



# Business models for sustainable technologies: Exploring business model evolution in the case of electric vehicles



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## ABSTRACT

Sustainable technologies challenge prevailing business practices, especially in industries that depend heavily on the use of fossil fuels. Firms are therefore in need of business models that transform the specific characteristics of sustainable technologies into new ways to create economic value and overcome the barriers that stand in the way of their market penetration. A key issue is the respective impact of incumbent and entrepreneurial firms' path-dependent behaviour on the development of such new business models. Embedded in the literature on business models, this paper explores how incumbent and entrepreneurial firms' path dependencies have affected the evolution of business models for electric vehicles. Based on a qualitative analysis of electric vehicle projects of key industry players over a five-year period (2006–2010), the paper identifies four business model archetypes and traces their evolution over time. Findings suggest that incumbent and entrepreneurial firms approach business model innovation in distinctive ways. Business model evolution shows a series of incremental changes that introduce service-based components, which were initially developed by entrepreneurial firms, to the product. Over time there seems to be some convergence in the business models of incumbents and entrepreneurs in the direction of delivering economy multi-purpose vehicles.

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## 1. Introduction

Sustainable technologies hold the promise to reduce harmful emissions and use resources more efficiently (Hockerts and Wüstenhagen, 2010; Johnson and Suskewicz, 2009). Despite being desirable for society, however, these technologies still face difficulties in penetrating mainstream markets (REN21, 2013). One barrier to market penetration is that sustainable technologies challenge prevailing business practices that depend heavily on the use of fossil fuels, especially in the oil and gas, electricity and automotive sectors (Jacobsson and Bergek, 2004; Johnson and Suskewicz, 2009). Since incumbents in these sectors have vested interests in profiting from unsustainable business practices (Cohen and Winn, 2007), they do not seem likely candidates to drive a change to more sustainable technologies. This role is expected from entrepreneurial new entrants instead (Hockerts and Wüstenhagen, 2010). However, new entrants not only face the problem that they have to challenge powerful incumbents (Ansari and Krop, 2012), but also deal with another barrier that is relevant to new entrants and incumbents alike: sustainable technologies lack market

attractiveness (Johnson and Suskewicz, 2009). Sustainable technologies often do not fit existing production methods, managerial expertise and customer preferences (Johnson and Suskewicz, 2009) and the potential benefit of resolving environmental degradation in itself does not seem a sufficient condition to generate widespread customer acceptance (Kley et al., 2011; Siegel, 2009).

It has been argued, therefore, that firms need different business models to transform the specific characteristics of sustainable technologies into new ways to create economic value (Chesbrough and Rosenbloom, 2002) and overcome the barriers that hinder market penetration (Johnson and Suskewicz, 2009; Kley et al., 2011). As Budde Christensen et al. (2012: 499) put it, "it might be that innovative technologies that have the potential to meet key sustainability targets are not easily introduced by existing business models within a sector, and that only by changes to the business model would such technologies become commercially viable." This would involve a fundamental reconsideration of the value proposition (product/services and segments targeted), the value network (product development, production and [after]sales), and the revenue/cost model (payment and financing) (Chesbrough and Rosenbloom, 2002; Demil and Lecocq, 2010; Johnson et al., 2008; Morris et al., 2005; Osterwalder et al., 2005). Moreover, through business model innovation, sustainable technologies would create new sources of value for customers in addition to their positive impact for the environment.

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Electric vehicles (EVs), the sustainable technology<sup>1</sup> on which we focus in this study, also face the challenge of how to create additional customer benefits, in particular to compensate for the higher initial investment compared to conventional cars (Kley et al., 2011). EVs could create such benefits through enabling more comprehensive mobility solutions (Kley et al., 2011), thus moving from product-based to service-based business models (Ceschin and Vezzoli, 2010); serving as energy storage in so-called 'smart energy' systems (Kley et al., 2011); generating new revenue streams from leasing the battery (Budde Christensen et al., 2012) or reusing it for second-use applications (Neubauer and Pesaran, 2011). However, the emerging EV 'industry' is still in search of a viable business model (Budde Christensen et al., 2012; Kley et al., 2011), which is not surprising as "[t]he right business model is rarely apparent early on in emerging industries" (Teece, 2010: 187). Both across and within firms various different business models are being pursued simultaneously through a process of learning, experimentation and adaptation (Demil and Lecocq, 2010; Sosna et al., 2010; Teece, 2010).

A key issue in this context is the respective impact of incumbents and entrepreneurial firms on this process (Chesbrough, 2010; Sosna et al., 2010); in particular because path-dependent behaviour shapes the business model that might eventually become the industry standard (Chesbrough and Rosenbloom, 2002). Path-dependent behaviour might cognitively constrain incumbents in finding new ways for value creation, as they prefer to stay close to what they are familiar with and to rely on a continuation of past successes. Nevertheless, these firms do have "a stable source of income from old business models that can cross-subsidize new business models" (Sosna et al., 2010: 403). Conversely, entrepreneurial firms are less constrained by path dependencies which makes them more flexible in designing more radical business models from scratch, but lack the resources to sustain a process of experimentation for a longer period of time (Sosna et al., 2010). It is therefore not clear upfront how the extent to which incumbent and entrepreneurial firms are driven by path-dependent behaviour will affect business model evolution in an emerging industry.

