SHAPING SMART MOBILITY FUTURES

This page intentionally left blank

SHAPING SMART MOBILITY FUTURES: GOVERNANCE AND POLICY INSTRUMENTS IN TIMES OF SUSTAINABILITY TRANSITIONS

EDITED BY

ALEXANDER PAULSSON

Lund University, Sweden

and

CLAUS HEDEGAARD SØRENSEN

Swedish National Road and Transport Research Institute (VTI), Sweden

United Kingdom – North America – Japan – India – Malaysia – China

Emerald Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2020

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-83982-651-1 (Print)
ISBN: 978-1-83982-650-4 (Online)
ISBN: 978-1-83982-652-8 (Epub)

ISOQAR certified
Management System,
awarded to Emerald
for adherence to
Environmental
standard
ISO 14001:2004.

Certificate Number 1985
ISO 14001

INVESTOR IN PEOPLE

Contents

List of Figures and Tables

Chapter 9

Chapter 10

List of Contributors

David Ashmore	Faculty of Architecture, Building & Planning, University of Melbourne, Australia
Carey Curtis	Curtin University, Australia
Iain Docherty	Institute for Advanced Studies, University of Stirling, UK
Albin Engholm	Integrated Transport Research Lab, KTH Royal Institute of Technology, Sweden
Nils Fearnley	Institute of Transport Economics, Norway
John Hultén	The Swedish Knowledge Centre for Public Transport, (K2) Sweden
Johanna Jussila Hammes	Swedish National Road and Transport Research Institute (VTI), Sweden
Jamil Khan	Lund University, Environmental and Energy Systems Studies, Sweden
Ida Kristoffersson	Swedish National Road and Transport Research Institute (VTI), Sweden
Annica Kronsell	School of Global Studies, University of Gothenburg, Sweden
Crystal Legacy	Faculty of Architecture, Building & Planning, University of Melbourne, Australia
Sam McLeod	Curtin University, Australia
Ioanna Moscholidou	Institute of Transport Studies, University of Leeds, UK
Dalia Mukhtar-Landgren	Department of Political Science, Lund University, Sweden
Alexander Paulsson	The Swedish Knowledge Centre for Public Transport, (K2) Sweden and Lund University School of Economics and Management, Sweden

Anna Pernestål	Integrated Transport Research Lab, KTH Royal Institute of Technology, Sweden
Fredrik Pettersson	Lund University, Transport & Roads, Sweden
Louise Reardon	INLOGOV, University of Birmingham, UK
Claus Hedegaard Sørensen	The Swedish Knowledge Centre for Public Transport (K2), Sweden and Swedish National Road and Transport Research Institute (VTI), Sweden
John Stone	Faculty of Architecture, Building & Planning, University of Melbourne, Australia
Anna Wallsten	Swedish National Road and Transport Research Institute (VTI), Sweden

About the Contributors

David Ashmore is a Researcher at the University of Melbourne. He recently completed his doctorate, which examines the symbolic aspects of transport choice across different cultures. His professional background is in transport regulation and procurement; he has worked for consulting firms, universities, and the civil service.

Carey Curtis is a Professor of City Planning and Transport at Curtin University, a Director of Urbanet Research Network, and a Guest Professor at the K2/University of Lund. Her research interests include city form and structure, transit-oriented development, personal travel behaviour, accessibility planning, institutional barriers to sustainable transport, governance, and transport policy.

Iain Docherty is the Dean of the Institute of Advanced Studies and a Professor of Public Policy and Governance at the University of Stirling, Scotland, UK. His research and teaching address the interconnecting issues of public administration, institutional change, and city and regional competitiveness, with particular emphasis on the structures and processes of local and regional governance, policies for delivering improved economic performance and environmental sustainability, and the development and implementation of strategic planning and transport policies. His recent books include *The Transport Debate* and *Transport Matters*, both with long-term research collaborator Professor Jon Shaw.

Albin Engholm is a PhD candidate at Integrated Transport Research Lab at KTH Royal Institute of Technology in Stockholm, Sweden. His research interests include the long-term impacts of driverless vehicles on the transport system and society by combining future studies methods with various modelling approaches. He is particularly interested in how driving automation creates opportunities and challenges for making freight transport systems more sustainable.

