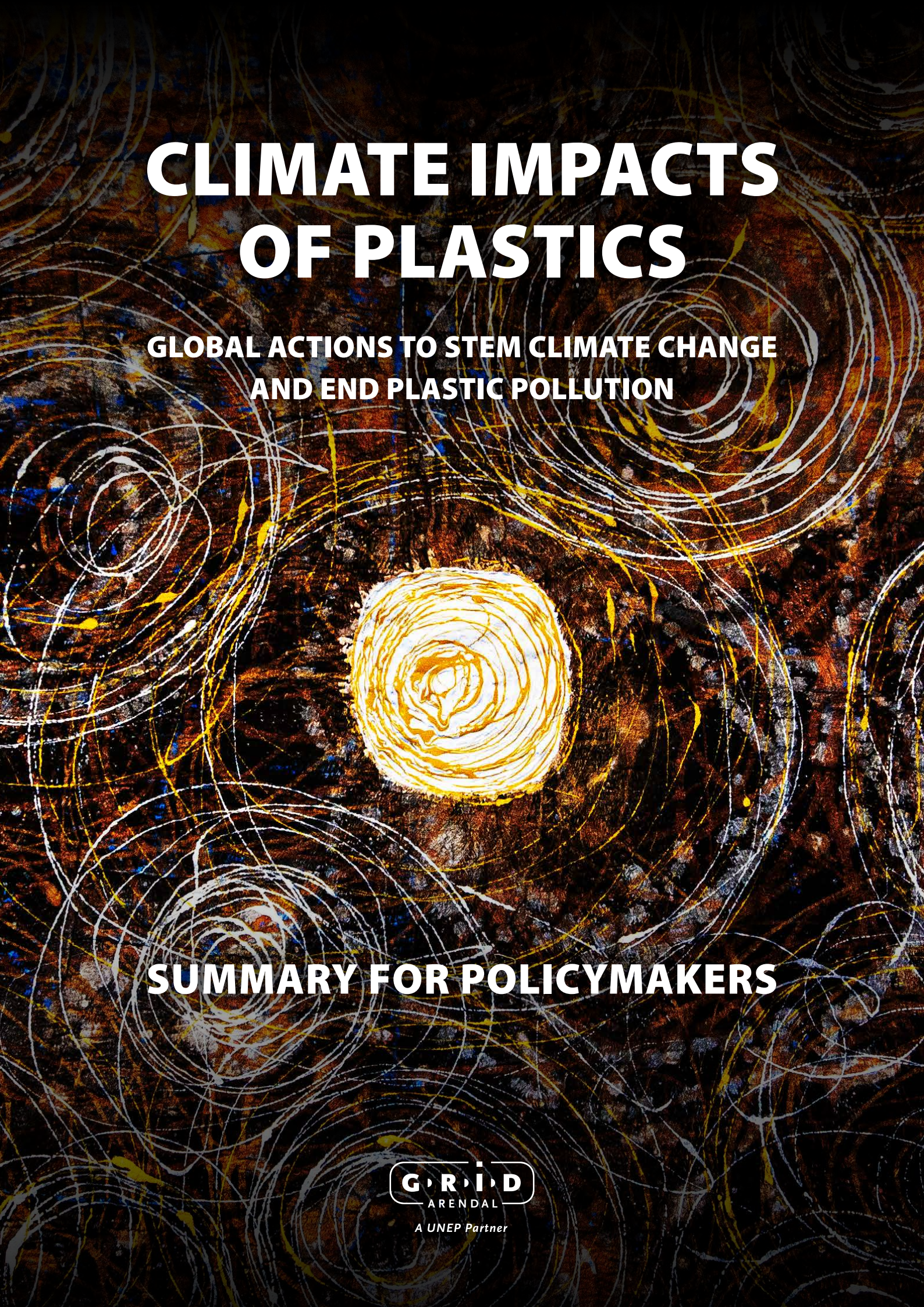


The background is a dark, textured surface with intricate, swirling patterns in shades of brown, gold, and white. A prominent, glowing, circular orb with concentric rings of light is centered in the middle of the page.

CLIMATE IMPACTS OF PLASTICS

**GLOBAL ACTIONS TO STEM CLIMATE CHANGE
AND END PLASTIC POLLUTION**

SUMMARY FOR POLICYMAKERS



A UNEP Partner

The GRID-Arendal report “Climate impacts of plastics: Global actions to stem climate change and end plastic pollution” (2024) seeks to identify possible measures to strengthen governmental accountability in addressing the climate impacts of plastics. It aims to maximise the climate benefits of the plastics instrument by clearly delineating its responsibilities in conjunction with the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. This summary for policymakers provides the key findings of the report’s comprehensive literature and content analysis.

