EXECUTIVE SUMMARY

NEW CLIMATE INSTITUTE

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REGIONAL PRIORITIES FOR TACKLING PLASTIC LIFECYCLE IMPACTS

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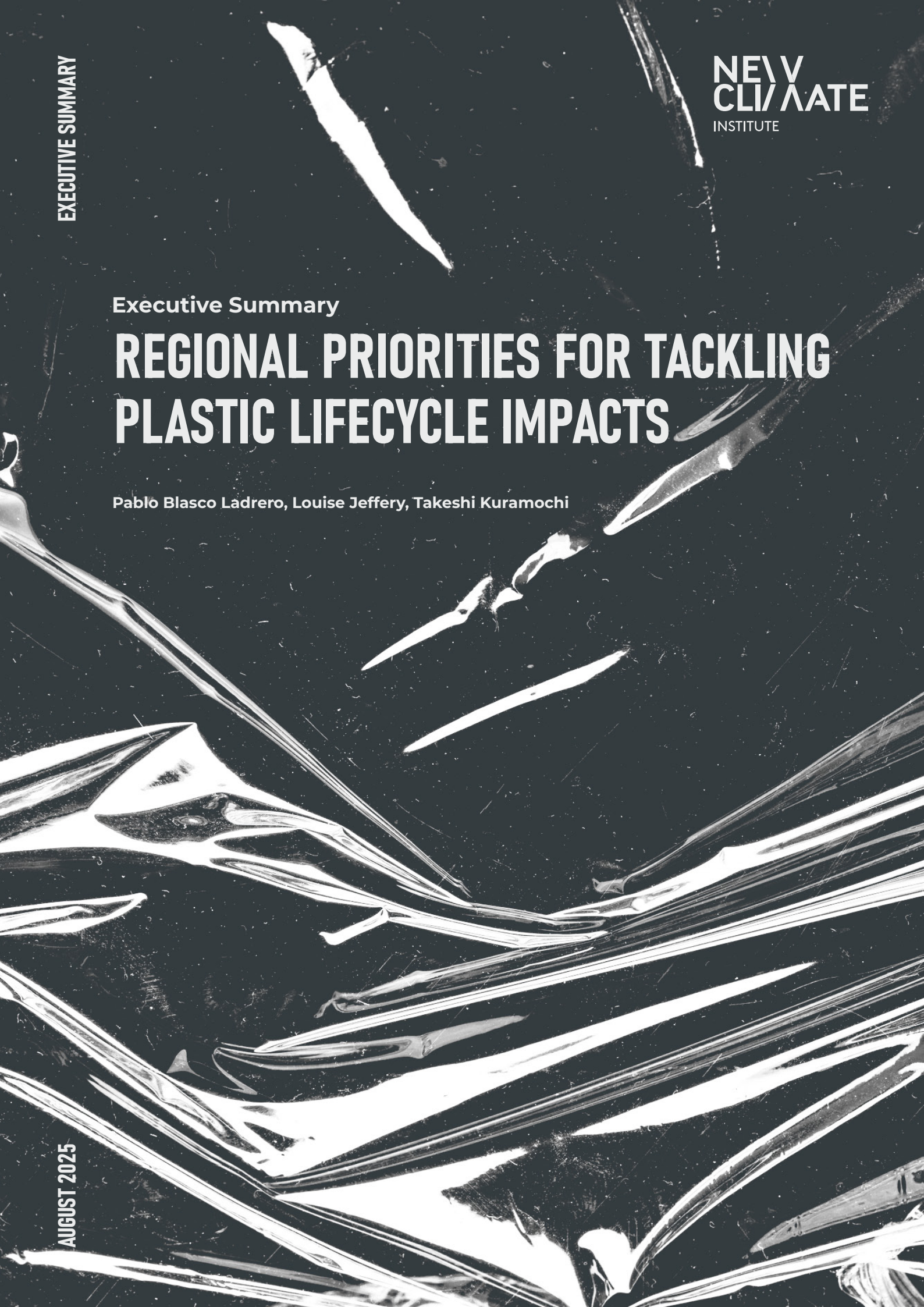

AUGUST 2025

Plastics are critical to global climate action. While public attention has focused on plastic pollution in oceans and rivers, the sector's climate impact is equally significant. The plastics sector contributes between 3%[1] and 5%[2] of global greenhouse gas (GHG) emissions – comparable to the aviation sector. This is especially concerning as plastics are one of the fastest-growing sources of industrial emissions, with production increasing from two million tonnes in 1950 to 400 million tonnes in 2022[3]. Without intervention, emissions from plastics could more than double or almost triple by 2050[2], consuming up to 31% of the remaining 1.5°C carbon budget[2].

