



# *UNEP Green and Sustainable Chemistry Manuals*

**Sandra Averous-Monnery, UNEP**

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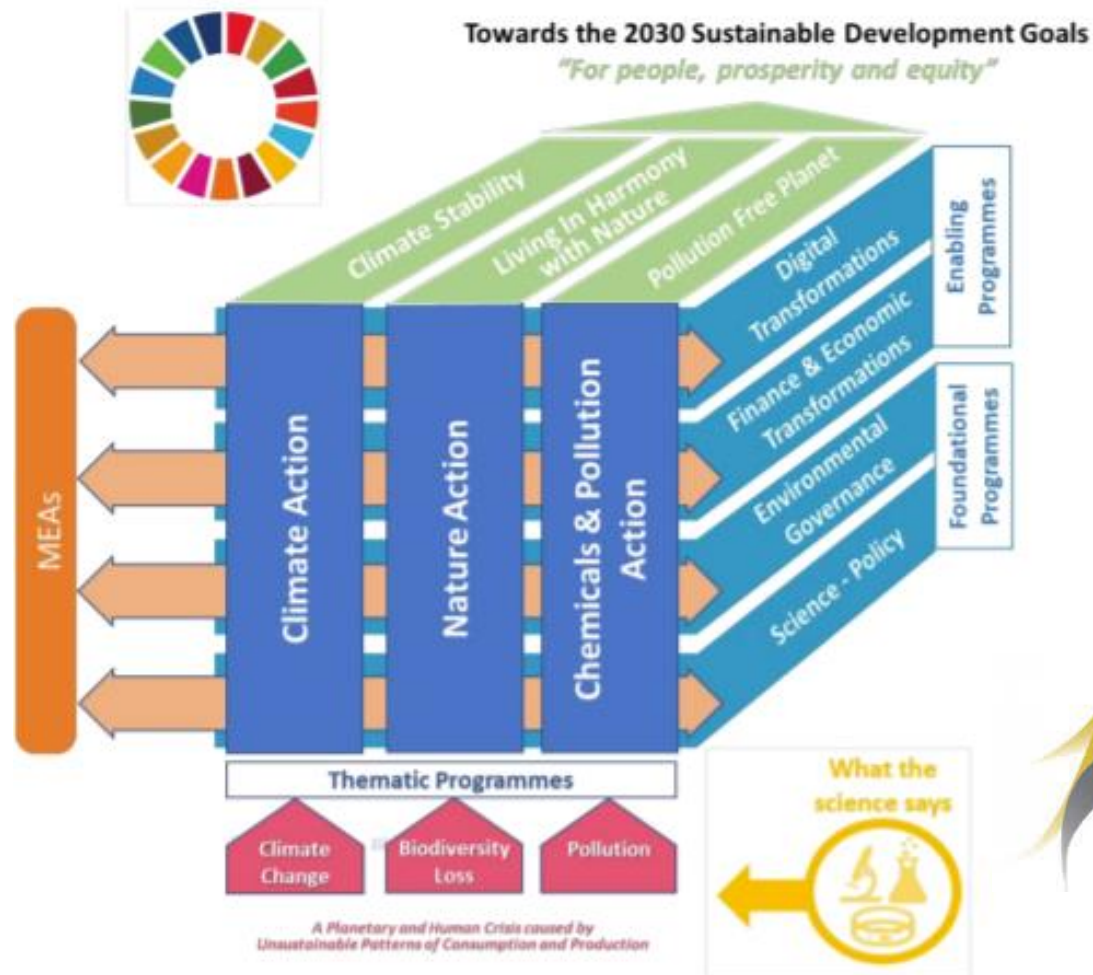
XIII IUPAC POSTGRADUATE SUMMER SCHOOL ON GREEN CHEMISTRY – 7/9/2021

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# UNEP and Chemicals and Waste Management



Sets the global environmental agenda  
Implements the environmental dimension of sustainable development



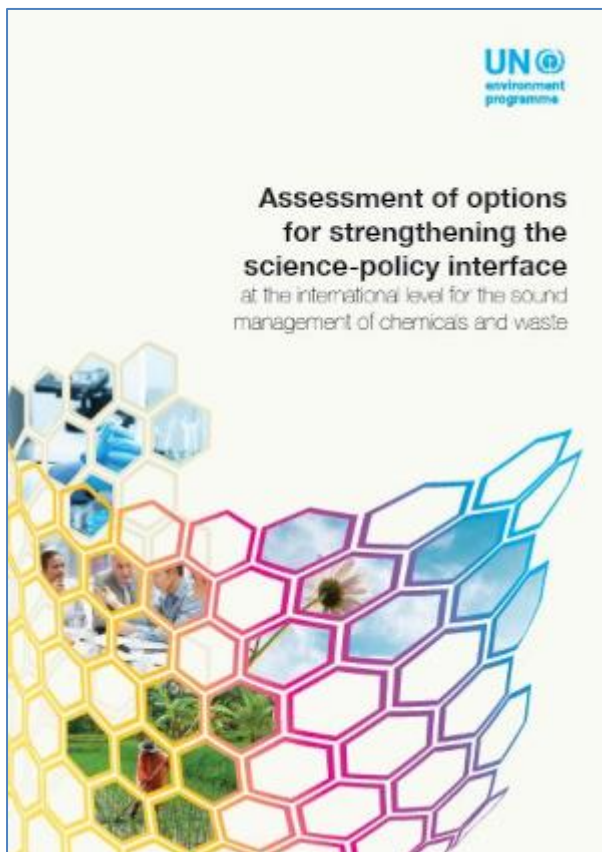
UNEP develops mainstream solutions for the sound management of chemicals and waste



