Lecture Notes in Mobility

David Beeton
Gereon Meyer *Editors*

Electric Vehicle Business Models

Global Perspectives

IEA INTERNATIONAL ENERGY AGENCY
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Preface

Electric vehicles are a global phenomenon. Global in that every corner of the planet is affected by the environmental, energy security and health imperatives for increased adoption of electric vehicles. Global in that the challenges and opportunities this presents are universal to governments and industry worldwide. Global in that achieving this transformation requires a holistic system of innovative technologies, policies and business models.

This book therefore sets out to explore these global perspectives. It presents insights from around the world and across the network of organisations, technologies, consumers, products and services which characterise the electric vehicle ecosystem. It draws on the networks of the International Energy Agency's Hybrid and Electric Vehicle Implementing Agreement to present commentary and case studies from experts in eleven different countries from across five continents.

The focus on electric vehicle business models recognises that market development will be a key enabler in realising a rapid transition from niche to mainstream adoption. This will demand that electric mobility products and services are developed to provide benefits which exceed apparent costs and supersede any perceived relative advantage of fossil fuelled vehicles. In simple terms, the goal is to make electric vehicles more cost-effective, convenient, desirable and rewarding to use.

History suggests that this is seldom a straightforward process. The right business model is rarely apparent early on in emerging industries. Furthermore, customers and incumbent industry players often face multiple restraining forces and switching costs in adjusting to new technologies or ways of doing business. Therefore, while business model innovation can undoubtedly facilitate greater market adoption of electric vehicles, it also represents an area that is replete with challenges and exposed to continuous change.

This book considers this further and presents a series of discussion papers on electric vehicle business models. This provides expert commentary and analysis from cities, boardrooms and research labs around the world.

It commences by considering the macro dynamics and changes that are at play in the industry as a whole. Electric vehicle business models are placed in a wider

context, and conceptual structure is provided for the various solutions and approaches that are emerging in this space.

The next section explores business models for recharging infrastructure. This includes market models and billing strategies for public charge points, the business case for deploying rapid chargers on a motorway network, and solutions for residents of multi-unit dwellings. Consideration is also given to the potential for wireless charging technologies and the associated business models that are emerging for this new technology.

Energy systems are then considered from two perspectives. The first is the potential for electric vehicle batteries to be integrated with grids to provide dynamic storage and supply. The second focuses on the vehicle itself, considering how vehicle design and battery systems influence energy efficiency and the associated total cost of ownership.

Attention then turns to fleet applications of electric vehicles. This reviews the evolution of electric mobility in carsharing business models and the challenges and opportunities that electric vehicles present to carsharing operators around the world. It then presents an example of how fleet managers can use analytical tools to identify applications for electric vehicles to save money and significantly reduce emissions.

The final section presents a series of case studies on different aspects of electric vehicle business models from around the world. This provides lessons learned and conceptual insights from experiences in Japan, China, Hawaii and Chile.

Most new business models emerge from analogy and lessons learned. Thus, we hope readers find the analysis presented in this book helpful and inspiring to launch multiple initiatives that further accelerate the *global* deployment of electric vehicles.

July 2014

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Part I
Industry Perspectives

EV Business Models in a Wider Context: Balancing Change and Continuity in the Automotive Industry

Peter Wells and Paul Nieuwenhuis

Abstract This paper seeks to balance the tendency to analyze EV business models in isolation by setting them in a wider context in which the automotive industry is seeking to reconcile continuity and change in an increasingly volatile and uncertain competitive environment. This paper argues that one reason for the relative lack of penetration of EVs and the relative failure of the organizational innovations that have accompanied them is that there are powerful forces for continuity. It is argued that there are many other aspects of change in the industry that have been neglected by EV protagonists and policy-makers but which, for the industry itself, may be more urgent. Consequently, policy-makers may need to reflect upon the utility of traditional market incentives, research support and regulatory pressure.

Keywords Electric vehicles · Business models · State intervention · Automotive industry · Tesla · Autolib

1 Introduction

Is the Paris Autolib scheme a viable business model? How far do the innovations introduced by Tesla constitute a radical innovation in business model terms? How disruptive are innovations in EV business models for the existing automotive industry? This paper explores some of these and related themes by taking a wider, and longer, view of the automotive industry. In so doing, we urge some caution to those that wish to herald a new dawn in automobility, but equally recognize that in an industry facing myriad pressures there is an appetite for technological and

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organizational innovation, albeit tempered by considerable uncertainty as to what the future holds.

