The need for a complex system perspective in dealing with plastic pollution in the oceans

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Mare Plasticum – The Plastic Sea

Systemic Thinking and Complex Systems

- Thinking in systems can uncover hidden causes and effects as well as a more holistic view
- A systemic analysis considers a multidimensional perspective that reflects on different strategic facets—like the cultural, scientific, social, political, industrial, economic and financial and develop frameworks and paradigms in investigating the complexity of reality in its different manifestations
- This allows for the coordination of different type of considered elements and the development of integrated and structured collaborative circular sustainable solutions which can then be scaled up in the near future
- It takes into account how different kinds of relations are in play, their shape and dynamics to discover the systemic multiplicity which moves the plastic value chain and its different related aspects in a non-linear fashion as complex system with its adaptive and dynamic characteristics

Characteristics of Complex Systems:

- Organic and interrelated
- Based on dynamic relations which build self-organized behavioral framework
- Emergence
- Dependence on the future evolution of present events
- Characterized by several causes

Current Status of the Ocean Plastic Problem

- The current situation of ocean plastic pollution is the result of the present and past economic and industrial model
- Such a model has accumulated waste without proper capabilities to manage it effectively and has not satisfactorily considered the complexities of the context in which it operates

Global Issue of Import/ Export of Plastics
• Growing export of plastic scrap, mainly from Europe and North America to Asian countries like China, Indonesia, Malaysia and Vietnam • Accumulation of plastic waste resulted in China's National Sword policy to ban import of plastic waste • Shift in the flow of plastic scrap away from China but towards other Asian countries with lax policies regarding the treatment of this plastic scrap • Massive flow of plastic scrap into Thailand, Malaysia and Vietnam far exceeded permitted volumes • Regulations are increasing to reduce these impacts

Increasingly Growing Production of Plastics
• Global production of virgin plastic from fossil fuels has grown exponentially as business and society have built a lot of behaviours that focus on single-use plastics • Oil and gas sector looks at plastic as one of the primary sources of growth, so plastics production is expected to continue to increase • Oil and gas sector has been monitoring the pushback against plastic waste and will likely resist reduction in plastic use and shift from virgin to recycled plastics • This is exacerbated by the significant investment and large subsidies provided to the oil and gas sector

Current Solutions to the Ocean Plastic Problem

- There are some existing initiatives to develop solutions to these problems:

Plastic Waste Legislation

- European Commission has many initiatives to promote legislation for better waste management such as the *Circular Economy Package*, the *EU Plastic Strategy*

Plastic Recovery, Reuse / Recycling

- One of the main streams of innovations facing the plastics issue focuses on the collection, reuse and recycling of existing plastic waste
- Recovery projects: The Ocean Cleanup, Terracycle's Beach Plastic Cleanup Program, 4Ocean, Parley for the Ocean Global Cleanup Network, Plastic Whale, etc.
- Reuse/Recycling projects: Aquafil, Buero, Loop Industries, GreenMantra, BioCellection, Agilyx, Bin2Barrel, etc.

New Material, Design

- One big solution are bio-based plastics, but there are concerns regarding its impacts on agriculture and food, and they also require advanced waste management
- Other solutions combine innovative designs and new materials to replace plastic: AirCarbon, Ooho, etc.

New Consumption Models

- New consumption models present different ways for consumers to use plastic, aimed at preventing the need for more plastic products
- One such model is reusable products: Cupclub, Ozarka, Splosh, and Loop provide services with reusable containers to replace single-use plastic
- Other models focus on behaviour change: WaytoEco provides information to consumers to use less plastics

