1 Introduction

Sustainability Transitions in the Automobility Regime and the Need for a New Perspective

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1.1. MISSION STATEMENT

> *. . . while we flatter ourselves that things remain the same, they are changing under our very eyes from year to year, from day to day*—Charlotte Perkins Gilman
>
> The more things change, the more they stay the same—French saying

We begin the book with these two statements because they refer to the fundamental issue of change and stability. On the one hand, automobility faces a need for change to address persistent problems such as increasing traffic congestion and atmospheric pollution (including emissions that contribute to climate change). On the other hand, automobility is deeply embedded in western lifestyles and stabilized through sunk investments, interests vested in its continuation and taken-for-granted beliefs and practices. While the last two decades saw many attempts to introduce radical innovations with higher sustainability performance, the wider automobility regime still seems relatively stable. But under the surface, cracks may be appearing that create opportunities for wider system change and transitions to sustainability. The fundamental goal of this book is to examine these and other dynamic tensions between stability and change in and around automobility and the interactions between different types of change. These tensions have worldwide salience in the case of motorized transport. While the explosion in vehicle ownership and use, initially in the developed nations but now spreading to the emerging economies in Asia, Africa and the Americas, has brought about a revolution in personal mobility with many positive consequences, it increasingly threatens both the quality of life for the individual and the wider global environment. The complexity of these problems relates to the fact that solutions in one area may aggravate problems in another. For example, while alternatively fueled vehicles (battery, fuel cell, biofuels) may offer solutions to pollution problems caused by the internal combustion engine, they may also encourage a new wave of vehicle growth

that, in turn, can aggravate problems of congestion and the quality of the spatial environment.

The way forward therefore involves not only technological solutions, but also the development of fresh perspectives that offer novel ways of understanding how society as a whole can make transport transitions that encompass more radical change in mobility behavior, spatial planning, traffic management and infrastructure. At the same time, it must be recognized that change processes work alongside powerful forces of system stability. Consequently, a greater understanding is required of stability and change and of interactions between different types of change. The book aims to achieve this by developing a "transport in society" perspective grounded in transition studies. To that end, the book consists of contributions from scholars with different types of expertise that relate to culture, governance, traffic management and behavior, infrastructural and spatial planning, the car industry, emerging technologies and transitions. Knowledge about transitions helps to put emerging technologies into a socio-technical perspective, and the involvement of transport experts helps to anticipate system-wide effects. Empirically, the book draws on primary research, but most importantly on the expertise from renowned specialists from transport studies and transition studies, which is combined and integrated in this book. With support from the Dutch Knowledge Network on System Innovation (KSI), the editors have organized two workshops to facilitate interactions and discussions between book contributors, aimed at fostering mutual understandings and creating coherence in the book.

The book investigates whether the current regime of automobility is in transition or not. Transitions are long-term processes (40–50 years), which are the outcome of alignments between multiple developments; they are not caused by a single factor such as a high oil price, a transport innovation or a government intervention. Transitions are a special research topic, because they are large-scale and relatively rare, only occurring now and then. During the 20th century developed countries experienced a transition from existing regimes of public transport to a regime of automobility, with the privately owned and driven car as the main means of personal transport. In some of those countries the regime of automobility may have stopped expanding (in the United Kingdom automobility is no longer growing, as Chapter 4 shows), but it is not at all clear how personal mobility will develop in the face of current pressures.

In examining the mechanisms of stability and change, the book offers a novel perspective by differentiating between incremental evolutionary change, technological discontinuities and more comprehensive systemic change. An important question that guides the book is the following: Will we see a greening of cars, based on technological innovations that sustain the existing car-based system? Or is something more radical desirable and likely, for example, the development of travel regimes in which car use is less dominant and in which the logic of travel is based on *combining*

different forms of transport, leading to a more sustainable transport system? Other questions for investigation are whether crossovers between private transport and public transport are occurring and gathering pace and whether we are moving to a greater diversity and variety in transport modes and travel behavior.

Over and above these questions, the book will address questions such as why automobility has remained dominant, despite its association with growing societal problems; why motor manufacturers have only recently (re)promoted the use of electric vehicles; why public transport has failed to benefit from problems of car-based mobility; why intermodal travel might hold greater promise than modal shift; and which developments, innovations and policy measures *jointly* could break the dominance of cars and promote opportunities for broader change in transport systems (or not).

Every expert holds implicit or explicit views on the evolution of mobility, based on disciplinary backgrounds and specialist knowledge. Such views are based on assumptions of what people want, technological expectations, views on what government can usefully do and beliefs about future oil prices. The transition perspective used in this book helps to scrutinize these assumptions and knowledge from experts by taking the authors outside their traditional field of expertise and by taking a longer (historical) view. An important aspect of the transition perspective is that our beliefs are historically bounded and part and parcel of the process of change. This has important implications for the *study* of transition processes: We have to be mindful that our own viewpoints as well as those of real-world actors (government, companies, consumers, social movements, engineers and traffic planners) are evolving in connection with events, circumstances and possibilities. By bringing together insider perspectives on the car industry, with those on (transport) governance, planning, traffic management, innovation and car culture, we are able to reveal the multitude of factors at play and thus obtain a richer and deeper understanding of processes of change and forces of stability.

The transition perspective plays an important role in integrating various kinds of knowledge: It helps to put specific dynamics into a broader context which pays attention to lateral and unexpected developments, hype-disillusionment cycles, innovation cascades, redefinition of goals and interests and knock-on effects, as well as inertia. By examining developments within and outside the transport sector, the book aims not only to analyze more closely the mechanisms behind stability, evolutionary change and more discontinuous systemic change, but also to gain a greater understanding of how these dynamics may shape the interactions between transport systems and society in the decades to come. The transition perspective has developed a specific way of looking at these dynamics that recognizes recurring patterns, for example, of regimes resisting change, the role of special (local) niches for the exploration of transformative change and conditions under which these changes can spread to regimes and societal landscapes. The

perspective thus helps to understand what is currently happening in the transport system, as well as to anticipate possible outcomes of new developments, and to identify useful intervention strategies for working towards more sustainable systems of mobility.

The case studies in the book focus primarily on developments in and around automobility in the Netherlands and the United Kingdom. These countries strongly experience the problem of stability and change: On the one hand, they have mature and relatively stable systems of automobility; on the other hand, they have undertaken distinctive attempts of radical change, for instance with new propulsion technologies, intermodal transport, traffic information systems, congestion charging and mobility behavior. The case studies in these countries therefore contribute to developing the principal themes of the book. We recognize that transport systems and mobility cultures in other parts of the world (United States, China, India, South Africa) differ substantially from those in the United Kingdom and the Netherlands. We therefore do not claim simple geographical generalizability of the findings in this book. Instead, we aim for analytical generalization via theoretical patterns and underlying mechanisms. These findings can be applied for transitions in other countries, although this requires in-depth knowledge of the transport systems, actors and contexts in these countries. The book does not address all transport modes. Because we want to investigate if automobility remains dominant or not, the book focuses on the car and on transport modes that may affect the car system (either via replacement or reconfiguration into hybrid systems). We therefore do not address slow modes (walking, cycling), nor air and water travel. Having set the scene with this mission statement, the subsequent sections further elaborate transport achievements and problems, transitions to sustainability, research topics, book aims, the transition perspective and the contributions from the various chapters.