MINAMATA  
CONVENTION  
ON MERCURY



# Chemicals and Waste – UNEP reports



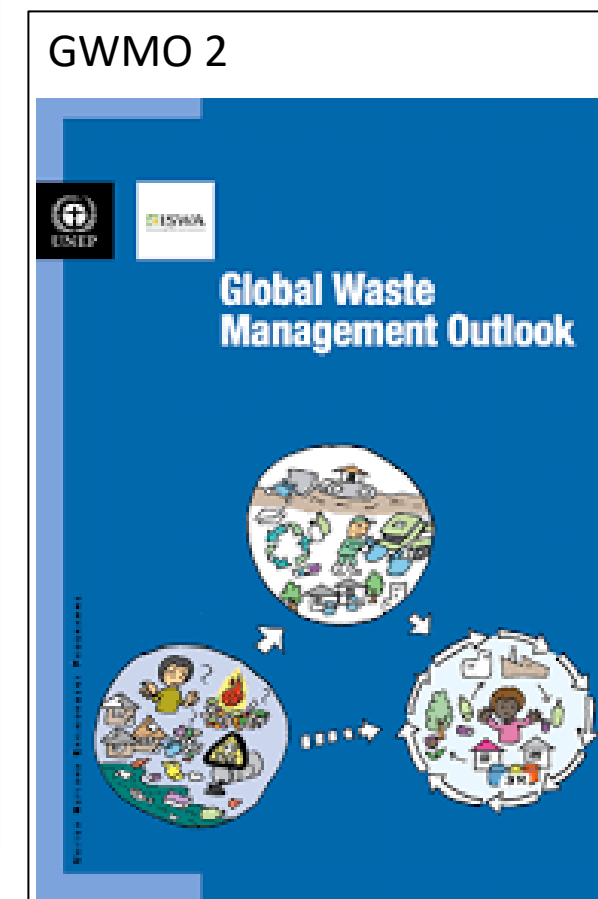
[Assessment of options for strengthening the science-policy interface at the international level for sound management of chemicals and waste](#)



[An Assessment Report on Issues of Concern: Chemicals and Waste Issues Posing Risks to Human Health and the Environment](#)



[Green and Sustainable Chemistry: Framework Manual](#)



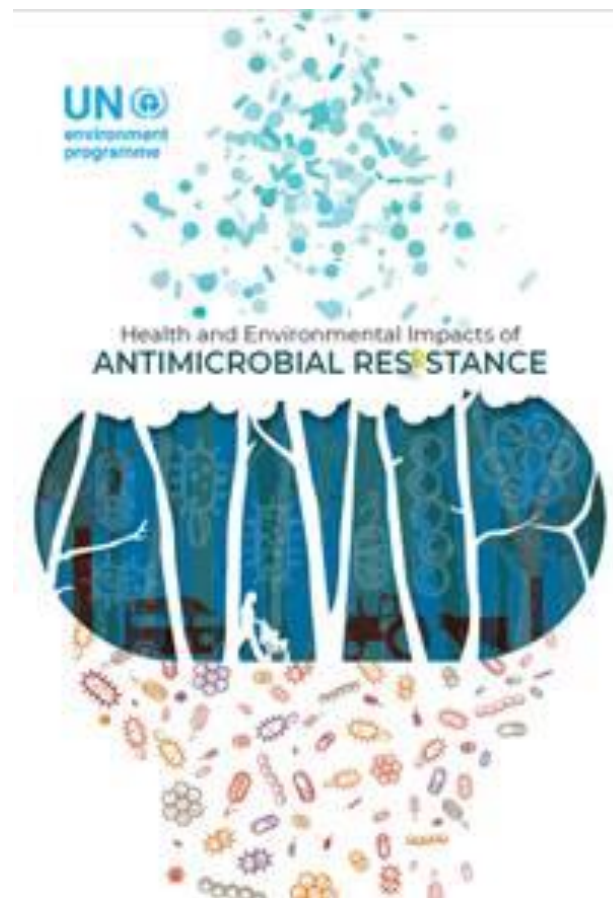
[Global Waste Management Outlook](#)



# Chemicals and Waste - UNEP reports



[Environmental and health impacts of pesticides and fertilizers and ways of minimizing them - A summary for policy makers](#)



[UNEP Website on Antimicrobial Resistance](#)

UNITED  
NATIONS

EP

UNEP/EA.4/3

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United Nations  
Environment Assembly of the  
United Nations Environment  
Programme

United Nations Environment Assembly of the  
United Nations Environment Programme  
Fourth session  
Nairobi, 11-15 March 2019  
Item 6 of the provisional agenda\*

