K2 WORKING PAPER 2021:2

Policy instruments for a more transport efficient society: A pre-study comparing the cases of California and Sweden

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Date: January, 2021
ISBN: 978-91-986323-6-1
Print: Media-Tryck, Lund

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Foreword

Reduced amount of vehicle kilometers traveled (VKT) and an increased modal share of alternatives to cars and trucks, for both passengers and goods contribute to reaching a more transport efficient society that does not counteract but instead contributes to environmental policy objectives and a sustainable development.

To reach those goals, policy instruments are important tools, and have become a main focus of policymakers globally.

It is suggested that comparing the experiences of countries and cities with different contexts, levels of experience and practices can accelerate the learning efficiency and solution finding process. This study compares the State of California with Sweden in relation to the development of policy instruments for a more transport efficient society, particularly with respect to the instruments targeted towards reducing VKT[1]. The report provides summary information by identifying, describing and comparing the implemented economic, administrative and informative policy instruments between and across different administrative levels in the State of California and in Sweden. Similarities and differences between the two cases are included in this report. Finally, a short section on gendered mobility and equity issues, containing a proposed framework for policy and policy instrument assessment, is also included in the report.

This report is funded by the Swedish Environmental Protect Agency through Lund University and K2, The Swedish Knowledge Centre for Public Transport. The authors would like to thank Dr. Suzanne Hague from the California Strategic Growth Council, California, Prof. Karin Brundell-Freij and Associate Professor, Lena Hiselius from Lund University, Sweden for their help in guiding the investigation directions of this study.

Lund, January 2021

Chunli Zhao, Jean Ryan and Anders Wretstrand

[1] The terms 'vehicle kilometres travelled' ('VKT') and 'vehicle miles travelled' ('VMT') refer to the total distance travelled by vehicles. This study uses the term 'VKT'.

Summary

The purpose of this report is to provide summary information of the policy instruments that have either been implemented or are under discussion in order to reduce vehicle kilometers travelled (VKT) by cars and trucks in the state of California and in Sweden. The summary is based on a review of policy documents, reports and scientific papers that are relevant for both cases, as well as interviews with a senior policy advisor from California, and a professor with more than 30 years of experience in a wide range of issues within the fields of transport analysis, transport modelling and transport policy within the Swedish context, from Lund University, Sweden.

In both cases, reducing VKT is mainly linked to reaching policy goals of reducing greenhouse gas (GHG) emissions. In both cases, this is considered an effective strategy for reducing GHG emissions. However, both cases appear to be engaged in an exploratory process with respect to the development of both policy and policy instruments for reducing VKT, even if the cases appear to be in slightly different stages of this exploratory process.

In California, reducing VKT is a clear policy purpose. The Senate Bill 375 (SB375), signed into law in 2008, legislated for the reduction of VKT. Following the passage of SB375, focused policy and planning instruments have been both developed and proposed at state, regional and local levels. Legislating for the reduction of VKT as a policy is considered a clear step towards integrating land use and transport planning. The legislation SB375 is intended to ensure that the housing and transportation organizations align their goals and strategies with the aim of reducing VKT. The implementation process has facilitated tight collaboration between public and private sectors, non-profit organizations, researchers and professionals, which has contributed to the development and implementation of the instruments for reducing VKT, in line with SB375.

In Sweden, reducing VKT is not framed as a policy purpose in itself, but is instead discussed as a sub-goal for reaching the other policy purposes. Such policy purposes include reducing GHG emissions and alleviating congestion, as well as increasing the modal share of active transport and public transport in order to achieve environmental objective and promote sustainable urban development, including to improve public health and create livable cities. These policies can potentially reduce car dependence, and hence reduce VKT. Several of the policy instruments in the Swedish context exist at different administrative levels: local (e.g. land use, parking fees), regional (e.g. most of the public transport provision) and national (e.g. taxes and tax rebates, funding mechanisms and incentives).

Established funding programs are one of the economic instruments implemented in order to reduce VKT in both cases. Furthermore, while the state and the regional authorities have the capacity to provide and coordinate the incentive programs, it is important to install the corresponding capacity at a local level in order to effectively use the incentives.

The administrative, informative and economic instruments and measures to reduce VKT in California and Sweden, respectively are summarized as follows:

Table 1. Policy Instruments for the reduction of VKT in California

Administrative Instruments	
Description of instrument	***Organizational level*** [a]
Road diet (roadway reconfiguration)	State
Transit-oriented development	State
Investment for improving conditions for cycling and walking	State
Investment for improving public transport	State
Infill development program	State
Providing affordable housing choices for all income groups with good accessibility to car alternatives	State
Building complete neighborhoods	State
Developing more housing in areas with high job proximity	State
The California Environmental Quality Act	State
Economic Instruments	
Description of instrument	***Organizational level***
Congestion pricing/cordon pricing	State
Fuel tax	State
Road charging	State
Parking pricing / Parking Cash-out law	Local
Informative Instruments	
Description of instrument	***Organizational level***
Telecommuting/remote work program	Local
California Employer-Based Trip Reduction Program	Local

a. Organizational level refers to the level of the organization where the instruments are initiated and decided.

Table 2. Policy Instruments for the reduction of VKT in Sweden

Administrative Instruments	
Description of instrument	***Organizational level*** [a]
Adjusting parking requirements	Local
Introducing 'Park-n-ride' facilities	Local
Reallocating street space – making other modes more competitive	Local
Adjusting speed limits	Local
'Car-reducing' planning	Local
Goods transport effectiveness	National
Green corridors	National
Intermodal transport	National
Economic Instruments	
Description of instrument	***Organizational level***
Introducing parking charges	Local
Implementation of parking at the workplace as a taxable privilege	National
Distance-based taxes	National
The removal or adjustment of tax rebate for work trips	National
Government support for developments linked to high-speed rail	National
Government support for sustainable urban environments	National
Government support for city logistics in sustainable urban environments	National
Kilometer-based charges for goods transport	National
Informative instruments	
Description of instrument	***Organizational level***
Mobility management and sustainable travel	Local
Campaigns for travel behavior change	Local

a. Organizational level refers to the level of the organization where the instruments are initiated and decided.

1. Introduction

The transport sector is key in the transition from fossil fuel dependence and requires action in three areas: (1) energy efficient and fossil-free vehicles; (2) a higher share of renewable fuels and; (3) a more transport efficient society. A transport efficient society means reducing the number of VKT (the total distance travelled by vehicles) with energy intensive and motorized transports such as cars, trucks and aero planes (The Swedish EPA, 2017).

In order to reduce the amount of VKT, the focus needs to switch from physical mobility to access to goods and services in a broader context. The level of VKT can be reduced by shortening trips or by substituting transport entirely, especially in urban regions e.g. through improved urban planning and telecommunications, respectively. A reduction can also be achieved by improving the efficiency of transport, e.g. shifting travel from passenger cars or trucks to more energy efficient alternative modes as well as increasing the ratio of passengers and goods per vehicle.

Policy instruments are regarded as an element of the policy intervention chain and are used as a tool to reach political goals, incentivizing actors to change their behavior in pre-defined ways (Transport Analysis, 2018). The Swedish Transport Administration (2012a) categorizes policy instruments as economic, administrative or informative, while Transport Analysis (2018) details a more fine-grained division of instruments: legal, economic, informative, societal, infrastructure and transport planning, negotiations and agreements, public procurement and research and innovation. Within the Swedish context, the discussion around sustainable mobility is often framed around modal share (in terms of proportion of trips) as opposed to share of the total vehicle or person kilometers travelled (Dickinson and Wretstrand, 2015).

This study surveys the instruments by the categories outlined by the Swedish Transport Administration (2012a), namely, economic, administrative and informative. There are different economic, administrative and informative instruments that can be used to achieve increased transport efficiency. Economic instruments include parking fees, congestion charging and taxes. Spatial planning and transport infrastructure planning on the local and regional level is an important administrative instrument and tool to reduce urban sprawl and car dependency, promoting denser transit-oriented, mixed-function urban developments.

The aim of the study is to identify, describe and compare policy instruments for reducing VKT in California and Sweden. The focus is on reducing VKT by passenger cars and freight transport by road. The studied instruments include those that have been implemented, those that have been under discussion, and those that are currently being considered in California and Sweden, respectively. Knowledge of the effects of these instruments is also presented.

The study is based on a review of the relevant literature, policy documents, reports and is guided by interviews with a policy advisor and a researcher who have relevant backgrounds from California and Sweden, respectively.

2. California and Sweden

2.1. California

California is the third largest state in the US in terms of area. By 2018, its population had reached 39.6 million. The state of California is facing unprecedented challenges in accommodating the growing population and reducing GHG emissions. The state predicts that it will accommodate 50 million residents by 2050, which is 10 million more than the population of today. This growth requires a strategic plan in order to ensure a robust and efficient transit network to positively contribute to the quality of life of California's residents, which at the same time, has positive effects for the community, environment in dealing with the impact of climate change. According to the Executive Order (EO) B-30-15 signed in 2015, the total GHG emissions should be reduced by 40% by 2030 and by 80% by 2050 (relative to the 1990 level) (Caltrans, 2017).