Key findings

Despite not directly focusing on plastic pollution, the UNFCCC and the Paris Agreement have both guided actions to address the climate impacts of plastics. An analysis of national reports under these agreements revealed that countries often highlight plastic waste management efforts in their reports. However, the fact that the plastics industry is generally treated more broadly as part of the chemical and petrochemical industries is limiting the understanding of current activities to reduce and mitigate emissions associated with the plastics industry.

The UNFCCC and the Paris Agreement have the potential to significantly reduce the greenhouse gas emissions of plastics by steering the decarbonisation of the plastics life cycle, which heavily relies on fossil resources for energy-intensive production processes. Indirect emissions from fuel combustion are greater than direct emissions for plastic production, highlighting the urgent need for energy reform in the industry (Cabernard *et al.* 2022). Shifting towards renewable energy sources and improving energy efficiency aligns with the outcome of the first global stocktake from the twenty-eighth session of the Conference of the Parties (COP 28) to the UNFCCC, which calls for moving away from fossil-based energy systems (UNFCCC 2023).

The development and the implementation of the international legally binding instrument on plastic pollution, including in the marine environment, (the instrument) provides **a unique opportunity to strengthen global efforts in addressing climate change across the plastics life cycle**, complementing the broader decarbonisation activities of the UNFCCC and the Paris Agreement. To achieve these goals, it is recommended that the instrument:

- Explicitly recognise greenhouse gas emissions as a form of plastic pollutant that will need to be minimised across the plastics life cycle.

- **Reduce overall production of primary polymers** by reducing their use, increasing the use of secondary plastics, phasing out problematic, unnecessary and avoidable plastic products and increasing the use of low-carbon non-plastic substitutes.
- **Limits greenhouse gas emissions by developing design criteria that focus on** 1) employing low-carbon polymers, 2) using polymers with low net-energy requirements considering the full life cycle, particularly production, and that are suitable for reuse/refill systems and mechanical recycling, and 3) minimising the release of microplastics.
- **Limits greenhouse gas emissions from waste management** by 1) limiting open burning and other forms of mismanagement of plastic waste, and 2) developing criteria to support the life cycle assessment of waste management facilities towards investment in lower-emitting technologies and avoiding lock-ins to high-emitting technologies.
- **Highlights the critical need to address plastic pollution in the environment** and its impacts on climate change through proactive measures on environmental and landfill remediation.
- **Strengthens trade control measures** to include considerations of greenhouse gas emissions.

The absence of internationally agreed definitions and harmonised terminology in research and national reporting presents a significant challenge in understanding and communicating intervention points for addressing the climate impacts of plastics. Clear definitions for the life cycle stages and associated measures are needed to help generate a common understanding of the problem, its broader linkages to climate change, and necessary interventions to address them.

The scientific evidence

Scientific evidence shows that climate impacts are generated at every stage of the plastics life cycle. Greenhouse gases emitted across the entire plastics life cycle are estimated to account for 3.8 per cent to 4.5 per cent of total greenhouse gas emissions (Hamilton and Feit 2019; Zheng and Suh 2019; Cabernard *et al.* 2022). This is set to grow with a projected increase in primary plastic production, which poses a substantial challenge to global efforts to limit global temperature rise to below 1.5°C (Masson-Delmotte *et al.* 2018).

The plastic production stage accounts for 85 per cent of greenhouse gas emissions and the sourcing of raw materials for 9 per cent, whereas the waste management stage accounts for 6 per cent of total plastics-related emissions (Cabernard *et al.* 2022) (Figure 1). Calculations of emissions from waste management exclude emissions from uncontrolled waste disposal and open burning. Furthermore, greenhouse gas emissions linked to the use and reuse of plastics are not quantified and remain an area of uncertainty.