System Diagram of the Current Status Quo

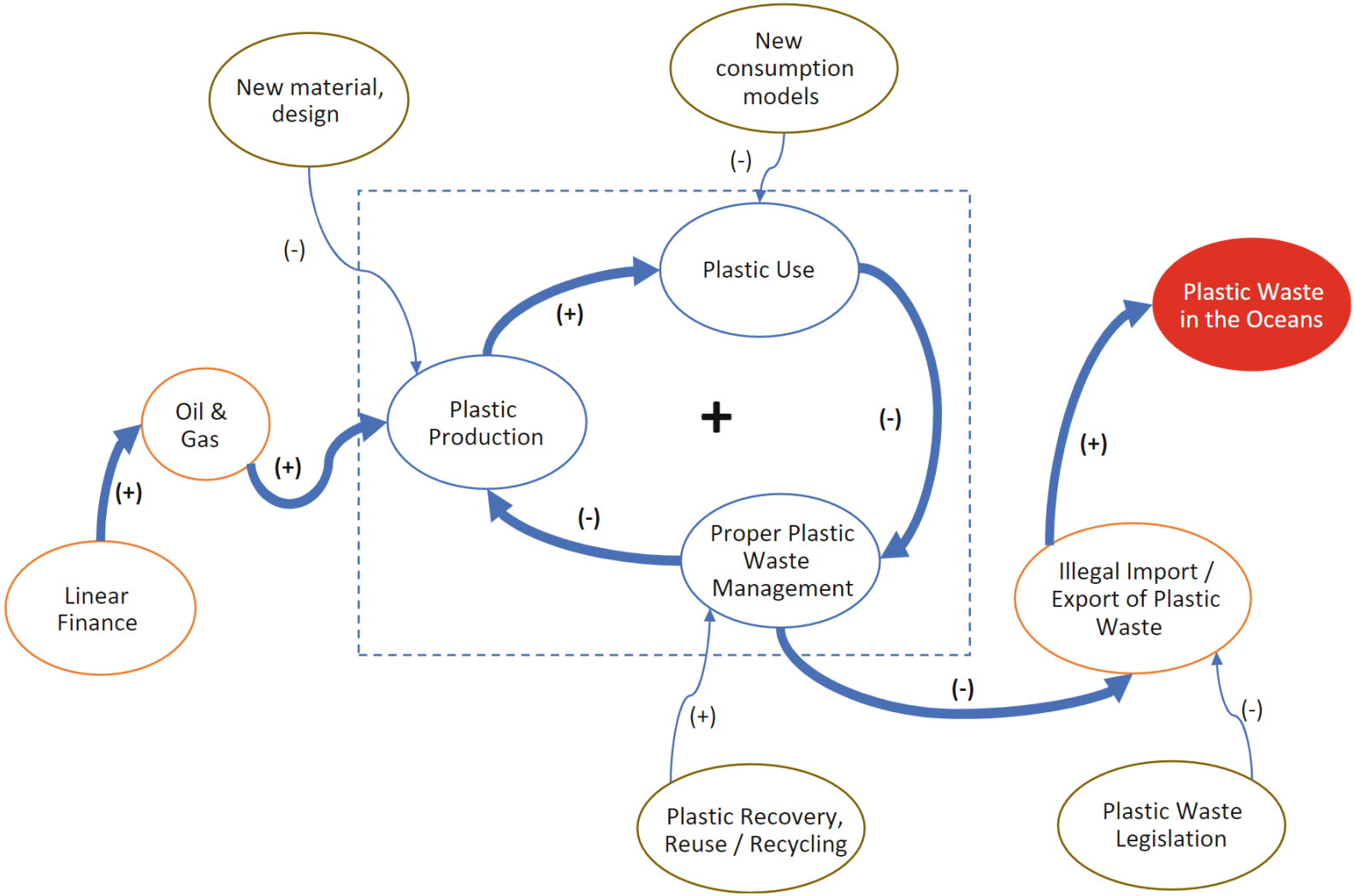

Fig. 1 Simplified global model of plastic waste problem

Circular Thinking and Dynamic Patterns of Relations

Circular thinking can be defined by understanding, identifying and naming the dynamic patterns of relations in a wider complex social and economic landscape

These dynamic relations are characterized by variability, iteration, reflexivity and a multiplicity of synergistic processes

Recognizing the source and impact of these relations on innovation lies at the core of the complexity in the circular economy

These relations show up in social interactions, physical environments, emotional experiences and conceptual models. And they can be outlined as similarities, differences and connections that could have specific meanings across space and time.

Circular thinking stresses more the qualitative aspects such as the nature of relations and operative procedures to implement innovations, rather than solely the quantitative aspects such as profits, growth targets and productivity measures that are typical of the current linear mindset.

The complexity of innovation processes are captured and pondered by this deeper, subtler and at same time simple way of thinking

Application to the Ocean Plastics Problem

- To face the growing plastic problem in a systemic way, it is necessary to take a two-pronged approach:

Integration of Existing Solutions To More Effectively Tackle Ocean Plastic Pollution	Increased Global and Social Awareness of the Ocean Plastic Problem
• In order to have a more effective impact on the plastic waste problem, there needs to be a greater integration of solutions. • The different initiatives that are working on combatting plastic waste need to collaborate in a more systemic ways in order to develop truly closed loop solutions that address the complexity of the plastic waste problem	• There is a very weak link between the problem of plastic waste in the oceans and the societal use of plastic, so the impact of increasing societal plastic use is not considered. • There needs to be a more concerted effort to raise the level of global awareness in order to encourage people to shift towards new consumption models and change their behaviour when it comes to plastic use

- The two "prongs" also reinforce each other as greater awareness enhances the generation of new solutions, which systematically reduces the use of plastics and consequently the problem of plastic waste in oceans

