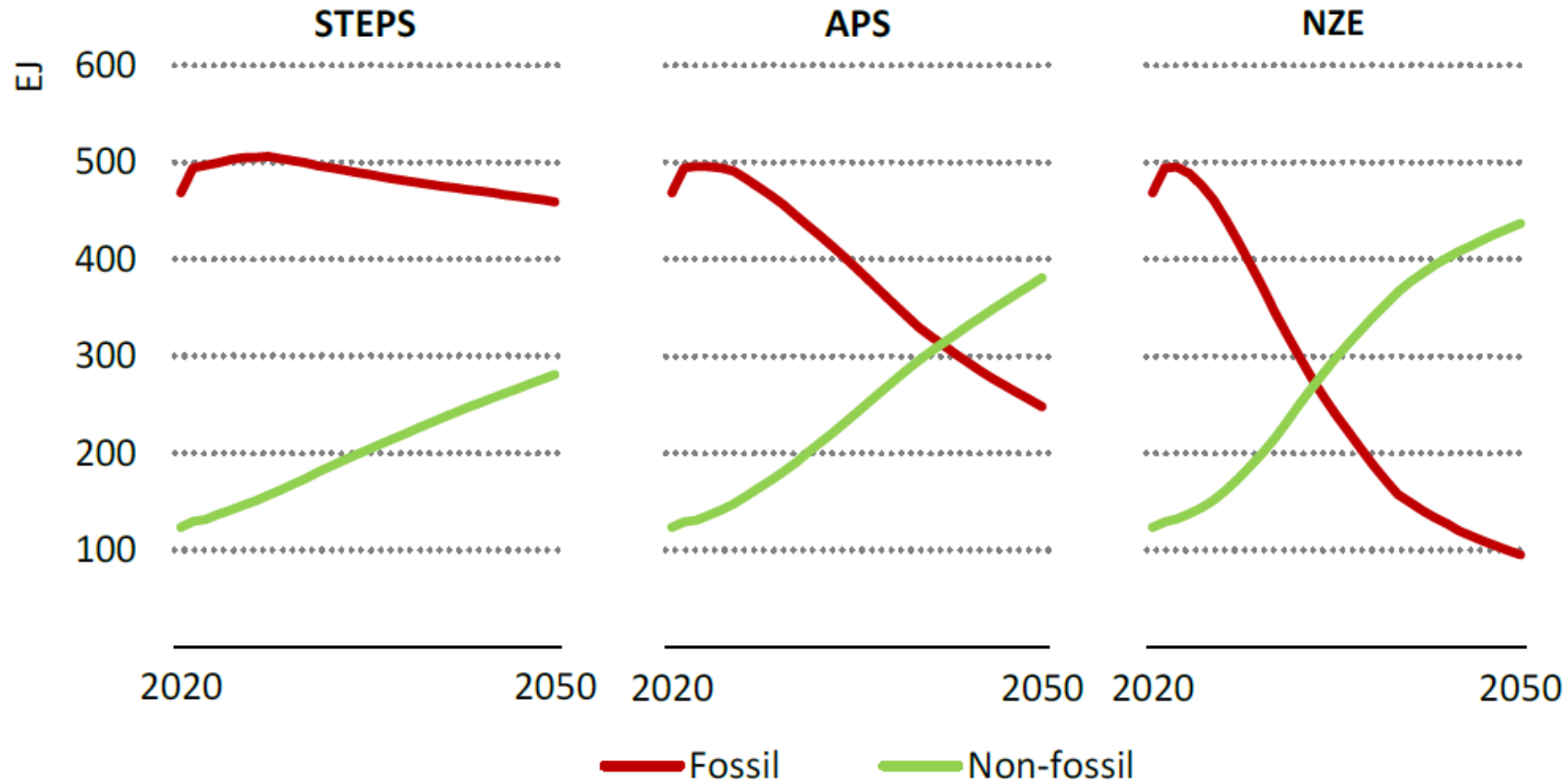


IEA. CC BY 4.0.