1.2. ACHIEVEMENTS AND PROBLEMS IN PERSONAL MOBILITY

During the last half century, personal mobility has rapidly expanded with many positive consequences in terms of convenience, speed, comfort and freedom. In particular, the use of private cars has increased enormously, compared to other transport modalities such as train, bus/metro/tram, and bicycles. Figure 1.1 describes the evolution of passenger kilometers per capita in eight industrialized countries—the United States, Canada, Sweden, France, Germany, the United Kingdom, Japan and Australia. In each country, personal mobility increased enormously between 1973 and 2007–2008. The greatest increase in passenger kilometers is for cars, the dominant mode of transport. The mode share of bus and rail has remained relatively constant or declined slightly, except for Japan where it fell significantly (Millard-Ball & Schipper, 2010, p. 10).

The relative prominence of other transport modalities may differ somewhat between countries, depending on public policies, public support and geographical circumstances. The Netherlands, for instance, is characterized by relatively high bicycle use, which was more or less on a par with car use around 1960 in terms of passenger kilometers. The share of bicycle kilometers fell gradually owing to the rise of car-based transport, but today total passenger kilometers by bike is almost as high as that of train (14.1 million against 15.4 in 2007).[1] Nevertheless, the overall pattern is that other transport modalities are currently relatively small compared to car use. Terrestrial passenger transport is thus clearly dominated by cars, which is the reason this book focuses on automobility. The book addresses other transport modalities mainly with regard to how they relate to car transport, possibly via new intermodal mobility services such as bicycle train schemes and park and ride schemes.

The long-term change in transport modalities coincided with the increasing adoption of cars by consumers. In the Netherlands, car ownership

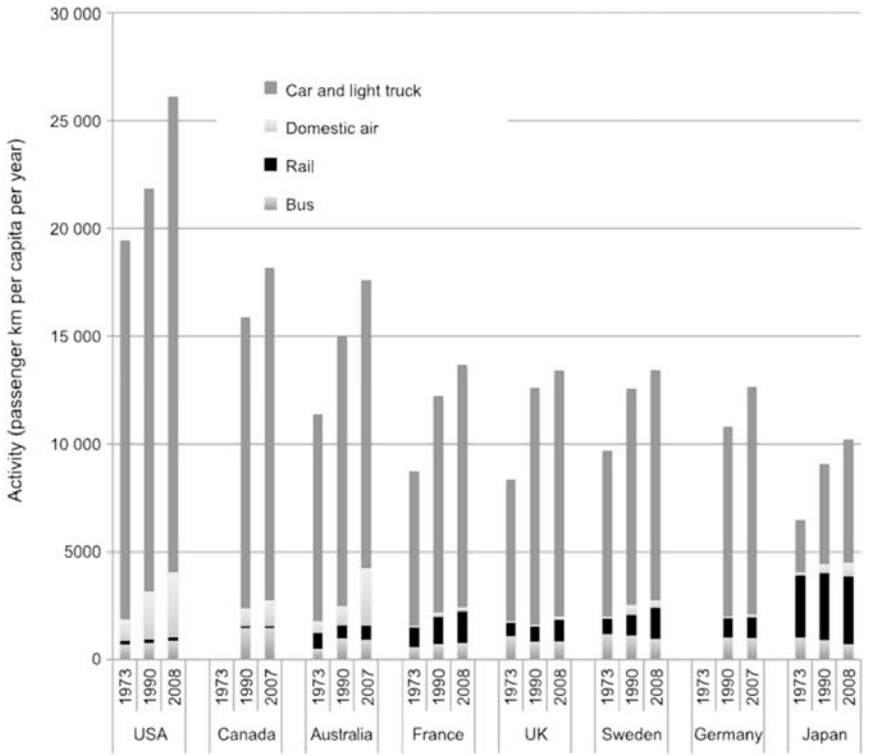

Figure 1.1 Passenger travel per capita by mode. Note that for Canada, metro and other local rail services are included in the 'bus' category (Millard-Ball & Schipper, 2010, p. 10).

increased from 165 per 1,000 households in 1960 to 1,005 in 2007. In the United Kingdom, 80% of the households possessed a car in 2005,[2] against 41% in 1965 (see Chapter).

The expansion of car-based transport has given rise to a range of persistent social problems such as congestion, deaths and accidents, climate change, local air pollution, social exclusion, land fragmentation, noise pollution, end-of-life disposal, oil dependence and energy security (Cohen, 2006; see also Chapter 4). Car use is also contributing to obesity and dehumanization of public space (Bassett, Pucher, Buehler, Thompson & Crouter, 2008). Some of these problems have been substantially reduced in the past few decades. Traffic safety, for instance, has generally improved. The fatalities per million inhabitants in the European Union has fallen steadily, thanks to enhanced driver education, better vehicle design, safety technologies (seatbelts, air bags) and better road design. Still, about 40,000 Europeans die each year in fatal traffic accidents. In 2006, 42,950 persons lost their lives in road accidents: car drivers and passengers, occupants of buses and coaches, riders and passengers of powered two-wheelers, cyclists, pedestrians and commercial vehicle drivers (EU, 2009). This remains a staggering number, amounting to the crash of an average size aircraft each day.

In many places, problems of local air pollution have also diminished, especially due to catalytic converters, improved engine design and changes in fuel composition. The development is different from South East Asia where cities suffer from very bad air quality as a result of motorized transport. Despite improvements, air quality is not very good in developed world cities. A particular cause of concern is small particulate matter, because scientific research has shown that these small particles can diffuse deeply into the lungs, where they cause more damage than previously thought.

Other problems show only modest signs of improvement, such as CO_2 emissions per kilometer, fuel economy of new cars, or in some cases, such as congestion pressure, are even getting worse. Figure 1.2 shows that the congestion pressure (defined as the length of traffic jams times the period they lasted) has increased at a rate of more than 6% per year since 1990.

In absolute terms, CO_2 emissions from transport increased, with over 90% of the emissions coming from road transport (Figure 1.3). Between 1990 and 2007 the biggest increase in CO_2 emissions was for road transport (+200.7%; European Environment Agency, 2009).

