Editorial

Julia Hildermeier*

Institut für Sozialwissenschaften,
Humboldt-Universität Berlin,
Unter den Linden 6, 10099 Berlin, Germany
and
Ecole Normale Supérieure Cachan,
GERPISA, 61, avenue du Président Wilson,
94235 Cachan Cedex, France
E-mail: Julia.Hildermeier@ens-cachan.fr
*Corresponding author

Weert Canzler

Wissenschaftszentrum Berlin für Sozialforschung,
Reichpietschufer 50,
10785 Berlin, Germany
E-mail: weert.canzler@wzb.eu

Biographical notes: Julia Hildermeier is completing her PhD in Sociology at Ecole Normale Supérieure at Cachan and Humboldt University in Berlin on environmental conflicts in the European car industry. She is a member of the global research network on the automotive industry GERPISA. Her research interests are in market and political sociology, environmental lobbying, politics on electric mobility and alternative mobility concepts in France and Germany.

Weert Canzler is a Political Scientist with a PhD in Sociology. He is the co-Founder of the Mobility Research Group and Research Fellow of the Research Group Science Policy Studies at Science Center Berlin (WZB). His main research fields are innovation and future studies, automobilism and transport policy, and energy policy. His current research focuses on perspectives of e-mobility and intermodal services.

1 Introduction

Urban traffic problems are increasing – and so is the need for sustainable solutions. The world's largest cities increasingly suffer from congestion and noise pollution caused by passenger cars. In a broader picture, a shift away from a 'high carbon mobile life' is needed, in which social needs and forms of mobility will transform considerably (Grieco and Urry, 2011). Transforming current forms of automobility is one important lever of this shift. In Europe, urban transport is responsible for about a quarter of CO_2 emissions from overall transport [European Commission, (2011), p.8], and the passenger car remains the dominant mode of travel, representing 73.7% of all private inland transport inside the EU (2012). Facing the challenge that the need for mobility and urbanisation

will increase at the same time, governments in European and global car markets seek to build alternatives to automobility in its current dominant form, i.e., the individual ownership of a combustion-engine car. In its recent White Paper for Transport, the EU recommends to halve the use of conventionally fuelled cars in cities by 2030 (European Commission, 2011), and increases investments in research, development and demonstration of alternatively fuelled vehicles across Europe (JRC, 2013).

The converging innovations in the field of electric car technology (preceded by a surprising sales success of hybrid vehicles combining an electric with a combustion engine), intelligent energy supply and flexible information sharing opens up a new opportunity window for sustainable transport solutions (Mitchell et al., 2010). Car makers have increased R&D and run alternative technology demonstration projects, in collaboration with energy, transport and telecommunication firms who also investigate market opportunities on new products and related services. Local authorities, research institutes and transport companies investigate the roll-out of efficient charging infrastructure and collect knowledge and experience on how electric car technology could best reduce pollution and noise. National governments have set out ambitious support plans for the rapid commercialisation of (battery) electric cars, as their emission reduction potential could help reach climate goals. However, the environmental performance depends as much on the energy mix used to produce, charge and recycle the battery, as on the mass commercialisation. Both factors yield large uncertainties at the moment. As these developments go hand in hand with a structural production crisis in the sector, and a severe economic crisis since 2008, the car industry is likely to transform (Jullien and Lung, 2011).

A diversification of the dominant paradigm of automobile mobility converges with these new market opportunities (Canzler and Knie, 2011). The cultural and social significance of car ownership seems to be changing, especially among younger generations (Bratzel, 2011). This much discussed hypothesis, however, needs further differentiation concerning demographic, economic and geographic factors. Especially among the urban population, patterns of ‘intermodal’ use of different means transport have emerged, i.e., the combination of two or more transport modes during a journey (Parkhurst et al., 2012). Mobility research observes the emergence of a highly mobile population, changing demand for flexibility, accessibility and combination of transport modes (Lanzendorf and Schönduwe, 2013). The traditional car-sharing market has been expanding rapidly in recent years (bcs, 2014); if this behavioural change is linked to an increase in electric car sharing tests has yet to be shown. The sharing of public low-emission, hybrid or electric cars has been part of many recent demonstration projects across European cities since 2008 (Ruhrort et al., in this volume), but also in global automotive markets such as Japan (Faivre d’Arcier and Lecler, in this volume). Beyond enhancing new forms of use, some of these trials develop intermodal offers in combination with energy storage concepts, with the aim to render urban transport more efficient and sustainable in the long term.