We are at a critical moment in tackling the plastics problem. The International Legally Binding Instrument (ILBI) negotiations on plastic pollution resume in August 2025, while Nationally Determined Contributions (NDCs) with new GHG emission reduction targets for the post-2030 period are expected to be submitted before COP30 in November 2025. This presents a crucial opportunity to integrate climate considerations into global plastics governance.

Against this backdrop, this report provides a comprehensive analysis with three objectives: (1) mapping GHG emissions across the plastics value chain, (2) outlining guiding principles for a 1.5°C-aligned plastics sector, and (3) assessing policies and actions in four major players with different circumstances on plastic production, consumption, and recycling (China, the European Union, Saudi Arabia, and the United States) to identify critical gaps and possible ways forward.

1
OECD (2022) doi: 10.1787/de747aef-en
2
https://energyanalysis.lbl.gov/publications/climate-impact-primary-plastic
3
Houssini et al. (2025) doi: 10.1038/s43247-025-02169-5

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PLASTICS AS A CAUSE OF CLIMATE CHANGE AND ENVIRONMENTAL POLLUTION

GHG emissions from plastics are a major driver of exacerbating climate change. The plastics lifecycle reveals a stark concentration of emissions in the **production phase**, which accounts for 90% of total lifecycle emissions[1]. This results from energy-intensive processes – particularly steam cracking and methanol production – combined with the sector's reliance on fossil fuel as feedstock and energy input. Production emissions vary dramatically by route: the coal-based methanol-to-olefin (MTO) route has the highest emissions per tonne of plastic produced, followed by naphtha-based production using crude oil and ethane-based production using fossil gas. **End-of-life** treatment contributes the remaining 10% of emissions, primarily through incineration[1].

Plastics contribute significantly to ecosystem pollution, creating interconnected environmental crises. Approximately 30 million tonnes leaked into the environment in 2022[3], with ocean plastics projected to outweigh fish by 2050[4]. Microplastics have been found in almost every ecosystem and enter human bodies, causing health issues ranging from cognitive impairment to cancer[5].

The **use phase** critically influences both plastic production volumes and resulting waste flows. Short-lived plastics – such as single-use items – are a major driver, accounting for approximately 37%[1] of global plastic production. Consumption patterns vary significantly across regions, with per capita plastic use in high-income countries as high as 10 times that of lower income regions[1 3].

This twin crisis – climate change and pollution – demands integrated solutions.

GUIDING PRINCIPLES FOR A NET-ZERO EMISSION PLASTIC FUTURE

The report introduces guiding principles to transform the plastics sector toward net-zero emissions through a sequenced approach involving three strategies: minimise production, enhance circularity and decarbonise production **(see → Fig. 1 for a schematic representation)**. These principles address three fundamental questions: How can we reduce the need for virgin plastic? How can we produce necessary plastics without fossil feedstock? How can we power production cleanly?

The sequencing of these strategies is critical – prioritising production and demand reduction ease the implementation burden on circularity and decarbonisation technologies, while minimising the potential risk of shifting the burden of environmental impacts to new domains. Furthermore, the guiding principles consider an integrated sequencing of short-term actions and less mature long-term actions, minimising emissions over time. Beyond climate goals, the sequencing of the strategies also aims to reduce environmental pollution and health risk issues associated with it.