Declines in demand can be met without approving new long lead time upstream conventional oil and gas projects, new coal mines or mine lifetime extensions



Fossil & Non-Fossil energy supply by scenario (2020–2050)



IEA. CC BY 4.0.

There is an orderly process of change in the global fuel mix in all WEO scenarios, with the main differentiating feature being the rapidity of transition from fossil fuels



Electrification, Cracker Advancement (H2)

01

Consortium 'Cracker of the future'

- Game changing technology for the electrification of steam cracking
- Borealis/OMV, Total Energies, BP, Repsol and Versalis (ENI)
- Demo in 2023, Commercial availability in 2026

03

BASF, Sabic, Linde 'Cracker Electrification Pact.'

- Cracker Electrification Pact
- Joint Development Agreement March 2021
- Various techniques for electrically heated steam crackers furnaces,
- Construction demo plant started Sept 1st, 2022,
- Demo plant startup in 2023, possible commercialisation by 2024
- Electricity from renewable sources, reducing CO2 emission by 90%
- Applied for EU innovation fund, German decarbonisation Industry program

02

Dow/Shell

- JDA to accelerate technology to electrify ethylene steam crackers
- Designing and scaling "e-cracker" technologies
- Announced June 2020, TNO and ISPT added
- Pilot plant start-up is scheduled for 2025

04

INEOS 'Project One'

- Equipped with the best available technologies and the highest efficiency in feedstock and energy use, CO2 footprint <50% compared to the best units.
- Designed to maximise the use of Hydrogen as fuel and with 100% renewable energy.
- Replacing ethylene imports and reducing CO2 footprint
- World-scale unit
- Start-up planned in 2026

05

PKN Orlen Poland new Cracker



Common infrastructure & collaboration are key



- Port of Rotterdam, **project Porthos** Consortium, collecting emissions from multiple factories and refineries and store in empty gas fields in the North Sea
- Starting 2024, **2.5 Mln tonnes CO₂/a.**

- More CCS projects:
- Kairos at C: Belgium Netherlands/Norway
 - SHARC, Finland
 - Greensand, Denmark
 - Also in Steel, biomass

