

# PLASTICS CYCLE: A PARADIGM INDICATOR OF ANTHROPOCENE

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## Abstract

Significant human interference with nature and human impact on Earth's geology and ecosystems, such as rapid climate changes and plastics pollution, has been the subject of numerous studies which diagnose the reasons behind these phenomena. Anthropocene is a term proposed to describe the domination of humans over natural processes occurring around the globe. Just like the earlier concept of sustainable development, Anthropocene attracts the involvement of representatives of various scientific fields and disciplines. Therefore, an interdisciplinary and multidimensional transition to Anthropocene is already a fact.

Life cycle analysis of plastics is being the subject of numerous recent investigations. However, besides its great importance, these studies ignore what happens after the plastics are discarded since they will only take into account (re)processing, recycling and landfill, and not its effect through the various ecosystems processes. The effects of macro, micro and nano plastics, acting as pollutants stressors, in climate changes are far from being understood, as well as their effects on humans.

This work identified the key contemporary challenges associated with global socioeconomic development in the Anthropocene time, with a focus on plastic pollution.

## Introduction

Nowadays, a consensus exists that plastics pollution is not limited to the macro plastics products that are possible to see in any earth place. Several scientific studies are available that demonstrate that micro and nano plastics have a big interference on nature, and also that some chemicals additives present in plastic formulations have a strong interaction with the environment and humans, in this last case, concerning toxicity, for example [1]. Thus, it is not sufficient to act in the field of plastics pollution by performing only a Life Cycle Analysis (LCA), but it is also necessary to include some other issues. In this way, the definition of LCA as obtained from reference [2]:

“Life cycle analysis is a method used to evaluate the environmental impact of a product through its life cycle encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.”

must, also, include the following concept of The Plastics Cycle, as provided in reference [1]:

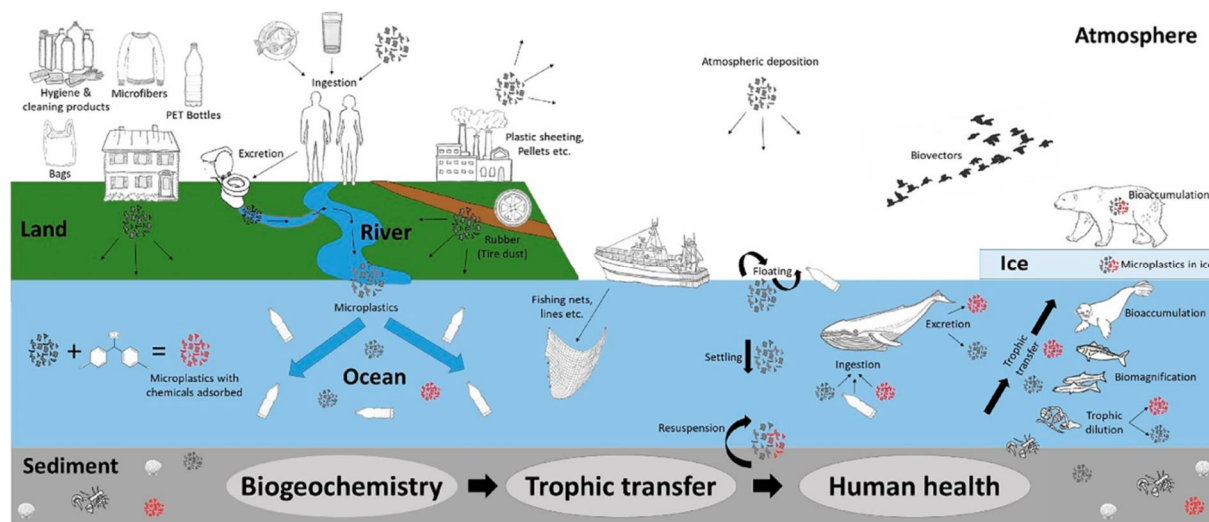
“The plastic cycle is the continuous and complex movement of plastic materials between different abiotic and biotic ecosystem compartments, including humans.”

The authors in reference [1] propose the hypothesis of a new paradigm for the research and management of plastics of all categories: considering the problem of plastics as polluters as representing a problem analogous to a biogeochemical or environmental cycle. Figure 1 shows

a possible view concerning this paradigm indicator of the Anthropocene [1].

Simultaneously, it was not possible to neglect: i) the need to investigate the consequences and social impacts (health, well-being, etc...); ii) the ethical-political (i.e., to verify if the problem affects different communities in different ways, such as the biggest polluters do not pay their dues for damages, etc...); and the socio-cultural dimension of the problem, namely the question of risks, i.e., how to reduce the health and well-being risks to our bodies and environments when interacting with plastics.

Supposedly, we have to live with plastics, but maybe we have to rethink how to do it. Perhaps it is worth making a connection between the biogeochemical cycle paradigm and the circular economy concept.



**Figure 1-** Conceptual model of the plastic pollution cycle and the interactions between biogeochemistry, trophic transfer, and human health and exposure. (Reprinted with permission from [1]. Copyright {2019} American Chemical Society.)

### The Plastic (Pollution) Cycle

Figure 2 illustrates a possible interconnection between the different disciplines involved in this issue. It is a multidisciplinary approach based on four corners of a square/rectangle: i) the plastics cycle; ii) the life analysis of plastics; iii) Anthropocene and iv) policies.

**The plastics cycle** – means the complete cycle, from the “collection of ingredients/additives” to the nano plastics that already can be seen in animal cells, taking into account the micro and macro plastics as well [1].