Today, more than 1 billion motor vehicles populate the world, and we are moving toward 2 billion vehicles in 2020 (Sperling & Gordon, 2009, p. 2). Behind this projected growth is demand for personal motorization in emerging economies such as China and India with a population of 2.4 billion people, whose markets are targeted by automakers, and which are creating their own motor car industries (Sperling & Gordon, 2009, p. 4). Because CO_2 emissions from motor cars cannot be captured and stored, total CO_2 emissions from motor cars are likely to rise if the majority of new cars are internal combustion engine cars, as is widely

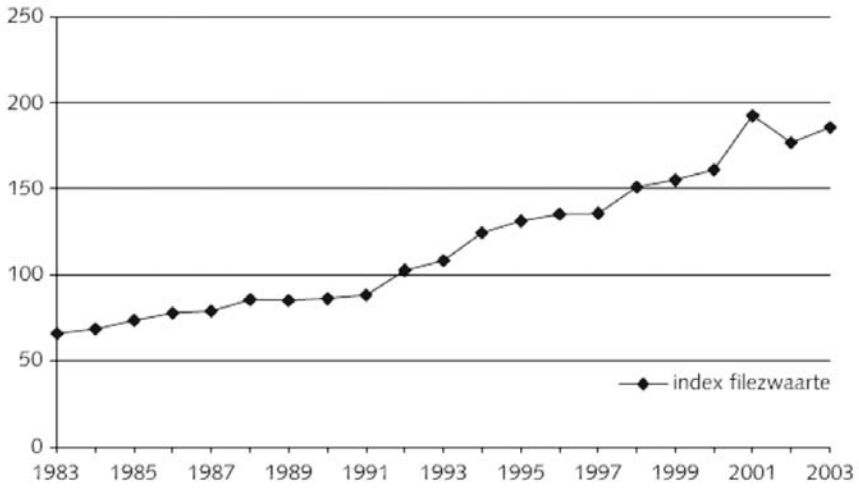

Figure 1.2 Congestion pressure on Dutch highways (Rijkswaterstaat, 2004, p. 12).

expected. Improvements in fuel economy are not expected to keep up with the increase in motor cars. This increase in the coming decade will change urban life and the landscape of countries. The growth in cars will come at a big cost for society.

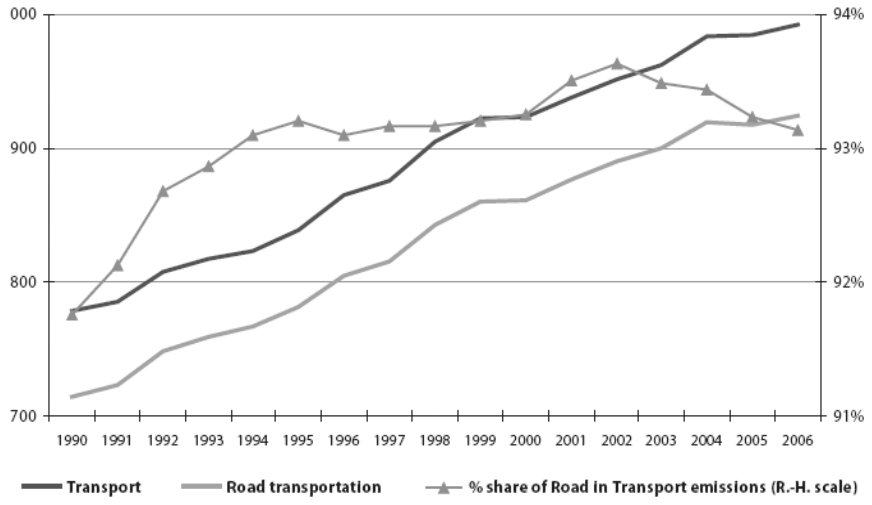

Figure 1.3 Total transport and road transport, European Union: Greenhouse gas emissions and share of Road in Transport emissions, 1990 to 2006 (million tonnes CO2-equivalent and percent; Eurostat, 2009, p. 171).

Economically, socially and environmentally, motorized transport based on fossil fuels is not sustainable. This raises the question: What is sustainable mobility? A useful attempt to define sustainable mobility has been provided by David Banister in a prize-winning paper published in *Transport Review*. Elements of the sustainable mobility paradigm are reasonable travel time rather than travel time minimization, reducing the need to travel (through distance reduction and home working), seeing transport as a valued activity rather than derived demand, achieving a modal shift (especially to walking and cycling), lower levels of pollution and noise from transport, greater energy efficiency, more efficient use of infrastructures (through higher vehicle occupancy and demand management) and increasing the quality of places and spaces (Banister, 2008). As authors, we think this is the best attempt to define sustainable mobility, but it is not one that is universally agreed and acted upon. Cleaner vehicles are supported chiefly for making a contribution to air quality, not to achieve sustainable mobility. Intermodal travel is being promoted by train companies to attract travelers to trains, not for sustainable mobility reasons. Traffic information is supported by transport authorities for increasing the efficiency of roads and reducing congestions, but for the providers of traffic information products, it is just a product. For transport authorities, sustainable mobility is not something they aspire to achieve on an everyday basis. Many of the things they do are not consistent with it.

In the book we could have assessed the contribution made to sustainable mobility of each innovation and development process studied (such as intermodal travel, battery electric vehicles). Although attention is given to various sustainability aspects, we have not sought to quantify this or to draw conclusions about it. Instead, our primary interest is with socio-technical dynamics of greener cars, traffic information systems, intermodal travel and sustainable mobility planning. In particular, we are interested in the following aspects: what *motivates* different actors to engage in those activities, *how* did they come about (through what actions, developments and special circumstances), their success and whether the developments and innovations are within the regime of automobility or an element of alternative mobility.

Accepting that sustainability is something normative, subjective and contested (Jordan, 2008; Kemp & Martens, 2007), we employ a more sociological and action-oriented analysis that focuses on how sustainability is understood by different social groups and what it is "doing": how sustainability claims and appeals are used by social actors to legitimize actions and to attribute blame. The book is foremost an analysis of processes of change, relevant to problems of sustainability expressed in society.

1.3. TRANSITIONS TO SUSTAINABILITY

The persistent or 'wicked' problems discussed previously may be difficult to address within the existing transport system. There is therefore increasing

interest in transitions to new transport systems with higher sustainability performance. There is no agreement, however, about the specifics of these transitions, nor about what constitutes 'sustainability'. Some people advocate technological changes, for example, new car engines and fuels, which promise to reduce CO_2 emissions. The President of the European Union, Barosso, for instance, champions a transition towards fuel cell vehicles and hydrogen. Rifkin (2002) also advocates the hydrogen economy, but his vision is broader and advocates not just changes in cars, but also suggests that citizens may use car-based fuel cells to generate electricity for their own houses, thus creating new linkages between transport and energy systems. But the hydrogen economy has become increasingly contested, as scholars draw attention to the many barriers and problems for realizing this transition (see, e.g., Romm, 2005).

Other people criticize the exclusive focus on climate change, or environmental problems more generally, because it neglects other persistent problems. Alternatively fueled vehicles may be more environmentally friendly, but their introduction is unlikely to have significant effects on the numbers of vehicles on the road. Thus they do not significantly address issues such as traffic congestion, road accidents and casualties, nor geographical and spatial problems, such as the role and place of the car in the built and natural environment. Broader visions of 'sustainable transport' therefore exist, with people advocating transitions towards multi-modal transport, car sharing, automated people movers, or even suggesting that future systems may be characterized as 'after the car' (Dennis & Urry, 2009). Spatial planners and geographers further suggest that changes in mobility will require transitions in spatial structures, for example, a move towards more concentrated cities with smaller distances between work, home, leisure, school and so forth (Henderson, 2009; Newman & Kenworthy, 1999). Transport planners and traffic managers, in turn, suggest that the integration of new information and communication technologies into highway systems may lead to intelligent highways, dynamic traffic management or even automated vehicle guidance that allow cars to drive at similar speeds on very short distances from each other, thus improving the efficiency of road use (Mitchell, Borroni-Bird & Burns, 2010).