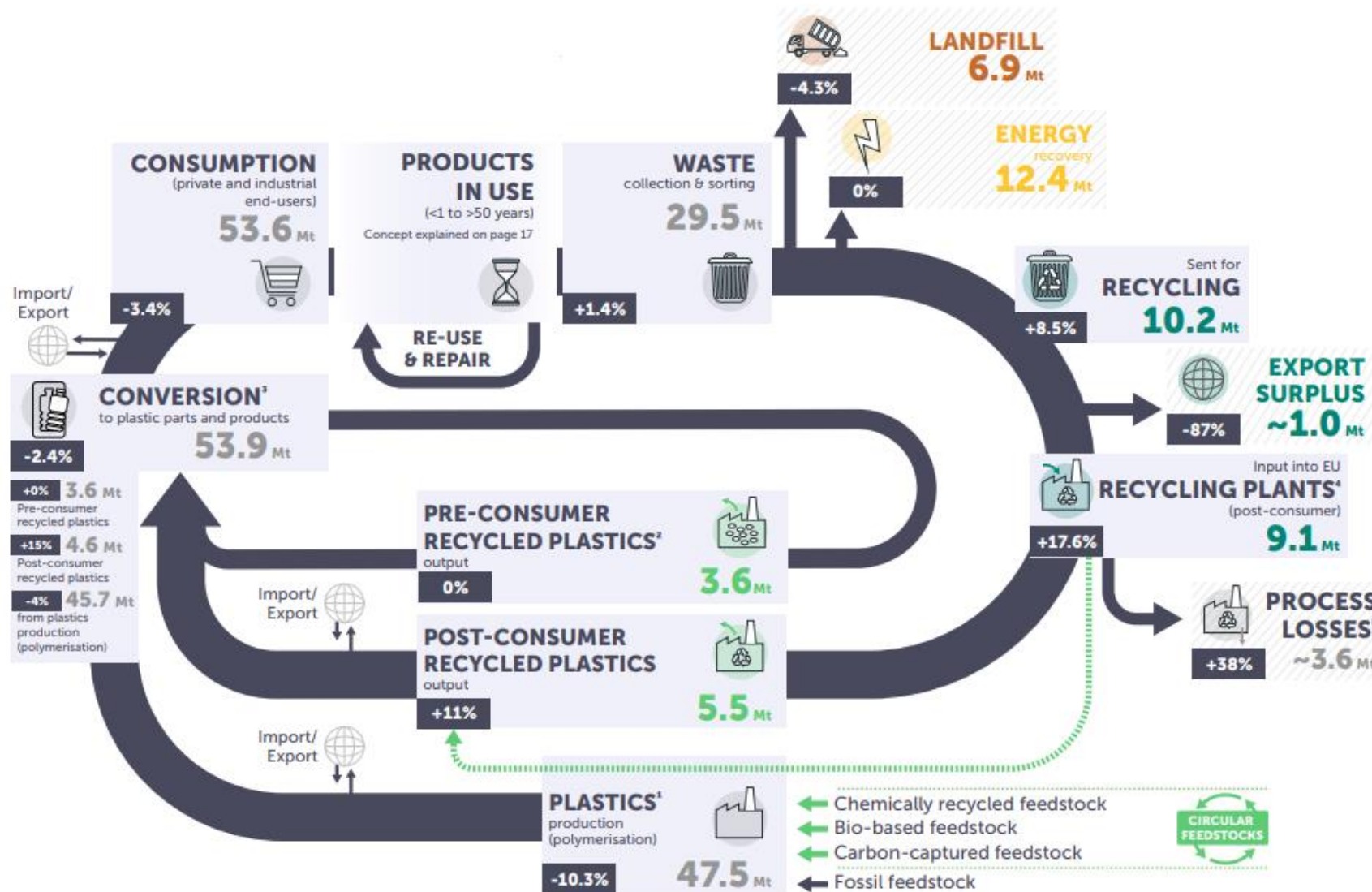


- **Project Antwerp@C:** Project of Port of Antwerp with 7 leading chemical and energy companies
- investigating technical and economic feasibility of building CO₂ infrastructure in the port of Antwerp.
- aims to keep CO₂ out of the atmosphere by capturing, utilising or storing CO₂. **9 Mln tonnes CO₂/a**



Plastics Circularity

The Circular Economy for Plastics – A European Overview – Plastics Europe



8.5% of recycled plastics (post-consumer) in the manufacturing of new products

waste going to landfill, incineration, export, needs to be diverted to recycling, and keeping the Carbon in the loop

How is chemical recycling of plastic waste contributing to the EU ambitions?

Cefic views:

- We all want to achieve a **circular economy** and meet the climate targets.
- Where possible, mechanical recycling or dissolution recycling should be used. **Chemical recycling is an important, complementary solution** to tackle plastic waste, and will be needed to hit the **recycling targets** as set out in the Proposal for Packaging and Packaging Waste Regulation.
- For the operation of chemical recycling plants, it is necessary to have a stable, continuous supply of plastic waste. Therefore, **an open, single market for plastic waste should be created.**
- **More collection and sorting of plastic waste is needed**, diverting waste from landfilling, incineration and exports
- To be successful, chemical recycling must be underpinned by a **holistic enabling policy framework** and an open investment environment.
- Europe should shift from a “waste orientation” to a “resource orientation”, **decreasing the dependency on imported fossil feedstock.**