In 2015, plastics contributed to 2 gigatonnes (Gt) of carbon dioxide equivalent (CO₂e) annually (Cabernard *et al.* 2022). The production and manufacture of plastic polymers is energy intensive and relies predominantly on energy from fossil fuels, such as coal (Hamilton and Feit 2019). Around

85 per cent of all greenhouse gas emissions from plastics stem from the combustion of fossil resources, both directly during production and indirectly through related activities, such as transport and electricity generation (Cabernard *et al.* 2022). Furthermore, the production landscape remains dominated by fossil-based plastics, accounting for approximately 90.6 per cent of global production (Plastics Europe 2023). Secondary plastics constitute 9 per cent, bio-based plastics comprise 0.5 per cent, and carbon-captured <0.1 per cent of global production (Plastics Europe 2023).

The carbon content of plastics is estimated at 890 megatonnes (Mt) of CO₂e annually (Cabernard *et al.* 2022). Of this, only 120 Mt of CO₂e are emitted during the waste management stage, due to a combination of energy recovery processes and carbon stored in plastics that are landfilled or leak into the environment. Recent studies, however, highlight that plastic pollution further exacerbates climate change through negative feedback loops observed in various environments, such as sediments, water columns, soil, the cryosphere, and the atmosphere (Cole *et al.* 2016; Shen *et al.* 2020; Revell *et al.* 2021; Kida *et al.* 2022; Zhang *et al.* 2022; Chia *et al.* 2023). These complex interactions suggest that the true impact of plastics on greenhouse gas emissions is likely substantially higher than current estimates indicate, pointing to a considerable underestimation of their environmental impact.

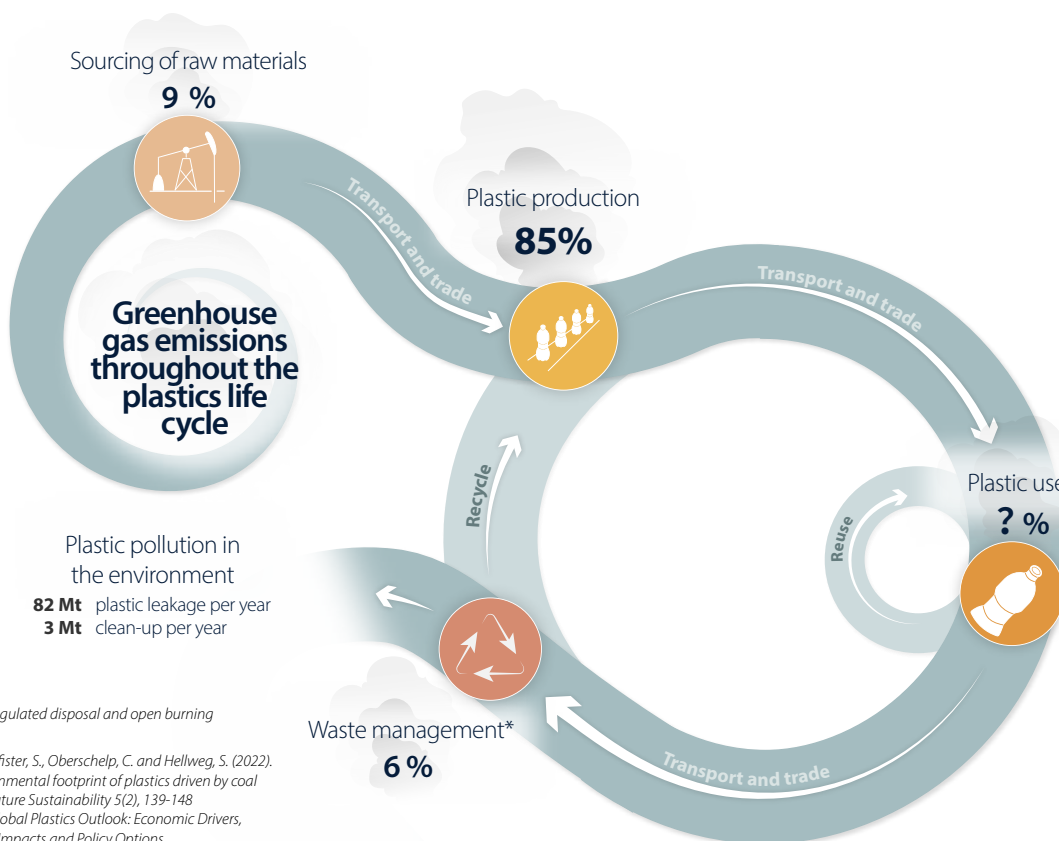


Figure 1. Greenhouse gas emissions across the plastics life cycle.

