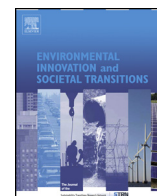




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## Survey

# What drives eco-innovation? A review of an emerging literature

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## ABSTRACT

This paper provides an overview of the emerging literature on the drivers of eco-innovation. Its main contribution lies in separating the drivers associated with the phases of development and diffusion and in identifying particular drivers based on different eco-innovation types. We find that research in this area primarily adopts the resource-based and institutional theories as its theoretical foundations and that the prevailing effects identified are those of regulations and market pull factors. Moreover, product eco-innovation, process eco-innovation, organizational eco-innovation, and environmental R&D investments seem to be driven by common drivers, such as regulations, market pull factors, EMS, and cost savings, as well as to be positively associated with company size. The majority of the studies in our literature review employ a quantitative research methodology and focus on the diffusion stage of eco-innovation. We end with providing a synthesis of drivers of companies' eco-innovation and directions for future research.

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## 1. Introduction

In recent years, the theme of eco-innovation has received increasing attention in academic research and policy circles. Eco-innovations are a subset of, and share many characteristics with, innovations in the economy (Wagner, 2008). However, eco-innovations also have unique, distinguishing features that suggest a need for particular management and policy approaches to foster them. To better understand how firm management and public policy can accelerate and direct eco-innovations, insight is needed into the drivers of the development (R&D) and diffusion (widespread adoption) of eco-innovations. In our study, a driver refers to a stimulus of eco-innovation, which can act as a motivation-based factor (e.g., regulatory pressure, expected benefits of implementation, profiling of company as environmentally friendly, competitive pressure, customer demand) or a facilitating factor (e.g., EMS, financial resources, technological capabilities).<sup>1</sup>

This paper reviews the academic literature on eco-innovation drivers and identifies their theoretical foundations, as well as the unique and typical characteristics of eco-innovation. Only a few studies (Del Río González, 2009; Pereira and Vence, 2012) provide a comprehensive literature review on eco-innovation drivers. The current review adds value in four ways. First, it offers a more complete literature overview than previous studies by including 155 articles, thus covering a broader and wider range of both quantitative and qualitative studies. Second, it considers the various eco-innovation types, such as product, process, technological, and organizational eco-innovations and green patents. Third, it addresses drivers in both

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<sup>1</sup> We thank an anonymous reviewer for bringing our attention to this point.

the development and diffusion phases of eco-innovation. Finally, it provides a synthesis of the findings, identifies research gaps, and provides suggestions for future research.

The remainder of this paper is structured as follows. Section 2 defines eco-innovation, discusses terms used to address it, and emphasizes its main peculiarities. Section 3 presents the research methodology. Section 4 reviews the literature on eco-innovation drivers by illustrating the theoretical backgrounds used to test eco-innovation drivers and delineating the factors that trigger eco-innovation, focusing on different eco-innovation types and stages of eco-innovation (innovation/development and adoption/diffusion). Finally, Section 5 summarizes the study's findings and offers limitations and further research directions.

## 2. Eco-innovation: definition and peculiarities

Defining eco-innovation is not a simple task, as the various research studies do not agree on a common definition. The *Eco-Innovation Observatory* (2012, p. 8) defines eco-innovation as the “introduction of any new or significantly improved product (good or service), process, organizational change or marketing solution that reduces the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances across the whole life-cycle.” In the Measuring Eco-Innovation project, *Kemp and Pearson* (2007, p. 16) defined eco-innovation as the “production, application or exploitation of a good, service, production process, organizational structure, or management or business method that is novel to the firm or user and which results, throughout its lifecycle, in a reduction of environmental risk, pollution and the negative impacts of resources use (including energy use) compared to relevant alternatives.” According to *Horbach et al.* (2012, p. 119), eco-innovations are “product, process, marketing, and organizational innovations, leading to a noticeable reduction in environmental burdens. Positive environmental effects can be explicit goals or side effects of innovations. They can occur within the respective companies or through customer use of products or services.”

Several other definitions exist (see *Carrillo-Hermosilla et al.*, 2010). However, despite differences in wording, all definitions embrace the environmental component and reflect the two main consequences of eco-innovation: fewer adverse effects on the environment and more efficient use of resources. However, while eco-innovation can be realized in many forms (e.g., product, process, and organizational and/or marketing methods), the effect of a diminishing environmental burden is not the primary reason for the deployment of eco-innovation.

Ambiguity also exists regarding the term with which to label this concept; throughout the literature review, researchers use the terms eco-innovation, green innovation, environmental innovation, and sustainable innovation interchangeably. However, it should be noted that the first three of these terms embrace ecological and environmental dimensions, while sustainable innovation addresses a broader concept and embraces an additional social dimension (*Charter and Clark*, 2007; *Schiederig et al.*, 2012). In their literature review, *Angelo et al.* (2012) discovered that the term environmental innovation is used in the majority of reviewed papers (65%), followed by the terms eco-innovation (22%) and green innovation (only 13%).

This discussion raises the following question: Should eco-innovation be distinguished from other innovations, and, if so, why? *Rennings* (2000) exposed three specific peculiarities of eco-innovation. First, eco-innovation can be technological, organizational, social, or institutional; it can be developed by companies or nonprofit organizations; and it can be traded or not traded on markets. The second peculiarity, which leads to the third, is that an interdisciplinary approach should be adopted when analyzing eco-innovation because of its placement between the disciplines of innovation economics and environmental economics (*Rennings*, 2000). This leads to the so-called “double externality problem,” which emphasizes the crucial role of environmental policy instruments as drivers of eco-innovation. Positive externalities are produced by eco-innovation (*Rennings*, 2000), including the usual knowledge externalities in the research and innovation phases as well as the environmental externalities in the adoption and diffusion phases, leading to the social desirability of eco-innovations (*Belin et al.*, 2009). While significant common knowledge spillovers exist for eco-innovation (as for innovation in general), environmental spillovers are also produced; society benefits from eco-innovation, while companies bear the costs to comply with regulations and reduce their environmental burden (*Rennings*, 2000; *Rennings et al.*, 2006). Therefore, companies investing in eco-innovation bear higher costs than their polluting competitors, and the positive externalities work as a disincentive for them (*Rennings et al.*, 2006). For this reason, technology push factors and market pull factors steer companies toward the deployment of general innovation, while regulatory push/pull effects should also be considered for spurring eco-innovation (*Beise and Rennings*, 2005; *De Marchi*, 2012; *Horbach*, 2008; *Porter and van der Linde*, 1995; *Rennings*, 2000; *Schmidt et al.*, 2010; *Van den Bergh et al.*, 2011; *Wagner*, 2008).

## 3. Research approach

This paper employs the literature review method used by several previous researchers (e.g., *Angelo et al.*, 2012; *Del Río González*, 2009; *De Medeiros et al.*, 2014; *Holtbrügge and Dögl*, 2012; *Karakaya et al.*, 2014; *Klewitz and Hansen*, 2014; *Pereira and Vence*, 2012) to identify drivers of eco-innovation and consolidate published research on the topic. Our literature review included two main phases. The selection phase consisted of gathering a comprehensive set of publications in the desired areas, while the analysis phase consisted of a careful and critical examination of the publications to identify patterns and recurrent themes.

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