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## Industrial Marketing Management



## Building markets for clean technologies: Controversies, environmental concerns and economic worth

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## ABSTRACT

In this paper, we investigate the construction of markets for clean technologies by examining the mechanisms through which new technologies succeed (or fail) to be transformed into goods that are both environmentally and economically valuable. We envisage this process as a particular form of market innovation in which new product qualities are inscribed into market architectures. We focus on the market for clean technologies that emerged as a result of the EU Integrated Pollution Prevention and Control (IPPC) directive that required polluting industries, including livestock farms, to implement the “best available techniques” in order to reduce their emissions. Our case study traces a Danish start-up firm’s endeavors to commercialize one such “best available technique:” a solution for reducing ammonia emissions from farms. Building on the literature on the shaping of markets, we show that the construction of a market for clean technologies hinges upon the composition of a complex network of actors with divergent, and sometimes conflicting, interests, in which market devices (in this case, a technology list) play a pivotal role. More generally, the paper contributes to discussions on controversies and performativity in market practices and on the construction of markets designed to address environmental issues.

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### 1. Introduction

Markets have been granted a central place in policies aimed at addressing environmental issues. The most salient illustration of a market-based approach to combating climate change is the design of a “carbon market” in the wake of the 2003 directive implementing the EU Emissions Trading Scheme (MacKenzie, 2009; Wettestad, 2005). Here, we focus on another market that emerged as a result of European environmental regulation: the market for “clean” technologies targeted at industrial customers who seek to mitigate the environmental impact of their production activities. Since 1996, the EU Integrated Pollution Prevention and Control (IPPC) directive has required the most polluting industrial operations to obtain “environmental permits” that are granted to those that use the “best available techniques,” defined as techniques that ensure the highest level of environmental protection without entailing excessive cost. The objective of the directive was to create demand for pollution-reducing solutions and encourage suppliers to invest in the development of new technologies, thereby establishing a market where new technologies qualifying as “best available techniques” would compete for industrial customers impacted by the IPPC regulation.

We analyze the market for clean technologies established by the IPPC directive as an instance of *market innovation*. The directive heralded the development of a “cleantech” industry that has since attracted growing attention from entrepreneurs, investors and policy makers (Johnson & Suskewicz, 2009). The main innovation brought about by markets for clean technologies lies in the attempt to combine environmental and economic values. This is apparent in the very notion of “best available techniques,” which links environmental performance and economic viability, as well as in the definition of the now burgeoning cleantech industry, which is described as a range of “new technologies and related business models that offer competitive returns for investors and customers while providing solutions to global challenges.”<sup>1</sup>

The literature on economic sociology and innovation hints at the challenges that such attempts to combine environmental and economic value may face. Economic sociologists have shown that markets are not natural and impartial arenas for competition but constructed market architectures with particular rules for property rights, governance and exchange (Fligstein, 2001) as well as metrics for the value and qualities of products (Caliskan & Callon, 2010; Callon, 1998c). In this regard,

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<sup>1</sup> This definition is taken from the website of the Cleantech Group (<http://www.cleantech.com/about-cleantech-group/what-is-cleantech/>, accessed in June 2013).

markets can be “hostile” to products with new qualities, such as environmental friendliness, because these qualities are different from those inscribed in the rules and metrics of existing market architectures (Karnøe, 2010). In this light, the construction of markets for clean technologies appears as a peculiar form of market innovation in which existing market architectures are transformed and value metrics are extended beyond the economic performance of goods to include their environmental impact.

This paper<sup>2</sup> examines how goods are made both environmentally and economically valuable in the new market for clean technologies that emerged in the wake of the IPPC directive. In order to address this question, we build on literature related to the shaping of markets (Callon, 1998c; Kjellberg & Helgesson, 2007b). Together with economic sociology, this perspective is particularly relevant for investigating processes of market innovation, for it envisages markets as ongoing achievements, constituted by actors, practices and devices. This allows for studying market innovation in ways that are not possible if markets are seen as preexisting and neutral mechanisms for the selection of goods through the forces of supply and demand.

Our analysis is based on a case study that traces a Danish start-up firm's endeavors to commercialize a novel technological solution for reducing ammonia emissions from farms, which was labeled as one of the best available techniques that would enable a livestock farm to obtain the environmental permit required by the IPPC directive. We describe the wide array of actors involved in the construction of a market for technologies that reduce ammonia emissions (Veal & Mouzas, 2012), the entailed changes in exchange, normalizing and representational practices and the controversies they trigger (Kjellberg & Helgesson, 2006), as well as the devices that equip these evolving practices (Callon, Millo, & Muniesa, 2007). In order to highlight the challenges of renewing markets to make the economic and environmental qualities of clean technologies valuable, we provide an account from the viewpoint of a start-up that attempts to commercialize a solution for reducing ammonia emissions. Our account centers on a device that appears to have played a key role in this process: the list of best available techniques produced by the Danish Ministry of the Environment (hereinafter called the “Technology list”). In this case, the transformation of the market architecture involved inscribing new value metrics (economic and environmental performance) in the tables and calculations of the Technology list.