The automotive industry faces great challenges linked to these trends. Established car makers, have long sought to maintain the individual ownership of the automobile, while at the same time they investigated alternative propulsion alternatives in their different product segments, adapt innovation and global market strategies. This “greening of the automobile industry” (Calabrese and GERPISA, 2012) has begun to challenge the institutionally embedded hierarchy on the car market. Many car makers are now exploring the growing car-sharing markets, cooperating with traditional car rental firms

in service development. One aim is to address younger customers who are interested in using cars but not in owning them. With their own electric car fleets, they investigate demand in free-floating sharing schemes such as Daimlers' Car2go in cooperation with EuropCar (Firnkorn and Müller, 2011), DriveNow by BMW, or in B2C car sharing services such as Peugeot's Multicity in Berlin. After a promising roll-out and given that more than two third of customers are younger than 36, some of those companies have started to create a viable market niche (for example, Car2go, now extending the electric car fleet and charging infrastructure in its rental scheme).

The question is if these niches will develop further into a coherent pattern of use which could build a long-term alternative next to individual ownership. Does the convergence of alternative engine technologies and mobility patterns produce a paradigm shift? Geels et al. (2012) identify two possible paths of transition: On the one hand, there can and probably will be a shift towards 'green cars' (based on a variety of alternative technologies), but individual ownership and use remain the dominant demand pattern. On the other hand, an alternative path emerges through many projects connecting electric cars with shared use schemes and more sustainable energy systems. These developments suggest that the role of the car be redefined, for example as part of an urban transport system.

This special issue investigates, based on empirical case studies, aspects of a possible transition to different forms of automobility. Research so far has focused on alternative powertrain strategies and the distribution of knowledge production in a globally structured industry (*IJATM*, 2009, Vol. 2, Special Issue), and the way traditional automotive clusters compete with new regions in terms of (green) value production (*IJATM*, 2012, Vol. 12, No. 3). This special issue takes a 'non-automotive' perspective on this possible transition by focusing on alternative players, policies and markets. In that perspective, current market dynamics suggest that both paths could co-exist: on the one hand, luxury electric sports car producer Tesla illustrates the first development path, providing individual electric automobility for a restricted customer segment. Based on recent sales successes, the former Californian start-up is currently investing in its own battery production facilities, and sells exclusive access to its own charging infrastructure, thereby expanding into European markets. On the other hand, the successful Paris-based electric car scheme Autolib' illustrates the second path: subsidised by the city of Paris, the company and its subsidiaries provide charging infrastructure, a battery-car and a one-way station-bound rental service as an urban transport alternative (Hildermeier and Villrareal, 2014). The public electric car sharing scheme has recently expanded to other French and US cities. Further research, case studies and cross-country comparison are needed: Which impact do new actors have on an emerging market of sustainable mobility? Which technological and institutional development paths emerge? How does the role of the customer as a passenger evolve?

Another open question is whether electric vehicles will be part of new decentralized grid structures based on renewable energies. At least two ways of combining renewable energy production and electric car use are possible: electric vehicles as private cars can be fuelled for example by photovoltaic panels (both at home and working place) or, as rental cars, they can be managed in fleets as part of a smart grid within a renewable energy landscape. Crucial technical problems have to be solved and open questions will have to be answered, especially the procedures of (mono and/or bi-directional) charging, the life time of batteries, stable business cases and cost reduction in general. It is also unclear whether users will accept the inevitable restrictions such as giving up full

sovereignty over using time. This concept of integrating EVs in emerging decentralised energy system seems to be visionary. Nonetheless, first pilot projects are running, in Japan (see Faivre d'Arcier and Lecler in this volume) and Germany (Canzler and Knie, 2011), operated by car makers in Japan and by the leading rail company Deutsche Bahn in Germany. The convergence of electric mobility and the transition of the energy system could create several product innovations as well as promising technical and social innovations.

2 Contributions

The eight contributions of this special issue discuss different aspects of a possible transition towards urban sustainable transport, alternative technologies and use patterns of the car. They were part of the current (2012–2016) and previous research programme (2008–2012) of the international network of automotive research GERPISA (http://www.gerpisa.org). A number of contributions assembled here were presented at GERPISA's 17th international conference at Ecole Normale Supérieure de Cachan (Paris) in June 2013, creating a much needed dialogue between research on established car makers and markets and emerging niches around alternative technologies, behaviour and corresponding regulation.