A number of key laws have been introduced for targeting challenges related to climate change. These, in turn, have led to actions for reducing VKT since 2006. At the national level, in 2006, states were mandated to reduce GHG emissions to 1990 levels by 2020. This was implemented through the Global Warming Solutions Act of 2006 (AB 32). This law led to the California Air Resources Board regulating emissions sources, including emissions related to transportation and land use. During the last number of decades, to achieve the goal to reduce GHG emissions from the transport sector, a lot of effort has been put into providing cleaner fuel and cleaner vehicles. Reducing VKT did not become the main issue until 2008, when the California Sustainable Communities and Climate Protection Act of 2008 (SB375) was signed. This represented an important shift towards reducing VKT in California. With that, this became the main state level law that legislated the reduction of VKT. SB375 aligns land use and transport planning in order to support and reinforce transit-oriented development with less dependency on cars. It allows the regions and local counties and cities implement certain policy instruments for reducing VKT.

To encourage the regions and cities at the local levels to follow the law and implement the policy for reducing the VKT, SB375 requires the 18 California Metropolitan Planning Organizations (MPOs) at the regional level to make a Sustainable Communities Strategy (SCS) which acts as the new component of federally-mandated regional transportation planning that integrates the land use and transport planning. SB375 requires that SCSs must specify which cities and counties will reduce VKT, by how much, and what strategies will be engaged to do so. SCSs (in each MPO) encourage the compact and efficient development in transit accessible locations. At the same time, MPOs must plan according to the Regional Housing Needs Assessment[2] (RHNA) with SCS in order to

[2] The RHNA is a regional organization that is mandated by the State Housing Law. It ensures coordination between the state, regional and local planning agencies in the quantification of the need for additional affordable housing in each city in order to accommodate the expected population growth.

facilitate the planning of housing in such a way that would reduce the dependency on cars. The state and the MPOs, as such, develop the funding programs for incentivising the implementation of the projects documented in the SCS.

SB375 provides the legislation to allow the regions and local level counties/cities to implement certain policy instruments for reducing VKT. However, it is not mandatory for them to implement the policy. Since SB375 was passed in 2008, most of the instruments have been implemented at the regional or local level. However, there is no administrative department at the state level with the specific function of following up on the implementation at local levels.

Some of the challenges for reaching the goal of this study are as follow. The policy for reducing VKT in the state of California is rather new. Not much time has passed from the point of its introduction into legislation for the steps of policymaking and implementation at the regional and local levels to have fully developed. This means that this is still in what can be described as an exploratory phase. As such, there are not so many (well-developed) policy instruments aimed at reducing VKT that have been implemented in California. Rather, a number of policy instruments are in the process of being piloted, proposed, discussed, or are currently open to the public for comment. In-depth overviews and evaluation studies on the effect of SB375 (with respect to the reduction of VKT) remain very limited. Therefore, there is limited available information on the effects of these instruments.

Against this background, for the California case, this study summarizes the policy instruments based on the policy documents that have been released by the state, regions and local municipalities, scientific papers and public information released by the authorities on their official websites. A senior policy advisor from California Strategic Growth Council, Dr. Suzanne Hague has provided useful information for guiding the survey of the documents, both through interview and via email.

2.2. Sweden

Sweden is part of Scandinavia, located in Northern Europe. By 2018, its population had reached 10.23 million (Statistics Sweden, 2019). Following the targets set out by the EU, Sweden aims for its carbon emissions to be at least 63% less than 1990 levels by 2030. As part of this aim, emissions from transport within Sweden (excluding internal air travel) should be reduced by at least 70% by 2030, compared to 2010 levels (The Swedish EPA, 2017). According to the Swedish Climate Policy Council (2019), from 2010 to 2017, emissions had decreased by approximately 20%. However, this rate of decline is too slow with respect to the trend required in order to reach the national emission targets. In 2018, there was even some growth in greenhouse gas (GHG) emissions in the transport sector. VKT by motorized road transport has increased in Sweden during the last number of years, contradicting the aim to contribute to a more transport efficient society. VKT by road has grown at a faster rate than that with which the population has grown (The Swedish EPA, 2017). The Swedish EPA (2017) emphasizes that private car usage in Sweden has increased during the last number of years, compromising the gains made by the expanding use of more fuel efficient and electric vehicles. However, it is considered

that more targeted and stringent use of policy instruments could steer Sweden towards a more transport efficient society (see Stelling, 2014). With clear goal-oriented planning, Sweden can start to reach its climate targets. This can take the form of planning new transport infrastructure according to the national climate policy goals, and ensuring that no new projects or plans that contradict and compromise these goals are approved (The Swedish EPA, 2017). This implies that in order to reach the long-term goal of reducing GHG emissions by 2030 and 2050, a powerful joint effort by the relevant sectors is necessary, while an even more ambitious effort is required by the transport sector as it contributes to about 50% of the current level of emissions (Swedish Climate Policy Council, 2019).

In line with the national goal of reducing GHG emissions, the Swedish Climate Policy Council has pointed out that comprehensive actions are required within three key areas: (1) a more transport-efficient society; (2) accelerated electrification and; (3) a higher share of biofuels in more efficient vehicles. In particular, it is emphasized that policies underpinning the goal for a more transport-efficient society and faster electrification need to be strengthened (Swedish Climate Policy Council, 2019).

Reducing the VKT in motorized road transport (by private car in particular) would, in part, contribute to the development of a more transport-efficient society. In light of the purpose of this study, this report comprises descriptions of policy instruments which have the potential effect of reducing the VKT in Sweden. These policy instruments either have been implemented, are currently being implemented, or their implementation is being considered or discussed. The identification of policy instruments was based on reviews of relevant documentation for each respective case. The information was also supplemented by an interview with Adjunct Prof. Karin Brundell-Freij at Lund University, a researcher and former consultant with more than 30 years of experience in a wide range of issues within the fields of transport analysis, transport modelling and transport policy within the Swedish context. This provided an account of the strategies for reducing VKT in Sweden from, with a perspective from within academia, as well as within the industry.

3. Instruments for reducing VKT in California

A number of instruments for reducing VKT, such as investment in transportation, infill development, and informative measures have been implemented or are proposed and/or under discussion in the state of California. The instruments are implemented in different organizational levels. For land use planning, such as infill development, it is usually the case that local governments (both cities and counties) have the responsibility to make decisions. However, state policy can influence these decisions by including land use as a policy for reducing GHG emissions, and initiating grant programs for encouraging the implementation of such policies. Regions do not have any authority over land use either, but they receive grants from state, and distribute the grants to the cities and counties to encourage and support implementation.

According to Handy (2017), the funding for transport system in U.S. primarily comes from federal funds, regional and local taxes, but a proportion also comes from state level. In California, state policies and funding support the investment in transportation modes that have the potential to reduce VKT, including public transport, cycling and walking. Funding allocated under such types of investment can be used for infrastructure as well as non-infrastructure improvements such as studies, planning, education, and campaigns which support a modal shift from the car to alternatives.

This section summarizes the instruments in three categories: administrative, economic and informative, and at different organizational levels.

Many of the instruments are initiated at the state level, while usually the state has a more direct role in implementing economic strategies than they do administrative and informative instruments. The state can directly implement some of the strategies, such as pricing strategies. Other instruments are initiated at state level, but the implementation relies on actions at regional and local level, while the state supports the implementation through incentives, requirements, or other mechanisms. In this report, this type of instrument is classified as ‘state level’ instruments.

3.1. Administrative instruments

3.1.1. State level

Road diet (roadway reconfiguration)

'Road diet' or road reconfiguration[3] refers to a measure which 'removes vehicle lanes from a roadway and reallocates the extra space for other uses or modes, such as parking, sidewalks, bicycle lanes, transit use, turn lanes, medians or pedestrian refuge islands' (Federal Highway Administration, 2015). Road diet was initiated for improving safety, providing operational benefits, and increasing the quality of life for all road users.

The implementation of road diets has become more common in US cities during recent years. It acts as a countermeasure to the 'expansion highway capacity' which was originally implemented in order to reducing congestion but has mainly resulted in increased car use in terms of VKT (Handy and Boarnet, 2014). It is a measure that decreases the supply of space for cars to provide more space to other transport modes, especially cycling and walking, or for other purposes. It is also an instrument response to the 'complete streets' concept which emphasizes that the needs of all road users should be considered and catered for.