We contribute to the literature on market shaping and on market-based approaches to sustainable development by empirically examining the construction of a market for clean technologies in the field of agriculture. In particular, we show that the market innovation process hinges upon the composition of a complex network of actors with divergent (and sometimes conflicting) interests. We relate the pivotal role of a market device such as the Technology list in this network to its position at the intersection of exchange, normalizing and representational practices. We analyze this role as performative, in so far as the inscription of economic and environmental qualities in the list helps bring these qualities into existence and shapes the valuation of new technologies designed to reduce emissions.

The paper is structured as follows. First, we introduce literature on the shaping of markets that provides the theoretical background for our study. After presenting our methodology and our empirical data, we continue with a discussion that emphasizes the variety of actors involved in building a market for clean technologies and the key role played by a device such as the Technology list. Relating our findings to

those from studies of carbon markets, we conclude by reflecting on the dynamics and politics of market innovation.

## 2. Practices and devices in market innovation

The literature on the shaping of markets (Araujo, 2007; Kjellberg & Helgesson, 2007b) provides fruitful ground for the study of market innovation. It draws inspiration from a line of research in economic sociology that has examined the construction of markets, defined as arrangements of heterogeneous elements such as rules and regulations, technical and calculative devices, discourses and material infrastructures (Caliskan & Callon, 2010). Markets are understood as transactional spaces in which neither the goods exchanged nor the agents who exchange them are pre-existing (Callon & Muniesa, 2005). Economic agencies, which have the ability to calculate, compare and contrast goods, require tools and instruments such as the supermarket shelves on which goods are positioned, shopping lists and shopping carts (Cochoy, 2010; Grandclément, 2006). The qualities with which goods are endowed are the result of qualification processes that may involve competing efforts to define and value them (Callon, Méadel, & Rabeharisoa, 2002). Thus, stabilized and well-defined market architectures (Fligstein, 2001) are the outcomes of framings (Callon, 1998c) that entail negotiations and devices, and involve multiple actors and specific kinds of politics. However, due to the controversies involved, markets are not to be seen as stable entities. They evolve and change, shaped by reflexive and concerned actors who “explicitly question their organization and, based on an analysis of their functioning, try to conceive and establish new rules for the game” (Callon et al., 2002, p. 194).

Kjellberg and Helgesson's (2006) analysis of market practices is instrumental to understanding the processes that drive market innovation. The authors distinguish three types of practices that intervene in the shaping of markets: exchange practices related to the configuration of buyers, sellers, and the object of exchange (e.g., the introduction of self-service in retail, Kjellberg & Helgesson, 2007a; normalizing practices related to the formulation of rules, norms and standards for market behavior; and representational practices related to descriptions of markets (such as those produced by manufacturers and retailers in category review meetings; Azimont & Araujo, 2007). Discrepancies across and within these three types of practices are a driving force for processes of market innovation. Across practices, tensions can arise when changes in one dimension are not followed by changes in the other two dimensions (for example, when new ways of representing the market are not credible or useful because they are not supported by existing norms or modes of exchange). Within normalizing practices, competing efforts to shape markets can result in political struggles among different groups promoting the standards and rules of conduct that fit their own interests. Within representational practices, debates over the “correct” measures and images of markets may develop.

Kjellberg and Helgesson (2006) analyze such controversies as a singular kind of performativity. Performativity refers here to the ways in which theories and knowledge about markets intervene in shaping market practices. Taking inspiration from studies on the performativity of economics (Callon, 1998b), scholars have shown that formalized theories of markets and other forms of expertise can become performative as they are inscribed into devices (Araujo, Finch, & Kjellberg, 2010). Market devices—the “material and discursive assemblages that intervene in the construction of markets” (Muniesa, Millo, & Callon, 2007, p.2)—thus play a key role in the “performative controversies” (Kjellberg & Helgesson, 2006) that stem from actors' competing efforts to shape market practices and drive market innovation.

The role of market devices in processes of market innovation was illustrated in a case study by Beunza and Garud (2007) of reports produced by securities analysts in the late 1990s describing Amazon.com as it first emerged in the market. According to the authors, the analysts' reports can be viewed as “calculative frames” made of

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