2.1 Theme 1: urban modal share and transport politics

Discussing future global trends of mobility, the paper by Aguiléra and Grébert. analyses the current distribution of the world's largest cities modal split. Compared to usual measures of modal shares, they suggest a detailed typology of ten means of transport to seize its citizens' mobility in a more detailed manner. This analysis takes account of the growing hybridisation of transport modes (public/private, individual/collective) and the development of new services, especially around the automobile (car sharing, collective taxis, etc.). Future trends are investigated by an expert survey: the results show that only a gradual shift in modal share can be expected, and that automobility will remain the dominant means of transport. Does this mean that the best way to integrate electric cars into the market is via the dominant passenger car model? Authors contend that it needs public policy to develop alternative use concepts. Because car use remains dominant, alternative propulsion innovations remain crucial for sustainable mobility. In a global view, the contribution by Aguiléra and Grébert argues for a gradual, not a radical shift towards sustainable mobility that will remain car-based in most parts of the world.

How politics interact with market forces in enhancing new forms of mobility such as car sharing is analysed by Lindloff et al. Their analysis of the German car market's recent growth includes a comprehensive multi-method analysis of politics, demand and supply. The authors show that demand and acceptance of car-sharing offers is already high, especially for free-floating car-sharing services. The most important use motives, however, are not environmental awareness but value (economic accessibility) and convenience (geographic accessibility). On the supply side, the shape of the offer is crucial. It can be assumed that the increasing offer of free-floating car-sharing services has caused recent car-sharing market growth. Interestingly, intermodality increases usage frequency for car-sharing schemes. However, to develop car-sharing as a mass phenomenon, administrative and political support is needed. Lindloff et al. show that the

disposal and pricing of parking space is the central political lever for the traditional car-sharing in Germany to gain importance. Compared to other governments such as Italy, the German car-market has been lacking sufficient political support. From the analysis of Lindloff et al., a shift towards new forms of automobility seems economically likely. What is currently hindering their diffusion is conservative political regulation.

One classic instrument to regulate parking space in cities, and its effect on car use, is investigated by Dijk and Parkhurst. Comparing the history of 'Park + Ride' schemes in six cities in the Netherlands and Great Britain, the authors show that the choice of the instrument needs to be very well adapted to local car use and parking patterns in order to be effective. The two cities in which P+R was most successful, Oxford and Amsterdam, have had the strongest pricing incentives for P+R combined with most effective management of parking spaces. The fact that in other cities, the sustainability effects of P+R have remained marginal, points to the ambiguity of the transport policy tool. While it aims at discouraging urban car use and encourage public transport, it can also accommodate the growing number of cars by increasing overall parking supply. Parkhurst and Dijk argue that P+R impact on car use and overall parking regulation will globally stay a niche phenomenon. In terms of a possible transition towards more sustainable use of cars, they conclude that "the tendency of P+R to trigger urban car mobility transition […] is low".

Given increasing demand and growing public and political awareness, how should offers for car sharing then look like to be more efficient? What are the development opportunities for conventional round-trip car sharing? Existing offers often face the difficulty to meet spontaneous and planned use at a time. If they cannot meet both criteria, they lose attractiveness in terms of convenience and flexibility. Investigating these challenges from a business point of view, Le Vine's contribution explores a trading mechanism for car sharing use at no additional cost, making consumers' willingness to pay the guiding principle. With applicability left to future research, the advantage for users would be, as the author argues, an optimal distribution and accessibility of cars to be rented when and where most needed.

2.2 Theme 2: scenarios for electric mobility

The second part of the issue deals with scenarios for electric mobility and their potential to encourage sustainable transport. Contributions contrast scenarios for urban (Ruhrort et al.) and rural use (Newman et al.) of electric vehicles, and their integration into different energy management systems as in tested in various Japanese cities (Faivre d'Arcier and Lecler). Proff and Fojcik elaborate a market scenario for Germany testing whether car-sharing is an incentive to buy electric cars.

