Ecological Economics 145 (2018) 75–89

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

Lost in Transition? Drivers and Barriers in the Eco-innovation Road to the Circular Economy

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ARTICLE INFO

Keywords:
Circular economy
Eco-innovation
Barriers
Drivers
Survey

ABSTRACT

Understanding which drivers and barriers exist in the development of a circular economy (CE) is a relevant and timely endeavour. The aim of this paper is to contribute to this debate by analysing evidence regarding the different factors helping and hampering the development of a CE. Specifically, this paper focuses on the eco-innovation (EI) pathway towards a CE, and tries to coordinate available but fragmented findings regarding how "transformative innovation" can foster this transition while removing obstacles to sustainability. Drawing upon a new corpus of both academic and non-academic literature, this work offers a framework for analysis, as well as an evidence-based survey of the challenges, for a green structural change of the economy. We argue that the combination of the innovation systems' view with the more recent "transformation turn" in innovation studies may provide an appropriate perspective for understanding the transition to a CE. Ultimately, the paper aims to capitalise on these insights to contribute to the design of policy guidelines and organisational strategies.

1. Introduction

The circular economy (CE) has emerged as a key approach in the transition to a more sustainable economic paradigm. It highlights what is to be rejected, the linear 'take-make-dispose' economy, and proposes instead a "(…) system that is restorative or regenerative by intention and design" (EMF, 2012, p. 7). Furthermore, a CE is not described necessarily as a disruptive concept, but rather as a workable socio-technical approach for attaining economic and ecological sustainability. It is depicted as a framework compatible with companies' and countries' needs to reduce input costs, as well as desires to operate in a world with less unpredictability (WEF, 2014).

Creeping into academic literature since the late 1960s, but only recently entering the policy agenda, the CE is considered as a motivational and inspirational compass, a desired "end-state" (Gregson et al., 2015). The CE formally entered the realm of actual public policy in China in the *Cleaner Production Promotion Law of 2002* and the subsequent *Circular Economy Promotion Law* of 2009 (Standing Committee of the National People's Congress - China, 2009). The concept also became the main plank of the *EU Action Plan for the Circular Economy*, several years later (EC, 2015a).

Identifying the determinants of this societal transition is challenging (Stirling, 2011). One reason is that a CE is still a rather underspecified notion, difficult to describe, and comprising diverse areas, including: sustainable production-consumption systems; closed-loop supply-chains, and; product-service systems. Thus, despite its status as a transition hypothesis towards a new socio-technical regime, the CE is still a rather poorly understood notion. In addition, the methodologies for actually delivering a CE are even more blurred and uncertain. Hence, it is important to develop a thorough understanding of the factors that foster and hinder the transition to a CE. The primary goal of this paper is then to map out the drivers that promote or streamline a CE, as well as the barriers that most frequently derail it, or slow it down. A second, complementary, goal is to articulate more specifically what the CE concept really entails; this is done by employing the notion of systemic innovation, which is so central to modern neo-Schumpeterian studies.

Eco-innovation (EI) has been acknowledged as a particular pathway for increasing efficiency and competitiveness while also having positive impacts on the environment and society (EIO, 2013). EI can be used as a transformative *process* to move away from the *status quo*, to thus create a socio-economic system based on the concept of the CE. This EI transition towards a CE is both uneven (as some activities or sectors will change sooner than others) and destabilising (as pro-CE factors and

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http://dx.doi.org/10.1016/j.ecolecon.2017.08.001
Received 29 December 2016; Received in revised form 30 July 2017; Accepted 1 August 2017

actors will encourage others to change too). In other words, EI has the potential to trigger a chain of changes and create localised pressures, thus stimulating complementary adaptations elsewhere, which then come together to form a new techno-economic system. As innovation enabled the development of an industrial, carbon-intensive economy, it is plausible that ("transformative") innovation may now be the vehicle for triggering a new, "green" transition (Schot and Kanger, 2016). Today, it is both topical and urgent to understand how, and by which means, innovation is able to facilitate the emergence of a CE. This paper takes an innovation studies perspective to address the challenges to the CE, in particular by answering the following two questions: (1) What are the major drivers and barriers to a CE? (2) What is the role of EI in the transition to a CE?

Drawing on contributions from both academic and grey literature, the aim of this paper is to analyse available evidence regarding the transition towards a CE, using EI heuristics and trajectories. To structure the debate we offer an integrated and up-to-date conceptual and empirical approach to dynamic CE studies: the perspective is informed by the innovation systems view and the more recent "transformation turn" in innovation studies as we move on to assemble and make sense of a new database of relevant sources, including both academic papers and policy reports. These two distinct types of sources were used, in a complementary way, to take stock of progress in policy-relevant research.

The next section of this paper focuses on definitional issues regarding the CE, EI, and the drivers of, and barriers to, the CE. Section 3 then refers to the methodological framework used, and Section 4 presents the results regarding the identification of drivers and barriers to a CE, as well as the role of EI in this transition. Finally, Section 5 presents some concluding observations, highlighting the limitations of this research, as well as possible avenues for further work.