Programme of work and budget, and other  
administrative and budgetary issues

**Implementation plan "Towards a Pollution-Free Planet"**

Proposal by the Executive Director

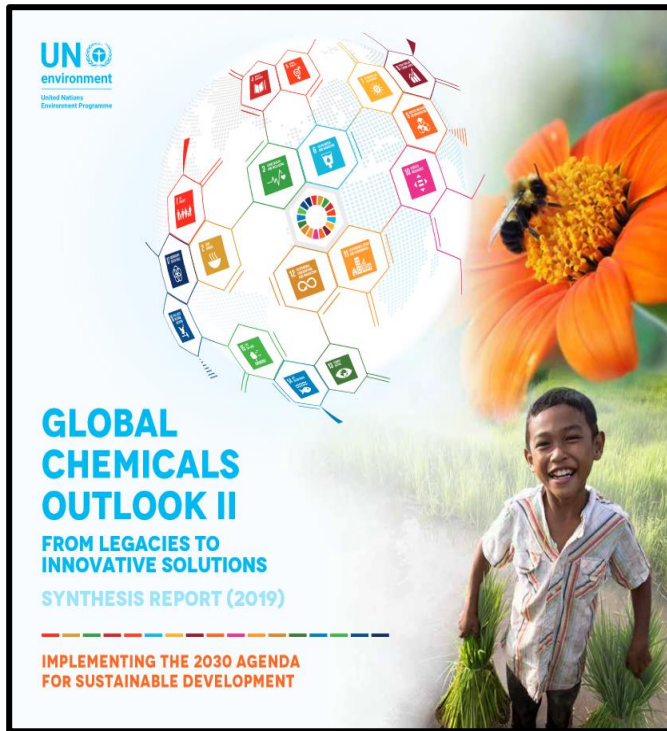
*Summary*

In 2017, member States adopted a ministerial declaration as a key outcome of the third session of the United Nations Environment Assembly of the United Nations Environment Programme (UNEP). In the declaration, ministers for the environment requested the Executive Director of UNEP to prepare an implementation plan on the issue of a pollution-free planet for consideration by the Environment Assembly at its fourth session. The present proposal has been prepared in response to that request.

[UNEP Implementation Plan "Towards a Pollution-Free Planet"](#)

# Current trends from the GCO II

**“Business as usual is not an option”**



[Global Chemicals Outlook II Website](https://www.unep.org/globalchemicals/outlook-ii)



Hazardous chemicals and other pollutants continue to be released and are ubiquitous in humans and the environment – even in the remotest areas



With consumption and production rapidly increasing, the global chemical industry is expected to double - making \$10 trillion in sales by 2030



In 2016 WHO estimated the burden of diseases from selected chemicals cost 1.6 million lives in 2016

*Global Chemicals Outlook II –Synthesis Report, UNEP, 2019*

# The 2030 Sustainable Development Agenda and the SDGs

Unveil the full potential of chemistry such that it is compatible with and supports the implementation of the 2030 Sustainable Development Agenda.

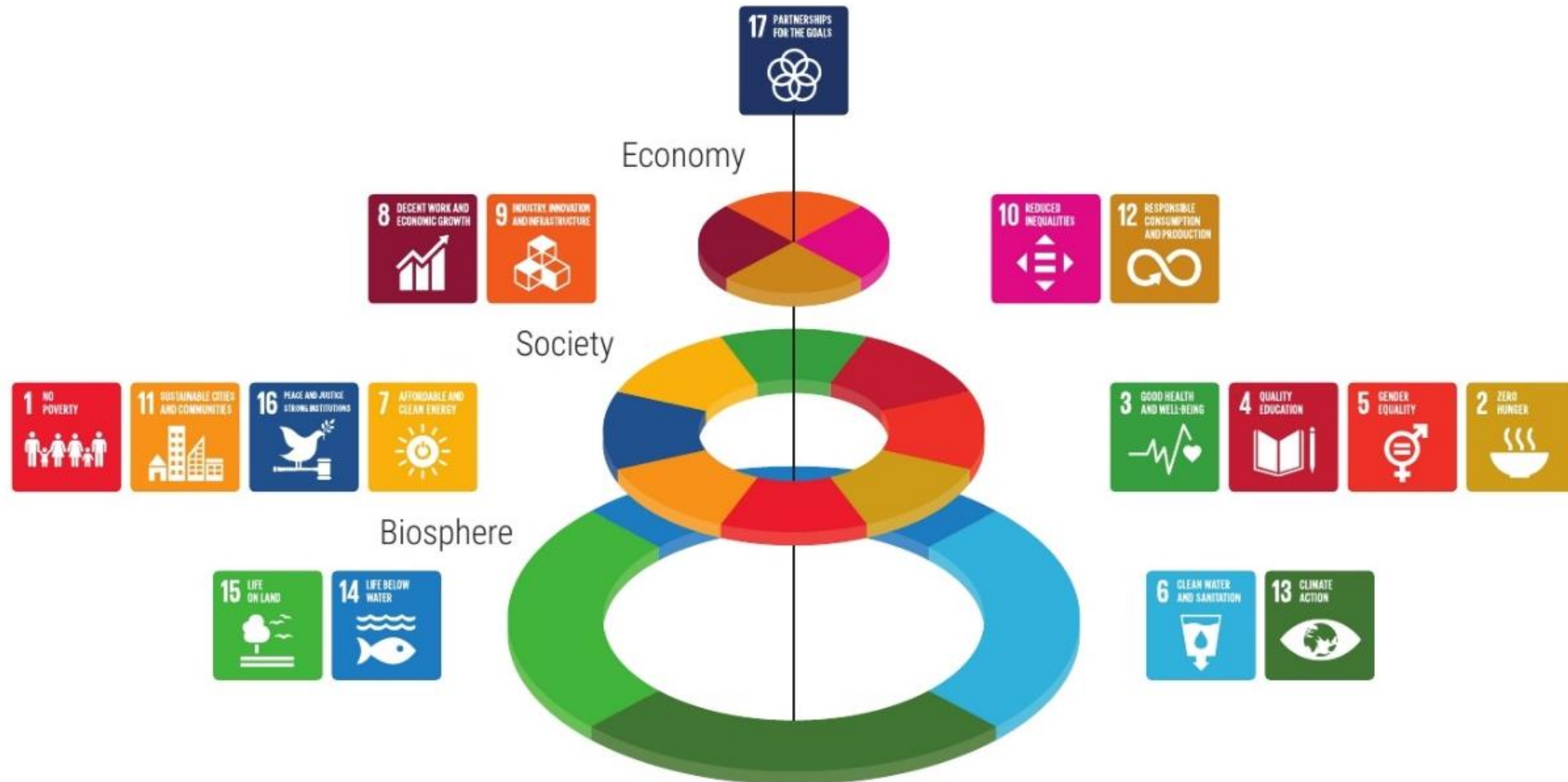
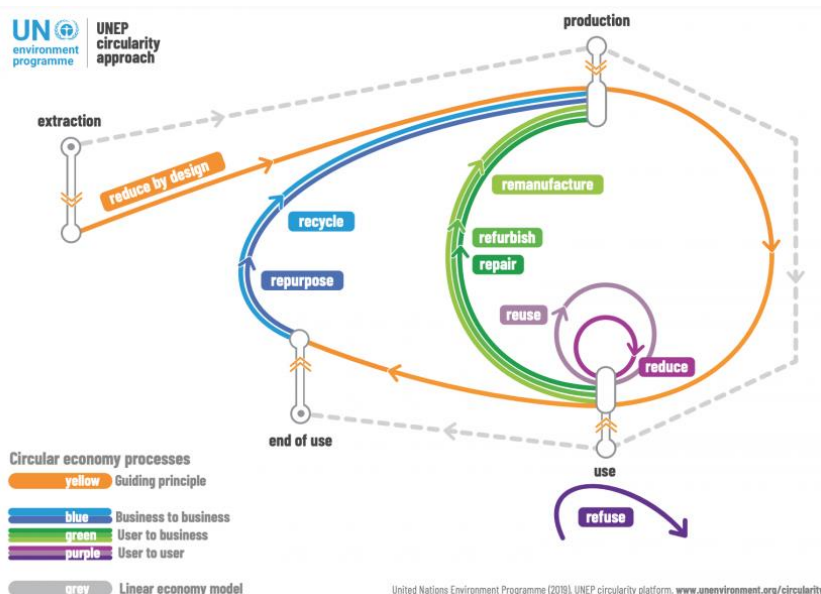