Nils Fearnley is a Transport Economist and a Senior Researcher in urban and passenger transport. He is currently a Chief Researcher for the Group Market and Governance at the Institute of Transport Economics. His research interests include governance, regulation, and financing of passenger transport; economic and social aspects of transport; market analysis; transport appraisal; transport policy; and transport statistics.

John Hultén is Director of K2 the Swedish Knowledge Centre for Public Transport. He has more than 15 years of experience from working with transportation and mobility in Sweden, for example, within the Swedish Road Administration, the Swedish Transport Administration, and the Ministry of Transportation. He holds a PhD in Political Science from Lund University and has conducted research on the politics of transportation planning, governance, and funding.

Johanna Jussila Hammes, has a PhD in Environmental Economics from the University of Gothenburg. She has been working at VTI since 2009, publishing analyses of the political economy of infrastructure investment planning, and policy instruments for biofuels, and infrastructure investment. She is currently working with local-level policies for sustainable transport in Sweden, the behaviour of civil servants in the decision-making process, electrification of roads for heavy transport, and the needs for changing present policies to facilitate a transition from the present, and fossil-based transport system towards a sustainable one.

Jamil Khan is an Associate Professor at Environmental and Energy Systems Studies at Lund University. He has researched on climate politics, low carbon transitions, and sustainable transport planning for 20 years. He has published widely in the field and has contributed to books such as *Rethinking the Green State* (2015) and *Sustainability and the Political Economy of Welfare* (2016).

Ida Kristoffersson has a PhD in Transport Science from KTH Royal Institute of Technology. She has been working as a Researcher at VTI since 2016 and in 2019 became a Senior Research Leader in the field modelling and analysis of passenger transport. Her main research area is in development of travel demand models to meet the needs for evaluation of new policies and innovations given the increased attention to sustainability and digitalisation of the transport sector. She has published book chapters and journal articles in fields such as modelling and effects of *congestion* charges, as well as future scenarios and long-term effects of self-driving vehicles.

Annica Kronsell is Professor of Political Science and Chair of Environmental Social Science at the School of Global Studies, Gothenburg University. She is interested in how public institutions can govern climate and sustainability issues. As part of various multidisciplinary consortia, she has studied different dimensions of climate governance in the Scandinavian context and published articles and books on the green public sector and environmental governance and on municipalities in experimental governance and they include: *Rethinking the Green State*. *Environmental Governance towards Environmental and Sustainability Transitions* (with Bäckstrand, Routledge, 2015) and 'The Green Decarbonised State and Industrial Governance' with Hildingsson and Khan in *Environmental Politics*. She also uses feminist theorising to study power relations in transport governance with publications such as 'Investigating the Link Between Transport Sustainability and the Representation of Women in Swedish Local Committees' (2019) with Winslott Hiselius, Dymén, and Smidfelt in *Sustainability*.

Crystal Legacy is a Senior Lecturer in Urban Planning at the University of Melbourne. Her research examines questions of urban conflict and citizen engagement with a current focus on the role of the citizen in contested transport processes in Australian and Canadian cities. She is the Co-editor of *Instruments of Planning: Tensions and Challenge for more Equitable and Sustainable Cities* (Routledge, 2016).

Sam McLeod is a Researcher at Curtin University, and a practicing Transport Planner at consultancy firm GHD. He has contributed to a range of academic and applied research, with particular focus on strategic metropolitan planning, transport planning and economics, planning for freight, managing uncertainty and change, and evidence-based planning. He holds qualifications in Urban and Regional Planning and Project Management.

Ioanna Moscholidou is a PhD student at the Institute for Transport Studies, University of Leeds. She is researching how cities govern smart mobility services and how public authorities can steer services towards achieving local sustainable transport goals.