The paper commences with an account of the underlying logic behind the quest for an alternative to the mainstream automotive industry business model, propelled by the unique characteristics of EVs and the support 'ecosystems' they require [1]. Thereafter we highlight the ways in which there are enormous forces for path dependent inertia in the industry as a whole, and in wider society, that may act to ameliorate the incentives for business model innovation [2].

Moreover, as we subsequently argue, the issues surrounding EV technology and business model innovation are hardly the only pressures exerted on the contemporary automotive industry, and hence the issue of EV business model innovation needs to be placed in a broader strategic context. In particular, at a time of considerable economic austerity in many markets with the attendant financial pressures on revenues and profitability for vehicle manufacturers and their suppliers, the industry must simultaneously adopt a fundamental shift in global capacity locations and parallel development of several key technologies. Thus in the penultimate section of this paper we consider whether prevailing government interventions, both regulatory and fiscal, have been sufficient to compensate for the risks the industry faces both within the EV sector and more generally. We conclude with a call for stronger public-private partnerships that embody a long-term vision for the future of mobility in our societies.

2 Business Model Innovation and EVs: The Search for the Right Formula

The re-emergence of the EV as a potentially viable alternative to traditional petrol or diesel cars has been accompanied by an expectation that with it will come dramatic changes in 'automobility' and in the business models that vehicle manufacturers and others would need to access the market [3]. These twin expectations derive from the particular characteristics of EVs, particularly with regard to the initial stages of developing a market for these cars.

Compared with equivalent conventional cars, EVs have a high initial purchase price, more limited range, greater sensitivity to weather and other driving conditions, uncertain rates of depreciation, and lower expectations with regard to the longevity of the powertrain. While there are offsetting performance attributes that count to the advantage of EVs for consumers, such as smooth power delivery and quiet operation, the main financial attraction lies in reduced running costs (chiefly due to the lower cost of using electricity)—although such reduced running costs may still not entirely compensate for the initial higher purchase cost. In addition, EVs need access to a network of domestic, corporate and public recharging points. The concerns over the issue of range, and the time required for recharging, make the provision of accurate and timely information on infrastructure availability and road

network conditions critical elements of the entire EV experience, and hence the wider EV 'ecosystem' in which business model innovation has been expected to occur includes electricity generation and distribution companies (including resellers and virtual aggregators), the manufacturers of recharging equipment, the installers of the recharging network, managers of that network, financial organizations to enable smart card payment systems, mapping and traffic information providers, public authorities at all spatial levels, software providers, and multiple organizations prepared to install recharging points [4, 5].

The orchestration of these multiple agencies is in itself a daunting task, and one of the key reasons why there has been an expectation of innovative business models, particularly from new entrants. The mainstream automotive industry, with its established business model and significant sunk costs, may be expected to show some reluctance in nurturing an alternative where it has the potential to render their existing investments redundant—a form of 'incumbents curse' [6]. Moreover, the low initial volumes expected for EVs opens up more opportunities for small and innovative companies to re-write the rules of competition.

Perhaps as a consequence of these considerations, the existing mainstream vehicle manufacturers have been relatively cautious in their pursuit of innovative business models, despite initiatives such as the Peugeot Mu concept or the Nissan-Sumitomo 'second life' idea to re-use automotive batteries in static emergency back-up operations. Rather, for the vehicle manufacturers, the preferred option may be to make EVs as much like traditional cars as possible by driving down battery and system costs and hence reducing purchase price or lease rates for consumers. As incumbents, the established vehicle manufacturers have some advantages that should not be discounted. These advantages include brand recognition, established retail and support networks; vast experience in marketing; vehicle integration competencies, political leverage; financial depth; and, profound technical skills. Furthermore, a cautionary approach has been somewhat vindicated by some high-profile failures in terms of business model innovation around EVs, most notably of course with regard to Better Place. As is explained further below, even the 'success' stories of business innovation, such as that of Tesla, deserve rather more careful evaluation when the industry is considered in historical perspective.

Governments at national and local level have also experienced some policy challenges with regard to EVs, particularly where the agenda has been to leverage investments in local recharging infrastructures in order to attract investment from the EV manufacturing sectors. Similarly, government support in terms of R&D programs and other incentives has some political attractions but is inevitably also fraught with hazard—as the media debate over A123 Systems and Fiskar (both recipients of US government funding and subsequently declared bankrupt) has shown.

As a consequence there is a sense in which there is an apparently lucrative market with high growth potential tantalizingly close, but which needs a judicious choice of intersecting business models at the right time, in the right place, and with the right combination of participants in order to unlock that opportunity.