According to a study based on 24 US cities that was carried out by the Federal Highway Administration, three selected case cities (Pasadena, Santa Monica, Los Angeles) in California have experienced positive effects from implementing road diet of e.g. increased safety, increased bicycle mode share, and reduced travel speed. Among these effects, the increase in walking and cycling could indicate or imply a decrease in VKT. Researchers have estimated a 10% car traffic reduction based on the scenarios in US cities which would potentially contribute to reducing the VKT (Noland et al., 2015). Road diets are considered to be inexpensive and uncomplicated to implement. Further effects of road diets based on experiences in other US cities, are presented by California Department of Transportation (Caltrans) as follows [4]:

- 94% of respondents to a recent Shasta Living Streets survey agreed or strongly agreed that if there were better bicycle (like buffered or protected bike lanes) facilities and pedestrian facilities in town, they would ride their bicycle or walk more often.
- 93% of respondents to a recent Shasta Living Streets survey agreed or strongly agreed that a buffered or protected bike lane would make them feel more comfortable riding their bicycle on city streets.
- Nearly two-thirds (65%) of Americans who don't bicycle say they would like to ride more often.
- After buffered green lanes were installed on Philadelphia's Spruce and Pine streets, bike traffic increased 95% and the number of bicyclists riding on the sidewalks decreased by up to 75%

[3] http://www.californialtap.org/index.cfm?pid=1091

[4] http://shastalivingstreets.org/complete-streets/california-street-road-diet-bike-lanes/

- After a green lane was installed on Chicago’s Kinzie Street: Bicycle ridership on increased 55 percent, according to morning rush hour counts; Forty-one percent of respondents changed their usual route to take advantage of the new protected green lane.
- NYC’s Prospect Park West protected green lane saw a 190 percent increase in weekday ridership, with 32 percent of those biking under age 12.

Instruments for implementing Transit-oriented development planning

Transit-oriented development (TOD) is a planning concept introduced by Calthorpe in late 1980s. He defined TOD as ‘mixed-use community within average 2000-foot walking distance of a transit stop and core commercial area’ (Calthorpe, 1993). Later on, the concept has been broadly applied in cities in America, Europe and Asia. Researchers further interpreted it as a concept which ‘entails the development of compact mixed-land-use development near transit facilities to promote sustainable transport to urban dwellers in cities by providing them with improved access to transportation, which reduces the negative impacts of private cars’ (Tamakloe et al., 2021). TOD strategies support people in changing their personal travel mode from the private car to public transport and other more sustainable modes. In California, this is done by improving the service level of sustainable transport modes, and by building more residential and commercial mixed neighborhoods via infill development as opposed to on greenfield sites outside the dense core.

In line with the implementation of SB375, in order to improve the service level of public transport, cycling and walking, California has directed the funding program for improving the service level of these three modes. This program covers the improvement of infrastructure for these transport modes, as well as non-infrastructure aspects, including improving planning, carrying out travel surveys, and developing education programs for more sustainable travel behavior (Byars et al., 2017). To create compact neighborhoods, the state has initiated an “infill development program” for effective land use. The specific instruments under TOD program are presented in more detail below.

Investment for improving conditions for cycling and walking

Metropolitan Planning Agencies (MPOs) at the regional level are encouraged to adopt bicycle and pedestrian plans and to establish grant programs for local governments to improve the infrastructure. In a number of regions, active transportation funding in their most recent, short- and long-term spending plans was higher than in previous years. For instance, in Southern California, the amount programmed for walking and cycling infrastructure grew from $520 million for the 6 years beginning in 2015 to $1.04 billion for the 6 years beginning in 2017 (CARB, 2018). The funding is used for improving the infrastructure in support of active transport (walking and cycling), as well as for evaluating the current take-up of active transport in order to develop measures for the future (Byars et al., 2017).

According to CARB (2018), in the four largest regions, the walking and cycling modal shares are highest in the Bay Area where the modal share of walking and cycling rose from 4.2 percent in 2005 to 5.5 percent in 2016. In San Diego Association of Governments (SANDAG), this has increased from 2.4 percent to 3.9 percent during the same period, while it has remained more or less constant in the other large regions. Some

rural regions such as Santa Barbara, Butte, and San Luis Obispo, have comparatively high rates (above 6 percent) with an upward trajectory.

Investment for improving public transport

From 2005 to 2016, statewide, the funding for public transit operations has increased by 60 percent. It is worth noting that, in some of the areas (e.g. the San Francisco Bay Area, and the Southern California Association of Governments (SCAG)), the funding for road maintenance in the most recent Regional Transport Planning (RTP) has increased, while funding for road and highway expansion has however decreased, even though the total budgets were expanded. Drawn based on the limited data, for instance, in SANDAG, '*nearly three times as much is planned to be spent on building high-occupancy vehicle and/or toll lanes than on general purpose highway capacity in the long-term Regional Transport Planning, and over three times as much in the short-term Transportation Improvement Programs*' (CARB, 2018).

Two funding sources at the state level have been established for supporting the improvement of public transport: Local Transportation Fund (LTF) and the State Transit Assistance Fund (STA). The LTF funding can be used for a broad range of programs in addition to public transport, while STA funding is only allowed to be used for transportation planning and mass transportation purposes[5]. In 2014, the California Low Carbon Transit Operations Program was created for improving the operating and capital assistance for transit agencies. The funding prioritizes projects that improve the transit services in disadvantaged communities. Investment is made through the transit agencies, including Public Transportation Account (FTA, funded by a sales tax on diesel fuel), the Public Transportation Modernization, Improvement and Service Enhancement Account (funded by bond measure) and the California High-Speed Passenger Train Bond Fund (funded by bond measure)6 (Caltrans, 2017). Some transformative projects have been built for providing new beneficial transportation options (i.e. expanding LA Metro's rail lines, ACE Rail to Merced, BART to San Jose, and many other significant public transit investments). However, no large shift of modal share has been observed in most regions in correspondence to the decrease in budget devoted to road expansion and increases in budget for public transport, walking and cycling.

The operations funding for public transport has increased statewide since 2005. However, since 2014, on average, public transport has experienced a continual decline in use across California, in both urban and rural regions. However, in some other regions the increased public transport provision that is supported by the operations funding (the amount of the budget was not able to be acquired) have resulted in a significant increase in ridership. For commuting trips, the public transport modal share has stayed the same or under 5% in the large urban regions, except in the Bay Area, the modal share rose from 9.4 to 11.9 percent. Other regions were generally below 2 percent for most years.

No studies on examining the exact effect of the instruments to the change of modal share have been carried out. According to CARB (2018), in general, the change in modal choice has not been effective enough to contribute to a reduction in VKT. During the last ten

[5] http://www.dot.ca.gov/drmt/docs/tda/TDA_07-2018.pdf

[6] http://dot.ca.gov/budgets/docs/CA%20Transportation%20Financing%20Package%202017-18.pdf

years, the car modal share has experienced continual growth. The transit service per capita has rebounded to pre-recession levels (CARB,2018).

CARB (2018) emphasize that the redistribution of funding has not been an easy task even though with the support from political level through SB375. Challenges point to the interplay between local, regional and State authorities. The evaluation of the impacts of recent State actions, therefore, become a difficulty. CARB (2018) pointed out the challenges which should be solved in the next steps for carrying out future evaluation. These challenges may serve as an indication of potential challenges ahead should Sweden opt for the preparation of a similar evaluation approach for a similar purpose in future.

- Transportation spending is administered and tracked by many different agencies at state, regional and local levels, but these spending streams are not compiled to help understand whether current investments align with long-term goals.
- Cyclist and pedestrian infrastructure data are not compiled in a standard format across multiple jurisdictions to track whether and how these how infrastructure for these modes is expanding are expanding.
- Transportation Network Company (TNC)7 trip-level data is not available to State, regional, and local public agencies, nor to academic researchers in California to understand how they are affecting VKT and transit travel.

Even though the investment in public transit, walking and cycling has steadily increased, this has only been enough to keep up with the pace/demand brought about by the growing costs and increase in population.

From 2005 to 2014, with the reduced budget for road expansion, from total state wide, the interstate and principal arterial lane miles built has increased by 7.9 percent, 0.4 percent per capita. The roadway capacity expansion is intended to address congestion and public safety. However, it is emphasized that the new roadway capacity results in additional driving, increased air pollution, and has environmental, equity, health, and other societal impacts, and may not result in overall reductions in congestion.

Infill development for effective land use

Infill development refers to 'building within unused and underutilized lands within existing building development patterns' (Byars et al., 2017). According to the American Planning Association, infill development and redevelopment, increased density of development, and the adaptive re-use of existing buildings can potentially increase the efficiency of utilization of land resources, build more compact urban areas, improve the efficiency of delivering the quality of public services, and encourage people to travel without relying on cars.

At the state level, infill development in California so far is facilitated by three strategies, 1) Providing affordable housing choices for all the income groups with good accessibility to an alternative to the car; 2) developing more housing in areas with high job proximity;

[7] https://www.irmi.com/term/insurance-definitions/transportation-network-company-tnc. Transportation Network Company (TNC) — a business model that offers prearranged rides or car rentals for a fee, utilizing an online application (app) via a mobile device to connect passengers or automobile renters with drivers/car owners. Examples include Uber, Lyft, and Zipcar.

3) building compact neighborhoods with good accessibility to daily activities (e.g. grocery stores, public facilities) by walking and cycling.