Dalia Mukhtar-Landgren is a Senior Lecturer in Political Science at Lund University, Sweden. Her research interests are centred around relations of power and politics in urban planning and development, as well as in local development politics at large. Her recent publications include studies of public sector projectification, experimentation, and local innovation work. She is currently engaged in research projects on testbed planning, urban experimentation, smart mobility, and processes of local innovation and development practices.

Alexander Paulsson is a Lecturer at Lund University School of Economics and Management and a Researcher at the Swedish Knowledge Centre for Public Transport. He is currently doing research on the governance of new forms of mobility and the marketisation of public transport as well as political economies of post-growth societies. His research interests are broadly within the areas of organisation studies, science, and technology studies as well as ecological economics. He has recently edited (with S. Barca and E. Chertkovskaya) *Towards a Political Economy of Degrowth* (Rowman and Littlefield Publishers, 2019).

Anna Pernestål received her PhD in Systems Engineering in 2009. She has been active in transportation industry for more than 15 years, and has had managing positions within both road and rail sectors. Currently, she is the Director for the research centre Integrated Transport Research Lab, where the focus is building knowledge about how new technology such as digitalisation and automation can contribute to a sustainable transportation system. Her research interests are within system level analysis and design of the transportation system.

Fredrik Pettersson is Associate Senior Lecturer at Transport and Roads, Lund University, and also involved in K2 the Swedish Knowledge Centre for Public Transport. His research interest is in the dynamics between different levels of

decision-making and different organisations in the transition to a more sustainable transport system. In the last decade, he has published research on national level transport policy-making as well as planning and decision-making processes at local and regional levels.

Louise Reardon is a Lecturer in Governance and Public Policy at the Institute of Local Government Studies, University of Birmingham. Her research is at the forefront of knowledge at the interdisciplinary nexus of governance and public policy, transport, and wellbeing research. In particular, her research focusses on the role multi-level governance and institutional networks play in influencing policy agendas and shaping policy outcomes. She recently co-edited the book *Governance of the Smart Mobility Transition* (Emerald, 2018). The book presents an agenda for future research and policy action around the role and impact of governance in relation to smart mobility. She is the Co-editor of the journal *Local Government Studies* and Co-chair of the Governance and Decision Making Processes Special Interest Group of the World Conference on Transport Research Society.

Claus Hedegaard Sørensen is a Research Leader at the Swedish Knowledge Centre for Public Transport (K2) and a Senior Researcher at Swedish National Road and Transport Research Institute (VTI). He is conducting research on transport governance, and his research has mainly focussed on environmental policy integration in transport; national transport planning; organisation and collaboration within public transport; as well as the use and role of knowledge in transport policy-making. The last couple of years he has mostly researched and published on the governance of smart mobility.

John Stone is a Senior Lecturer in Transport Planning at the University of Melbourne. His research explores the political and institutional context for variation in international transport planning practice, with a focus on cities in Australia, Canada, and German-speaking Europe. He has also worked in local government and as a community advocate for sustainable transport.

Anna Wallsten is a Postdoctoral Researcher at the Swedish National Road and Transport Research Institute (VTI). With an interdisciplinary background, she addresses research within the field of sustainable transitions; citizen engagements; science and technology studies; and future studies. She holds a Doctoral degree in Technology and Social Change. Her previous work concerns visions of smart grids, and the tensions that occur when such prospects are translated into practice within demonstration projects. Her current research focusses on issues concerning the digitalisation of the transport system, emerging digitally supported transport solutions, and the institutional capacity of public actors to steer the development towards achieving long-term societal objectives.

Preface

By the beginning of 2018, we were leading a number of research projects affiliated to the Swedish Knowledge Centre for Public Transport (K2). All the projects in one way or another focussed on the governance of smart mobility. Being engaged in these projects, we saw a need for contemplating these issues in another way than allowed by academic journal papers or presentations at conferences, seminars, and workshops. Editing an anthology like this book was an attractive opportunity, as it provided a possibility for showing the complexity of the issue and the diversity of perspectives.

