



Business models for electric vehicles

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Two key sectors to reduce greenhouse gas emissions (GHG) and energy consumption in the UK and globally are electricity and transport. At the interface between these two sectors, electric vehicles offer a significant potential to reduce GHG emissions due to their higher well-to-wheel energy efficiency relative to conventional internal combustion engines and other alternative fuel vehicles [1], [2]. Meanwhile, EV life-cycle emissions are improving due to policies in the UK and in Europe supporting an increasing share of renewable energy in the electricity generation mix [3], [4]. Despite these advantages, customer adoption of the technology remains limited due to high battery costs, insufficient driving range, and a lack of charging infrastructure [5].

A central question for my research is how to overcome these barriers and create value through innovative business models that enhance the value proposition of EVs with other services. Taking a multi-stakeholder perspective on all companies involved in the commercialisation of EVs, from battery manufacturers to mobility-as-a-service providers, the objective of my work is to develop a comprehensive vision and framework of the opportunities offered by electric mobility. Based on case study interviews with industry experts, company founders and CEOs in four different countries (the US, Japan, France, and Norway), the analysis in my PhD will synthesise leading-edge thinking in the automotive, electricity and ICT sectors.

The ecosystem perspective reveals that the value of this innovation extends beyond the automobile product market into electricity and ICT network service industries. From the point of view of electric supply companies and distribution network operators, grid-connected EV batteries represent a potentially very interesting device that can be used as a generator, as a flexible load for demand-side management, frequency regulation services, and electricity storage [6], [7]. As the electric power system is progressively transitioning to a more distributed and decentralised structure with the integration of small-scale generation, intermittent renewable energy, and smart meters, policy makers will have to adapt regulations to the new market system [8–10].

According to the international case studies, the most expensive component of the electric vehicle, the battery, offers multiple sources of value creation

across the business ecosystem. Internalising the value of long-term strategic opportunities into the initial price of batteries may help bring EVs to cost-parity with conventional cars and give them a better chance to emphasise their other advantages to customers. In addition to the secondary life value of EV batteries, the R&D spill-over effect creates an indirect source of value when battery technical knowledge is used in other industries and markets [11]. Finally, another innovative solution to reduce battery costs to customers is to separate the ownership of the battery from the vehicle, with customers leasing rather than buying the battery from the manufacturer [12].

Information and communication technologies (ICT) in the vehicle can help drivers alleviate “range anxiety” through advanced route planning that incorporates information about their journey, the state-of-charge of the vehicle, typical driving habits, and electricity prices and charging rates. In line with general trends in the manufacturing sector, EVs may also speed up the transition from selling cars through simple product-based business models to outcome-based integrated service models [13].

The uncertainties in the early-stage market are leading companies to design and develop technological standards in order to become “platform” leaders [14]. The “platform” business for electric vehicles may be in charging services, in mobility services, or wider service platforms such as smart home energy management systems and smart cities [15]. Realising such business models often requires building strong collaborations and relationships between industries that previously did not interact with each other – a task that has already been found challenging [16].

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