At the state-level, California has created a number of grant programs to encourage infill development and has adopted changes to state policy that aim to ease the way for infill development. However, it is still considered very challenging for the region and local level to implement infill development and these processes tend to be postponed to the next decade by many cities. It is difficult to trace its effect for reducing VKT as the relevant data is likely missing. Challenges lie in many aspects, according to (Mawhorter et al. 2018), one of main challenges is that even though some cities are likely engaged in collaborative planning processes for supporting housing development, a lot of cities choose to use the funding for improving bicycle and pedestrian facilities rather than producing infill development.

The followings instruments are implemented at the local level under the infill development policy at the state level.

Providing affordable housing choices for all income groups with good accessibility to car alternatives

The state is offering programs to help regions promote affordable housing. The programs target reducing the replacement risk. Replacement risk is the term used to describe the process where low-income groups are forced to move away from high-quality transit areas which resulting in an increase in car ownership, and a corresponding increase in VKT. By providing housing in areas with good accessibility to sustainable transport, it is expected that the VKT created by this replacement risk can be counteracted.

In 2015, California's Affordable Housing Sustainable Communities (AHSC) program awarded $122 million in funding to the Metropolitan Planning Organizations (MPOs). For example, in Southern California Association of Governments (SCAG), $27.5 million was awarded to ten projects which support building 842 affordable units, while 294 of those units are designated for households with an income lower than the area median income level. Additionally, two bills: Senate Bill 628 (Beall) and Assembly Bill 2 (Alejo), provide legislation for establishing funding sources to supporting the construction of affordable housing, infrastructure and amenities (CARB, 2018).

Across California, 89 percent of local jurisdictions have certified Housing Elements as the important first step to show how future needs can be accommodated, even though it does not guarantee that those houses will be built. However, most regions are ahead of schedule in issuing permits for housing for the wealthiest 'above-moderate' housing types but are falling short in the three more affordable categories: moderate, low-income and very low-income.

CARB (2018) reported that, among 13 of 18 MPOs who have reported information on total new home construction, by 2016, in all regions, the number of new provided homes is far behind the assumed number in the plans. However, based on the California Household Travel Survey data, the study reported that income and location efficiency[8]

[8] In the referred study, 'location efficiency' is measured by three indicators: employment density, transit availability, and neighbourhood commute distance.

are independently associated with VKT. A case study based on city of West Sacramento showed that with investing 6,730,888$ in building the affordable housing and transport related infrastructure, it achieved the GHG reduction equivalent to 70.4 VMT/removing 6205 cars from road within a year[9].

Building affordable housing for lower-income households in TOD areas is likely more effective for reducing VKT than developing affordable housing in TOD areas for higher-income households (Newmark et al., 2015). Lower-income households who have access to public transport within 800m (0.5miles) drove 25% to 30% less kilometers than those living beyond the 800m public transport buffer in the TOD areas. Lower-income households who can access public transport within 400m drove 50% less. However, the high-income group who live within the 400m public transport buffer drove more than twice as much and own more than twice the number of cars owned by low-income households (Newmark et al., 2015).

The transportation agency serving the Los Angeles County in California has suggested some tools for building affordable housing:

- Utilize public subsidies such as land dedication, loans, and grants
- Establish partnerships with non-profit developers
- Establish inclusionary zoning requirements
- Explore joint public/private development
- Provide process and zoning accommodations, such as fee waivers and expedited processing
- Acquire land or buildings near transit for housing
- Provide incentives including density bonuses and reduced parking requirements

Building complete neighbourhoods

Complete neighborhoods refer to the neighborhoods in which residents have good and safe accessibility to non-work-related destinations, including groceries and discretionary goods, public facilities, etc. Good and safe access to these destinations implies that residents can travel to these places by non-automobile modes as the most convenient way, including public transport, but mainly by walking and cycling. Such compact neighborhoods are found effective for reducing VKT (Ewing and Cervero, 2010). MPOs do not have land use authority, thus, they have released the grant programs to encourage cities and counties to implement these policies.

The transportation agency of Los Angeles County have suggested some tools for building complete neighborhoods[10]:

- Mix complementary land uses
- Create active ground-floor uses
- Support commercial and retail service diversity
- Support community-serving uses, such as child care and health services

[9] https://sgc.ca.gov/programs/ahsc/docs/20180612-Update-AHSC_CS_City_of_West_Sac.pdf

[10] https://www.metro.net/projects/tod-toolkit/complete-neighborhoods/

- Mix housing types, including senior and affordable housing
- Create public gathering places and open spaces
- Balance jobs and ho*using*

Developing more housing in areas with high job proximity

Almost all US studies indicate that residents living in low-density neighborhoods drive more than the residents in high-density neighborhoods (Handy et al., 2005). Implementing the two instruments introduced above will create more jobs, which is however, not sufficient to build a high-density area that can reach the maximum capacity to reduce VKT. Developing more housing in areas with high job proximity is another strategy of infill development for densifying the areas, and it is one of the emphasized strategies in SB375.

In line with the goal of SB375, the Regional Housing Needs Assessment (RHNA) requires that it '*must not only accommodate the expected growth, but it must also facilitate growth in places where development is projected to reduce vehicle miles traveled and greenhouse gas emissions*' (CARB, 2018). This incentivized the RHNA to award more housing to the cities with above-median access to the jobs. According to CARB (2018), in some of the cities, the share of allocation in high-job-access cities show a growing trend from before to after the passage of SB375.

One incentive is the Affordable Housing and Sustainable Communities Program. The program funds projects that build housing in the areas that can bring people closer to jobs, schools, commercial and grocery stores, hence, making it easier for people to walk, bike, or take public transit to their destinations. It is funded by California's Cap-and-Trade emissions reduction program, and administered by the Strategic Growth Council and implemented by the California Department of Housing and Community Development[11].

The California Environmental Quality Act

The California Environmental Quality Act (CEQA) is a statute passed and signed to a law in 1970. It generally 'requires state and local government agencies to inform decision makers and the public about the potential environmental impacts of proposed projects, and to reduce those environmental impacts to the extent feasible'[12] (Governor's office for planning and research, n.d.). California Natural Resources Agency has issued a guideline for the implementation of CEQA[13] (California Natural Resources Agency, n.d).

Under CEQA, cities, counties and public agencies must analyze real estate as well as transportation projects to determine if they have a significant impact on the environment. Transportation impact should be evaluated according to SB 743[14], which was signed into law 2013 (Governor's office for planning and research, 2013). According to SB 743, the transportation impacts of for example new housing projects, that is whether the project

[11] http://sgc.ca.gov/programs/ahsc/vision/

[12] https://opr.ca.gov/ceqa/

[13] https://resources.ca.gov/CNRALegacyFiles/ceqa/docs/2018_CEQA_FINAL_TEXT_122818.pdf#page=11

[14] https://www.opr.ca.gov/ceqa/updates/sb-743/

adds increased car travel onto roads, should be evaluated in VKT or rather, VMT (vehicles miles travelled). The purpose of SB743 is to make sure that new development projects are built in a way that allow Californian residents to drive less, by reducing time and cost for such projects. A project can still be approved even if it has significant and unavoidable transportation impacts. But it is pointed out that if projects increasing car VKT can be avoided, then economic growth will be facilitated, as it is now an established fact that economic growth does not require an increase in driving[15] (Governor's office for planning and research, n.d.). The latter could instead slow economic growth by creating development pattern such as urban sprawl, which leads to congestion and thus limits residents' ability to get to their destination.

3.2. Economic instruments

3.2.1. State level

Congestion pricing

California has implemented congestion pricing for optional toll lanes. It imposes higher tolls on bridges during peak hours in selected locations. Cordon-pricing, in the form of congestion pricing, in which drivers pay a toll to travel into a designated area during peak times, in selected locations has also been considered. California has not proposed policies that impose higher prices on vehicles with higher per-mile GHG emissions.

According to Handy (2017), cordon pricing has been considered but not yet implemented in the U.S. but California has authorized Treasure Island, in the San Francisco Bay Area, to form a transit authority and to implement cordon pricing. San Francisco considered the feasibility of area-wide pricing through a program called Mobility, Access and Pricing Study (MAPS). MAPS found that pricing could be a highly effective way to manage their transportation system and support the city's future growth plans. Los Angeles has implemented a pilot program called Express Travel Choices to study cordon pricing; as of fall 2016, it was engaging stakeholders and reviewing economic and environmental justice components of the cordon project.

Economists considered the congestion-based tolling as the single most viable and sustainable approach for reducing traffic congestion, but it remains unclear regarding its effect on reducing VKT. So far, it has been tested in the state-owned bridges in the San Francisco Bay area. It was for the first time tested in the Bay Area in 2016. Tolls are differentiated according to the day and time. For example, in 2016, Bay Bridge tolls were $6 during weekday peak commute times, $4 during weekday off-peak and $5 all day Saturday and Sunday[16]. Until today, for example, San Francisco still holds a skeptical attitude towards it. It has raised a fund for studying its feasibility further[17] .