The result is this book. During the spring of 2019, we invited potential chapter authors to a seminar at K2 in Lund, Sweden to be held in September 2019. This seminar provided a valuable opportunity to discuss ideas, and drafts of all chapters were critically reviewed. Some of the chapters were authored by researchers involved directly in the above-mentioned research projects. Other chapters were penned by members of scientific advisory groups connected to these projects. And a third group of chapters were written by other colleagues involved in similar research projects.

We would like to express our gratitude to all chapter authors for their engagement in this project, as well as to colleagues at the K2 Centre, as this has formed an inspiring environment for the work. The research projects making this book possible were funded by the Swedish Energy Agency, The Swedish Innovation Agency (Vinnova), and The Swedish Knowledge Centre for Public Transport (K2).

Last but not least, we would like to thank our families for support and understanding throughout this process.

Lund, Sweden, January 2020
Alexander Paulsson and Claus Hedegaard Sørensen

This page intentionally left blank

Chapter 1

Smart Mobility and Policy Instruments: Broadened Definitions and Critical Understandings

Alexander Paulsson and Claus Hedegaard Sørensen

ABSTRACT

The point of departure of this book is that smart mobility will only be developed in a desired direction and fulfil societal objectives if it is steered in that direction. The market, left to itself, will most certainly not deliver on these objectives. This message has been conveyed extensively in recent literature, but this book aims to take this discussion one step further by focussing on what governance of smart mobility looks like today and in the future. In this introductory chapter, the authors provide a framework of different understandings of policy instruments, how they are selected, developed and used. After the array of policy instruments within the transport sector has been extensively discussed, the authors turn to discussing a broader understanding of policy instruments found within political science and political sociology. In doing so, this book contributes to the critical scholarship on policy instruments, while exploring the why, the how and the what of policy instruments in relation to smart mobility. The chapter closes with a brief introduction to the structure of the book as well as a description of the content of each chapter.

Keywords: Smart mobility; policy instruments; governance; transport policy; political objectives; sustainable mobility

Introduction

In recent years, the advent of autonomous vehicles, the roll-out of electrification and the introduction of shared mobility solutions have influenced the

Shaping Smart Mobility Futures:
Governance and Policy Instruments in times of Sustainability Transitions, 1–16

doi:10.1108/978-1-83982-650-420201001

public debate as well as academic conferences and publications within the field of mobility and transport. While these developments differ in terms of both technologies and business models, the notions of 'smart mobility' and 'smart transport' are increasingly applied as synonyms of mobility and transport futures. Included in smart mobility futures are, for example, autonomous and connected vehicles, shared platform-based mobility such as car-sharing, bike-sharing, ride-sharing, combined mobility like Mobility as a Service, as well as electrification (Papa & Lauwers, 2015). The term 'smart' is currently used in connection with a multitude of devices (smart phone, smart television and smart card), and '"smart" is the order of the day' as one author stressed (Lyons, 2018, p. 2). There is considerable political and industry-related enthusiasm for this development (Fagnant & Kockelman, 2015; Herrmann, Brenner, & Stadler, 2018; Seba, 2014). However, public debate and academic publications to an increasing extent stress that smart mobility might also be counterproductive, for example, regarding sustainability, congestion, attractiveness of cities, etc. (Docherty, Marsden, & Anable, 2018; Marsden & Reardon, 2018; Schiller, 2016). It is indeed contestable whether 'smart mobility' really *is* smart.

Landmark studies within the field include several transport model studies focussing on specific cities carried out by International Transport Forum. Studies have been conducted for Lisbon, Auckland, Helsinki, and Dublin (International Transport Forum, 2017a, 2017b, 2017c, 2018) and have inspired similar studies in other cities (COWI & PTV, 2019). The main conclusion from these studies is that sharing is necessary to achieve societal objectives using new technologies, and sharing in combination with public transport can contribute to reducing the number of cars, traffic volume, parking spaces, congestion, pollution, CO_2 emissions, etc. Though the studies have been criticised for applying unrealistic assumptions (Docherty et al., 2018), the studies have both inspired and prompted public authorities (COWI & PTV, 2019) and corporations (e.g. Pietzsch, 2018) to launch initiatives on shared and combined mobility.

A Need for Governance?

