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**COMMENTARY**

# Sustainability Transitions from an Ecological Economic Perspective

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## 1. INTRODUCTION

The concept of sustainability transition is widely used, and the desirability of such transitions is generally emphasized. However, various authors and research fields attach widely different meanings to the concept, particularly with regard to the degree of radicality implied. This brief commentary introduces an ecological economic perspective on sustainability transitions, which can be considered one of the more radical versions of the concept. First, the ecological economic understanding of the challenges is presented, and second, some topical aspects of the research agenda of the field and some of its close cousins are outlined.

## 2. THE SUSTAINABILITY CHALLENGES

Ecological economics is based on the pre-analytic vision of the economy as a metabolic organism in the biosphere, keeping itself alive by taking in energy and materials from the biosphere, transforming them in metabolic processes and emitting waste back again. Globally, the organism has grown so large in relation to the biosphere that we now live in a "full world" (Daly 2015). As the work on planetary boundaries illustrates (Steffen *et al.* 2015), we are already far into dangerous territory, and the prospects for the future are even more challenging due to continued population growth and pressure for improving living standards.

The background for the emergence of the "full world" economy is the use

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of fossil fuels. In terms of energy, human history has passed through three phases: hunter-gatherers using fire, pre-industrial agriculture adding draught animals and wind and water power, and the industrial phase adding fossil fuels and later also nuclear energy (Haberl *et al.* 2011). Each transformation has increased the availability of energy for human use. During the industrial phase, the abundance of fossil energy enabled an enormous increase in population and improvement in living standards. As the risk of climate change now limits the future use of fossil fuels, humans have to enter into a fourth phase in their energy history – this time in a situation where the number of humans is very large and where, for the first time, the consumption of energy per capita can be expected to fall.

Since fossil fuels still constitute about 80 per cent of the global energy supply, the challenge is considerable.[1] Furthermore, another nearly 10 per cent of energy use is still based on biomass, thus competing with food production and adding to the heavy pressure on biodiversity and ecosystems. Humans seem to be driving the sixth mass extinction of life on Earth, maybe even making Earth inhabitable for humans.

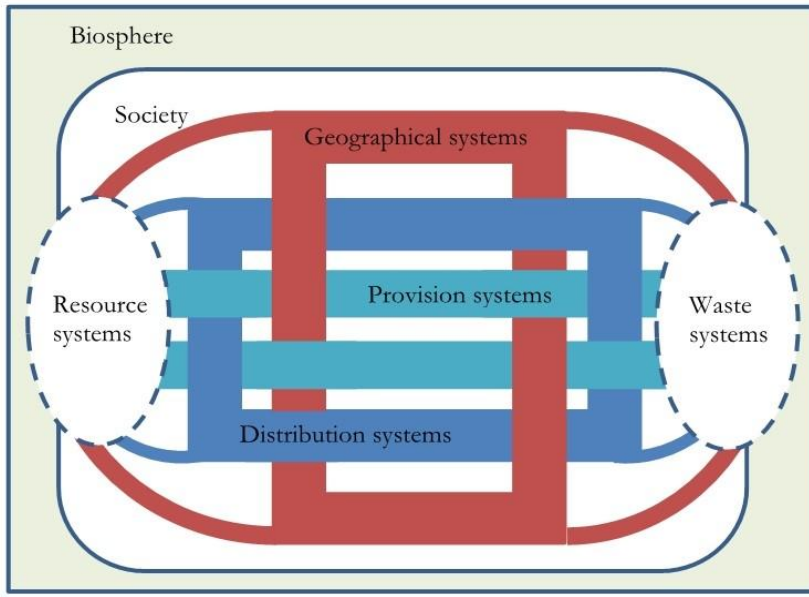
Based on this understanding of the challenges, ecological economists argue that sustainability transitions ought to involve radical transformations not only of technologies but also of societal arrangements. Since it is not possible to solve problems of poverty through biophysical expansion in a "full world", there is an ethical call for redistribution of resources from rich to poor – a redistribution that could also be helpful in reducing population growth.