Despite these comments, the runaway success in the EV sector has been the Renault-Nissan alliance, at least in terms of the sheer number of cars built and in use. The Nissan Leaf in particular does not embody any radical departure in terms of the business model, although Renault has sought to separate the battery from the car in terms of ownership and payment.

2.1 The Tesla Case

With the introduction of the Model S in mid-2013, Tesla became synonymous with entrepreneurial success in the nascent electric mobility market with strong product reviews for the car and optimism for the business model underwriting a surging stock market price in the US. In many regards the celebrations and plaudits appear somewhat premature. Bearing in mind the tumultuous history of EV pioneers such as Think (four times bankrupt in the 20 years to 2011), the financial position of Tesla does not appear particularly strong notwithstanding the backing of Elon Musk. As of the quarterly report filed on 9th August 2013, Tesla had grown revenue in the 6 months to June, 2013 to US$401 million, compared with just US $22 million in the 6 months to June, 2012. However, Tesla still reported a net loss (US$30 million), albeit reduced from the equivalent period in 2012 (US$105 million).

From Table 1 it is notable how far Smart and others have pre-figured many of the business model innovations offered by Tesla, including (with Daewoo) fixed price or 'no-haggle' sales. Smart embodied a high risk strategy for Mercedes as it simultaneously included a radical new vehicle design intended for a novel market segment, a new factory of unusual design and process operation, new supplier relationships, new distribution and sales including of course a new brand, mobility packages including tie-ins with rail service providers, and a focus on 'green' consumers. Many years of missed targets and accumulated losses followed. In 2013 Bernstein Research awarded Smart the dubious accolade of being the biggest loss-making model in the history of the European automotive industry, accumulating losses of £2.82 billion or £3,763/car [12]. Daewoo, another pioneer of alternative business model concepts albeit for different reasons (essentially to compensate for uncompetitive products), fared even less well—eventually the company was absorbed by GM.

Other vehicle manufacturers have struggled to make major shifts in their operational expertise or approach to market. Ford, in around 2000 under Jac Nasser, attempted to shift the centre of gravity of the business downstream by buying into, for example, car servicing and repair company KwikFit and vehicle dismantling operations. The project (termed Ford 2000) was rapidly abandoned. Others have sought to introduce new brands to access distinct market possibilities, again with largely unhappy outcomes. Mercedes failed with the luxury Maybach brand, just as GM did with the 'youth' Saturn brand. Alongside these notable failures from within the industry, there is a growing list of start-up failures or companies in tenuous

Table 1 A comparison of the business model innovations from Tesla with pre-existing innovations

Tesla innovation	Pre-existing example
Ownership of retail outlets	Very common and long-established practice in continental Europe; adopted by Daewoo as a market entry strategy in the UK in the 1990s
Creation of 'boutique' retail or experience outlets in shopping malls and other mixed retail locations	Attempted by Smart during early phase of marketing. Parallel examples include the Toyota Amlux Centre in Tokyo and the VW Wolfsburg 'Autostadt' brand experience facility
Fixed price, 'no haggle' retailing	Adopted by Daewoo as a market entry strategy in the UK in the 1990s
Provision of free access to unlimited charging via own fast-charger infrastructure (30 min recharge)	No comparable example, but many instances where new cars have been offered with 12 month supply of petrol
Battery swap system (on Model S) allows replacement in 90 s at US$60–80/swap	Initially tried by better place (now bankrupt). Only works for Tesla S models despite US $500,000 cost/swap station
Cars built to order, not sold 'off the lot'	Very common in Europe, particularly for prestige and sports cars for at least a proportion of total output. Morgan is a good example
Ordering new cars via retail outlet or internet	Internet retailing is well established, though because of legal constraints orders still need to be routed via dealerships
High levels of vertical integration (estimated at 70 % by value)	Historically common (e.g. Ford; VW); widespread for key technologies and materials e.g. fuel cells; magnesium
Introducing new brand, new model and new manufacturing facility simultaneously	An even more ambitious version of this was attempted at launch by Smart with the Hambach plant

Source [7–11]

positions in the nascent EV sector including Fisker, A123 Systems (Batteries), Coda Automotive, Bright Automotive, Aptera Motors, Miles Electric Vehicles, Ecotality (recharging networks), Next Autoworks Co. and of course Better Place (recharging networks).

