

How innovations lead to structural change: Elements for a theory of system transformation

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Abstract

Accelerating decarbonization to limit global warming to 1.5°C requires a deep change in the provision and consumption of essential services such as mobility, thermal comfort or substance. It involves the dissemination of several social, technological and institutional innovations across multiple sectors. This contrasts with the traditional perspective in the literature that focuses on specific innovations in a single sector (e.g., solar PV in electricity generation). This research examines the conditions and processes that enable system transformation, here defined as a structural change which have wide social and economic impacts on several sectors (energy, transport, building, industry, food). Building on theories and concepts from economics, innovation and technological change, and sustainability transitions, four main conditions for system transformation emerge: technology; business model; social acceptance; institutions. These conditions underpin processes of system transformation that can be led by demand, supply or coordination. The analysis of two empirical examples (digital convergence and sharing economy) illustrates the explanatory power of this framework and offers insights for improving both the theory and the strategies for deep decarbonization.

Keywords: system transformation; sustainability transitions; multi-sectoral interactions.

1. Introduction

How sociotechnical transitions can spur structural change towards more sustainable economies? Decarbonization must accelerate to avoid temperature increases higher than 1.5°C or 2°C with unpredictable effects on the climate (IPCC, 2022). Inverting the current trends of growing greenhouse gases emissions will require both technological and behavioral change (IPCC, 2022). This transformative change will have deep social and economic effect (Altenburg & Rodrik, 2017). There is an increasing need to study the “whole system” reconfiguration (Markard et al., 2020; Geels, 2018; Geels & Turnheim, 2022), i.e., the analysis of far-reaching, multi-sectoral impacts, rather than single sector effects. However, the analyses

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