Such grand technological schemes have been criticized, however, by sociologists of innovation (Geels & Smit, 2000), who found that many historical and contemporary grand schemes failed because of lack of social support or because car drivers and consumers developed alternative, unexpected behaviors. Congestion charging, for instance, remains a politically and socially contested issue, despite ongoing claims by transport planners about the efficiency of pricing mechanisms. While the London Congestion Charge, introduced in 2003, has been relatively successful in reducing inner city traffic and congestion, proposals to introduce congestion charging in Edinburgh and Manchester have recently been heavily defeated in referendums. The social and political obstacles inherent in the introduction of urban congestion charging illustrate the difficulties in bringing about (partial) system innovation and

the importance of public acceptance. Indeed, technological advances may themselves create new problems of public acceptance. For example, road pricing that works through satellite controlled guided positional systems is able to track, and then illustrate to the user, when and where the individual has driven. This can arouse public concern about a 'big brother' system that challenges established norms of privacy and confidentiality. Sociologists of mobility therefore suggest that visions, policies and discussions of transport transitions should pay more attention to 'darker' possibilities and to cultural, motivational and behavioral dimensions (see Sheller in Chapter 9).

This variety in views and visions, which has changed over time, has resulted in a flurry of activities, ranging from local projects such as improved light-rail, transformations of city centers into pedestrian areas, promotion schemes of bicycle use, park and ride schemes, urban congestion charging, car sharing projects, automated vehicle projects to transfer commuters to business parks, to large-scale programs such as the American FreedomCAR and Vehicle Technologies (FCVT) program, the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) of the European Union and international intelligent highway systems programs.

But while these activities contain seeds for substantial change, they do not yet appear to have substantially influenced the automobility system, which still accommodates the majority of passenger miles (around 90%, with some differences between countries). Despite two decades of work on alternatives, the internal combustion engine still reigns supreme, although hybrid-electric vehicles have gained a market foothold, and battery electric vehicles are much discussed again. Use of public transport and bicycles is still small, compared to cars. Cars are also deeply embedded in lifestyles (e.g., bringing children to school or sport, shopping, family visits, holidays), supported by cultural discourses (around freedom, individuality, adventure) and stabilized by positive feelings and emotions. Sheller (2004) therefore concludes that "cars will not easily be given up just (!) because they are dangerous to health and life, environmentally destructive, based on unsustainable energy consumption, and damaging to public life and civic space. Too many people find them too comfortable, enjoyable, exciting, even enthralling. They are deeply embedded in ways of life, networks of friends and sociality, and moral commitments to family and care for others" (p. 236).

1.4. FURTHER ELABORATION OF RESEARCH TOPICS

Against this background, the book addresses two important research topics that relate to sustainability transitions: (a) the forces of stability and change and (b) the prospects of a transformation in personal mobility. The first topic concerns stability and change in automobility. On the one hand, there are many visions of sustainable transport systems and many (local) change activities. On the other hand, the existing automobility system is

characterized by stability and lock-in. Following the literature on path dependence and lock-in (Arthur, 1989; Unruh, 2000; Walker, 2000), we can distinguish several factors that contribute to stability, for example, (a) low costs of existing technologies due to economies of scale and learning-by-doing; (b) sunk investments in infrastructure, machines and people; (c) people's life styles and behavioral patterns; (d) legislation, institutions and subsidy schemes that favor existing technical systems and hinder new ones; (e) mental maps and cognitive schemes that blind incumbent actors to alternatives that fall outside their scope of attention; and (f) resistance from powerful actors who aim to protect their vested interests.

With regard to this first problem, the book will empirically investigate (a) the degree of stability of the existing automobility system and the possible presence of certain 'cracks' that may create 'windows of opportunity' for sustainability transitions and (b) the degree to which several change initiatives are ready to take advantage of these windows of opportunity.

By addressing both processes, the book will further address the puzzle and prospect of 'tipping points', raised by Sheller (2004): "Despite incremental change and experimentation in new transportation policies (regulation, taxation, road pricing, congestion charging) there has not been a radical transformation of the car and the road system itself, nor of the patterns of habituation and feeling that underlie existing car cultures. However, there are signs that suggest we may be approaching a 'tipping point' in the demise of current configurations of the dominant culture of automobility" (p. 236).

The attention given to climate change, which has increased strongly in the last 5 years, and the current economic problems in the car industry, are just two developments that may push the automobility system firmly in a new direction. The bankruptcy of General Motors (GM; the second largest automobile company in the world) in June 2009, which was the third largest US bankruptcy ever, may have provided a shock that will stimulate car manufacturers to search more actively for new technologies and business models. The GM bankruptcy entailed the creation of a new GM company and was supported by $50 billion in US Treasury loans, which gave the US government a 60.8% stake in the new company. In addition, the Canadian government invested $10 billion for a 12% stake. These controversial public investments indicated both the fact that GM would cease to exist without official support and also that the US and Canadian governments could not afford to pay the political cost of seeing such a leviathan fall. During 2009–2010, a major restructuring of GM took place that included a reduction of more than 65,000 jobs in the United States. In November 2010, GM returned to the stock exchange and raised $20.1 billion dollars through a share offering. This reduced the shareholding of the US government from 60.8% to around 26% (*BBC News,* 18 November 2010). The gradually improving financial position of the company was also reflected in GM making a profit in 2010 for the first time since 2004. Nevertheless, the continuing major public investment in GM is likely to mean it maintains

a commitment to environmental and energy efficiency. For example, GM is planning to produce a small car at one of its formerly closed factories. This will be the first mini type vehicle produced by a major manufacturer in the United States. The company is also prominent in the development of hydrogen and electric powered vehicles.

Public concerns about climate change, and 'sustainability' more generally, provide another window of opportunity, although there are still substantial uncertainties about the degree to which public concerns translate into real consumer demand for green cars and the 'willingness to pay' for sustainable transport options. Citizens are unlikely to vote for car restraining policies, but certain cities such as the German town of Freiburg have moved in that direction. In many cities car-free zones have been introduced, and more cities are creating special lanes for cyclists and 30 kph home zones. Another trend that could create windows of opportunity is the increasing integration of information and communication technologies (ICT) in cars and transport systems. ICT may strengthen the car transport system in the form of electronic navigation devices or dynamic traffic management systems. But ICT can also act as a linking pin in, and catalyst for, intermodal transport systems, allowing people to determine en route what their transport options are, how to transfer from one mode to another and buy tickets in advance.

If we would move towards a transition to sustainability, the book's second research question is if a green technology pathway is more likely than a broad transformation of the mobility system. The green technology pathway would consist of green cars and car-facilitating measures. The transformation pathway would consist of the development of travel regimes in which car use is less dominant, in which bicycles are used for small trips and high speed rail for longer trips and in which the logic of travel is increasingly based on *combining* different forms of transport.

One important difference between both transition paths is the degree of change in mobility patterns and travel behavior on the demand side. In the first path, user preferences and mobility patterns remain more or less unchanged. People buy a 'greener' car but do not really change their travel behavior (although high penetration of ICT in cars and infrastructures may change car-based travel experience). The second transition assumes more change in mobility behavior, especially more active travel planning, mixed use of multiple transport modes, perhaps less private car ownership and so forth. This second path also assumes technological change (e.g., new ICT devices), investments in modal transfer and parking spaces that allow the linking of transport modes and policy change (e.g., new taxes, subsidies, visions and experimentation programs), but the main change concerns consumer behavior.