Figure 2.7: The three dimensions of sustainability (adapted from Stockholm Resilience Centre 2016), UNEP 2021

# The Potential of Green and Sustainable Chemistry

The real opportunity in the 21st century resides in accelerating greener and more sustainable chemistry innovations

## Circularity



[UNEP Circularity Approach](#)

Product design for  
circularity

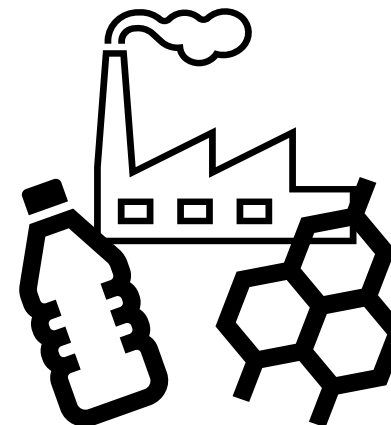
## Climate Change



<https://sdgs.un.org/goals>

Improved renewable  
energy generation and  
energy storage technology

## Pollution



Non-toxic alternatives to  
chemicals of concern

## Biodiversity



<https://www.cbd.int/biodiversity-day/logo>

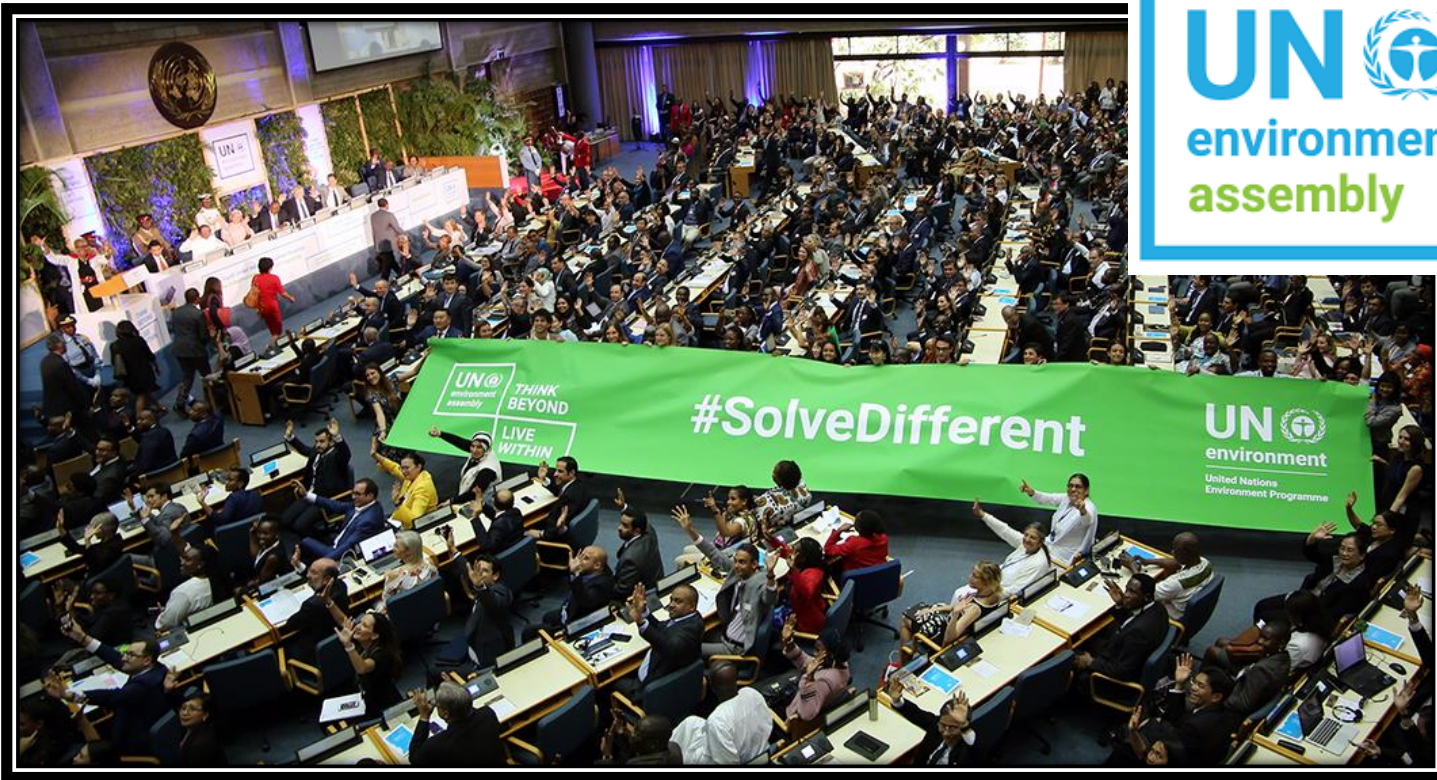
Green and sustainable  
solutions chemistry for  
environmental remediation