Based in the modelling studies mentioned above as well as several real-world pilots and tests, an emerging body of literature has stressed the need for governance of 'smart' mobility, not least during the transition process (Docherty et al., 2018; Finger & Audouin, 2018; Marsden & Reardon, 2018). Docherty et al. (2018) have argued that smart mobility can only be developed in a desired direction and fulfil societal objectives if it is steered in that direction. The market, left to itself, will most certainly not deliver on these objectives. Finger and Audouin (2018) as well as Lyons (2018) have stressed a need to align smart mobility with the sustainability paradigm. Docherty et al. (2018) have also argued that there is, in the transport sector, a tradition for public sector involvement that should be applied to govern the transition, while Reardon and Marsden (2018) express an urge to use the current window of opportunity for deliberate considerations and debates on societal goals, suggesting a need for cautiousness before entering into possible, disruptive societal changes.

This book is written and published in a time of climate crisis that probably represents one of the biggest global challenges in the history of mankind. A huge gap exists between, on the one hand, how scientists within the climate field express the need for policy initiatives at all levels of society (Lenton et al., 2019), and on the other hand, the actually implemented policy initiatives, which so far seem insufficient. When it comes to transport and mobility, smart mobility is often envisaged as a solution that enables highly mobile societies with a limited carbon footprint, because mobility is expected to be electrified, shared and more efficient (Seba, 2014). For that reason, achieving smart mobility is often expressed as a goal on its own, and some of the literature on smart mobility is focussed on how to introduce and implement smart mobility solutions, thus overcoming legal obstacles and popular resistance (Bjelfvenstam, 2018; Herrmann et al., 2018). However, the chapters in this volume do not subscribe a priori to this optimistic approach to smart mobility, since smart mobility might also have undesired and unintended consequences. When governance and policy instruments are analysed in this volume, the ambition is not to discuss how to implement smart mobility in the most efficient way, but rather to discuss how smart mobility can be governed so that broader sustainability goals or other societal goals are achieved.

The demand for governance and policy instruments in relation to the smart mobility transition is strongly linked to societal goals introduced in recent years at various levels of society. The 17 Sustainable Development Goals are one example (Hildebrandt, 2016; United Nations, 2019) highlighting global ambitions to combat poverty and climate change and to establish wealthy and more equal societies. The Sustainable Development Goals are inspiring national and local public authorities as well as corporations, which in some cases even adopt the SDGs in their vision and mission statements (Ali, Hussain, Zhang, Nurunnabi, & Li, 2018). At the national level, transport policy objectives are established in many countries, including ambitions regarding climate, safety, accessibility, environment and growth (Sørensen & Gudmundsson, 2010). Within other sectors, overarching goals are formulated which also aim to impact decisions within the field of transport. At the regional and municipal levels, a similar trend is observed, a remarkable example being the cities gathered in networks like C40 and ICLEI to achieve climate and sustainability goals (C40, 2019; ICLEI, 2019).

What is a Policy Instrument?

Despite the assumption that political involvement is necessary, surprisingly little is said in the literature about what such governance would look like. Policy instruments are one way that governance is carried out or achieved, and as such, are often imbued with a means-end rationality. While policy instruments are often designed to achieve specific objectives, policy instruments may also be developed and used for fulfiling a wide range of other objectives. The characteristics of the objective generally influence how the policy instrument is designed and implemented (Edmondson, Kern, & Rogge, 2018; Rogge & Reichardt, 2016). Also, the context of a specific policy instrument matters (Sørensen & Paulsson, 2019, in press). For example, during times of relative stability, policy instruments may

build on previously implemented instruments, become institutionalised and even mainstream, as it were. During times of rapid transition or unexpected and disruptive socio-technological change, newly designed policy instruments may become obsolete and older instruments may turn out to be counter-productive. In short, both the speed and the direction of socio-technological changes may impact which policy instruments are regarded as suitable and relevant for achieving the desired objectives (see, e.g., Stead & Vaddadi, 2019). In fact, the choice of instrument generally reflects the political and administrative elites' ideas about the relationship between the governing and the governed (Gössling & Cohen, 2014). Since the choice and design of policy instruments are shaped by political and administrative elites' ideas as well as broader socio-political developments, policy instruments are often highly politicised (Howlett, 2009; Howlett & Ramesh, 1993; Stead, 2018).