With some 20,000 Model S cars planned for production it is by no means clear that Tesla can generate sufficient funds for expansion of the product range and the deployment of the recharging infrastructure. The business model, however, also benefits from the revenues Tesla obtains selling zero emission credits to others (at one stage amounting to 12 % of revenues), and from the revenues obtained from selling battery packs to Daimler (ironically, for the electric version of the Smart used in the innovative Car2Go schemes) and Toyota (for the PHEV version of the RAV4). Both Daimler and Toyota are investors in Tesla. Crucially, Tesla is not just a tale of entrepreneurial guile and fortitude: Tesla obtained a US$465 million government loan on extremely generous terms while the initial public offering in

2010 raised US$226 million. While Tesla repaid the loan almost 10 years early, in 2013, that initial vote of confidence helped underwrite the expansion of the business at the Freemont assembly plant in California. Some concerns have been raised about this sort of funding:

> "Personal loans made in 2008 by Elon Musk, Tesla's co-founder and CEO, provide a telling contrast. Musk received a much higher interest rate (10 percent) from Tesla and, more importantly, the option to convert his $38 million of debt into shares of Tesla stock. That's exactly what he ended up doing, and the resulting shares are now worth a whopping $1.4 billion—a 3,500 percent return on his investment. By contrast, the Department of Energy earned only $12 million in interest on its $465 million loan—a 2.6 percent return" [13].

This is a substantive issue for the future of government intervention. It is readily apparent that simple reliance on 'the market' to bring forth appropriate solutions is not plausible in many contexts. Indeed, there is much to the view that it is government or public-funded R&D (including that conducted at universities) that has generated most of the key technological breakthroughs of the contemporary era, from decoding the human genome to the creation of the Internet. Equally, government helps frame the market in important ways through fiscal regimes, regulatory interventions and the ability to underwrite long-term structural investments.

2.2 The Autolib Case

Despite the apparent differences, there are some similarities between Tesla and Autolib, the EV rental scheme pioneered in Paris. In the case of Autolib there is also the distinctive involvement of a wealthy individual, key investment and planning decisions from government, and partnership with the mainstream automotive industry. As with the Tesla case, the business logic behind Autolib is not entirely reducible to that of building and selling EVs.

Autolib is run by the Bolloré Group. While traditionally outside the automotive industry, a key interest for the Group is in lithium metal polymer (LMP) battery technology for which they hold all the patents. The battery division of Bolloré Group, Batscap has two battery factories: one in Quimper in Brittany; and a second in Montreal, Quebec. Initially, Bolloré approached car manufacturers in 2002 with their LMP technology but to no avail. In 2004 the company then partnered with CeComp in Italy, who developed the car, which in turn was designed and is built by Pininfarina as a subcontractor to CeComp, using Batscap batteries. The so-called 'Bluecar' has a 250 km range (urban cycle), 150 km on mixed cycle, four seats, and takes 8 h for a full charge (2 × 16 amp can reduce charging time from 8–4 h). The chassis is a combination of steel and aluminum, the body panels are aluminum, with some plastic panels (e.g. bumpers).

Bolloré won the Autolib tender in early 2011 with this vehicle, the Bluecar. It was able to combine the vehicle with its own in-house data management and automated interface terminal maker IER, which is a world leader in terminals for

public services (e.g. automated check-in at airports). For Autolib IER supply the access card, charge points, kiosks (where you can sign up), operations centre, and information management. For Autolib, IER can keep track of cars through both GPS and via the charging points. Bolloré was also able to use Polyconseil—its own in-house telecoms consultant. Hence Bolloré had a neatly intersecting set of competencies to provide both the vehicle and the management of the system. These competencies make a difference, both to the overall value proposition and the success of the scheme. In particular subscribers (and those wanting to subscribe) can interact via a screen or via telephone to obtain help and information.

Autolib covers 47 towns in the region of Ile de France, with Paris at the centre. By mid-2012 Autolib had 1,740 Bluecars, 500 stations and 600 staff with a target of 3,000 cars, 1,000 stations and 1,200 staff by the end of 2013. By mid-2013 there were reportedly 82,000 subscriptions sold from late 2011 onward. Users can choose from three tiers of membership, with an additional cost depending on how much they drive. Autolib' memberships can last a day (€10), a week (€15), a month (€30), or a year (€144). About 35,000 are members with a yearly subscription. Once a subscriber joins, they are able to use the cars as often as desired subject to finding an available car and payment of the in-use fee (€7 per 30 min for day members, €6 for week and month-long members, and €5 for annual users).