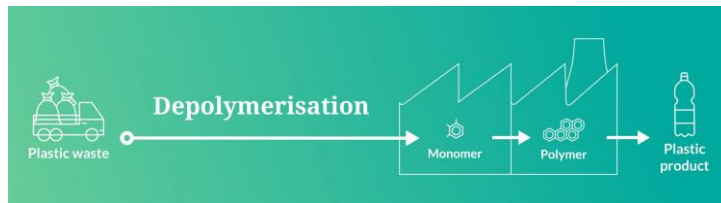
Different technologies needed to move to a circular economy: mechanical & chemical recycling are complementary technologies

Examples for CR: Chemical – Dissolution – Mechanical Recycling of Plastic Waste

Chemical

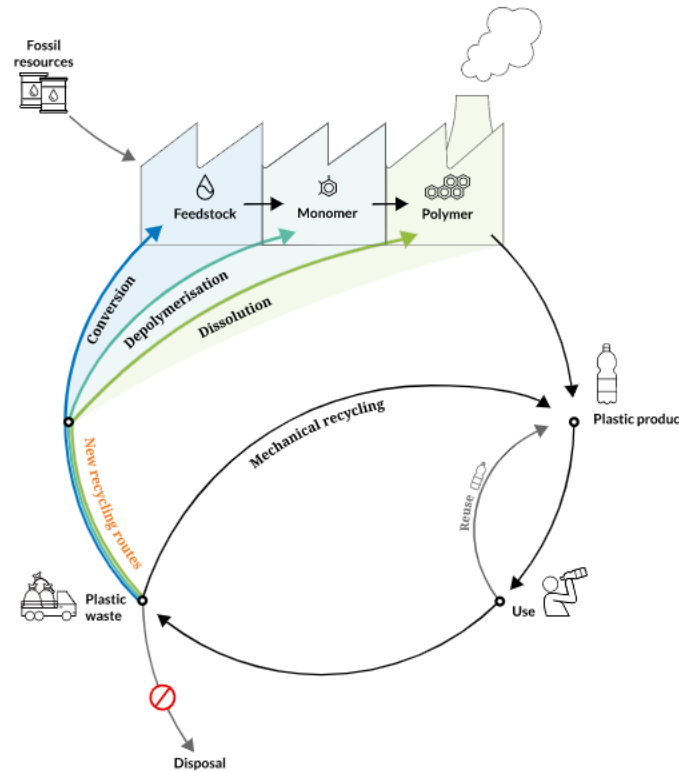
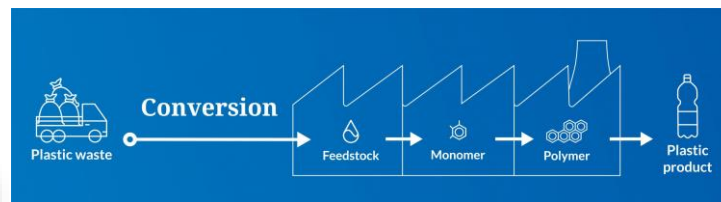
Depolymerisation

- Sorted plastic waste is **broken down** into **monomers** (basic building blocks) to feed them back into the plastic production



Conversion into Feedstock

- Mixed plastic waste is **broken down** into oil- or gas-like **feedstock** (raw materials) that is then used to produce chemicals including plastic



Mechanical

- Sorted plastic waste is **molten and granulated** into recycled plastic

Dissolution

- Sorted plastic waste is **dissolved to extract** the polymers and make new recycled plastic from them



The increasing use of secondary raw materials calls for a different chain of custody approach

Chain of custody (CoC):

- Process by which **inputs** and **outputs** and **associated information** are transferred, monitored and controlled as they move through each step in the relevant supply chain.
- *References: [ISO 22095](#)*

Cefic views:

- **Promote the principles of a chain of custody mass balance approach** for the accounting and attribution of recycled content from chemically recycled materials. Mass balance is included in the chain of custody models as defined in ISO 22095.
- **Implement transparent certification of the mass balance system**, data and claims verified by independent auditors. Help stakeholders understand the role and position of chain of custody systems in the transition towards a full circular economy for plastics.