The role of the plastics instrument in stemming climate change

For the instrument to effectively address the climate impacts of plastics, it should explicitly recognise greenhouse gas emissions as a plastic pollutant. This aligns with the United Nations Environment Assembly (UNEA) resolution 5/14, which mandates the development of an international legally binding instrument based on “a comprehensive approach that addresses the full life cycle of plastics” (United Nations Environment Programme [UNEP] 2022).

The zero draft of the plastics instrument supports this comprehensive approach by defining plastic pollution as “the negative effects and emissions resulting from the production and consumption of plastic materials and products across their entire life cycle” (UNEP 2023). This inclusive definition is essential for addressing plastic pollution as part of a wider strategy to tackle the triple planetary crisis, not only as a waste-centric problem but also in relation to its impacts on climate change and biodiversity loss.

The instrument should also align with the global goal set by the Paris Agreement to keep the global temperature below 2°C, preferably aiming for 1.5°C, compared with pre-industrial levels, and incentivise climate co-benefiting actions to strengthen its climate dimension. This could be further supported by acknowledging the instrument’s role in the protection of the climate system alongside its role in safeguarding human health and the environment.

Against this backdrop, this report outlines specific measures to combat climate change alongside the plastics life cycle. To generate the greatest impacts regarding greenhouse gas reduction, the primary focus must be on reducing the production of plastics and focusing on low-carbon design. Limiting greenhouse gas emissions from waste management and remediation also play important roles. More specifically, under the plastics instrument, negotiators can strengthen global climate action by developing measures as provided in Table 1.

Table 1. Measures under the plastics instrument

Sourcing of raw materials	Production of plastics	Plastic use and reuse	Waste management	Plastic pollution in the environment
• Sourcing/extraction reduced through effective implementation of measures under the plastics instrument	• Reduce use of primary polymers • Increase use of secondary plastics • Minimise production of problematic, unnecessary, and avoidable plastics • Increase use of low-carbon non-plastic substitutes • Include low-carbon feedstocks in design criteria • Include low-carbon polymers in design criteria • Include minimisation of microplastic releases in design criteria	• Develop and expand scalable models for reuse and refill systems	• Minimise open burning and other forms of plastic waste mismanagement • Minimise the carbon footprint in plastic waste management	• Promote environmental and landfill remediation

The role of the UNFCCC and the Paris Agreement in addressing plastic-related emissions

Under the UNFCCC and the Paris Agreement, there is opportunity to strengthen efforts to reduce overall greenhouse gas emissions across the plastics life cycle. The greatest potential for such emission reductions lies in the decarbonisation of the plastics life cycle and the energy used in production processes, such as heating, electricity generation and transport, which complements the activities of the plastics instrument. Acknowledging the urgent need to avoid “carbon lock-ins” associated with long-term infrastructure investments will be crucial for success.

However, the absence of direct reference to plastics as a material and the plastics industry is a critical gap in the UNFCCC and the Paris Agreement. An analysis of national reports under the UNFCCC and the Paris Agreement revealed the lack of a comprehensive reporting mechanism to account for the contribution of plastics to climate change and to assess the effectiveness of mitigation actions to reduce emissions associated with plastics.

Recent developments under the UNFCCC and the Paris Agreement are providing momentum for more targeted action on plastics. The conclusion of the first global stocktake of climate action under the Paris Agreement led to the adoption of a decision at COP 28 that calls for “transitioning away from fossil fuels in energy systems,

in a just, orderly, and equitable manner, accelerating action in this critical decade, so as to achieve net zero by 2050” (UNFCCC 2023). This marks a pivotal step towards decarbonising the plastics life cycle, although it presently addresses fossil fuels in energy systems only, not as feedstocks in plastic production.

A decision adopted at the twenty-seventh Conference of the Parties (COP 27) to the UNFCCC in the Sharm El-Sheikh Implementation Plan, which notes “the importance of transition to sustainable lifestyles and sustainable patterns of consumption and production for efforts to address climate change” (UNFCCC 2022), plays an important role in recognising the energy-intensive nature of plastics production and the work towards decarbonising the plastics life cycle. Moreover, the decision on the first global stocktake adopted at COP 28 notes the importance of circular economy approaches in this regard (UNFCCC 2023).

The role of nationally determined contributions (NDCs) in decarbonising the entire life cycle of plastics should be emphasised. Similarly, Long-term Low-emission Development Strategies (LT-LEDS), encouraged under the Paris Agreement, are also crucial in this regard, especially for strategic long-term planning to transition to net-zero emissions by, or around, mid-century.