The book will also give attention to policy and governance. We will examine the various roles of transport policy and the tensions between policies that aim to sustain or change the present automobility system. We will examine the beliefs, expertise and motivations behind those policies, the outcomes of

such policies and why they did (or did not) have their intended effects. Special attention will be given to how sustainability is framed and translated in policy acts, the support for (better) public transport, bicycle infrastructure, traffic management and/or the promotion of green cars. The way in which sustainability is defined and translated in policy is an interesting transition issue. Sustainable mobility may be defined in terms of access rather than mobility, the use of cars may or may not be assumed, and demand management may be viewed as an essential element (which is currently not the case). The book will look at the various ways in which policy is involved in fostering change, and also at the ways in which it seeks to protect non-sustainable practices and businesses. Over many decades, the motor industry has developed as a hugely powerful institution that encompasses mutually reinforcing interests including oil, raw materials, engineering and component industries, as well as vehicle dealerships and consumers. For many people, the car remains a powerful status symbol that helps to define personal identity and shapes social behavior. This probably means that policymakers are inhibited from acting too much against car-based modes of transport.

With this dual focus on the elements that give the system of automobility stability, together with the elements of change, the book hopes to avoid two potential mistakes:

- Wishful thinking about certain solutions 'solving' transport problems. The book will not only show that solutions often have unanticipated effects (e.g., the effects of creating more sustainable transport systems typically fall short of what is expected), but also that 'innovation journeys' (Van de Ven et al., 1999) often experience ups and downs and twists and turns. Innovative solutions may also face a mis-match with other dimensions of transport systems (e.g., lack of infrastructure, market demand or regulations), which hinders wider diffusion.
- The assumption that private car use will simply continue as we know it, because car mobility reflects people's true preferences. Because the future of transport systems depends on choices and interactions between various social groups, the book will show that people's travel modes and mobility choices reflect situational characteristics, cultural values and cultural ways of thinking that help define and frame individual preferences. The success of public bike systems in France and other countries shows that there is a dormant interest in cycling.

1.5. THE NEED FOR A NEW ANALYTICAL PERSPECTIVE

With regard to transport studies, the book argues that a new theoretical perspective is needed to analyze systemic transitions. This perspective has

the following characteristics, which make it suitable to address the topics discussed previously:

(a) *Co-evolutionary and 'systemic' view on transport*: We view the transport system as consisting of a semi-coherent configuration of mutually aligned elements, which include technology, industry, markets, consumer behavior, policy, infrastructure, spatial arrangements and cultural meaning (Geels, 2004). Although the configuration is semi-coherent, tensions and mis-alignments may (temporarily) exist between elements, which create windows of opportunity for wider change. This means that system change is rarely driven by single factors such as prices or technological change, but usually involves co-evolution between multiple developments.
(b) *Actor-based approach*: The book differs from mainstream transport approaches that tend to focus on technology (e.g., engineering assessments and comparisons of various technologies) or economic transport modeling (where cost, performance, prices and incentives are the main variables). The book instead takes an actor-based approach, which focuses on framing, strategies, perceptions, actions and interactions between car drivers, transport planners, car manufacturing firms and public opinion.
(c) *Stability and change*: The perspective should encompass dynamic stability and incremental change on the one hand and radical innovations and system change on the other. We are especially interested in the co-existence, synergies and competition between various developments and emergence of mixed forms (tram-trains, shared taxis, hybrid electric cars).
(d) *Complex dynamics*: The book adopts a particular view on dynamics, which deviates from simple drivers and linear cause-and-effect relationships. Instead, the emphasis is on mutually reinforcing developments and (sometimes unexpected) alignments, co-evolution, mixed forms, circular causality, innovation cascades, knock-on effects and hype-disappointment cycles.

Because, to our knowledge, such a dynamics and actor-centered perspective does not exist in the transport and mobility domain, the book opens up new ground. With regard to policy the book aspires to bring out the various ways in which policy is involved in transport and how such policies are entangled in multilevel processes of change. For example, it is valuable to look at problem–solution sequences, the use of visions, and non-intended effects of policies. Policy support for radical change will be investigated, alongside policy efforts that support automobility but mitigate negative effects. The evaluation of past policies may be used to say something about the need for policy to be more concerned with transformative change and what policymakers could usefully do.

The book will use a socio-technical perspective on transitions, which we think meets the four criteria formulated previously. The socio-technical transition perspective comes from an 'evolutionary' system approach of innovation which does not prioritize social and technical elements but sees these as inexorably linked (Geels, 2002, 2005; Geels & Schot, 2007; Hoogma, Kemp, Schot & Truffer, 2002; Rip & Kemp, 1998).

The multi-level perspective (MLP), which is further discussed in Chapter 3 can deal with both stability and change. To explain *change*, it uses concepts such as 'niches', which are protected spaces where radical innovations emerge, and 'socio-technical landscape', which are external developments that create pressure on existing systems (or better 'regimes'). To explain *stability*, the notion of socio-technical regime plays an important role, which says that we are locked into car-based modes of transport because societies have adapted themselves to their use in terms of car ownership, infrastructure, training and knowledge, communities of practice, regulations, social practices and cultural acceptance.

The interactions between niche, regime and landscape developments are enacted by social groups (firms, policymakers, customers and car drivers, social movements, transport planners, engineers), who have their own perceptions, interests and resources but are also linked together to maintain and reproduce the regime. These various social groups navigate a transition, finding their way through searching and learning, while also engaging in power struggles, controversies and debates. The dynamics are not mechanical but socially constructed and enacted. Because perceptions and strategies of actors change over time, transition dynamics are not linear, as the chapters in this book will show.

1.6. THE ANALYSIS OF SOCIO-TECHNICAL TRANSITIONS

The transitions perspective brings an innovative approach to the analysis of change processes, particularly through the manner in which it allows us to not only trace the often complex dynamics of the interactions between technological and social change but also how these relate to the framing of ideas and the associated shifting perspectives with regard to problems and their solutions. As an example of this type of analysis, we offer a brief discussion how the motor industry responded to the emergence of ideas concerning sustainable development and the derived transport concept of sustainable mobility.

1.6.1 Competing Solutions

Over the past two decades, one of the primary challenges to the motor industry is the rise of environmental ideas and concerns, often expressed in concepts such as sustainable development and sustainable mobility. From the 1980s, these challenges were expressed in terms of the harmful effects

of vehicle emissions on public health, such as the impact of lead in petrol on children's learning processes and the contribution made by a variety of emission gases to the rising incidence of respiratory diseases such as asthma. Pressed by regulations, car manufacturers sought ways to reduce emissions. The lean burn option lost against the catalytic converter, which was effectively prescribed by regulation, first in the United States and later in other countries (Nills & Tiessen, 2005). For lean burn engines a window of opportunity existed only for a small period.

With the rise of the climate change issue over the past 10 years, research efforts shifted toward emissions of carbon dioxide. In the absence of a control device, car manufacturers had to look for alternative propulsion and energy sources. The emerging long-term response of the motor vehicle is to develop effective alternative technologies to the internal combustion engine that have less harmful emissions, such as electric, hybrid electric-petrol or hydrogen fueled vehicles.