Each Autolib recharging station has 4–6 spaces, and a terminal for signing in. Some 250 sites also have charging for other EVs (one space for a car and one space for an electric two-wheeler). The 47 municipalities pay €47,000/station as a subsidy, but Autolib pay a fee for the parking spaces, which will repay this subsidy by 2014—4 years ahead of plan. Once Autolib is profitable, profit will be shared with the municipalities.

Various claims are made about the impact of the Autolib scheme in terms of traditional vehicles replaced, CO_2 emissions reduced, and the contribution made connecting the city centre with the outlying suburbs. To date, however, no comprehensive evaluation has been undertaken. As a result, critics of the scheme are concerned that, for example, Autolib is primarily a substitute for public transport not private cars and hence does little to improve the environmental performance of the whole transport system.

Interviews with Autolib personnel in mid-2012 revealed that the average rental was 40 min and 10 km for Premium subscribers. Monthly subscribers tend to use the cars for longer each trip, typically about 3 h each rental. In addition, 70 % of Autolib users are in the 18–34 age-group: Contrary to expectations, tourists do not as yet constitute a high proportion of Autolib users.

Total investment in the whole project so far is €1.7 billion Euros, including cars, batteries, and infrastructure: Mostly from Bolloré. However, in turn Bolloré obtained a significant European Investment Bank loan of €75 million in 2012. Formal public investment is limited to the subsidy offered per charging station. Hence for the 'public purse' the scheme offers excellent value for money at relatively low risk. A crucial question in the context of this paper, however, is whether the project and the business model adopted is sensible for Bolloré. As a stand-alone activity there must be some considerable doubt over the viability of the Autolib

project for Bolloré, at least in the short term. The number of vehicles is relatively low (only 3,000 projected) and once into a regular replacement cycle the Autolib 'market' might constitute 300 new vehicles per annum, but replacing these vehicles are an investment cost for Bolloré. Vandalism and accidental damage to the vehicles is an ongoing cost problem. Revenues from the subscription fees and use fees will of course become the most important income stream from the project but to date no figures have been released on this matter.

The business case for Bolloré begins to look rather more plausible when the wider context is considered [14–16]. In brief, Bolloré is looking to expand the business in a number of ways. First, private individuals can now lease the cars at €500/month, which includes a charging point. Second, Bolloré will now also sell the cars for €12,000 while renting the battery for €80/month. Third, the company is expanding the service side of its business with new markets in Lyon (Bluely) and Bordeaux (Bluecub), and most recently Indianapolis. Fourth, in a press release of the 12th September 2013 it was announced that Bolloré had signed a letter of intent with Renault for the joint development of car-sharing solutions and of new EVs, including the possible construction of a three-seat vehicle using Bolloré battery technology. With all these further developments, the Autolib case can be seen as a valuable shop window for Bolloré from which a much larger, longer-term and profitable business can be constructed around their intellectual capital and unique operational expertise.

3 Constraints on Innovation: Continuity in the Automotive Industry

It is worthwhile considering just why the established automotive industry is considered as relatively slow to change [17]. There are multiple facets to this issue, including both practical considerations such as the availability of appropriate skills and capacities, and more nebulous issues such as the lessons learned from historical experience.

Clearly, the vehicle manufacturers have an established workforce and physical assets premised on the design, integration, sourcing, manufacture, distribution, sale and support of all-steel vehicles with petrol or diesel engines. Such assets require large investments of substantial longevity. Moreover, the opportunities for switching may be constrained by external factors. For example, a wholesale shift into alternatives to the all-steel body is effectively impossible, because there is not a sufficient supply base for aluminum or carbon-fiber reinforced composites at present to substitute for the volumes accounted for by steel. Vehicle manufacturers are understandably reluctant when the supply of a key material or component is constrained, and therefore 'risk assessment' forms an important element in any strategic purchasing decision. It is telling that BMW felt the need to secure supplies of carbon fibre reinforced composites for the i3 and i8 models, for example.

This case is also an interesting illustration of the ways in which the reduction of life-cycle carbon emissions attributable to the use phase (currently circa 85 % for a standard car) throws increased attention on the carbon cost of manufacturing, and hence the need to mitigate emissions in this area.