1
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2
https://energyanalysis.lbl.gov/publications/climate-impact-primary-plastic
3
Houssini et al. (2025) doi: 10.1038/s43247-025-02169-5
4
The New Plastics Economy: Rethinking the future of plastics
5
Symeonides et al. (2021) doi: 10.1111/jpc.15777

Strategy 1: Minimise production

This strategy aims to reduce overall plastic production and consumption by eliminating plastic uses that do not require replacement and substituting plastics with alternative materials. **Reduction of plastic production and consumption** offers a low-cost and low-emissions pathway to cutting fossil fuel dependence and can be achieved through the elimination of unnecessary plastics or material efficiency[6]. Its implementation faces behavioural lock-in challenges – particularly in high-income countries, where plastic use is deeply embedded in daily life and often perceived as a cheap and convenient option[7]. The environmental benefits of **substitution by alternatives to plastics** depend on several context-specific factors, including the weight, durability, end-of-life treatment and production footprint of the alternatives[8 9]. Beyond emissions reductions, this strategy also plays a critical role in addressing plastic waste, helping to curb environmental pollution and mitigate associated health risks.

Strategy 2: Enhance circularity

Maximising recycling reduces virgin feedstock demand through two primary routes. **Mechanical recycling**, the most mature option, can achieve 75-90% emission reductions versus virgin production[10] but currently only represents less than 10% of global plastic production[1]. The quality of waste streams and physical limitations of the process – products can only be recycled a concrete number of times – limits the amount of plastic that can be recycled through mechanical processes[11]. **Chemical recycling** can handle contaminated waste streams that mechanical recycling cannot process, but it risks diversion to fuel production rather than maintaining plastic-to-plastic circularity and is an energy- and emission-intensive process[12]. Both approaches face the fundamental limitation that recycling capacity cannot match projected demand growth, reinforcing the essential role that production and demand reduction strategies play[13]. At the same time, this strategy is also critical to reduce environmental pollution and the associated health risks.

Strategy 3: Decarbonise production

For essential remaining production, reducing the use of fossil fuel as feedstock and as an energy source is essential to reduce emissions intensity. Alternative feedstocks, whether **bio-based** or **synthetic**, face significant constraints – biomass competes with food systems[14] and other sectors decarbonisation needs[10], while synthetic routes combining captured CO_2 with green hydrogen remain at early technology readiness level (TRL 3)[12]. **Change to carbon capture utilisation and storage** (CCUS) cannot achieve 100% capture rates and risks perpetuating fossil fuel dependence[12]. Processes can be powered with the use of clean energy sources such as **green hydrogen**, but this requires massive renewable expansion and the implementation of electrolysers at the required scale[6]. **Electrification** through electric steam crackers could eliminate combustion emissions but still faces process emissions and infrastructure challenges[12]. Decarbonising remaining production over the coming decades will require a combination of these different technologies[15 16].

1
OECD (2022) doi: 10.1787/de747aef-en
6
ReShaping Plastics | SYSTEMIQ
7
Tilsted et al. (2023) doi: 10.1016/j.oneear.2023.05.018
8
Dolci et al. (2024) doi: 10.1177/0734242X241241606
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Meng et al. (2024) doi: 10.1021/acs.est.3c05191
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Mission Possible: Reaching Net-Zero Carbon Emissions - ETC
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IPCC (2022) doi: 10.1017/9781009157926
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Aligning the Global Plastics Treaty with <1.5oC
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ETC/WMGE Report 3/2021: Greenhouse gas emissions and natural capital implications of plastics (including biobased plastics) — Eionet Portal
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Meys et al. (2021) doi: 10.1126/science.abg9853
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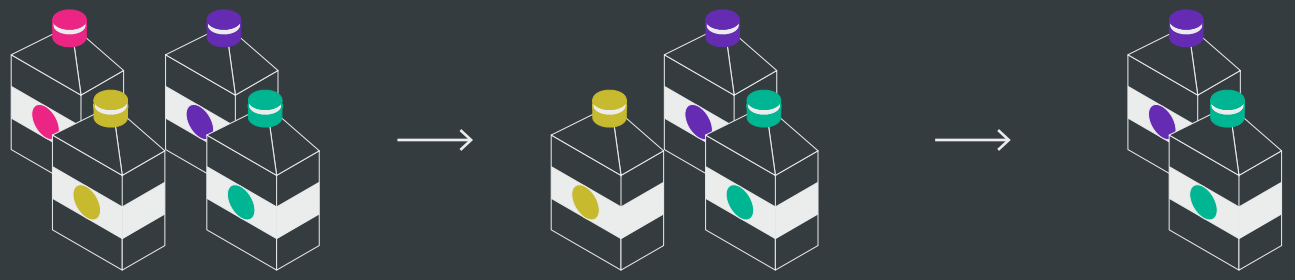
Stegmann et al. (2022) doi: 10.1038/s41586-022-05422-5

Fig. 1
Guiding principles for a net-zero emission plastic future

How can we reduce the need for virgin plastic?