[15] https://www.opr.ca.gov/ceqa/updates/sb-743/faq.html#economic-growth

[16] https://www.eastbaytimes.com/2010/06/28/bay-area-bridge-toll-questions-answered/

[17] https://www.sfchronicle.com/bayarea/article/Congestion-pricing-SF-considering-a-fee-to-drive-13614717.php

Fuel tax

As one of the most commonly implemented measures, California has implemented fuel tax. Since 2000, the tax level has been adapted with frequent up-and-down changes. In 2017, California increased the gas tax by 12 cent, 20 cent diesel excise, 4% diesel sales tax, and zero emission vehicle registration fees (Handy 2017). It is suggested that California should simplify the gas tax scheme to let the citizens know what and how much they are paying for when they purchase the fuel. Boarnet, et. al, (2014) reported that the increased fuel costs curb fuel usage which hence contribute to reducing the GHG emission.

Road charging[18]

The increasing fuel efficiency and decreasing fuel purchasing indicate a reduced revenue for maintaining the highway system in California. The state needs to explore a new funding mechanism to accommodate the growing demanding from increasing population and expanding economy. The California Transportation Commission has piloted a road charging program that would assess fees for road maintenance based on the number of miles driven, pursuant to SB 107719. The Road charging was piloted from July 2016 to March 2017, and involved more than 5000 volunteers state wide. The pilot program focused on understanding the participants' overall opinion on the program and acceptance. The result showed that 73% of the participants think it is fairer than a gas tax. By 2019, California is continuing to explore the suitable funding models for sustaining the revenue for road maintenance. The strategy in itself does not directly contribute to reducing the VKT, however, it may indirectly support other measures which may potentially contribute to reducing VKT, such as enabling the possibility for increasing the fuel tax.

3.2.2. Local level

Parking pricing

Parking pricing is a local strategy that states are encouraged to implement in the US since 1992. In California, parking pricing is implemented in a form of 'Parking Cash-out law'. According to California Environmental Protection Agency (2009) 20 '"Parking cash-out program" comprises an employer-funded program under which an employer offers to provide a cash allowance to an employee equivalent to the parking subsidy that the employer would otherwise pay to provide the employee with a parking space'. In this program, the employer can offer the employees transit passes or a cash allowance by using the public tax. The amount set aside for the transit passes in the budget corresponds to the cost for the parking spaces for the employees who drive. It is legislated that the cash-out law applies only to employers who are eligible for reducing the number of paid parking spaces they maintain for the use of their employees, and provide their employees

[18] https://californiaroadchargepilot.com/

[19] https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1077

[20] https://ww2.arb.ca.gov/sites/default/files/2020-05/CA_Parking_Cash-Out_Program_An_Informational_Guide_For_Employers_2009.pdf

the cash-out instead. In California, such a program requires the participation of employers who have at least 50 employees and who provide leased or subsidized parking spaces for their workers.

The law was enacted in 1992, and it is considered effective for encouraging employees to use alternatives to cars. Therefore it reduces the trips traveled by private car. The state is exploring approaches for stimulating the demand-based parking pricing strategies where transportation alternatives are present.

3.3. Informative instruments

A number of transportation demand management programs in relation to reducing the congestion and GHG emissions by reducing dependency on cars have been discussed or are under discussion, while very few have been implemented. The programs include employer-based trip reduction (EBTR) programs, telecommuting/remote work programs, and voluntary travel behavior change programs. Car-sharing services are also considered as a potential measure. However, their effects are understudied.

3.3.1. Local level

Telecommuting/remote work program

Telecommute is not a regulated instrument in California, but the state encourages agencies and employers to provide telecommuting as a work option[21]. Employees apply for telecommuting through their direct administrative office. Private employers and employees should make their agreement on it, and a safety self-certification for the home office should be signed.

California Employer-Based Trip Reduction Program [22] [23]

Employer-based trip reduction (EBTR) programs referring to the employer using various measures/solutions to reduce solo driving to work and the associated GHG emissions. Typical measures including[24]:

- Providing carpool facilitation, preferential parking for carpoolers, vanpool service, cars haring programs, or a guaranteed ride home for employees who commute by transit;
- Financial incentives for carpoolers, vanpool users, cyclists, or pedestrian commuters, free or reduced public transit fares (often subsidized by the

[21] https://www.blr.com/HR-Employment/Staffing-Training-/Homeworkers-Telecommuting-in-California

[22] http://www.baaqmd.gov/~/media/files/planning-and-research/commuter-benefits-program/proposed-rule-packet/proposed-rule-reg-141.pdf?la=en

[23] https://www.valleyair.org/rule9410web/Documents/eTRIPMeasuresGuidance.pdf

[24] https://www.arb.ca.gov/cc/sb375/policies/ebtr/ebtr_brief.pdf

employer), or a cash transportation allowance combined with a parking fee, also called a parking cash-out;
- Worksite facilities, such as showers, lockers, or bicycle racks, for physically active commuting;
- Alternative work schedules that include flexible work hours and/or a compressed work week;
- Information and marketing, such as a commuter information center or a transit promotion campaign.

EBTR programs are encouraged or required by State or local governments, and sometimes can also be voluntarily implemented by firms. California has not implemented a state-level EBTR program by 2017, but it has been implemented at the regional level since 1988[25][26]. In 2009, San Joaquin Valley Air District implemented a commute trip reduction program which requires firms design their own EBTR programs. It is not mandatory for employees to select the provided modes in the program, but it provides options for the employees to decide whether or not to use alternatives to solo driving.

In 2013, the Bay Area Air Quality Management District (BAAQMD) developed the Bay Area Commuter Benefits Program in collaboration with the Metropolitan Transportation Commission. It requires employers with 50 or more employees to provide commuter benefits to their employees in the forms of four options for reducing the solo driving trips to work. According to Boarnet (2014), the evidence suggests that EBTR programs can potentially contribute to decreasing the commute VKT for employees by between 4 percent and 6 percent.

3.4. Instruments under discussion and development for passenger travel

Under SB375 from 2018, the California Metropolitan Planning Organizations (MPOs) are developing the second round of SCSs which continually addresses the strategies for reducing the VKT in California. Besides the instruments discussed above, the state has developed a scoping plan for reducing the VKT with suggestions on the instruments that should be developed and implemented for passenger travel in the future, including 1) tools to support more efficient and equitable land use; 2) investment on the better integration of transit and land use, e.g. sharing mobility, education program for behavior change, non-transportation infrastructure; 3) tools for pricing policies; and 4) tools for maximizing the efficiency of existing transportation infrastructure. The scoping plan on reducing VKT functions as supporting action for local levels to take the suggested plan. The document is written in a very precise and clear structure, see the document via the link[27].

[25] https://www.arb.ca.gov/cc/sb375/policies/ebtr/ebtr_brief.pdf

[27] https://www.arb.ca.gov/cc/scopingplan/2030sp_appc_VKT_final.pdf

3.5. Freight transport - instruments for reducing VKT

According to the California Transportation Plan 2040[28], California has the most intensive, interconnected and complex freight transport system in the US. Policymakers in California confront huge challenges for improving the existing systems to support economic growth and ensure a healthy, livable and clean environment. Executive Order B-32-15 directed the State agencies to establish targets to improve freight efficiency, as well as the transition to zero emission technologies, and increase the competitiveness of California's freight transport system. To reach the goal of reducing the GHG emission at the state level, a number of strategies at state, regional and local level have been regulated, however, to our knowledge, it seems no specific instruments for reducing the VKT in freight transport sector has been implemented, but rather being discussed based on international experience by the studies that carried out by researchers from universities (National Center for Sustainable Transportation, 2017)[29] . The instruments under discussion include:

- Truck VKT tax
- Truck lane tolls
- On-site parking and loading

[28] http://www.dot.ca.gov/hq/tpp/californiatransportationplan2040/Final%20CTP/FINALCTP2040-Report-WebReady.pdf

[29] http://www.dot.ca.gov/hq/tpp/offices/ogm/index_files/CaltransFreightImpactsProject_finalreport.pdf

4. Instruments for reducing VKT in Sweden

There are several instruments both directly and indirectly targeted towards the reduction of VKT in Sweden. Some instruments have been implemented, or partially implemented in experimental settings, while others are proposed and/or under discussion. The instruments are implemented in three organizational levels, although mainly at national and local level. This section outlines the instruments in three categories: administrative, economic and informative.

4.1. Administrative instruments

4.1.1. Local level

Adjusting parking requirements

The legal basis for municipalities' management of parking spaces is the Planning and Building Legislation (PBL) (1987:10), outlining that a 'sufficient number' of parking spaces should be provided with due consideration given to the city and/or landscape context (Dickinson and Wretstrand, 2015). Municipalities have the option of charging for parking spaces which lie on public property, in accordance with the Local Area Plans. This process is largely regulated by the Transport Regulation (1998:1276), Legislation regarding the right for municipalities to charge for the use of public space (1957:259) and Legislation on fines for illegal parking (1984: 318) (see also ibid.). Aretun and Hansson (2012) highlight that municipalities have the possibility to put in place local restrictions and regulations, meaning that municipalities have a (considerable) freedom to introduce their own tailored policies.