Furthermore, incremental gains have been quite effective for the industry as a strategy to ameliorate some of the apparent advantages of EVs. In terms of environmental parameters therefore the advantages of EVs over conventional vehicles given an EU electricity generation mix are relatively modest [18, 19]. Regulatory regimes over carbon emissions have been largely shaped around a pace of change deemed acceptable—essentially political compromise with the industry—rather than that which is technically possible or environmentally imperative [20–22]. Incremental change therefore has been hard-wired into the industry by regulatory frameworks—although it could be argued that this position is changing. Moreover, fundamental assumptions about what constitutes a vehicle and how it may be used are also largely informed by the pre-existing industry, making it difficult for more radical concepts to establish an appropriate place in our pantheon of mobility opportunities.

4 Countervailing Pressures for Change in the Automotive Industry

The focus of attention on EVs is understandable, but for senior management in the vehicle manufacturers it is only one area of strategic concern demanding attention and resources. The following may be highlighted:

- Imbalanced capacity demanding closures in some locations, and new plants in others.
- Shortening product cycles, increased market fragmentation, and greater market volatility requiring a much larger product range.
- Requirements for a portfolio of new technologies of which EVs are but one.
- Shifting cultures of automobility in mature markets, along with ‘peak car’ saturation, resulting in concern for future revenue growth.

All of the above issues are significant for costs, revenues, or both. Some threaten to undermine the existing business model, which is interesting as a potential stimulus for the search for alternatives. However, contemporary economic conditions in the period since 2008 (especially in the EU) have not been conducive to growth, putting pressure on the ability of the industry to generate sufficient investment resources internally. In this context, the somewhat innate industry tendency towards conservatism is reinforced by necessary financial prudence in the face of increased volatility and uncertainty. What is most likely is the emergence of what might be termed ‘portfolio’ strategies whereby vehicle manufacturers seek to

calculate a workable balance of product segment, technology and relative sales that both meets regulatory demands and still generates profitability.

Electric vehicles are of course part of this wider story. The pressure to develop EVs and new ways of bringing them to market is just one aspect of the multi-facetted challenges confronting the industry in terms of new technologies: existing petrol and diesel engine improvements; hydrogen fuel cells; hybrid systems; integration with mobile communications and mapping systems; new generation safety systems; and lightweight design via magnesium, aluminum and plastics are all individually demanding significant resources. Again, the industry has been here before. With the emerging technology of fuel cells, or with the strong possibility that magnesium would become a significant material in the future, vehicle manufacturers have sought strategic responses that enhance technical understanding and/or control over key resources. Typically, these responses have involved alliances, joint ventures or outright acquisitions as was the case with Daimler and Ford in the example of Ballard (fuel cell manufacturer). Whether such responses are enduring rather depends upon whether the technology or material does subsequently become of strategic significance, and whether the partner businesses can sustain some competencies that others may desire.

Fragmenting markets into a larger number of smaller product niches, combined with compressed model cycles, threatens to negate the benefits achieved via vehicle architecture strategies and overall result in a more turbulent market environment in which sales forecasts are increasingly difficult. Perhaps more significantly in the longer term are more nebulous concerns around an apparent shift in cultures of automobility that in the mature markets entails a downgrading of car ownership and use by younger people (the so-called ‘peak car’ phenomenon). The vehicle manufacturers, faced with the near certainty of saturation, can only increase revenues by capturing more value per vehicle: it is by no means self-evident that such a strategy can be realized by all. Overcapacity in the mature markets can only be resolved by expensive and socially-divisive plant closures, absorbing the resources and management attention that really needs to be concentrated on expansion in emerging markets.

5 Market Incentives or a New State-Business Relationship?

It is a debatable point whether EV registrations have been disappointing. The expectations of policy-makers and much of the media may not have been met as yet, but equally those expectations may have been unrealistic. The hopes of the industry have not been met either, but theirs is a more tempered concern. Early sales of hybrids, it is argued, were also modest. However, a stronger consensus appears likely over the need to orchestrate the novel powertrain and weight reduction strategies that must form the basis of the reinvention of the automotive industry. In most instances it is likely, again, that the vehicle manufacturers are central to this

orchestration, bringing together constellations of companies that might hitherto have been largely outside the industry.

What is somewhat more problematic to forecast is the future participation of the state, which has been instrumental in seeking to establish the nascent market for EVs thus far [23–26]. The contemporary state intervention model does not stand up particularly well to detailed scrutiny either because of concerns over value for money against the risks taken, or because of competition between locations. Moreover, rules over state aid often preclude state involvement beyond the early stages of R&D, but often this means innovations are still well short of genuine market readiness. That is to say, there tends to be something of a 'desert' between prototype or demonstration levels, and the typical mass production scales associated with the high-volume automotive industry. Possibly initiatives like the 'Proving Factory' [27], established in the UK with the help of state funding to help bridge the prototype to mass production gap are one of the new ways in which state intervention can help partner with industry and thus bring products to the market.