Reduction of plastic production and consumption
Eliminate unnecessary plastics and reduce material intensity

Substitution by alternatives to plastics
Substitute plastic products with environmentally sound options

Enhance circularity
Keep plastic materials in a closed cycle

How can we produce necessary plastics without fossil feedstock?

Bio-based and synthetic feedstocks
Use bio or synthetic feedstock to replace fossil-based plastic

Fossil feedstocks with CCUS
For unavoidable fossil use, apply CCUS to mitigate emissions during production

How can we power production cleanly?

Electrification of production
Electrification of steam cracking and other low-temperature production processes

Clean energy sources
Green H_2 to power high-temperature processes

RISKS AND CHALLENGES OF PLASTICS DECARBONISATION: ACTIONS NEEDED TO CHANGE COURSE

Limited development and deployment of some of the key mitigation technologies pose significant risks. There is a growing risk of over-reliance on unproven technologies – such as CCUS and green hydrogen – being treated as "silver bullet" solutions, assuming future availability and scalability of these technologies. This could lead to fossil fuel lock-ins and delay necessary action today. Similarly, other technologies not yet widely available at scale, such as bio-based feedstock and chemical recycling, may pose trade-offs by shifting environmental burdens to new domains.

As the full decarbonisation of plastics requires the strategic combination of these technologies, it is essential to prioritise research, development, demonstration and deployment (RDD&D) to accelerate their maturity and availability. However, this must be accompanied by a precautionary approach, recognising the risks and challenges these technologies face. Accordingly, the guiding principles propose a sequencing of mature short-term actions with less mature long-term solutions. This approach enables immediate emissions reductions, minimising cumulative emissions and avoiding lock-in or unsustainable decarbonisation pathways.

POLICIES AND MEASURES IN SELECTED MAJOR ECONOMIES WITH DIFFERENT NATIONAL CIRCUMSTANCES

The report analyses China, the European Union (EU), Saudi Arabia, and the United States (US) because they collectively dominate global plastics across all dimensions – fossil extraction, feedstock production, manufacturing, consumption and trade. Each represents a distinct production route and faces unique challenges.

Tab. 1
Characteristics of the four selected major economies related to plastic lifecycles, with classification based on global comparisons

*Fossil fuel outputs of the refining process of crude oil and fossil gas that are used as basic building blocks in the production of plastics

** Final plastic product, ready to be used.

	China	EU	Saudi Arabia	US
Plastic production [by volume]	Largest producer	Third largest producer	Not top 10 producer of plastic products	Second largest producer
Production system	Coal – based/ MTO	Crude oil – based/ Naphtha	Fossil gas – based/ Ethane	Fossil gas – based/ Ethane
Plastic use	Largest consumer by volume	Second largest per capita consumer	Not top 10 consumer	Largest per capita consumer
Trade	Largest importer of refined products* Largest exporter of plastic products**	Important role as importer and exporter in every category	Second largest exporter of refined products*	Largest exporter of refined products*
Key importance	Largest consumer and producer of plastic products**	Declining producer and high per capita consumer	Large producer of refined products* for other regions	Large producer and highest per capita consumer

Globally, there are a disproportionately small number of climate-related policies that explicitly address plastics[17], and policies on reducing emissions from industrial energy use have historically also been sparse[18]. The four countries selected here are no exception.

Many countries have introduced regulations targeting plastic pollution[19], primarily aimed at reducing environmental leakage. Measures such as China's Plastic Pollution Control Action Plan[20] and the EU's Single-Use Plastic Directive[21] target limited **production reduction** goals by banning specific plastic categories.

Circularity is promoted through instruments like the EU's Packaging and Packaging Waste Regulation[22], which aims to enhance reusability and recyclability. However, these policies often fall short due to limited scope (e.g. only addressing limited plastic types), vague targets and insufficient focus on systemic and behavioural change.

Specific **decarbonisation** plans for the plastic industry are not developed and some of the policies and targets analysed may even increase emissions. For example, China's Clean and Efficient Use of Coal[23] promotes coal use in the chemical industry and Saudi Arabia's Vision 2030[24] encourages growth in gas-based sectors like plastic production.