Due to their limited autonomy, public electric car sharing has been mainly discussed as a future urban means of transport. Indeed: if sufficient cars are available for driving, parking and charging and using is sufficiently convenient, Ruhrort et al. argue, e-car sharing could be efficient in terms of emission-saving. It could replace private cars in the medium and long term. Based on user data from Berlin's public electric car sharing trial BeMobility, authors analyse patterns and motivations of electric car use. They confirm Lindloff et al. in that generally free-floating systems will be more advantageous, and that offers must be sufficiently diverse as to meet different "mobility types" and thus user profiles. Based on quantitative and qualitative analysis, authors present a detailed description of 'BeMobility' user types and derive future demand patterns. They confirm

Le Vine's point that offers must include spontaneous as well as planned use. However, as BeMobility is an intermodal project combining electric car sharing with public use, data also show that a combined offer for public transport and shared individual mobility was more attractive than electric car-sharing by itself. This also confirms Lindloff's and Pieper's finding on intermodality as a factor of added value, and hints towards an interesting yet little investigated future business model. Judging from their experimentation case, Ruhrort et al. are slightly more optimistic regarding an overall paradigm shift, if necessary conditions are met.

A contrasting hypothesis is inquired by Newman et al. The electric car, they argue, can serve just as well as rural mode of transport. The case of an electric car trial the region of Wales, linking several small towns with EVs and charging stations, shows that consumers (a public service fleet) were successfully testing EV use for their purposes. For planned and regular distances, the authors argue, a stationary EV system can be a sustainable alternative for the use of private cars. They reverse the common argument for the urban scenario by saying that in rural areas, where car use is most developed and public transport only poorly covers people's mobility needs, electric car schemes are all the more valuable as a sustainable alternative. For Germany, this argument is investigated considering families' needs in rural areas (Herget, 2013). Questioning mainstream assumptions, Newman et al. deliver convincing food for thought about how and where a future shift to electric mobility should be encouraged.

Electric cars are not only a means to render mobility more sustainable, but also energy storage and thus a household's, a company's or even a city's energy system. It is because of their combined use as a mobility and energy storage device that Toyota has invested in a comprehensive electric car testing scheme in various Japanese 'smart cities'. Presenting the project as part of Japan's ambitious electric car support scheme, Faivre d'Arcier and Lecler study how electric car roll out is governed, and accepted, across one of the largest and most innovative automotive markets in the world. The smart cities project realises an overarching scenario of electric car market integration: For households participating in the smart cities, electric cars function as a storage device, while connected to an energy management system helps to improve the house's overall energy consumption. This project thus aims at an innovative 'systemic' integration of the electric car, which opens up the electric car market to other player such as utilities. The scenario, if successful in the long term, would show an interesting transition in terms of more sustainable transport systems.

If above discussed electric car (sharing) market scenarios are tested successfully in regional markets, under which conditions could they commercially viable ? From a management point of view, Fojcik and Proff investigate incentive factors for electric car purchase in combination with car-sharing use. Based on a case study in the urban and semi-urban agglomeration of Duisburg and Essen in Germany, authors find that technology-affine consumers tend to buy a battery electric vehicle, while car-sharing can be an attractive solution for users with low technology affinity. Confirming Ruhrort et al. in their argument for diversifying offer according to user types, their case study suggests car-sharing as one option (among others) for future electric car markets. Based on detailed calculation of the willingness to buy of surveyed potential consumers, authors show that one of the main obstacles for an electric car market uptake are high prices compared with comparable conventionally-fuelled models. Results call for caution to claim a paradigm shift, but suggest some potential in car-sharing options for electric cars.

Contributions show that there is still much uncertainty about whether the trends observed empirically, i.e., consumers' acceptance of e-car-sharing, alternative technology projects and intermodal offers, will eventually converge into a larger transformation of automobility. While some contributions indicate progressive trends from case studies such as Berlin or Japanese cities, broader market analyses show that individual car use and ownership are still deeply rooted behavioural patterns. Policy instruments are not sufficiently well coordinated and targeted to induce a paradigm shift. While the range of currently investigated 'roles' of the electric car in future transport is broad, an interesting trend is that intermodality, i.e., the combination of car-use with public transport, seems to enhance passengers' acceptance of electric cars. This could suggest an alternative scenario for integrating electric cars in existing markets, making urban transport systems more sustainable in terms of efficiency and the emissions. If there is no clear path change towards one direction, contributions have clearly illustrated that there are multiple options of sustainable urban mobility. They can be viable in the future if they are sufficiently well adapted to local mobility patterns and demand, and if they are able to compete with conventional automobility.

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