Collaborative action to mitigate climate impacts of plastics

The plastics instrument, the UNFCCC, and the Paris Agreement could explore collaborative activities that aim to:

- Promote research, innovation and low-carbon technology development to expedite the reduction of greenhouse gas emissions and to remove uncertainties related to certain technologies, such as chemical conversion and carbon capture and utilisation, before their inclusion in the agreements.
- Strengthen transparency and accountability by developing an indicator framework to track climate-

related measures under the new plastics instrument and disaggregate plastics-related greenhouse gas emissions under the UNFCCC and the Paris Agreement.

- Scale sustainable financing from public and private sources to address the climate component of plastics and emphasise the need for the financial sector to redirect investments away from fossil-based and emissions-intensive petrochemical production and disposal practices, in order to prevent carbon lock-ins.

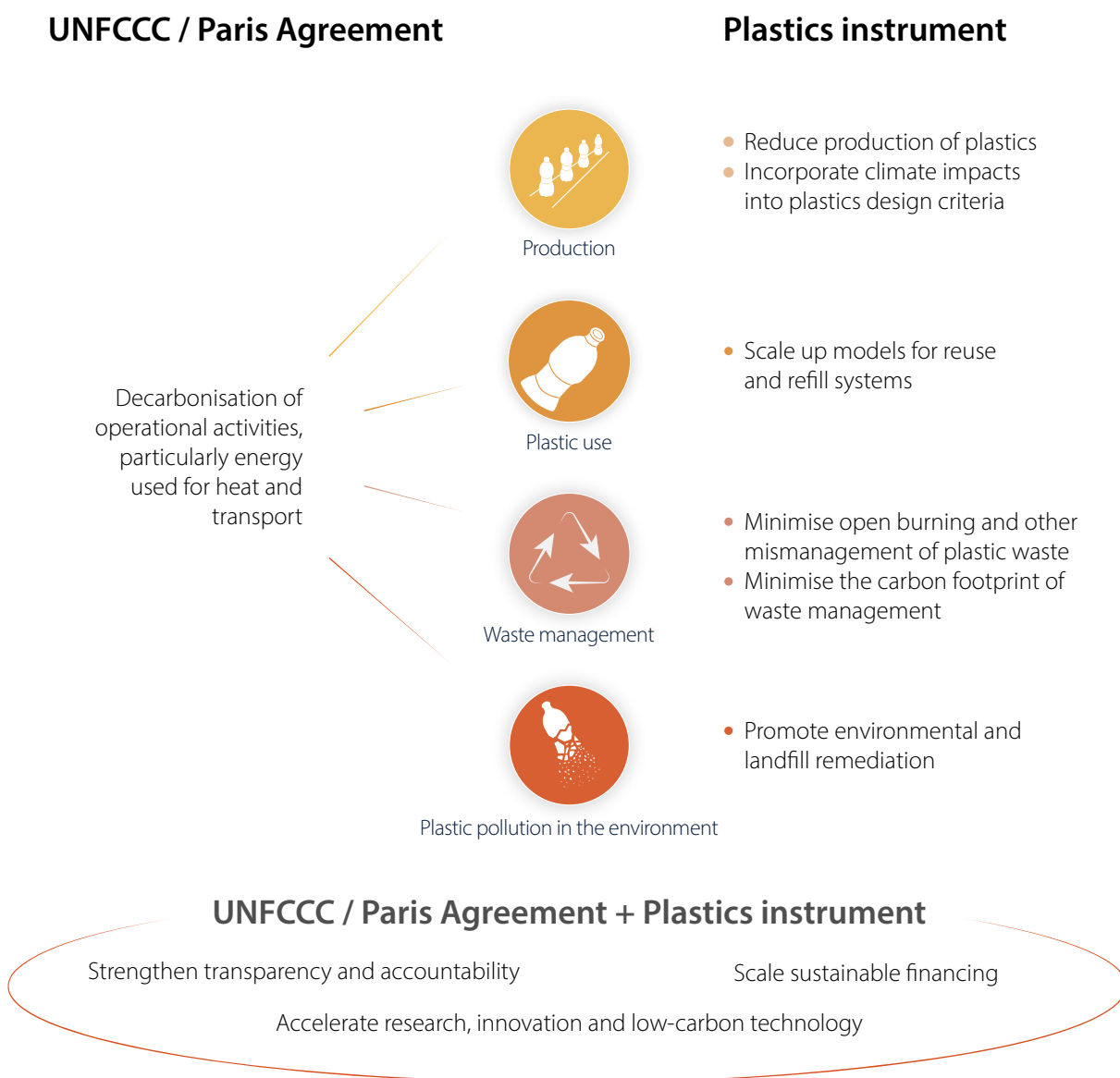
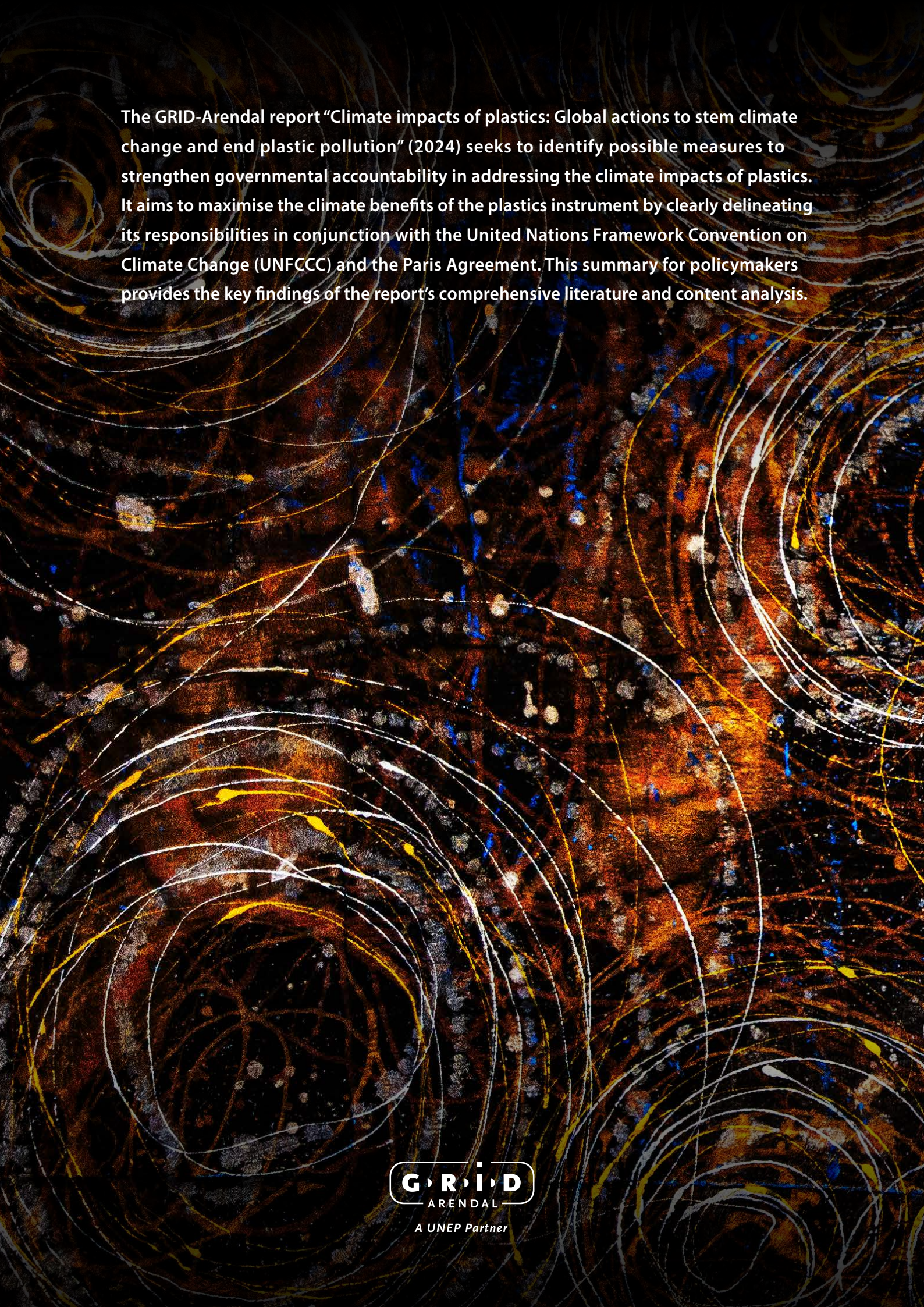


Figure 2. Summary of measures suggested to optimise climate outcomes under the plastics instrument, the UNFCCC and the Paris Agreement.

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