The ambition of this book is to take the call for governance of smart mobility one step further by considering the policy instruments used today and the instruments that might be used in shaping smart mobility futures, thus enabling them to meet the societal objectives like tackling the ongoing climate crisis and achieve the goal of sustainable mobility. As of today, policy instruments used in the transport sector include, but are not limited to, a range of taxes and fees, as well as legislation on traffic and vehicles that includes parking restrictions and land-use planning. In futures of smart mobility, some of these policy instruments might be weakened as the technology makes them either obsolete or redundant. For example, autonomous cars presumably would not have to care about parking restrictions, because they can continue circulating or park outside the city centre. With changing ownership structures and shared forms of mobility solutions, some taxes on vehicle ownership and fuel consumption may prove to be weak instruments to shape travel behaviour. Yet, other policy instruments might be strengthened as the socio-technological changes are more aligned with the objectives of the instruments, for example, taxes or fees based on kilometres travelled. There might also be completely new forms of instruments emerging from the socio-technological changes that public authorities may try to use, or they might want to recalibrate current policy instruments due to the emergence of smart mobility. We see this focus on policy instruments as a new topic within the literature on smart mobility, since it goes beyond the plain call for governance to secure public values.

A framework is developed below to gain an overview of the policy instruments presently used in the transport sector. However, we want to stress that in this book, there is no normative standpoint as regards certain types of policy instruments, nor do we endorse a certain type of knowledge or framework about policy instruments. Instead, the point of departure is broad, and we suggest that policy instruments should be understood as 'techniques of governance that, one way or another, involve the utilization of state authority or its conscious limitation' (Howlett, 2005, p. 31). Rather than resorting to functionalist explanations of policy instruments, that is, as rational tools used by governments to achieve clearly defined objectives, we include a range of conceptualisations, from economics and political science to sociology. In doing so, we contribute to the literature

by problematising the definition of policy instruments and how they develop, operate and impact their target audience.

In light of such a broad understanding and the multitude of conceptualisations included in this book, we will first discuss policy instruments and instrument categorisations applied within the field of transport, and we will then turn to more recent research, advocating a broader understanding of policy instruments.

Policy Instruments Used to Govern Transport

In the transport sector, the discussion on policy instruments remains vivid and the debated socio-technological changes associated with smart mobility, as well as the policy ambitions to reach the climate goals, has brought to light the need to consider the importance and effectiveness of the policy instruments used in the sector. Therefore, we will now discuss the instruments in use. The purpose of these instruments is often to steer the development towards societal objectives, for example, reducing travel demand, shifting travel from car to walking, cycling and public transport, as well as developing or using more energy-efficient fuels.

As discussed above, the purpose of using policy instruments is to influence the decisions and behaviours of a subsector of society or a predefined target group in order to achieve certain intended effects. In the transport sector alone, there is a plethora of instruments. According to one estimate, there are up to 60 different types of instruments in this sector (Institute for Transport Studies, 2009). Because of this multitude and lack of overview, there have been several attempts to categorise the policy instruments used in the transport sector. Santos, Behrendt, and Teytelboym (2010) divide instruments for sustainable road transport into three categories: physical instruments, soft instruments and knowledge as an instrument. Physical instruments include policies that affect the built environment and infrastructure, for example, raising land and capacity for the construction of roads. Soft tools and knowledge aim to change behavioural patterns through targeted information and marketing, as well as norms and standards.