Consumer or market incentives, on the other hand, do little more than send a message that this is a 'challenged' product that needs a sweetener before consumers will accept it. The use of such incentives is as flawed as those offered to scrap apparently perfectly functional cars after ten or even 8 years of use, justified at the time as a means of stimulating demand. Incentives distort the market for a modest short-term benefit and while in reality they do not 'cost' the governments in question a great deal, neither do they really help a great deal either. The short-term attitude inherent in much of the political process, wherein governments always have a wary eye on the next forthcoming election, makes policy announcements about incentives rather appealing regardless of their efficacy.

If there is continued market failure, which is certainly still an area to be debated rather than simply accepted, then the state needs to uncover better ways to resolve that failure. The Autolib case illustrates that the partnership approach whereby the state effectively underwrites the creation of a market space for EVs can work as an initial means of nurturing the transition to higher volume manufacture. The Tesla case in turn illustrates what can be done via entrepreneurialism, with the proviso that there is some concern over the future of standards and inter-operability with the Tesla model.

The notion of some form of collective rather than individual ownership that the Autolib case illustrates is probably a portent of things to come, particularly with the ongoing growth in various forms of car sharing schemes that both ensure a more efficient use of a given fleet of cars, and often speak to the operational advantages of EVs [28–30]. Again, car sharing is in the early stages of development and of course need not necessarily involve EVs, but the deployment of EVs via one or other version of such schemes is again an area of substantive potential; car sharing schemes may offer protected market niches, perhaps allied with 'committed' consumers that subscribe to the ambition of more sustainable mobility [31–34].

6 Conclusions

Business models in the EV world are still emerging and evolving, as they must do in response to shifting contexts. What we have sought to argue here is that the notion of a business model needs to extend well beyond the formal boundaries of the business itself; and beyond the boundaries of a particular point in time. Companies like Bolloré have the resources and the insight to aim at the long-term prize, so it would be a mistake to rush to judgment on an unfinished strategy.

On the other hand, perhaps the state also needs to be more innovative and to take more risks, but also to be more interested in sharing the rewards if those risks are then translated into success. In this sense, perhaps the state needs to act more like an investor, and in so doing can perhaps channel the rewards of investment back into further risk underwriting activities.

The business models literature tends to rather underplay the role of the state as a pivotal agency defining market possibilities, and yet a business model in a sector like that for EVs that ignores the role of the state is absolutely doomed to fail; indeed it makes little sense at all. The state at national and international level is pivotal in regulatory framing, and in steering all manner of developments that are critical to the success or failure of EV business models. Hence it is only through active engagement and interaction between the state and business that innovative business models will be able to deliver more sustainable mobility.

In the longer term the incremental extensions of EV business models either backwards or forwards along the value chain may come to be seen as temporary expedients. Alternatively, these developments and others like them may just be the start of a fundamental shift in the architecture of sustainable business as organizational forms come more closely to enabling the realization of government policies promoting the circular economy.

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Four Business Models for a Fast Commercialization of Plug-in Cars

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Abstract Plug-in vehicles are one important means to lower CO_2 emissions from the transport sector. Despite this, uptake is slow. This can be well explained by theory on social dilemma problems and on diffusion of innovations. The traditional "sell-and-disengage" business model is not suitable for plug-in cars. Using an entrepreneurial business model generation process we have developed four alternative business models that address important factors for the speed of which customers adopt an innovation. The results show that alternative business models are necessary, but they cannot alone ensure a fast, and lasting, commercialization of plug-in cars. As a complement, governments will have to take measures to control external factors that influence the viability of business models for plug-in cars.

Keywords Plug-in car · All-electric car · PHEV · REV · Business model · Social dilemma problem · Diffusion · Innovation

1 Introduction

Plug-in vehicles are seen as one important means to lower CO_2 emissions from the transport sector and to reach a fossil independent vehicle fleet by 2030, a goal set by the Swedish government.[1] The slow commercialization of plug-in vehicles seems to have taken people by surprise.[2] What is surprising though are the high expectations

[1] See http://www.regeringen.se/sb/d/15703/a/196433 (read 2013-09-03).