# Resolution 4/8 – The 4th United Nations Environmental Assembly

**Welcomes the analysis of best practices in sustainable chemistry and recognizes the value of developing a better understanding of sustainable chemistry opportunities...**

<https://www.unep.org/environmentassembly/unea4>



**[By UNEA-5] Synthesize the analysis of best practice in sustainable chemistry produced by the Environment Programme into manuals on green chemistry and sustainable chemistry**

**“the world’s parliament on the environment”**



# UNEP Green and Sustainable Chemistry: Framework Manual

Foster general learning, reflection and scaling-up action based on a common global understanding of green and sustainable chemistry

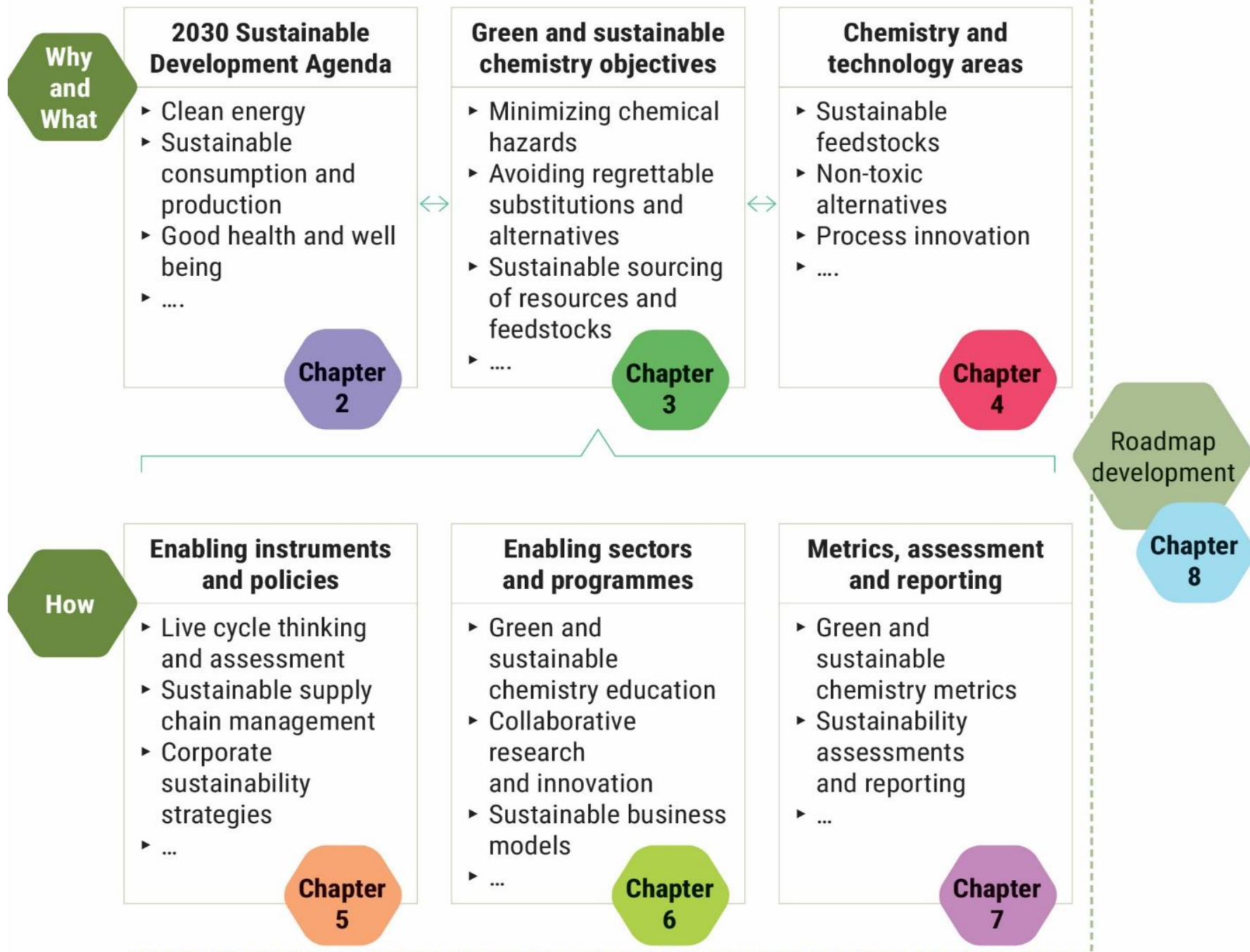


Figure 1.1: Advancing sustainability through green and sustainable chemistry, (UNEP, 2021)