Market introduction of alternative propulsion cars has been slow. However, the hybrid electric-petrol Toyota Prius is the first alternatively fueled vehicle to make significant inroads into the mass car market, with 2 million sold worldwide by September 2010 (*Financial Times,* 9 October 2010). Two interesting issues here are why Toyota devoted considerable resources to the Prius in a time (the 1990s) when climate policies were absent and why the Prius did so well. The introduction of the Prius car was based on perceived first-mover benefits and the expectation that there is a market for cars equipped with electric propulsion. Their thought was that the Prius was the leader for the cars to come, which is reflected in the car's name: Prius, which in Latin means [to go] before.[3] The success of the Prius led other manufacturers to follow suit. The success owed a great deal to the Prius being redesigned for the American customer and being singled out for public attention, not so much because of its fuel efficiency but because it fit with cultural values of greenness and sensations of electric drive. It became a fashionable consumer status symbol. Government was enrolled and provided support through subsidy schemes. The response of the car manufacturers to the success of the Prius car is interesting. Many companies started to develop hybrid-electric vehicles but they also continued to invest large sums of money in the improvement of internal combustion engine vehicles. They may shift their resources more firmly into electric cars if the market develops. What this shows is that cultural change interacts with car manufacturing product choices and technical change.

1.6.2. Changing Configurations and Co-evolution

In terms of a taxonomy of change used in this book, the development of electric vehicles is interesting in that it may contribute to a transformation of the electricity systems, when vehicles start to deliver back electricity to the grid, and may facilitate intermodal travel, when cars are used in combination with

other modes of transport. The latter necessitates shifting perceptions on the part of users, planners, politicians and companies, so that issues are framed in a new way that challenges existing dominant ideas and interests.

The stimulus for a rethink may come from discussions about sustainable mobility, but it may also come from somewhere else. For example, with regard to demand management policies, it is significant that early examples of urban road pricing, such as those in Norway, were designed to raise revenues for infrastructure projects, rather than to reduce the number of vehicles on the road. In general, successful new developments in mobility behavior can be expected to spread, but there is no guarantee that this will happen. The London Congestion Charge proved to be a success in terms of achieving its principal aim: Compared to the previous year, 60,000 fewer cars and delivery vehicles per day entered the zone in the first 6 months after implementation. This experience raised expectations that it might become a template for the introduction of schemes of this type worldwide. However, progress here has so far proved elusive, with only Stockholm implementing a similar type of road pricing. In the United Kingdom itself, proposals to introduce congestion charging in Edinburgh and Manchester have both been heavily defeated in referendums. The social and political obstacles inherent in the introduction of urban congestion charging illustrates well the difficulties in bringing about system innovation through framing a problem in a new way. Even if the technology exists, public acceptance can present formidable barriers. The socio-technical perspective helps to appreciate this and leads one to perceive issues of change more as *co-evolution* rather than diffusion. It also points to a general dynamic, which is that technology and society adapt to each other.

All the issues just mentioned can be given a proper place in a multi-level transition analysis, which looks beyond immediate transport issues.

1.7. THE STRUCTURE OF THE BOOK

The book's structure reflects the transition perspective. The chapters in Part I introduce the "transport in society" perspective of which the transition perspective is a special case. The chapters in Part II focus on the regime level, analyzing various dimensions of automobility. These chapters will address which factors and trends contribute to the lock-in and stability of the existing automobility regime and which ones create tensions and 'cracks' that may provide windows of opportunity for wider change. Several chapters in this part include a historical analysis of developments in recent decades, because this is the best way to investigate path-dependencies and lock-in, and possibly aspects of 'unlocking'. The chapters in Part III focus on developments that may benefit from regime problems and pressures: niche innovations and modes of public transport. Part III contains chapters on electric mobility (battery electric and fuel cell electric) cars, public

transport, user innovation, new ICT devices and forms of information provision, spatial innovations and intermodal transport. The chapters talk to each other and are especially written towards this aim, giving the book a coherence which is unusual for an edited book. We also made a great effort to synthesize the findings in a final chapter.

The following is a short outline of the individual chapters.

1.7.1. Part I: The Transition Perspective and Problems Associated With Car Mobility

Chapter 2, "Visions for the Future and the Need for a Social Science Perspective in Transport Studies" by Glenn Lyons, discusses the shift in transport studies to incorporate social and behavioral factors into the analysis, as exemplified by foresight studies in the past 16 years. The transition perspective of this book is believed to take the analysis one step further, in giving attention to social and technical interaction, tensions between stability and change and addressing all relevant actors and subsystems.

Chapter 3, "The Multi-Level Perspective as a New Perspective for Studying Socio-Technical Transitions" by transition experts Frank Geels and René Kemp, describes the transition perspective as a theoretical framework for the study of stability and change. It explains the multi-level framework and presents transition patterns and actor-related dynamics identified in innovation and transition studies, using examples from transport. One such pattern is the fit-stretch pattern, which is illustrated with early cars moving from a 'fit' with the horse-based regime, toward 'stretch' in terms of articulating their own technical and use principles. The seeds of a new auto regime emerged with the T-Ford (1908), as a new technical form with more practical, utilitarian types of use (initially by farmers, doctors and taxi drivers). Technology and use thus co-evolve both materially and socially in terms of user groups and beliefs. These co-evolution processes mean that innovations may gradually evolve to have more radical and transformational implications. Two contemporary examples are road pricing and batteries, two regime-preserving innovations which may be game changing in the longer term. Other patterns in transitions are the hype-disillusionment cycle, innovation races, domestication, societal embedding, cultural framing and transport issues becoming part of wider power struggles.

1.7.2. Part II: Stability and Regime Pressures

Chapter 4, "The Dynamics of Regime Strength and Instability" by Geoff Dudley and Kiron Chatterjee, offers a historical analysis of UK government policies toward cars, with special attention to policies for sustainable mobility. Automobility developed rather late, with the Minister of Transport rejecting the concept of a motorway network in the 1940s. The first motorway was build no earlier than 1959 in an attempt to please car

drivers. It also describes how the motor car transcended social groups and assumed a place at the forefront of the consumer revolution. In the 1990s the credibility of the roads strategy was undermined by sustainable development, becoming a new point of orientation. Optimistic plans and high ambitions for sustainable mobility were formulated between 1997 and 2000, but material achievements were low, as car-restraining policies proved unpopular.

Chapter 5, "The Governance of Transport Policy" by transport governance experts Iain Docherty and Jon Shaw, explores the impacts of changing forms of governance on the formulation of transport studies in two UK jurisdictions: Scotland and London. Particular attention is given to how the ideology of marketization and devolution of responsibilities are affecting transport policies. It is found that changes in governance have profound effects on transport policies but not in a deterministic way, as transport authorities in Scotland and London made quite different choices. Whereas London curtailed car mobility and invested in public transport, Scotland invested in new roads and public transport (more of everything). Their chapter shows that it is not easy to repeat the success of congestion charging in other jurisdictions and that the transition to sustainable mobility is affected by national and decentralized systems of governance, in which many considerations come into play.