Despite a growing literature on the evolution of business models (Demil and Lecocq, 2010; Sosna et al., 2010; Teece, 2010), there is still limited understanding of how incumbent and entrepreneurial firms contribute to business model innovation and evolution in unique ways (cf. Hockerts and Wüstenhagen, 2010). We address this gap by exploring the following question: What is the impact of incumbent and entrepreneurial firms' path dependencies on the evolution of business models for the electric vehicle in the automotive industry? Based on a qualitative analysis of EV projects of key industry players over a five-year period (2006–2010), we aim to identify the main competing business models in the EV industry and trace their evolution over time. By contrasting the historical background, the role of complementary assets, and the impact of critical events, we seek to uncover how incumbent and entrepreneurial firms have influenced the evolution of business models, and thereby also shed light on processes that shape the development of a (future) dominant business model. Before moving to the empirical analysis, first the main tenets of the theoretical debate about sustainable technologies, business models and path dependencies will be discussed.

### 1.1. Sustainable technologies, business models and value creation

While sustainable technologies have the specific attribute to reduce environmental degradation (Rennings, 2000), firms face the challenge of how to develop a business model that transforms this attribute into sources of economic value creation (Chesbrough and Rosenbloom, 2002). An appropriate business model can increase the market attractiveness of a technology, improve the full value capture of an innovation and lead to a competitive advantage (Björkdahl, 2009). It is unclear, however, what an appropriate or 'right' business model is (Chesbrough, 2010). In case of emerging technologies the right business model is not yet apparent (Teece, 2010) and requires a process of experimentation based on several alterations (Chesbrough, 2010). That is, "one needs to distill fundamental truths about customer desires, customer assessments, the nature and likely future behaviour of costs, and the capabilities of competitors when designing a commercially viable business model" (Teece, 2010: 187). A business model therefore evolves over time (Morris et al., 2005; Sosna et al., 2010; Teece, 2010) through "progressive refinements to create internal consistency and/or to adapt to its environment" (Demil and Lecocq, 2010: 228).

While the need for business model innovation has received widespread attention (Chesbrough, 2010; Demil and Lecocq, 2010), it remains difficult to identify what a business model exactly entails (Teece, 2010). Business models tend to be rather complex (Casadesus-Masanell and Ricart, 2010; Zott and Amit, 2010), and many different conceptualizations have been suggested (Zott et al., 2011). On the one hand, scholars conceive of a business model in a broad sense, as a 'scale model' that describes a business as such as well as the general way in which firms create and capture value (Baden-Fuller and Morgan, 2010; Chesbrough, 2007; Demil and Lecocq, 2010; Teece, 2010). This generic conception enables a comparison of business models of different firms/industries and an identification of business model archetypes (Morris et al., 2005; Zott et al., 2011). Examples of such archetypes are the razor-and-blade business model that used to dominate the printing business (Chesbrough and Rosenbloom, 2002) and instant photography (Tripsas and Gavetti, 2000), or the double-sided market business model in which a firm creates an exchange platform for other producers and customers, popularized by online stores such as Amazon (Rysman, 2009). In an emerging industry, firms are still in search of a generic business model that may become the standard (Morris et al., 2005). Interest in converging to a dominant business model stems from the need to create legitimacy and customer acceptance for the emerging technology that all actors involved in the technology could benefit from (Aldrich and Fiol, 1994). Due to this convergence, "successful business models very often become, to some degree, 'shared' by multiple competitors" (Teece, 2010: 179).

On the other hand, scholars use a firm-specific conception of a business model to describe and design specific components and the interaction between them (Demil and Lecocq, 2010). The literature contains many depictions of components to describe and design a business model (Zott et al., 2011). Exemplary frameworks include Chesbrough and Rosenbloom (2002), Johnson et al. (2008), Morris et al. (2005), and Osterwalder et al. (2005), with key recurring elements being the value proposition, the value network and the revenue/cost model. The main implication of a firm-specific conception is that within one archetypal business model, firms still have the choice to make unique choices to gain competitive advantage, implying a strategic perspective (Morris et al., 2005; Teece, 2010). While a business model is not the same as a business strategy (Teece, 2010), business model innovation provides firms with opportunities to gain competitive advantage (Morris et al., 2005). The uniqueness of the business model concept is its focus on value creation instead of value appropriation (Chesbrough and Rosenbloom, 2002; Zott et al., 2011). Business model thinking

<sup>1</sup> It must be noted that electric vehicles are not sustainable per se. The potential to improve energy efficiency and reduce environmental degradation depends on the electricity source used to power the car. Acknowledging this caveat, we use the term sustainable technology to refer to electric vehicles because, if used correctly, they have a potential to contribute to sustainability, also in view of lower emissions.

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