Municipal parking policies assist with respect to a holistic perspective on parking issues (how they interact with spatial planning issues). Since the 1950s, developers in Sweden have been required to provide at least a minimum number of parking spaces with respect to e.g. the number of dwellings, retail unit floor space, etc. However, more recently, a shift has taken place where municipalities have begun to question these parking standards, and several have even chosen to relax them in certain cases. Instead, less tangible incentives are offered such as membership in a car pool, a monthly public transport pass, access to electric cargo bicycles, etc. (see Hamilton and Braun Thörn, 2013).

Parking cash-out is a policy instrument applied in Sweden whereby developers and property owners, instead of providing the number of parking spaces outlined in the municipal parking standards, strive to expand opportunities for travel by more sustainable modes of transport for those working in the respective properties (see Trivector Traffic,

2013). Parking cash-out (potentially supported by the Planning and Building Legislation) is cited as a means of improving accessibility by modes of transport other than the private car and, as a tool, can be combined with a maximum number of parking spaces in cities and dense areas. It is considered that parking cash-outs can result in a reduction in VKT by approximately 15% (The Swedish EPA, 2018).

Jönköping is one example of a municipality where a new parking strategy has been introduced. Jönköping's Programme for Parking was introduced in 2016 (see National Board of Housing, Building and Planning, 2020a). The program must be used when drawing up local area plans ('*detaljplaner*' in Swedish) and when applying for planning permission. The program contains parking requirements for bicycles as well as the requirement to draw up green travel plans/mobility management plans in tandem with plans for new buildings and developments. In this respect, both developers and landowners can, through the mobility management plan mechanism, reduce the number of car parking spaces required by up to 15%. Potential buyers and/or tenants must, however, be informed about the pre-conditions for the development, and exactly why the number of parking spaces has been reduced, and the ways in which this has been compensated for (ibid.).

Introducing 'Park-n-ride' facilities

'Park-n-ride' facilities in close proximity to dense areas have also been considered a means of reducing VKT, with the traveler then encouraged to complete their journey to the city center on foot, by bike or with public transport, with SKL (2013) expressing support for such facilities (see Hamilton and Braun Thörn, 2013).

Reallocating street space – making other modes more competitive

Striving for a combination of policy measures is likely more effective in ensuring a shift from private motorized transport to more sustainable modes of transport (e.g. Wicki et al., 2019), meaning that both 'carrot' and 'stick' measures are required in order to ensure that sustainable modes are more attractive, and that private motorized transport is made less competitive (Dickinson and Wretstrand, 2015).

Municipalities have the possibility to influence the location of activities (origins and destinations) and the structure of the built environment so that the pre-conditions for public transport use, cycling and walking are improved, and so that the equivalent conditions for car (particularly with respect to travel times) are disimproved. This can be operationalized through the strategic use of the Planning and Building Legislation and the Environmental Code ('*Miljöbalken*') (Dickinson and Wretstand, 2015). One way of doing so is to ensure that residential areas are designed so that public transport lines are as straight, direct and short as possible (Holmberg, 2013; KolTrast, 2012), with a similar approach applied for walking and cycling infrastructure.

For instance, Malmö City's Sustainable Urban Mobility Plan (2016) outlines how flow capacity and the space required per person (per transport mode) is used as a tool for analyzing and ultimately reorganizing the use of streetscapes. This tool involves ranking transport modes according to their surface efficiency, and highlights how walking, cycling and public transport are more surface efficient than the private car. The intention

is to reorganize the use of streetscapes so that the flow capacity for walking, cycling and public transport are increased. These more surface-efficient modes are thus allocated more space and priority. This is a means of making the private car less attractive and potentially reducing VKT.

Car-free city centers (mechanisms to restrict car use in the city's center) have been tested in a number of Swedish municipalities, usually during a special test period (Dickinson and Wretstrand 2015). The results of such experiments have been mixed. Surveys among citizens in the cases of the experiments in the cities of Malmö and Gothenburg have shown that there have been conflicts between different modes of transport (e.g. between cyclists and pedestrians) and issues with unauthorized driving on such streets (Koglin et al., 2019). However, it is emphasized that further investigations are required in order to determine the full effects of such experiments (ibid.), among which reduced VKT may feature.

Adjusting speed limits

Reducing maximum speeds by private car is one means of ensuring an increased travel time by car (and potentially reducing VKT), with the limitation of speeds on national primary roads considered to have the potential to reduce fuel consumption by about 3-4% (*Fossilfrihet på väg* (FFF), 2013; The Swedish EPA, 2018).

Malmö City has regulated the speed limits so that a maximum limit of 40 kilometers per hour applies in the inner city areas, while Gothenburg is aiming for a maximum speed limit of 30 kilometers per hour on all streets where an element of walking and cycling occurs. Both measures are largely supported by inhabitants (Malmö City, 2017; Gothenburg City, 2018; see Koglin et al., 2019).

'Car-reducing' planning

It has been argued that it is necessary for the state to intervene in order to encourage and produce a more transport effective and efficient, as well as 'car-reducing', built environment and transport system (The Swedish EPA, 2018; Johansson et al., 2012).

WSP (2013) outline possible means of integrating transport and land use planning so that the reliance on the private car is reduced. It is argued that a stronger integration of transport and land use plans is required, recommending that the regional transport plans and regional development programs be merged and developed together. It is further recommended that funding for infrastructure investment should be administered on the condition that the overall aims of the plan contribute to a form of 'car-reducing' urban planning. It is further outlined that strengthening the planning hierarchy is an important means of reducing car dependence. In this way, the municipal plans would actively address how the municipality intends to achieve a form of car-reducing spatial planning. Making municipal plans binding is an important element of this process, which would ensure that Local Area Plans (with the legal basis of the Planning and Building Act) would in turn have to follow the municipal plans. The National Board of Housing, Building and Planning has developed guidelines for drawing up Local Area Plans (National Board of Housing, Building and Planning, 2018) and for drawing up Comprehensive (Municipal) Plans (National Board of Housing, Building and Planning,

2020b). In this way municipalities can plan in such a way that the effect on the climate is reduced, part of which relates to reductions in VKT. See also Statens Offentliga Utredningar (2019) for further developments in this respect.

Guidelines for regional development programs and municipal plans to overcome depopulation/de-densification in larger regions could be introduced, with financial support offered to regions or municipalities striving to overcome depopulation/de-densification in their respective plans. Such processes can be then evaluated (to what extent municipalities and regions are striving to overcome de-densification?). National guidelines or regulations for how many new developments may be located on greenfield sites or in rural or peri-urban areas could also be introduced. A requirement for regional plans and municipal plans to aim to densify their respective regions and cities (e.g. a certain amount of new developments must be brought about through densification) could also be introduced in order to strengthen such processes (WSP, 2013, see also the Swedish EPA (2015) as well as See also Statens Offentliga Utredningar (2019)).

4.1.2. National Level

Goods transport effectiveness

The Swedish Climate Policy Council (2019) recommends comparing the amount of goods transported with the economic growth, arguing that this highlights the extent to which economic development is dependent on transport. However, comparing the total VKT to the total person-kilometers and freight-kilometers is one way of capturing the transport system's basic function: just how effectively people and goods are transported. For instance, it is argued that the more goods that can be shipped with the same transport system (e.g. number of vehicles), the greater the system's effectiveness. However, again, we must question whether this could reduce transport costs, and in turn, increase the demand for VKT. It is further suggested that shared services, improved logistics planning as well as improved and shared traffic information could serve as a means of reducing VKT. In cities, it is argued that improved coordination and shipment can result in the use of lighter and emission-free vehicles (ibid.).

Green corridors

Mandell and Carlén (2014) explore means of reducing GHG emissions from freight transport. They conclude that the implementation of what are refer to as 'green corridors' can function as a means of reducing carbon emissions. They also suggest the introduction of tools which can be used in order to solve more complicated issues with respect to coordination. This could be, for instance, route optimization or improved logistics (see Swedish Climate Policy Council, 2019). However, it must be considered that longer vehicles carrying larger weights could reduce transport costs, and in turn, increase the demand for VKT.

The authors stipulate that the existing framework of instruments surrounding freight transport by both road and rail is not strong enough relative to the social costs they produce. They further argue that if these costs were internalized, freight volumes could decline, while with the current setup, energy consumption is 'inefficiently large'. The authors recommend the proper calibration of appropriate instruments to handle and manage the externalities arising from this sector.

Intermodal transport

The Swedish Climate Policy Council (2019) argues for a shift to rail and sea transport as a means of increasing the effectiveness of goods transportation. WSP (2019) highlight that there is a need to promote the use of intermodal freight transport in order to support the government's ambition to promote a shift of freight transport from road to rail and cargo boat (shipping). However, transshipment comprises an additional cost for transport companies who choose to transport goods via rail or cargo boat (see WSP, 2019).