**Life cycle analysis of plastics** – involves the design, production, use and recycling. It is something that has been done for a long time (with great progress during the years) and that is sometimes considered sufficient by industrialists and uninformed politicians, but certainly, it is not. A considerable number of studies are available in the literature [3,4,5]. Often, when the plastics are discharged their effects on the various ecosystems processes are ignored [6,7]. Also, the effects of macro, micro and nano plastics, acting as pollutants stressors, in climate changes are far from being understood, as well as their effects on humans [8].

**Anthropocene** – in this case, the word itself indicates the meaning and its importance in the theme. It may involve subjects such as archaeology, but it would be important to understand/study the present and future relationship of plastics with humanity and nature.

**Policies** – are a key point in this process since are the national and international organizations that define the rules for plastics production, use and post-use. Table 1 shows some important objectives concerning plastics pollution that are addressed by those organizations. It is relevant to note the date of the beginning of such initiatives. This seems clear to indicate that even the governments and other international organizations, only act after the problem assumes big proportions and by the pressure of the population.

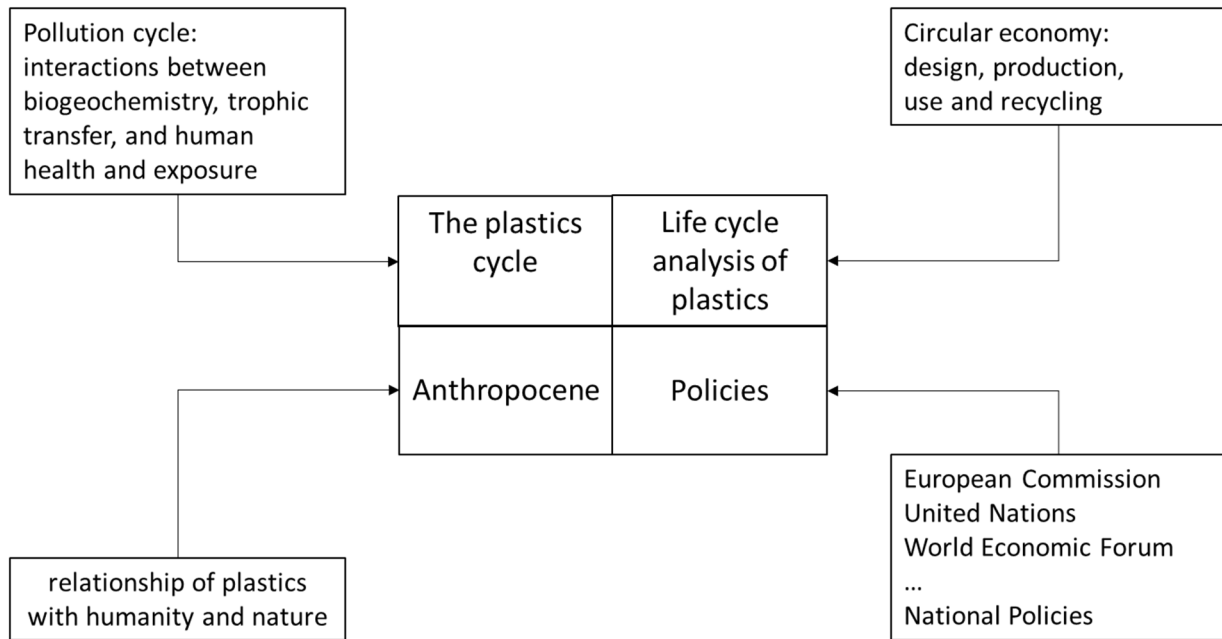


Table 1- An overview of key transnational circular economy policy initiatives in the area of plastics (Reprinted with permission from [9]).

Name	Lead organization	Year	Scope
EU Plastics Strategy	European Commission	2018	Goals for recycling, packaging design, and innovation; reduction targets for marine litter and single-use items; global partnerships between the EU and other countries and international organizations; voluntary pledges by companies to meet reduction and recycling targets; fostering collaboration among industry members in pursuit of circular systems.
Global Plastics Platform	United Nations Environment Programme	2018	Supports countries and cities in setting plastic reduction targets; explores ways to change the design, production, consumption, and disposal of plastics in line with a transition to a more circular economy.
New Plastics Economy Global Commitment	Ellen MacArthur Foundation	2018	A commitment signed by more than 350 organizations (as of March 2019), representing more than 20% of all plastic packaging produced globally, to eliminate plastic waste and pollution at the source.
Global Plastic Action Partnership	World Economic Forum	2018	Funded and supported by the UK & Canada along with several major companies (Coca-Cola, PepsiCo, Dow chemical); collaborates with governments and businesses in coastal economies.
Platform for Accelerating the Circular Economy	World Economic Forum	2018	Develops public-private partnerships in support of CE; lends policy advice and support to address barriers; scales up and accelerates CE projects by partners (over 50 members from the public and private sectors).
Circular Plastics Alliance	European Commission	2019	Gathers 30 stakeholder organizations along the plastics value chain to promote voluntary action on the circular economy; aims to provide 10 million tons of recycled plastics to the EU by 2025.
Plastic Leak Project	Quantis International & Shaping Environmental Action	2019	A multi-stakeholder initiative including 18 major companies together with UNEP and other international organizations to map plastic and microplastic pollution and develop circular economy initiatives.

## Conclusions

Looking to plastics production, use and discharging as an environmental or biogeochemical cycle is a key step in defining policies for sustainable integrated solutions. This is not only a “holistic” paradigm of Anthropocene but can induce new practical ideas for the research of new materials, products and processes that incorporate in their development all the required issues, as referred to in this text.

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