# 10 Objectives and Guiding Considerations for Green and Sustainable Chemistry

**Promote innovation to unveil the full potential of chemistry such that it is compatible with and supports the implementation of the 2030 Sustainable Development Agenda.**



# Key Stakeholders for green and sustainable chemistry action

The objectives encourage and seek to inspire actors to shift their chemistry innovations activities towards green and sustainable innovation. They are offered to stakeholders engaged in chemistry innovation, management, and policy development



Academic and research institutions	
Entrepreneurs / innovators / start-up companies	
Finance institutions	
Small and medium sized enterprises	
Government (local and national)	
Civil society organizations / non-governmental organizations	
Regional institutions / inter-governmental organizations	
Transporters	
Recycling and waste sector / informal waste sector	

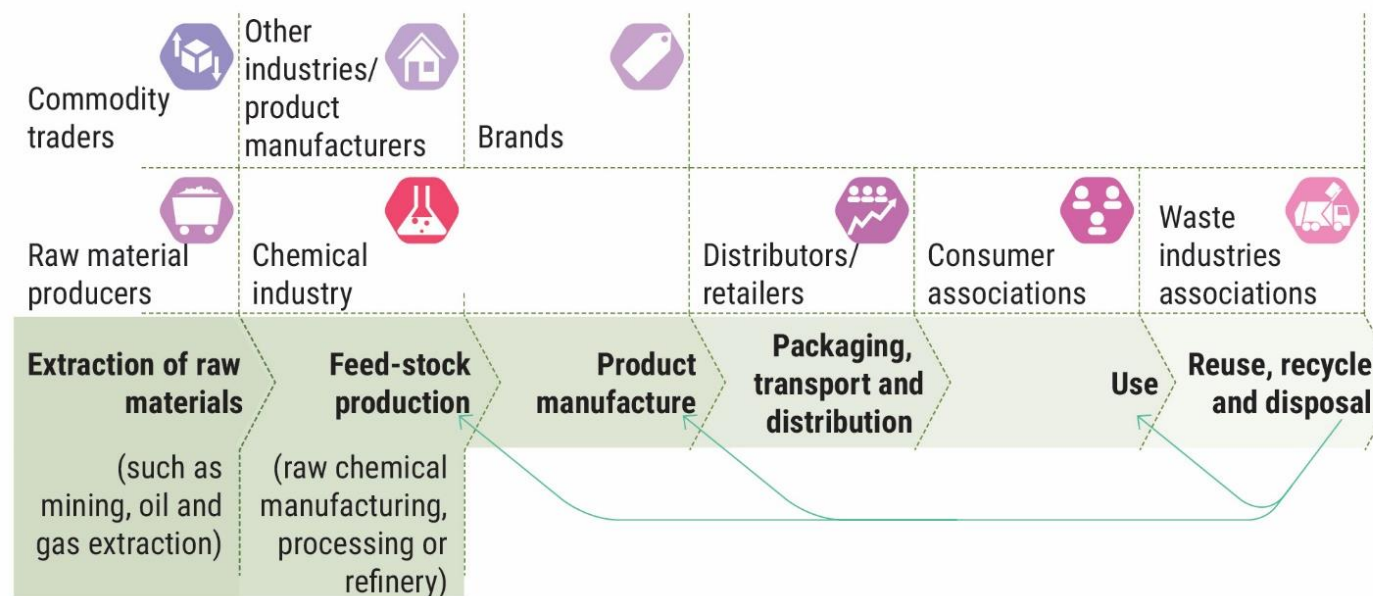


Figure 3.1: Mapping of key green and sustainable chemistry stakeholders (Adapted from Ryberg, Laurent and Hauschild 2018, p.10), (UNEP, 2021)





## Chapter 4 – Chemistry and Technology Innovation to Advance Green and Sustainable Chemistry

### Alternative Chemical Feedstocks

- Biobased feedstocks
- Carbon Dioxide as a feedstock

### Chemical Innovation Opportunities

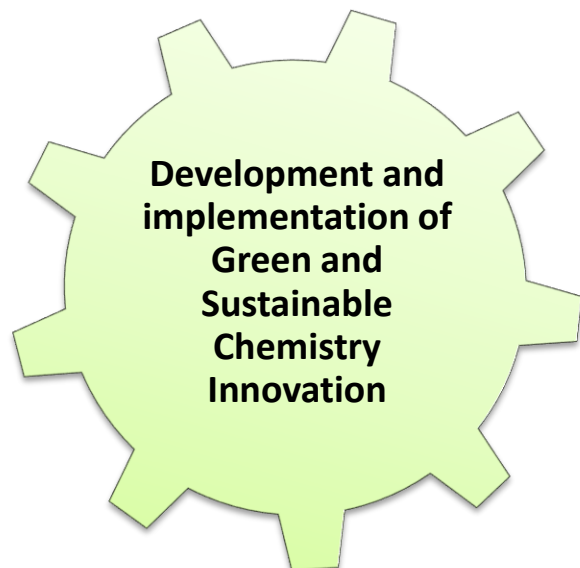
- Biodegradable, non-toxic plastics
- Chemical and non-chemical alternatives to CoCs

### Process Innovation Opportunities

- Alternative catalytic materials
- Continuous processing
- Biorefineries

### Illustrative Example: The Energy Sector

- Solar fuels
- Energy storage materials
- Less energetically demanding chemical processes
- Improved renewable energy generation





## Chapter 5 – Enabling Policies Tools and Instruments

### Policies, regulatory action and standard setting

- GSC specific push and pull policies
- Access to information: Labelling, certification and transparency