Mass balance is a key enabler for the circular economy

Mass balance credit chain of custody with third party certification is the most suitable option to reliably and robustly account for the contribution of chemical recycling processes



Key Policy activities in 2023 that can contribute to creating that an enabling policy framework :



1. Single Use Plastics Directive (SUPD)– Implementing act

Defining calculation rules for recycled content, incorporating mass balance for chemical recycling

2. Packaging and Packaging Waste Regulation (PPWR)

- a. Recycled content targets – implementing act by 31st dec 2026
- b. Design for Recycling
- c. Recycling targets

3. Food Contact Regulation – Amendment 17 on R10/2011 and alignment with Regulation R2022/1616

4. Waste Shipment Regulation – facilitating shipments destined for recycling

5. Waste Framework Directive – End of Waste



Major investments of commercial scale have already been announced, covering different chemical recycling technologies.

Partnerships are key

Eastman to invest up to \$1 billion to accelerate circular economy through building world's largest molecular plastics recycling facility in France

January 16, 2022 - 6 min read

TotalEnergies and Indaver sign an offtake agreement for petrochemical feedstock from advanced recycling

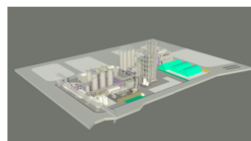
Press release, Paris - TotalEnergies, a global multi-energy company and Indaver, a leader in sustainable waste management and advanced recycling in Europe, announced a commercial agreement for the supply of petrochemical feedstock generated from recycling of mixed polyolefins waste.

Under this agreement, TotalEnergies will purchase the petrochemical feedstock produced at Indaver's first Plastics2Chemicals plant (P2C). Indaver will supply and transform post-consumer mixed plastic waste into a petrochemical feedstock at its plant in Antwerp using its proprietary depolymerization technology. Currently under construction, the plant is expected to become operational by 2024.

TotalEnergies will process this petrochemical feedstock into high-quality circular polymers at its plants in Antwerp. With properties and quality identical to virgin polymers, the recycled polymers will be suitable for a wide range of high demanding applications including food-grade packaging.

"We are delighted to support the development of advanced plastic recycling through this new offtake agreement. A collaboration throughout the value chain is critical to develop a more circular and sustainable economy. This partnership contributes to our ambition of producing 30% circular polymers by 2030.", said **Valérie Goff, Senior Vice President Renewable Fuels & Chemicals.**

"We are very pleased with this agreement. Our companies share the same vision of a true circular economy for recycled end-of-life plastics" declared **Paul De Bruycker, CEO of the Indaver Group.** "Indaver's Plastics-to-Chemicals (P2C) depolymerisation technology allows to recycle end-of-life plastics such as polyolefins and polystyrene by converting them into a petrochemical feedstock that can be used for the production of high-demand packaging materials. With P2C, we significantly expand the possibilities for recycling of end-of-life plastics waste that could previously not be recycled or only be used for conversion into low-value applications" Mr De Bruycker added.



Sabir confirms it will produce circular polymers in Europe by the end of 2022

Françoise Albasini (Photo : Courtesy of Sabir)

30 April 2022

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Located on the huge chemical platform of Brightlands Chemelot in the Netherlands, Sabir will start producing polymers from its chemical recycling process by the end of 2022. Leading cosmetics brands are already trusting the company.

LyondellBasell Makes Decision to Progress Advanced Recycling Plant in Wesseling, Germany

USA - English

lyondellbasell
Advancing Possible

NEWS PROVIDED BY
LyondellBasell
Nov 18, 2022, 07:50 ET

SHARE THIS ARTICLE

ROTTERDAM, Netherlands, Nov. 18, 2022 /PRNewswire/ -- LyondellBasell today announces it has made a decision to move forward with engineering to build an advanced recycling plant at its Wesseling, Germany, site. Using LyondellBasell's proprietary MoReTec technology, this commercial scale advanced recycling plant would convert pre-treated plastic waste into feedstock for new plastic production. The final investment decision is targeted for the end of 2023.