17
https://www.iea.org/policies/ (accessed 31 July 2025). Only 36 out of more than 11,000 policies in the database mentioned 'plastic'.
18
Nascimento et al. (2021) doi: 10.1080/14693062.2021.1993776
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The plastics landscape: regulations, policies and influencers | Engagement guide | PRI
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国家发展改革委 生态环境部关于印发"十四五"塑料污染治理行动方案的通知_国务院部门文件_中国政府网
21
Directive - 2019/904 - EN - SUP Directive - EUR-Lex
22
Regulation - EU - 2025/40 - EN - EUR-Lex
23
【关于加强煤炭清洁高效利用的意见(发改运行〔2024〕1345号)】-国家发展和改革委员会
24
National Industrial Development and Logistics Program

WAY FORWARD

Immediate action is needed to reduce plastic production and demand through **reduction of plastic production and consumption, substitution by alternatives to plastics** with environmentally sound options and **enhanced circularity**. The ILBI can play a pivotal role by establishing globally agreed targets in these areas. While the current draft includes options covering these topics, ambition must increase and be formalised in the next negotiation round.

Full **decarbonisation** of the plastic sector requires industrial transformation of the current production systems. Good alignment between the ILBI and the UNFCCC process could provide incentives to countries to take stronger action. Both processes must work together and inform each other to address complex climate impacts of plastics, avoiding siloed measures and decisions. As countries prepare their next round of NDCs, it is critical that these are aligned with a 1.5°C-compatible emissions pathway, setting absolute, economy-wide, emission reduction targets underpinned by robust national planning processes putting into action all sectors[25]. The mitigation of plastic-related GHG emissions should therefore be explicitly considered when preparing the post-2030 NDCs. Long-term low-emissions development strategies (LT-LEDS) need to detail how each country intends to align its plastic production and consumption with its long-term decarbonisation goals.

Regional imperatives and leadership

Countries dominating global plastic production and consumption are also among the world's major economies. These regions possess the economic and technological capacity to lead decarbonisation of the plastics sector through domestic policy, global cooperation and investment in RDD&D for emerging technologies. Moreover, financial support to other countries should be lead primarily from these regions to support global decarbonisation of the sector.

Decarbonising plastics requires distributed and coordinated leadership ensuring consumption and production systems are addressed globally. To implement an ambitious **phase-out of unnecessary plastics and reduce overall plastic use**, countries with high per capita consumption must take the lead, driving systemic changes in how plastics are consumed and perceived in their countries. At the same time, regions with lower per capita consumption must avoid building unnecessary dependencies on plastics as their economies and populations grow.

Alternative materials to plastics, need to be addressed through regionally appropriate strategies, ensuring sustainable use and avoiding resource over-exploitation. **Circularity** must be enhanced globally, with countries that have already advanced recycling infrastructure supporting processing of waste streams from regions with limited access to these technologies and transferring the required technology.

25
The Climate Action Tracker guide to a good climate target

Major producing countries must **decarbonise** their production systems. Those with upcoming infrastructure renovation needs have a unique opportunity to align new investments with clean technologies. Countries with relatively new plastic production facilities should plan for retrofitting to cleaner feedstocks and adapting to cleaner energy sources. Fossil-dependent countries must explore new strategic roles in a decarbonised plastic future, leveraging their specific advantages to support the transition of the sector. Countries decarbonisation plans must avoid overreliance on single-technology solutions – specially on technologies that are currently under development or not ready at scale – given the risks they pose to achieving emissions reduction targets.

Time for an ambitious ILBI on plastics

Plastic sectors decarbonisation requires systemic transformations, eliminating unnecessary usage of these products and shifting from cheap availability and fast disposability of plastic products to durability and reuse, especially in high-income countries. Technical solutions need to be further deployed and developed to achieve the full decarbonisation of the sector, avoiding overreliance on certain technology solutions.

The August 2025 ILBI negotiations represent a critical moment to integrate climate considerations into global plastics governance. Success will require not only strong commitments to reduce environmental plastic pollution but also clear ambition to address the sector's climate impact – recognising that pollution and emissions are inherently linked.

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