The distinction between hard and physical instruments on the one hand and soft and 'non-physical' instruments on the other is relatively established in the transport sector, but the analytical value of the distinction can be discussed. Policies that *directly* intend to steer behavioural patterns in a desired direction, such as information campaigns or marketing, are obviously non-physical. But measures aiming to change behaviour often also involve changes in the physical environment. Pedestrian crossings, speed bumps or other measures in the physical infrastructure are some examples of this. Transforming and changing the built environment and thereby increasing accessibility is a 'physical' policy instrument. At the same time, such instruments operate in a context where administrative or non-physical measures are inter-dependent. Pedestrianisation and car-free zones are two such policies often used by cities promoting sustainable mobility. Changing the use of road space so that buses and tramways are prioritised over cars are similar examples of cities promoting sustainable forms of mobility (Petterson-Löfstedt & Sørensen, 2019, in press). Such changes are primarily based on administrative decisions but also include changes both in the production of urban space and

more specifically in the use of existing road space. In short, administrative policy instruments and interventions in the physical and built environment often interact with each other.

In the transport sector, it is also common to distinguish between financial, administrative and informative instruments (Dickinson & Wretstrand, 2015). We will therefore briefly discuss and contextualise these categories below.

Financial instruments are based on financial incentives as well as monetary costs and benefits. Behaviour is affected to the extent that actors are motivated by or place monetary value on their behaviours and decisions. Because actors attribute different values to costs and benefits, for example, depending on relative budgetary constraints and priorities, the effects of financial policy instruments are highly differentiated. Fees, taxes and subsidies are prominent and common instruments (Frey, 2003). Fees, taxes and subsidies have the potential to manage behaviour as well as to finance and internalise costs associated with the use of the transport system (Nash & Matthews, 2013). However, the introduction of fees, taxes and subsidies affect different groups in different ways. For households with relatively high incomes, the effects may be marginal, while the effects for households with lower incomes will be comparatively substantial. Governments also use various forms of subsidies in the transport sector to promote certain desired behaviours and decisions (Notteboom, 2013).

Administrative instruments are instruments based on the ability of public actors to impose restrictions, requirements, certifications, permits or formal decisions. Administrative instruments include everything from legislation and regulations to policies and recommendations. Examples of administrative instruments in the road infrastructure network are speed restrictions and parking restrictions. Failure to comply with legislation and regulations can result in financial penalties, such as fines, as well as administrative penalties, such as suspension of permits and prohibitions. Failure to comply with policy usually causes suspension of permits or certifications (e.g. Dowling, 2018; Rodrigue, 2013).

Informative instruments refer to instruments intended to influence behaviour and traffic flows through knowledge, communication and nudging. *Mobility management* is an example of a policy instrument that incorporates informational elements. In practice, mobility management may be about informing and planning for a more efficient private car use, to encourage car users to share rides or vehicles, or use public transport or cycle and walk. Mobility management is the instrument that requires the smallest interventions to potentially influence the mobility practices and behaviours and so optimise the capacity of the transport system. However, it is an instrument that may lead to controversies, not least because it can be perceived to put individual liberty and freedom of movement into question (Hrelja, Isaksson, & Richardson, 2013). Intelligent transport systems (ITS), which are already in use in several places, are expected to grow in usage because of the roll-out of automated and connected vehicles (see Hopkins & Schwanen, 2018; Janecki, 2011).

In addition to these three categories of instruments, there is a fourth policy instrument: *research and development*. Research, development and demonstration projects are ways of 'correcting' market failures, since the market produces too

little knowledge and innovation when left to its own devices. Knowledge about the effects of new technology and innovations is often seen as a prerequisite for being able to achieve different environmental goals in the long term. This justifies the use of public funds to steer knowledge development in a desirable direction through pilot experiments, test beds or earmarked research funding.

Governments at various levels – be it national, federal, regional or local – are all involved in governing the transport sector using different policy instruments. Cities are central to the transport system as they accommodate loads of cars and freight trucks, but cities are also innovative when it comes to policies curbing car use. With the help of land-use policy and traffic strategies, cities are trying to steer urban mobility in a sustainable direction, not least by combining 'physical' instruments with changes in the built environment. According to a study by Grazi and van den Bergh (2008), land-use policy is a superior policy instrument, as it sets out the material framework and the possible effects of the other policy instruments: whether they are financial, administrative and/or informational policy instruments.