More investments are taking place... Visit Cefic website for a complete overview Often in collaboration with technology providers

Joint News Release

BASF and ARCUS sign agreement on the production and procurement of pyrolysis oil from mixed plastic waste

- ARCUS plans to start up first commercial pyrolysis plant for mixed plastic waste in Germany
- Supply of pyrolysis oil from mixed plastic waste enables further expansion of BASF's ChemCycling™ business
- Agreement foresees take-up of up to 100,000 tons of pyrolysis oil per year

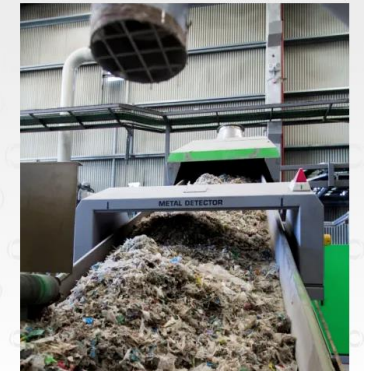
Evonik partners with The Vita Group for pioneering efficient polyurethane mattress recycling process

- The process helps the flexible polyurethane foam industry to increase circularity
- Hydrolysis technology enables used flexible polyurethane foams and mattress materials to be recycled
- Innovation will significantly reduce the number of mattresses incinerated or going into landfill each year

INEOS and Petroineos at Grangemouth partner with Plastic Energy in an important breakthrough in the recycling of plastic.

Friday, December 17, 2021 | INEOS Group

- The process will use existing refinery operations replacing oil with TACOIL made from waste flexible food packaging to remake virgin plastic for reuse in food and hygiene applications.
- This trial and the evolution of the policy environment in the UK will inform the development of a large-scale advanced recycling plant, which aims to be the first of its kind in the UK.



SHELL CHEMICALS PARK MOERDIJK ACCELERATES TRANSITION TO BECOME NET ZERO EMISSIONS AND PRODUCE MORE SUSTAINABLE CHEMICALS

Jul 13, 2022

First step is investment in upgrader plant that recycles plastic waste to produce circular chemicals.

Primeur voor Tessenderlo: Amerikaanse groep Trinseo gaat polystyreen recycleren

De Amerikaanse groep Trinseo gaat op zijn site in Tessenderlo een fabriek bouwen voor de recyclage van polystyreen afval. De investering van 50 tot 75 miljoen euro is goed voor twintig nieuwe jobs.

Dow and Mura Technology announce largest commitment of its kind to scale advanced recycling of plastics

07/21/2022

- Dow and Mura Technology to build multiple facilities in the U.S. and Europe, adding as much as 600 kilotons of aggregate advanced recycling capacity by 2030.
- Expansion of Mura's pipeline builds on its first plant in Teesside, U.K., which is on track to be fully operational in 2023.
- By using advanced recycling as a complementary technology to mechanical recycling, Dow is making significant progress towards its sustainability, climate and plastic waste reduction targets.
- Dow to become a key off-taker of circular feed from Mura, supplying major brands across the globe with sustainable products and helping to scale the elimination of plastic waste.
- Dow's support of Mura Technology provides critical resources for Mura to finance and deliver on its multi-year pipeline of advanced plastic recycling projects.



Towards the ambitions of the EU Green Deal:

Chemical Recycling: A perfect match in the mix

1. Shift from a “waste orientation” to a “resource orientation”
2. Create a single market for secondary raw materials, decreasing dependency on imported fossil feedstock
3. Progress Mass Balance as key to accelerating chemical recycling and to increasing the delivering recycled content
4. From Linear to Circular models, reducing virgin feedstock, across the full value chain.



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