2. The Circular Economy and Eco Innovation Under Scrutiny

2.1. A More Circular Economy

The structural socio-economic changes introduced by the Industrial Revolution and two World Wars changed the way goods were extracted, produced, delivered, consumed and discarded (Womack et al., 1990). Those changes, named the "First Deep Transition" by Schot and Kanger (2016), had severe cumulative consequences for the global environment, including climate change, degradation of ecosystems and depletion of natural capital. Even with significant environmental improvements, in developed and emerging economies alike, the prevailing global trends in manufacturing and consumption will continue to be a problem for current and future generations.

These issues have been addressed in technical and academic literature since the 1960s in diverse ways. Initial works on the "economics of the coming spaceship earth" by Boulding (1966), Georgesçu-Roegen's (1971) "ecologial economics" or Stahel's work on the "performance economy" (Stahel, 1982, 1986; Stahel and Reday-Mulvey, 1981) have raised fundamental methodological and substantive questions regarding linear economic dynamics in a context of limited availability, such as the resources of planet Earth. These intellectual traditions were brought together in a contribution by Pearce and Turner (1990) entitled *Economics of Natural Resources and the Environment*, particularly in the chapter titled "The circular economy". The development of other concepts, such as "industrial ecology" and "industrial symbiosis", highlighted the potential efficiency of natural ecosystems in resource recycling, thus suggesting the application of this same principle to production systems (Ayres, 1994; Frosch, 1992; Frosch and Gallopoulos, 1989).

The CE came of age in the 2000s as a synthetic concept. It encompasses diverse topics including: product-life extension activities (reuse, repair, recycling) and material efficiency (Rashid et al., 2013; Golini et al., 2014; Lund, 1985; Allwood, 2014; Lund and Skeels, 1983; Conn, 1978); product-service systems (Stahel, 1982, 1997; Tukker, 2013); sustainable consumption and production interactions (OECD, 2008); waste management and networks of recovery (Greyson, 2007; Liu, 2009; Allwood, 2014; Liu and Bai, 2014; OECD, 1982); closed-loop supply chains (Gupta and Palsule-Desai, 2011; Ji et al., 2014; Mirhedayatian et al., 2014; Govindan et al., 2014; Ying and Li-jun, 2012); cleaner production (Geng et al., 2012; Li et al., 2013; Su et al., 2013); green/regenerative design (Bakker et al., 2014), and; "cradle to cradle" approaches (Braungart and McDonough, 2002). Most importantly, recent literature has presented the CE as an analytical template for a new mode of socio-technical organisation, where the environment and the economy are rebalanced (George et al., 2015; Ghisellini et al., 2016).

Besides its academic penetration, the CE has been stressed as an overall strategic framework by international organisations such as the United Nations and the European Union, as well as by entities such as the World Economic Forum (WEF),[1] and non-governmental organisations such as the Ellen MacArthur Foundation[2] (EMF). These organisations have actively produced "grey literature" highlighting the potential of a CE for creating an innovative and sustainable transition (EMF, 2012, 2013, 2014b; UNEP, 2006; EC, 2015a; EC, 2014a).

Drawing on existing literature, the CE can, therefore, be defined as a *multidimensional, dynamic, integrative approach, promoting a reformed socio-technical template for carrying out economic development, in an environmentally sustainable way, by re-matching, re-balancing and re-wiring industrial processes and consumption habits into a new usage-production closed-loop system*. The drivers of, and barriers to, such transformative reform are, therefore, of policy interest.

2.2. Innovation for a Circular Economy

Transition is an inherently innovation-intensive process of reconfiguration and adaptation. More than just "novelty introduction", innovation is embedded in a wider social and economic structure, rooted in a specific historical and territorial context (Freeman, 1987). The connection between environmental challenges and the innovation agenda can be traced back at least to the early 1990s. In the first *Handbook* on innovation economics, management and policy, some significant attention was devoted to this connection under the heading of "Future challenges of innovation in a global perspective" (see Skea, 1994). More than two decades later, however, relevant literature, linking innovation and the environment, has still not been sufficiently developed. In a recent editorial in the *Journal of Economic Surveys*, in the context of a special issue concerning "Environmental economics and sustainability", the organisers, two scholars from Chinese universities who specialise in institutional economics and urban development, attempt to summarise the research agenda:

> "(…) environmental technological innovation may potentially lead to win-win situations in which improvements in environmental quality and economic growth coexist." (Lin and Zheng, 2016, p. 400).

In the field of innovation studies there are several approaches related to transition and sustainability. In the context of this paper, "eco-innovation" (EI) will be used as an operative definition of innovation with ecological and social concerns and effects (Boons et al., 2013; Carrillo-Hermosilla et al., 2009; Kunapatarawong and Martínez-Ros,

[1] In a report of 2014 entitled *Towards the Circular Economy*, developed in collaboration with the Ellen MacArthur Foundation and McKinsey & Company, the WEF stressed the need to re-engineer global supply chains and regenerate natural assets.

[2] The EMF initiated, for example, the "Circular Economy 100" programme to enable cooperation between companies (e.g. Desso, Michelin, Philips International, Unilever, Renault, Ricoh, Veolia, H & M, Nespresso among several others), regions (Danish Business Authority) and universities (University College London), and to assist in the development of circular commercial opportunities (EMF, 2014a).