The number of policy instruments in the transport sector is impressive, spanning from traffic rules via huge infrastructure investments to land use planning, and the broader scholarly debate on governance and policy instruments is similarly rich and encompasses an extensive literature. Although we do not intend to contribute to the discussion on the categorisation of policy instruments, we believe that we can add perspectives to the discussion by trying to broaden the understanding of policy instruments and by highlighting the limits of such instruments.

Towards a Broader Understanding

The research on policy instruments can be divided into two camps. On the one hand, there is a distinct normative approach that tries to describe how the state, by adopting 'the right' policy instruments, could plan, control or steer the development of society or specific subsectors. On the other hand, there is a more descriptive approach that attempts to map the instruments or mechanisms by which the state de facto governs society or aspects of it. In the middle of these lies the pragmatic approach, which aims to describe how the state can steer subsectors of society in certain directions, but doing so based on the policy instruments, tools and mechanisms that are already in use and where the state already possesses the required knowledge and competence. With the book *The Tools of Government,* Christopher Hood (first edition 1983, second edition 2007 with Margetts) introduced an analytical approach by developing a theoretical framework to understand what policy instruments – or tools – the state uses in governing. This analytical approach consists of four overarching categories of tools: nodality, authority, treasury and organisation.

In addition to Hood's influential categorisation, there are several later works that summarise and classify various sets of policy instruments. Often, these categorisations are based on the properties of the policy instruments, which can be either hard or soft (measures), push or pull (direction), voluntary or mandatory

(force), etc. (Vedung, 2011). Furthermore, policy instruments may range from financial incentives to administrative carrots and sticks, as well as spatial and physical instruments. In the book *Sticks, Carrots and Sermons,* Bemelmans-Videc and Vedung (2011) suggest that sticks correspond to formal regulations, carrots to financial instruments, while sermons correspond to information. In practice, authorities operating at different levels in the public sector have different access to different instruments (Kassim & Le Galès, 2010). For example, the state often uses taxes as a policy instrument, while it is generally cities and municipalities that employ land use as a policy instrument.

The knowledge production about policy instruments can be roughly divided into two camps as well; these camps have their own literatures and they rarely come into dialogue with each other (Howlett, 2005). Firstly, there is the economics literature on policy instruments. This literature is generally concerned with understanding and developing incentive structures and adapting economic or financial policy instruments to either punish or promote certain types of decisions or behaviours within a specified subsector of society or a clearly defined target group. The cost-effectiveness of certain policy instruments has also become a crucial question for economists. Secondly, there is the political science literature on instruments. Instead of studying what policy instruments lead to, given certain assumptions about decisions, behaviours and welfare effects, political scientists are often interested in how policy instruments are used, and what side-effects they cause. Of course, this is an immensely simplified picture of the two camps of knowledge production and their overarching research interests, but it nevertheless shows the basic features of much of the research that has been and still is produced on policy instruments (see discussion in Howlett, 2005).

During the past twenty years, scholars of policy instruments have also turned their attention to policy instrument selection and how policy instruments are becoming mixed in use (Bemelmans-Videc & Vedung, 2011; Bressers & O'Toole, 2005). Many research projects have been inspired by the observation that when multiple instruments are used at the same time, it tends to lead to knock-out effects or encourage decisions or behaviours that move in opposite directions than what was originally intended. As a result, much of the focus in the political science literature has moved on to finding criteria for selecting and designing 'the right' instrument or instrument mixes (see, e.g. Rist, 2011). But the question of the legitimacy of policy instruments has also gained much interest (Wallner, 2008). Research has showed that unless the policy instruments are considered legitimate by the target group or those affected by them, their effect may lead to unintended or even unwanted consequences (Galès, 2010).

While there is critical reflection and critique within these two camps of knowledge production, criticism has also emerged from other disciplines. Political sociologists Lascoumes and Le Galès (2007) have been critical of the assumptions behind much of the political science literature on policy instruments. They summarise the assumptions underlying the research by stating that public policy, in this literature, is primarily conceived as 'pragmatic — that is, as an apolitical and technical approach to solving problems through instruments', which in turn are understood as 'natural', whereby politicians and policymakers understand them