### Sustainable design approaches

- Life-cycle assessment methods and thinking
- Alternatives assessment for CoCs
- Sustainable product design
- Sustainable supply chain management and procurement

### Supporting policy approaches and principles

- Precautionary approach
- Product stewardship
- Extended producer responsibility
- Corporate social responsibility

**Enact and utilize  
enabling policies  
tools and  
instruments**



## Chapter 6 – Enabling Sectors and Programmes

### Green and Sustainable Chemistry Education

- Embed into broader efforts to integrate sustainability into education
- Educate a broad-range of stakeholders

### The ecosystem for chemistry innovation

- Universities, SMEs, Start-ups, The chemical industry, Government intervention, financial services
- Link research to development needs through collaborative innovation partnerships and strengthening science-policy bodies

### Financial incentives and business models

- Market based instruments
- Eco-innovation and other sustainable business models

**Strengthen and  
connect  
enabling  
sectors and  
programmes**



# Chapter 7 – Metrics and reporting



## Green and Sustainable Chemistry Metrics

- Hazard assessment and screening
- E-factor, Process Mass Intensity Index (PMI), Chemical Footprint Metrics

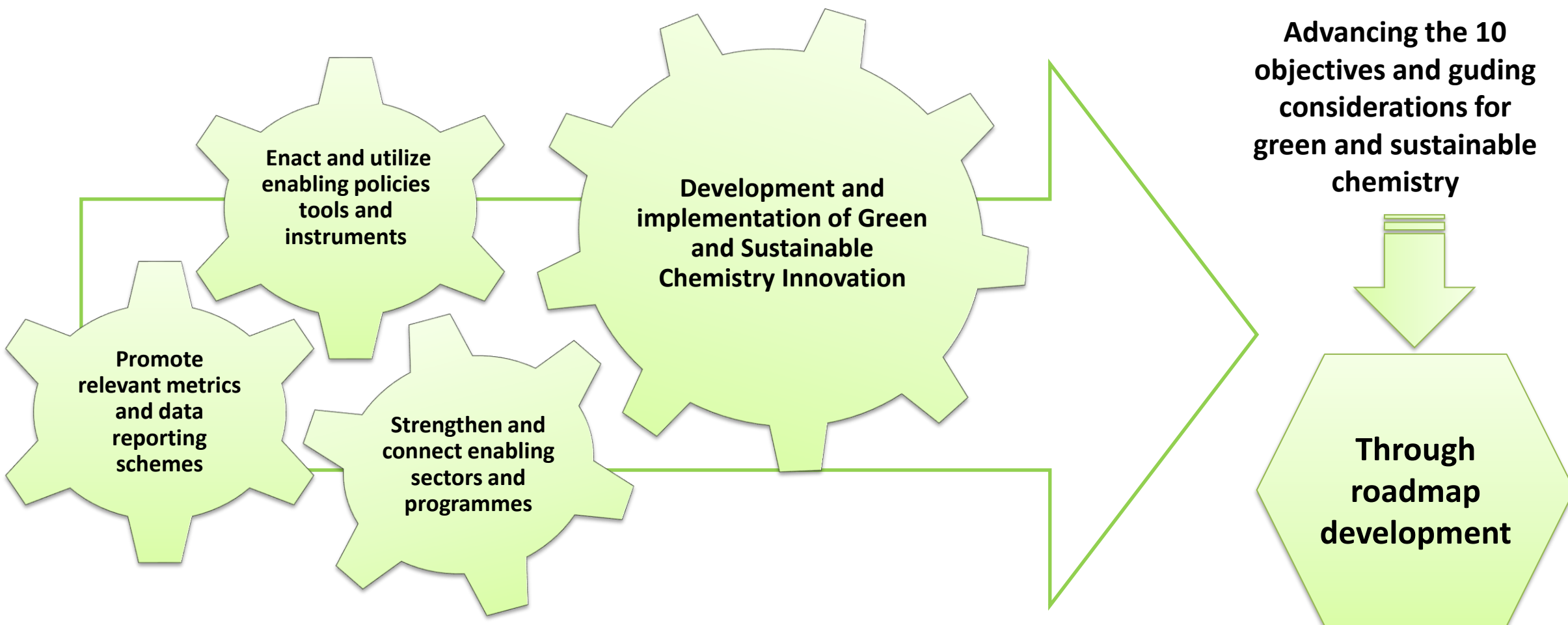
## Sustainability Assessment and Reporting

- Use and adjust existing sustainability metrics to measure GSC progress
- Include GSC in broader chemical management indicators
- Pollutant and transfer registries (PRTs) to identify opportunities and track progress