4.2. Economic Instruments

4.2.1. Local level

Congestion charging

It is widely acknowledged that increasing capacity in the road network is a measure that contributes to increased demand for VKT. As such, investing in a more effective use of the current road network combined with other policy measures such as a wider adoption of congestion charging, particularly in larger cities, could counteract such effects and reduce VKT (Department for Transport (UK), 2018; Hymel, 2019; Duranton and Turner, 2009).

Congestion charging is regulated by Congestion Charging Legislation (Law 2004:629, updated SFS 2020:849). In Stockholm, the charge is imposed on all Swedish-registered vehicles driven into and out of the city center and on Essingeleden on weekdays between 06:00 and 18:29. The year is split into two seasons; high and low. The amount charged varies depending on the time of day, where in the network the driver passes a payment station, as well as whether it is high or low season. In Gothenburg, the congestion charge applies to all cars entering the city center during fixed hours. The purpose of the congestion charges is to reduce congestion, with the revenue generated said to finance infrastructure investments in the respective cities (The Swedish Transport Agency, 2020). However, a dominant part of the revenue generated has so far been invested in expanding road capacity (The Swedish Transport Administration, 2020a), and thus potentially counteracting the effect of reducing VKT.

Introducing parking charges

Approximately two-thirds of Sweden's 290 municipalities monitored their municipal parking (in 2009), with a much lower proportion implementing parking charges, meaning that approximately half of the population lived in a municipality which did not charge for parking (SKL, 2010; Hamilton and Braun Thörn, 2013). In almost all of the larger municipalities, the municipality controls the on-street parking, while private actors manage the parking in garages or multi-level car parks. Fees in such garages and multi-level car parks are, as such, much higher than the fees for on-street parking, which generally results in an imbalance in supply and demand with respect to the latter (Hamilton and Braun Thörn, 2013).

Legally, residential parking in Sweden as it is implemented today, implies the preferential treatment of one citizen of a municipality at the cost of another (Hamilton and Braun Thörn, 2013). It is argued that residential parking should therefore not be provided. The same point is raised when arguing against the reservation of parking spaces for car pools or electrical vehicles. Furthermore, the Swedish Parliament could, in a similar way to the management of the congestion charges, decide upon and set the levels of parking taxes and charges at municipal level, which can in turn be funneled into financing more sustainable modes of transport (The Swedish EPA, 2017).

The use of parking charges as policy instruments to reduce car ownership and use is outlined in the Climate Programme for Gothenburg (Gothenburg City, 2014). Such mechanisms could in turn lead to a reduction in VKT by car. The Programme describes how parking charges can be increased in areas with good access to public transport. This is considered to be a means of reducing demand for parking at workplaces, while at the same time, incentivizing walking, cycling and the use of public transport. Separating the cost of parking from the cost of housing is also considered an important policy measure, whereby car owners bear the cost of parking individually, instead of the cost being shared collectively (by those living in the area/building) (ibid.).

4.2.2. National level

Implementation of parking at the workplace as a taxable privilege

Free employee parking at the workplace (with one's own car) is regarded as a taxable privilege in Sweden. Since 2003, employers are obliged to provide information with respect to parking privileges for its employees (Sweco, 2008). However, The Swedish EPA (2018) emphasizes that the state must start to ensure that this taxation is actually implemented.

Distance-based taxes

Several authorities have suggested that a transition to distance-based taxes (for distances travelled by cars/motorized vehicles), in tandem with a geographical differentiation in time and space, may be a more effective policy instrument as opposed to the mechanisms that currently exist (The Swedish EPA, 2017; Swedish Climate Policy Council, 2019). Such a geographical differentiation is accepted by both EU policy and is supported by economic theory more generally. Furthermore, The Swedish Energy Agency (2017) and, more recently, the Swedish Climate Policy Council (2019) have argued for a revision of the taxation of the transport system in its entirety, comprising a revised taxation of VKT by different modes of transport (heavy goods vehicles, cars, etc.). FFF (2013), MMB and SOFT[30] have all emphasized that a tax per kilometer (or a road use tax) is a necessary instrument, from both a climate perspective as well as a socio-economic perspective.

[30] '*Fossilfrihet på väg'* ('FFF'), '*En klimat- och luftvårdsstrategi för Sverige'* by Miljömålsberedningen ('MMB') and '*Strategisk plan för omställning av transportsektorn till fossilfrihet'* ('SOFT').

The removal or adjustment of tax rebate for work trips

Sweden's current system of tax rebates for work trips allows for individuals who commute to deduct costs related to their commute from their tax return. Those who travel by car for more than five kilometers between their home and their workplace, who gain more than two hours in comparison to using public transport, and whose annual costs exceed 11000 SEK (the rebate can only be applied to costs exceeding this amount) are entitled to a tax rebate. For public transport, the required distance is at least two kilometers, and for cycling, a maximum of 250 SEK per year can be claimed (The Swedish Tax Authority, 2019). This mechanism has been criticized and questioned from various perspectives.

Government support for developments linked to high-speed rail

A recent example of an innovative policy instrument in the Swedish context is the National Negotiation on Housing and Infrastructure which encompasses agreements between the state and municipalities. The intention with this process is to ensure the relatively fast implementation of high-speed rail in Sweden, as well as negotiation with respect to public transport measures and increased housing supply in cities. The municipalities with whom this process is concerned have submitted bids with respect to the amount of housing the municipality commits itself to building, as well as co-financing rail in a land value capture mechanism. These negotiations have resulted in agreements with all municipalities along the intended high-speed rail line and agreements on public transport and housing investment in two of Sweden's large metropolitan regions, including Stockholm (Transport Analysis, 2018; see further Ronnle, 2018). In this sense, this process could function as a mechanism to reduce reliance on the private car, and de facto, to reduce VKT by car. However, the outcome of such mechanisms remains to be seen.

Government support for sustainable urban environments

Urban Environment Agreements (SFS 2015:579) are another example of an economic policy measure (which can potentially and most probably result in a decrease in VKT by private car), as well as another example of agreements between state and municipality, where the agreements include economic incentives (Transport Analysis, 2018). The Urban Environment Agreements policy instrument is cited as a means to 'promote sustainable urban environments through public transport investments' (Government Offices of Sweden, 2015, cited in Isaksson, 2018). This incentive also supports cycling infrastructure and sustainable city logistics (for examples see The Swedish Transport Administration, 2020b). The Urban Environment Agreements include exchanges at three levels: the national, overall policy-making level; the interchange between the national and the local, where agreements are made between the Swedish Transport Administration and the respective municipalities; and lastly, the local level, where the implementation of projects takes place (see Isaksson (2018) for more details). In the case of both the National Negotiation on Housing and Infrastructure and The Urban Environment Agreements, municipalities are guided by state policy (Transport Analysis, 2018). However, there is no explicit link between this incentive and a targeted reduction of VKT by car.

Trivector Traffic (2017) highlight, however, that there is no clear definition as to which cities can sign an Urban Environment Agreement. In the same report, Trivector Traffic

(2017) present different scenarios and the gains that can be made by introducing different forms and packages of policy instruments in this context. They further point out that municipal policy for development of traffic levels, in the case of the three chosen case cities, differs from The Swedish Transport Administration's traffic forecasts. While the municipalities aim for a reduction (Gothenburg and Sollentuna) or at least the status quo (Linköping) with respect to VKT by car (per person), The Swedish Transport Administration predicts that VKT per person will increase. In this case, if The Swedish Transport Administration were to invest in roads in accordance with their predictions, this could counteract the efforts made by municipalities to reach their respective goals. As such, municipalities would need to invest even more as part of the Urban Environment Agreements framework in order to overcome such investments in road (Trivector Traffic, 2017).

This same report concludes that the construction of the Urban Environment Agreement framework appears to be quite effective, with many of the policy measures only requiring minimal investments yet having a considerable positive effect on the demand for sustainable modes of transport (Trivector Traffic, 2017), and potentially a negative effect on the demand for travel by the private car.

Government support for city logistics in sustainable urban environments

This incentive now supports sustainable city logistics (see The Swedish Transport Administration, 2020b). In this respect, municipalities can apply for funding to implement smarter city logistics, potentially resulting in reductions for VKT.

Kilometer-based charges for goods transport

The Swedish Transport Authority (2012b) highlight that the way in which fees and charges are imposed can have significant effects on the transport system. They point to the effects from countries who have introduced kilometer-based road charges for trucks; how such policies have proven to have an effect on the choice of route and type of vehicle. They further highlight a lack of capacity in certain freight transport systems and how if this latent demand is met, a more significant shift (from road-based freight transport) could take place.

4.3. Informative instruments

4.3.1. Local level

Mobility management and sustainable travel

Mobility management encompasses an approach within which different kinds of policy instruments and activities can influence a reduced demand for travel by private car, and a corresponding increase in the proportion of travel carried out by sustainable modes. Mobility management comprises combinations of informative, administrative and economic policy instruments (Dickinson and Wretstrand, 2015). It is considered that mobility management initiatives combined with other forms of policy instruments can

result in a reduction of 2.5% of VKT by car by 2020, and of 5% by 2040 (SIKA 2008; see Dickinson and Wretstrand (2015) for further discussion).