## 3. THE RESEARCH AGENDA: COMPLEMENTARY SYSTEM PERSPECTIVES

The research agenda of ecological economics and related scientific fields, such as political ecology, industrial ecology and transition studies, covers the potential for sustainability transitions from many different angles. Some of these can be described in relation to the figure in the next page. The figure illustrates the classical ecological economic vision of the economy as a metabolic organism within the biosphere. At the boundaries, the organism takes in resources and emits waste back into the biosphere. These boundaries are immediately visible as sites for environmental conflicts that

[1] Calculations based on statistics collected from the International Energy Agency: https://www.iea.org/statistics/kwes/supply/

**Figure 1:** System Perspectives




**Source:** Based on Røpke (2016)

may call for transition processes. Studies of social-ecological systems, the management of commons and ecosystem services can be seen as examples of perspectives focusing on the boundaries (Berkes *et al.* 2003, Ostrom 2015, Gómez-Baggethun *et al.* 2010). Most often, such studies concentrate on the input side of the metabolic organism – the management of land, forests, fisheries, etc. – and the scale is mostly local or regional. Besides, these studies explore the climate challenge as a commons issue, involving management at a global scale of an issue on the output side (Ostrom 2009). The increasing number of local environmental conflicts that follow from the ever-growing global metabolism is also the focus of studies from an environmental justice perspective (Martinez-Alier *et al.* 2016). A large number of conflicts have been mapped both on the input side, which is often characterized as the commodity frontiers, and on the output side, for instance, related to waste handling.[2] The studies not only highlight the environmental and social costs and the injustices related to biophysical growth, but also emphasize how local protests and related movements can contribute to sustainability transitions by obstructing unsustainable paths and pointing towards alternatives (Scheidel *et al.* 2018).

[2] See the maps here: http://www.ejolt.org/

The environmental implications of increased metabolism are most visible at the boundaries, but the dynamics behind these implications mostly emerges far from the boundaries. The production processes transforming the resources into goods and services and their consumption constitute key dynamics. The concept of provision system is often applied to characterize the complex of institutions and technologies involved in the whole process of production chains and consumption that fulfils a certain function in society, for instance, referring to the provision of food, housing or transport. The need for transforming these provision systems to make them more sustainable is the core topic of the Sustainability Transitions Research Network.[3] The field learns from studying historical transitions of provision systems, such as the transition from sailing ships to steamships (Geels 2002) or the establishment of the electricity system (Hughes 1987), in order to develop ideas for promoting sustainability transitions today. The time scale of these studies is thus relatively long, but obviously not as long as the one applied in relation to the three phases of human energy history. The system perspective in these studies highlights that "green" technologies are not always contributions to sustainability transitions, as some technological improvements may support and legitimize the continuation of systems that ought to be replaced. For instance, increasing the efficiency in the use of corn for biofuel production can be seen as counterproductive in relation to sustainability transitions of the food and energy systems.

When provision systems are organized in very unsustainable ways, the background can often be found in the large global inequalities. For instance, the availability of cheap clothes and electronics in the rich countries depend on the low wages paid to workers in sweatshops in poorer countries (Schor 2005). The inequality thus forms the basis for provision systems that enable rich people's appropriation of large amounts of biophysical resources (Fuchs et al. 2015). The unequal access to resources is continuously recreated through various distribution systems that cut across the provision systems. The concept of distribution systems refers to, for instance, the organization of labour markets, the rules of international trade, the organization of property and patent rights, tax systems, and rules of inheritance. The transformation of these systems is just as important for sustainability as the transformation of provision systems. This point is increasingly acknowledged and reflected, for instance, in studies on how to transform the financial systems that have contributed heavily to the deepening of inequality (Røpke 2017).

[3] The research agenda of the network can be found here:
https://transitionsnetwork.org/about-strn/research_agenda/

Much governance of the various systems mentioned above emerges from the processes that are endogenous to the development of the systems themselves and not always visible as governance. But some governance has the form of transparent interventions from the political systems that are spatially organized and characterized as geographical systems, referring to the political systems at municipal, national, regional and global levels. For instance, the national level is central to studies that focus on the relationship between economic growth and sustainability, exploring the potential for decoupling environmental impacts from GDP growth and the importance of multiplier and rebound effects (Jackson 2017). Increasingly, it is acknowledged that sustainability transitions can be successful in rich countries, only if improvements of environmental efficiencies are combined with rebound policies to ensure that the improvements are not followed by increased consumption (van den Bergh 2011). Furthermore, policies are needed to reduce inequalities so the standard of living for poor groups, nationally and globally, can increase although total material consumption has to go down. The growing field of ecological macroeconomics deals with the promotion of sustainability transitions at the national level through traditional macroeconomic policies as well as more radical institutional changes. Part of the discussion is concerned with the question of whether sustainability can be achieved within some sort of reformed capitalist framework, or whether the core institutions of capitalism have to be abolished. Some of the more radical positions are advocated by researchers belonging to the degrowth community, who emphasize that sustainability is not compatible with a system built on the search for profit and the continued drive for accumulation (Kallis 2018).

Although only some of the perspectives related to ecological economics are included here, it is obvious that the study of sustainability transitions covers a broad array of approaches. In conclusion, this brief commentary emphasizes the need for working on many fronts to achieve sustainability, as well as the need for taking the interplay between different systems and aspects into account. Sustainability is as much an issue of institutions and power relations, as it is an issue of technology.

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