[2] Illustrations: http://www.theengineer.co.uk/blog/uk-electric-car-take-up-is-slow-while-carmakers-charge-ahead/1016123.article or http://www.bloomberg.com/news/2013-05-27/german-automakers-falter-in-meeting-million-electric-goal.html or http://www.gizmodo.com.au/2012/01/electric-cars-off-to-a-slow-start/ (read 2013-09-03).

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of a rapid shift to plug-in cars, and even more surprising is the stubbornness most plug-in carmakers show when sticking to the same business model they use for traditional cars, despite the disappointing sales figures achieved when it is used for plug-in cars. The slow uptake of plug-in cars can be well explained by theory on social dilemma problems and on diffusion of innovations. By building on these two theories, we have developed four alternative business models that address the reasons why the traditional car sale business model is inefficient for plug-in cars. The business models' viability have been tested, and from that, conclusions can be drawn about specific societal support that will be required to avoid the risk of future social dilemma problems that may obstruct a fast introduction of plug-in cars.

The paper is structured as follows. First we set the terminology on plug-in cars used for this chapter. Then a brief description of the business model concept is given. After that we explain why the current business model for cars does not work for plug-in cars, after which we look into what issues a business model for plug-in cars should address. Thereafter follows a description of the business model generation process we have used for developing the four business models, which are then depicted through a common template. We then revisit the social dilemma problem, where governmental intervention is most likely required for a diffusion to take place and then not discontinue. The chapter ends with a concluding section including a description of limitations.

2 Terminology

The terminology for plug-in electric vehicles is not yet well defined. The study behind this chapter has focused on cars, although our findings may be relevant also for other vehicles. With plug-in cars we mean all cars that can be charged from the grid, i.e. both *all-electric* cars, like Nissan LEAF and the Tesla cars, plug-in hybrid (*PHEV*) cars, like Volvo V60 PHEV and Toyota Prius Plug-in, and range extender cars (*REV*), like Opel Ampera and BMW i3 with the range extender option. Since all plug-in cars, except the all-electric cars, can easily replace a traditional internal combustion engine (ICE) car, we have had the all-electric car in focus when designing the alternative business models. The business models should however be applicable, potentially with some adjustments, also to the other types of plug-in cars.

3 What Is a Business Model?

A business model is a description of how a company creates, delivers and captures value [1, 2]. A viable business model must provide value to the customer that is higher than the costs for providing it, and then capture the difference. Business models unleash technologies' inherent value with different degrees of efficiency and with different characteristics [3]. In the most common "sell and disengage" business

model, the ownership of a product, and all its future costs are transferred to the buyer in exchange of money at point of sale, possibly with some warranties included. An alternative business model can be to keep ownership of the product and sell access to it as a subscription, like renting an apartment.

It is the business model that defines what the offering will be compared with. A traditional "sell-and-disengage" business model for plug-in cars will make the established ICE cars the obvious reference point, while a carsharing service like Car2Go can have taxi and public transport as reference points.

A key to a viable business is the business model owner's ability to capture the excess value, i.e. the value above the cost for providing it. Since there is limited willingness to pay privately for something that will benefit the commons [4] this is extraordinary challenging when a substantial part of a product's value is common good and not private good. This will be further discussed in the section on social dilemma problems.

4 Why the Current Business Model for Cars Doesn't Work for Plug-in Cars

The "sell-and-disengage" business model where the physical product ownership, and hence all risk, is transferred to the buyer at point of sale may work fine for established technologies with low perceived risk, but not for novel technologies, especially not when they are not up to par with the technology they challenge. Using the traditional "sell-and-disengage" business model for plug-in cars encourages customers to use the ICE car as reference, hence giving three issues unnecessary focus; (1) the higher price, (2) the shorter driving range, and (3) the uncertain battery life length. The hesitance this creates among new car buyers becomes also valid for used car buyers, which makes the used car value uncertain.

People use a higher implicit discount rate for technologies that are unfamiliar to them [5], i.e. they demand a lower "price per utility" than from the established technology. Humans also have a nonlinear perception of gains and losses, where we perceive the punishment from losing as bigger than the joy from winning an equal amount of value [6]. This means that when a new technology performs worse than the established technology in any attribute, it will easily be discarded as inferior.

Price versus operating cost also matters. We can learn from behavioral economics that a high initial price but low future operating cost often is perceived as less attractive than a lower initial cost but higher operating cost, even when the total economic impact is exactly the same [6, 7]. Renault's decision to sell their all-electric cars without the battery and instead sign up the customer on a forcing monthly lease is an example of change in the temporal distribution of financing to make the all-electric car offering price- and cost-wise more similar to prices and costs of ICE cars.