Chapter 6, "The Nature and Causes of Inertia in the Automotive Industry" by Peter Wells, Paul Nieuwenhuis and Renato Orsato, offers an insider discussion of why a technologically sophisticated industry since the 1920s kept relying on the internal combustion engine and steel body. The reasons for this obdurance have to do with scale economies and associated capital costs, safety regulations that are based on the steel body, exit barriers as well as entry barriers, consumers becoming habituated to certain performance attributes, car-accident risks (which are lower for drivers of heavy vehicles) and apparently non-trivial matters such as paint finish. The trend has been towards achieving ever-greater economies of scale and scope. The car industry is prepared to meet the challenge of greening of cars but at their own preferred pace, with a great desire to stay within the internal combustion engine trajectory. They are supported in this by consumers preferring low-cost, heavy vehicles (with shiny paint finish) over light-weight, plastic-body electric vehicles. The prospects for newcomers are that they either fail or are being bought up. Big companies are not allowed to fail by governments because of their economic importance and the perceived national interest. Radical change is possible and being tried, but as this chapter shows, there are powerful forces working against it, with companies focusing the bulk of their research and investment on internal combustion engine vehicles.

Chapter 7, "Providing Road Capacity for Automobility" by Phil Goodwin, takes up the theme of road building and transport policy principles. Goodwin, a transport policy expert and first author of the influential report

Transport: The New Realism, describes how the policy principle of *predict-and-provide* came under increased criticisism. He views 1989 as a pivotal year in this respect, in terms of the new policy principle of predict-and-prevent becoming established. Road building continued, but at a slower pace. As also noted in Chapters 4 and 5, the new planning regime, based on reducing car mobility through traffic management, suffered from problems of implementation. Ever since the 1960s the use of road pricing for traffic management has been postponed, essentially for political reasons. In Goodwin's words, "everybody can be kept happy while the discussion is still about principles but not when the devil of the detail emerges." He offers an interesting discussion about whether we are in a transition away from automobility or not. He proposes that a transition in thinking already occurred 20 years ago and that traffic intensity (vehicle kms/GDP) has fallen since 1994. The share of car traffic, however, hardly fell, leading him to the conclusion that a transition to sustainable mobility requires many years of persistent effort, creative imagination, political courage and consistency. Sustainable mobility is, and will remain, a contested issue when it comes to the introduction of real measures to reduce automobility.

Chapter 8, "A Socio-Spatial Perspective on the Car Regime" by Toon Zijlstra and Flor Avelino, examines the link between car mobility and spatial planning. The authors start their chapter by questioning the rationality of car-based choices, even in a world in which mobility is organized around cars. In a similar manner to Chapters 4 and 7, they note that, despite the strong support for automobility, there has always been an undercurrent of radical criticism. This is elaborated in actor terms by describing the social movements that protested against car-based pollution, the decline of the urban and rural landscape, atomized individualism, forced car ownership, illusion of speed and freedom, oil dependence and road safety problems. The social criticisms set the stage for a discussion of four radical socio-spatial mobility niches, in which car mobility is less dominant: modal-split based planning regimes, low-speed and shared space areas, sustainable urban planning regimes based on reducing the need for mobility (as in compact cities) and self-reliant communities (with *Transition Towns* and *Slow Cities* as examples). Some of the niches have a strong modernist element, others are decidedly non-modernist and take a critical stance against consumerism and globalization. The niches undermine conventional assumptions that car-based mobility is always desirable and rational. At the end of their chapter the authors offer a criticism of the transition approach for being too functionalist. They also make a plea for a spatial planning-based approach towards sustainable mobility.

Chapter 9, "The Emergence of New Cultures of Mobility" by Mimi Sheller, adopts a cultural perspective in analyzing the factors contributing to stability of the car-based mobility regime in the United States, potential openings and prospects for a future transition. Culture is viewed as a crucial performative part of transitions: It is part and parcel of transition processes.

Culture is present in practices, actor networks and discourses. Automotive emotions are viewed as an essential element of car-based cultures. In her chapter, Sheller analyzes emergent cultural openings in the national and urban transport regimes in the United States, where she discusses the Transit Oriented Development regime of the city of Philadelphia. The creation of bike lanes, better public transit and electric vehicles is viewed as not enough for a transition. According to Sheller, new cultural articulations are needed for a transition. An interesting conclusion from this chapter is that a transition to alternative mobility may not be driven by sustainability concerns but by pervasive market forces assembled around personal entertainment and surveillance as well as by diffuse cultural forces.

1.7.3. Part III: Dynamics of Change

Chapter 10, "The Electrification of Automobility" by Renato Orsato, Marc Dijk, René Kemp and Masaru Yarime, examines what they call the "bumpy road" for pure battery electric vehicles (BEVs). They show that the history of BEVs has been one of twists and turns. For a short period, BEVs dominated the world of motor vehicles, losing their dominant position against noisy and polluting internal combustion engine vehicles around 1915. In the 1970s and 1990s there were brief revivals of battery electric cars, but the revival was short-lived and highly localized. Climate change concerns, high oil prices and the success of the Prius (a hybrid electric car) together with advances in battery technology helped to generate new interest in BEVs. Today almost all major car manufacturers are working on prototypes to be commercialized soon, with some companies such as Renault-Nissan, Mitsubishi Motors and the Chinese company BYD already offering battery electric vehicles to customers. Better Place, a Californian start-up, has been working with governments, businesses and energy producers to provide electric mobility services. Their business model is based on customers paying for electric mobility on a use-basis, with revenues being used to pay for charging and battery swapping infrastructure. A trajectory for electric mobility is underway, involving different types of vehicles: (plug-in) hybrid electric vehicles, battery electric vehicles and hydrogen fuel cell vehicles. The chapter considers fit-stretch patterns for BEVs in terms of technical forms and type of use (e.g., short-term rental). The authors do not expect that cars with electric drive will change patterns of car-mobility fundamentally. It may nevertheless fundamentally change the car industry, and there are interesting spillovers to the power sector and to bicycles and scooters. A significant difference from the 1970s and 1990s is that electric drive systems are now accepted culturally.

Chapter 11, "Introducing Hydrogen and Fuel Cell Vehicles in Germany" by Oliver Ehret and Marloes Dignum, describes the activities for hydrogen and fuel cell vehicles in Germany in the 1998–2010 period. The German government and energy companies became enrolled in research and

demonstration projects for hydrogen fuel cell vehicles (FCV). With hydrogen produced from low-carbon energy sources, CO_2 emissions from cars and light duty vehicles can be reduced to 20g CO_2/km (tank to wheel) by 2050, compared to some 160g CO_2/km in 2010 (car fleet average). The chapter describes how hydrogen became the favored transport fuel in Germany and the programs and widening network of actors involved in hydrogen fuel cell initiatives for road vehicles (cars and buses). The strategic selection and introduction of FCV in the transport sector is an example of strategic niche management, a model propagated by innovation scholars to escape lock-in (Hoogma et al., 2002). Interestingly, ideas from the model, which was originally developed to help challengers in their fight against incumbents, seem to fit well with activities of regime actors. Another interesting finding is that FCV are regime-preserving as well as regime-changing. Within the regime of automobility they are regime-preserving as they fit with current driver preferences, but for the energy sector they are a disruptive innovation, as the hydrogen is expected to be produced from wind power and biomass. The chapter also considers the relationship with battery electric vehicles, which is characterized as competitive *and* synergetic. They both compete for government support but the markets and technology are to some degree complementary. FCV incorporate advanced batteries and electric engines (just as electric vehicles do), but its users are believed to be different, making it sensible for car manufacturers to invest in both vehicle types.