**Promote  
relevant  
metrics and  
data reporting  
schemes**

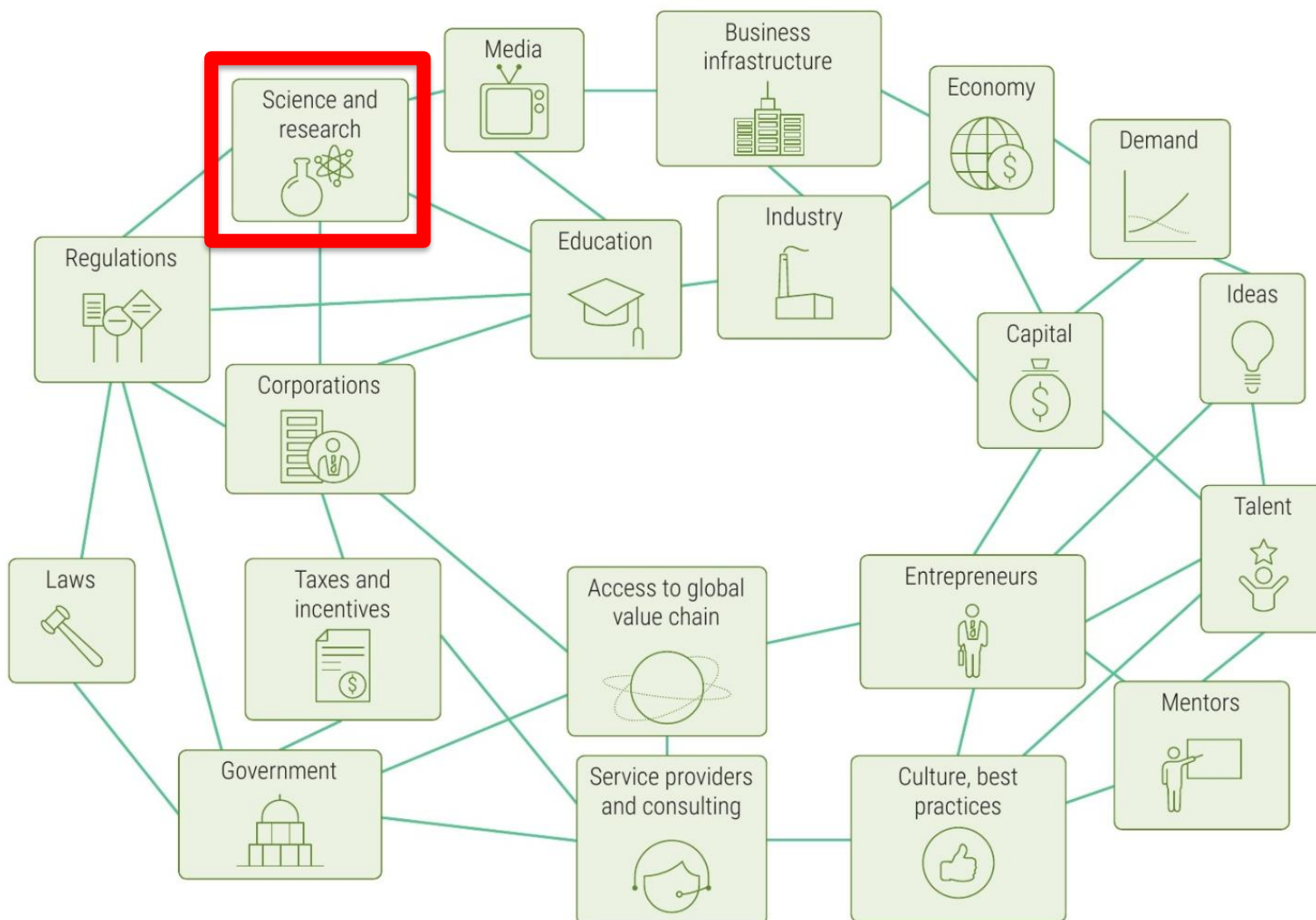
# Chapter 8 - Roadmaps to the transformation to Green and Sustainable Chemistry

All actors and decision-makers, from public officials to company CEOs and heads of chemistry laboratories, are encouraged to consider the analysis and guidance provided in this framework manual and consider the initiation of a “Green and Sustainable Chemistry Road Map” within their organizations



# Empowering Academic Researchers to Advance Green and Sustainable Chemistry

**Not only problem-solvers, inventors and entrepreneurs but also important stakeholders in the innovation landscape of green and sustainable chemistry.**



Link research to sustainable development needs

Promote collaborative innovation

Strengthen Science-Policy Bodies



# UNEP Specialized Manual on Green and Sustainable Chemistry Education

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**“Further action at all levels is needed to disseminate best practices in green and sustainable chemistry education and overcome barriers in academia and the private sector”  
(GCO-II, 2019)**

Stimulate and facilitate green and sustainable chemistry education action to empower stakeholders to advance the 10 objectives and guiding considerations

Targets education system actors as well as strategic change agents that influence the way chemistry is practiced

Provide a succinct synthesis formal, non-formal and informal dimensions of green and sustainable chemistry learning

Provide practical guidance, illustrative examples and educational resources

# IUPAC / UNEP Survey Results

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***“impart an environmental education starting from primary school”***

***“All of us had to do scientific projects related to green chemistry in high school”***

***“I first learned about green and sustainable chemistry on the internet”***

***Government regulation is very important and government should be ready to create awareness for the citizens on how to achieve sustainable chemistry. Also, more students should be encouraged to study science by providing the conducive atmosphere for learning.***

***“strong education from the primary school”***

***“I learned about Green Chemistry in some extra-curricular activities out of classroom during my undergraduation; and after that, I have been learning more about it in my post-graduate studies”***

***“Green and sustainable chemistry should to be our life style”***

***“Present and educate everyday people with the realistic perspective of what green and sustainable chemistry is really about and promote that, so they will also invest on this way of life”***

***“Teaching students early in their academic careers about green chemistry concepts.”***

***“activities to recycle and reuse second-hand goods to cultivate students' quality of saving and innovation in waste.”***

***COMMUNITIES WORLDWIDE, INCLUDING ITALIAN GOVERNMENT, HAVE ORGANIZED MEETINGS WHICH INVOLVE YOUNG PEOPLE, TO MAKE THEM AWARE ABOUT THE POLLUTION PROBLEM. THE GOAL IS TO ADDRESS THEM TO SUSTAINABILITY AND RECYCLING.***

***Above all, we need to focus on green chemistry from high school, so that those who are not going to pursue a career in chemistry are also aware of the issues. We can also use TV programs and social networks to better impact populations***

***“Having more lectures at a younger level explaining the impact in our planet and ways our society can change”***

# Thank you for your attention !

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