Closing the Loop of the Global Plastics Problem

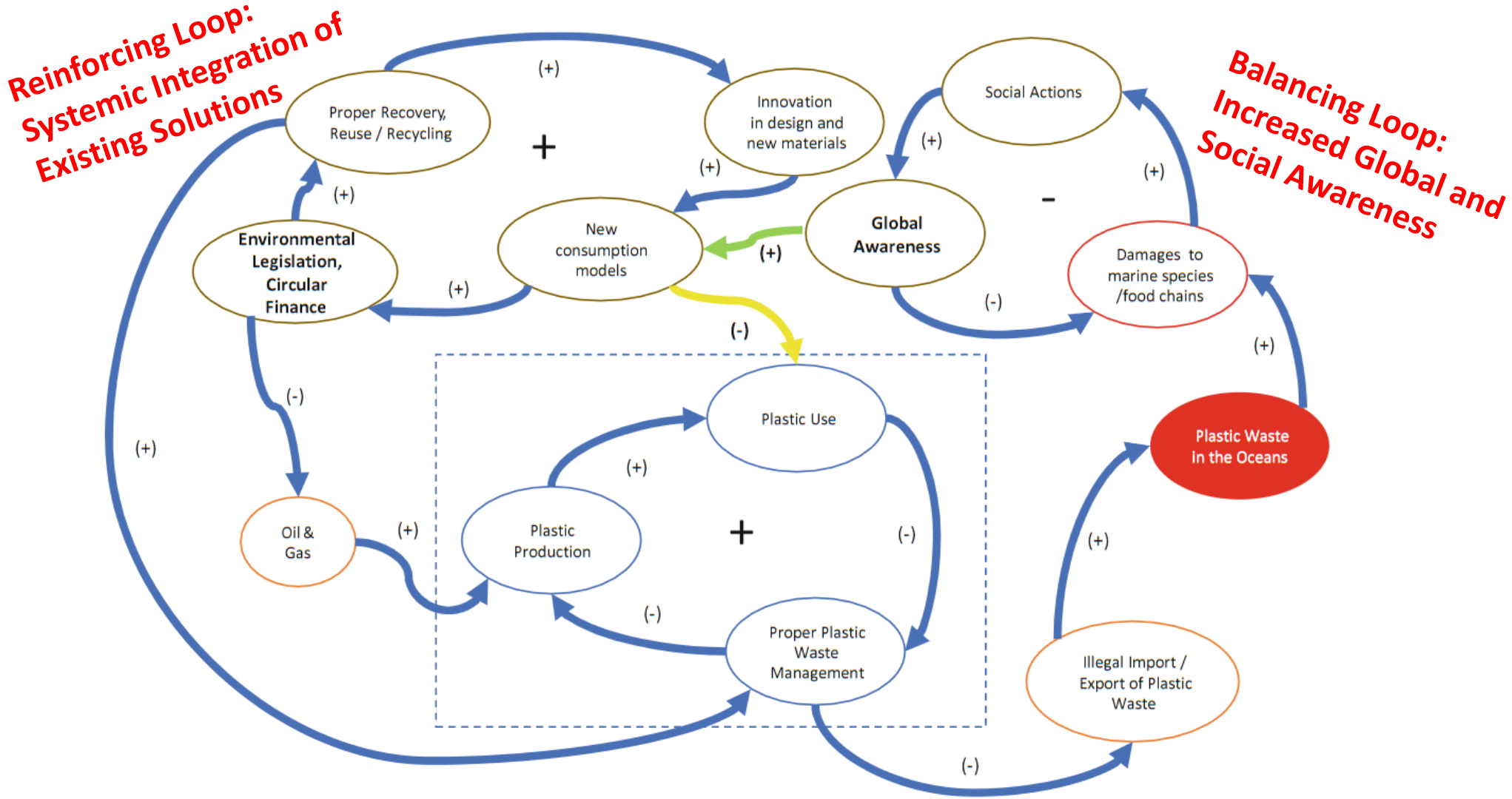

Fig. 2 Simplified systemic global model of plastic waste problem

Conclusions

- The analysis made has focused on the main macro trends and causes that have resulted in the huge pollution of our rivers and oceans with plastic garbage

- It provides an overview of the key variables behind the problem of plastic waste in the ocean and its management, namely the role of proper integrated solutions that utilize networks of relations as well as a greater global awareness of the plastic waste problem

- **What is happening for plastics is only a consequence of a wide and general demeanour that has created huge problems in other areas like climate change and CO2 emissions, the 2008 global financial crises, the global loss of biodiversity, etc.**

- It is important to note that a system perspective is not only relevant for the specific problem of plastic pollution. Instead, it should, in our opinion, be applied to many other fields. This will lead towards a more effective sustainable human actions

Thank You!

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