Chapter 12, "Transition by Translation" by Bonno Pel, Geert Teisman and Frank Boons, examines the innovation journey for travel information systems as a journey driven by cascading events. Drawing on complexity theory, and the concept of translation from actor network theory, it describes the creation of traffic information products. These include the different moments at which innovation processes got stuck and the subsequent cascading events that broke the stalemate. The problem of creating a business case for traffic information was resolved by TomTom's decision to integrate dynamic traffic data in their car navigation products without charging users specially for this. Public transport information provision met with opposition from transport operators to disclose dynamic data, revealing deficiencies in punctuality. The government stepped in to resolve this tension. The (ongoing) innovation journey for traffic information problems required translations and interventions. It also shows how regime-preserving change may cascade into regime-shifting change, an issue of great significance for the transition to sustainable mobility and management thereof. The traffic intelligence cascades developed an infrastructure that enables the introduction of road pricing, a vital measure for traffic control. Regime-preserving may thus lay seeds for regime-shifting change.

Chapter 13, "The Emergent Role of User Innovation in Reshaping Traveler Information Services" by Glenn Lyons, Juliet Jain, Val Mitchell and Andrew May, examines traveler information services from a transition perspective in which 'Intelligent Transport Systems' (ITS) is identified as

the (sub)regime and 'user innovation' as an emergent niche development. There is a growing interest in people's travel choices and how these can be supported and influenced; information is seen to be a key aspect of this. This chapter looks at Web-based user innovations in the area of transport: information services that are being created by users themselves to tackle the mobility challenges they and others like them face. The chapter presents six examples of user innovation: CycleStreets, ParkatmyHouse.com, PickupPal, TrainDelays, MyBikeLane and Slugging. After highlighting the sorts of factors which characterize these niche developments, the chapter goes on to look at the prospect for a regime transition. It questions the apparent (as yet) limited uptake of user innovations, suggesting that these innovations may, as with mainstream information systems developments in the ITS regime, not be taking sufficient account of human behavior and limitations to behavior change where travel and mobility are concerned. The chapter finally explores what is considered an important question: Will the emerging user innovations reconfigure the ITS regime, or will they be transformational (filling in the gaps)?

Chapter 14, "Innovation in Public Transport" by Reg Harman, Wijnand Veeneman and Peter Harman, offers a study of innovation in public transport. Despite the reputation of public transport systems for being inflexible and non-innovative, several innovations have occurred in them. Rail innovations include high speed trains and local tram networks serving the hinterland of cities. Innovations in busing include special bus lanes, demand-dependent services, information provision about arrival times and short distance radio systems allowing buses to get priority at traffic lights. In urban transit, innovations include rapid personal transit and tram-trains. Green and energy-saving propulsion also have been introduced into public transport, with public sector services acting as a lead market for hydrogen and natural gas. In the countries studied, Great Britain and the Netherlands, shares of public transport (in passenger kilometers) went up slightly between 1997 and 2007. But goals of a better modal split for public transport have not been achieved. Better public transport does not automatically attract car drivers. Apart from the usual explanation of drivers being wedded to their car, offering better transport services presents a dilemma for public transport companies because commuters want different services than regular public transport users do. Commuters want rapid services with few stops, whereas people dependent on public transport want many local stops. Logistically both things cannot be easily achieved. The chapter furthermore learns that the Netherlands has been more successful in creating an integrated transport system and public transport-based spatial planning than Great Britain for geographical and institutional reasons. Of the various innovations, the tram-train concept is believed to hold great prospects of attracting commuters and widening access to cities. Providing free buses is not a good idea from the viewpoint of sustainable development, as they attract few car drivers, give rise to additional travel and increase public

spending. When this was trialed in Hasselt (Belgium), more than half of the travelers were new travelers making low-value trips. Former cyclists started to take the bus.

Chapter 15, "Intermodal Personal Mobility" by Graham Parkhurst, René Kemp, Marc Dijk and Henrietta Sherwin, examines the development of intermodal travel in Europe, with case studies from the United Kingdom and the Netherlands. After defining intermodality and the reasons for its existence, the authors examine three cases of intermodality: access to trunk rail (by bike, taxi and public transport); short-range park and ride (to buses in the United Kingdom and urban rail in the Netherlands); and services to facilitate intermodal travel (mobility cards, integrated ticketing, intermodal information). The experiences and developments in both countries show that intermodal travel is a niche phenomenon both in terms of use and in terms of there not being a well-developed coalition behind it in terms of providers, business models, spokespersons and a community of experts. It is a niche caught between the regimes of car mobility and public transport, in which intermodal activities are not core. Both jurisdictions show that policy interest is unstable, often implicit, and over-dependent on local factors. In those cases where successful schemes of intermodality have been introduced, the impetus in a number of cases came from regime 'outsiders' joining up with traditional transport companies. An example is the OV-fiets (a public bike available from railway stations), invented by the bicycle organization and Prorail, which was brought 'inside' the regime through direct NS control (the national railway operator). Given the context-specificity, intermodal travel cannot be planned from the top, but must be developed from below, with the carrots and sticks emanating from the top. Intermodal travel is interesting from a transition point of view, as it may constitute a potential mechanism of resilience, enabling society to 'divest' from car dependence once this regime is no longer sustained, with cars increasingly used in combination with other modes of transport, alongside the use of feet and bicycles for short-range trips and public transport for longer trips. This hoped for effect does not happen easily. Car-restraining policies are needed to complement investment in intermodal interchanges, both for reasons of promoting intermodal travel and for making sure that there are sustainability benefits. One effect of better intermodality is that it promotes more travel. For example, in some places park and ride has encouraged car use.

The final chapter of the book (Chapter 16) brings the various contributions together. It draws conclusions about the sources of stability, mechanisms of change, the potential of various developments (i.e., which developments can be expected to break out) and the long-term effects of multiple developments. The reader will see that a major turning point has been reached on various issues, such as the trend towards hybrid forms of mobility, both in personal transport and public transport. At present, more activities, beliefs and resources are oriented towards a 'greening of cars', which sustains the existing car-based system, than towards more comprehensive system

innovations based on combinations of different forms of transport. For the latter to become more likely, we conclude that stronger landscape pressures, such as related to climate change and Peak Oil, and their translation into stronger policies are needed. The chapter also uses the empirical findings to draw theoretical conclusions that are relevant for transition studies (e.g., the importance of interactions between *multiple* regimes, the continuing importance of regime actors in sustainability transitions and the fact that some landscape developments may *stabilize* existing regimes). The chapter also evaluates current transport policies, concludes that these are too weak to bring about transitions and develops suggestions for a better sustainable transitions policy. Eight generizable policy lessons are derived from findings of the various chapters.

Together, the various chapters offer a wide and comprehensive analysis of stability and change in the automobility system.

NOTES

1. See http://www.swov.nl/nl/research/kennisbank/inhoud/00_trend/05_mobiliteit/reizigerskilometers.htm.
2. In the United Kingdom, 26% of households possessed two cars and 5% three cars or more in 2005.
3. See http://www.allaboutprius.com/blog/1014178_toyota-prius-a-brief-history-in-time.

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