Municipalities can offer information and incentives in order to encourage companies located within the municipality to set up mobility management plans. Mobility management plans incorporate a commitment from the employer's side to introduce a package of instruments and measures so as to encourage employees to travel more sustainably, with the aim of reducing car travel (particularly single occupancy car travel). Mobility management plans can result in reduced car travel for work trips by approximately 15-20% (Dickinson and Wretstrand, 2015).

Linköping Municipality introduced one such plan for its employees in 2015 (Linköping Municipality, 2015), with the first partial review having taken place for travel to work and business trips for the period 2017-2018 (Linköping Municipality, 2018). The measures implemented include: information and communication, online meeting trials, internal climate compensation, agreements for company bicycles as well as the rental of electric bicycles for travel to work and business duties, trial travel cards for public transport, parking charges as well as the introduction of an app for business trips. The partial review included a comparison of the years 2012-2013 and 2017-2018, with positive effects for both travel to work and business trips, from a sustainability perspective. For travel to work, trips by sustainable modes of transport had increased by 5%, with a corresponding decrease of 5% for trips by car. The actual distances travelled per employee had increased, with the average distance having increased from 11.7 kilometers in 2013 to 13.2 kilometers in 2018. This indicates that, despite employees on average living further from the workplace, there is a still a tendency towards more sustainable modes of transport. However, VKT per employee by car had actually increased by a small percentage. For business trips, VKT per employee with all modes combined had decreased by 15%.

WSP (2013), on a similar vein of thought, suggest that a policy measure could be to oblige all public authorities to introduce travel plans. Public authorities would be incentivized to do so through a partial state funding mechanism. Means of introducing and implementing such policy measures, alongside complementary measures, are currently being investigated on a national level (see Statens Offentliga Utredningar, 2019).

Campaigns for travel behavior change

Campaigns aimed at increasing the modal share by public transport have also proven to be rather effective (The Swedish Transport Authority, 2012a). Such campaigns often comprise contacting specific target groups directly by post, and then following up by telephone. Another form of campaign is a test-period campaign where test travel cards are sent out to, for instance, car drivers so that they can then experience the benefits of travelling by public transport, and will hopefully then either continue to use public transport or choose to use it again in future (The Swedish Transport Authority, 2012a; see Dickinson and Wretstrand, 2015). Another oft-cited successful campaign was Malmö Municipality's 'No ridiculous car trips' where people who use the car for very short journeys (e.g. 5 kilometers or less) were encouraged to instead use a more sustainable form of transport (see Hörlén et al., 2008 for an evaluation). It is further emphasized that, in order to realize as much potential as possible with respect to the implementation of

various forms of policy measures, it is necessary that such measures are complemented with information and behavior changing initiatives (Trivector Traffic, 2017).

Trivector Traffic (2017) point out that discretionary trips stand out as particularly car-intensive. This may be linked to a (too) strong focus on shaping the public transport system for work trips. Therefore, it is necessary to extend this focus to discretionary trips so that VKT for such trips can also be reduced.

5. Gender and equity aspects

This section will briefly raise some issues linking gender issues to the content in the previous chapters. It will begin with a short literature review. Then, after a few examples of travel data, a framework for gender and equity assessment of transport policies and policy instruments will be proposed.

5.1. Gendered mobility

Gender and mobility have come to be regarded as inseparable, influencing each other in profound and often subtle ways (see Uteng and Cresswell, 2008; Hansson, 2010). As pointed out by Kronsell et al. (2016), gender relations have effects on mobility patterns and, as Hansson (2010) shows, mobility is gendered. Previous studies of mobility patterns in Sweden conclude that women's mobility is on average less car-dependent and leads to lower CO_2 emissions than men's (e.g., Carlsson-Kanyama et al., 1999; Polk, 2003; Gil Sola and Vilhelmson, 2012), and that there are differences in distance and time for commuting and the corresponding social aspects (e.g. Sandow 2011).

Some studies suggest that gender differences may be more apparent in lower socio-economic areas (Lecompte and Juan Pablo, 2017). There may be differences in school children's mobility as well. McDonald (2012) uses data from the US National Household Travel Surveys to examine gender differences in school travel and how differences have changed over time. This study found that boys walked to and from school more than girls. Furthermore, boys biked to school two to three times more than females, indicating differences in independent mobility.

Not only gender shows differences in mobility, but of course also age. For instance, the low mobility of seniors in California may be due in part to a history of auto-oriented transportation and land use policy decisions, that is, a form of path dependency (Cao et al., 2010). As pointed out by Haustein and Sirén (2014), several researchers have shown that mobility and the ability to leave the home are essential aspects of the quality of life of older persons and often connected to psychological well-being, independence, and the sense of being empowered in old age. The ability to leave the home is a means of maintaining social and physical activities, and thus important for maintaining functional capacity in later life. Nevertheless, with increasing age, travel activities outside home decrease and unfulfilled mobility needs increase (see Luiu et al., 2017).

Both income and education have also been found to influence mobility. In another Household Travel Survey study (CA), conducted by Mitra and Saphores (2017), carless households were found to be more likely to have a lower level of education, a lower income, and fewer household members than motorized families. They also tend to live in denser, more land-use diverse, and in fact, more walkable areas with better transit coverage. Contrasting voluntarily and involuntarily carless households, the authors find

that involuntarily carless households are less affluent on average and that they tend to live in areas that are less land-use diverse, less walkable, and with less extensive transit coverage (ibid.).

Gender, age, education, occupation and household size influence and shape preferences. Looking at the current uptake and adoption of electric mobility and vehicle-to-grid systems, Sovacool et al. (2018), having conducted a systematic review of 197 peer-reviewed articles on the topic, suggest that predominantly men, those with higher levels of education in full time employment, especially with occupations in civil society or academia, and below middle age (30–45), are the most likely to buy e-mobility solutions. However, the researchers also detect other market segments where e-mobility may take root, e.g. among higher income females and retirees/pensioners.

Thus, different social groups exhibit diverse travel behaviours and will thus experience very different outcomes in adapting to any future (necessary) changes to the transport system, pointing towards issues of transport equity. Lucas and Pangbourne (2014) argue that there is a significant gap in both scientific and policy knowledge in this area. They continue by stating that a universal lack of data be a major barrier to the robust analysis of the equity impacts of climate change mitigation measures. Other studies (e.g. Rye and Wretstrand, 2019) indicate that, although equity policies exist, national infrastructure strategies/plans and their distribution of spending actually seem to be working away from greater social equity in their distributional impacts.

5.2. Gender equality in Sweden's transport policy goals

The overarching transport policy goal on a national level in Sweden is to ensure a socioeconomically efficient and sustainable provision of transport for citizens and businesses in the entire country. Equality features as part of the 'Accessibility' transport policy goal on a national level. The Swedish Parliament decided upon a revised structure for the transport policy goals in June 2009, whereby the equality goal is formulated as follows:

'The design, operation and use of the transport system should assist in giving everyone a fundamental accessibility of good quality and usability, as well as contributing to the economic development in the entire country. The transport system should be equal, that is, respond in an equivalent manner to women's and men's transport needs, respectively'. (The Swedish Parliament, 2009).

It is claimed that focusing on equality as part of transport policy in this way leads to better analyses and an improved understanding of how women and men use the transport system, as well the preconditions for and everyday effects of its use, for women and men, respectively (The Swedish Government, 2019).

5.3. Policy implications

Policy acceptance is influenced by environmental beliefs and previous experience with sustainable solutions (Jansson and Rezvani, 2019). Kronsell et al. (2016) show that in Sweden, women still on average have transportation behaviour with lower environmental impact than men have, and while Jansson and Rezvani (2019) found that women tend to have stronger preferences for improving sustainability in the sector. The results imply that there are interesting behaviour and attitude characteristics expressed by women that ought to be recognized and applied, e.g., through contesting prevailing norms and methods, in order to achieve sustainability goals for the sector. Altogether Kronsell et al. (2016) suggest that women, beyond democracy reasons, should become more active as change agents to challenge the dominant male norms. Policy implications of these findings include measures to improve gender equal participation that would, e.g., make it possible to take advantage of these differences by:

(i) placing a greater emphasis on the relationships among and between travel patterns, sustainability, and gendering on all levels of transport planning as a measure for improved sustainability;

(ii) implementing new/alternative ways of framing the issues at hand, challenging prevailing norms which work against gender equity and raising awareness of sustainability issues; and

(iii) using gender mainstreaming as way of monitoring policy impacts on different groups of men and women. (Kronsell et al., 2016, p.710)

Thus, women's transportation behaviour has a lower environmental impact than men's, and women also tend to have stronger preferences for measures improving sustainability in the transport sector. These facts imply that gendering the transport sector might not only be of importance for transport equality, but also important for gendering the climate and sustainability goals for the transport sector. Rosqvist (2019) argues that to more actively include a gender perspective in transport policy-making it is necessary to improve the democratic quality of policy-making by involving women as decision-makers. It might also improve the democratic quality of policy-making for overall sustainability, as including a gender perspective on measures and decisions for the transport sector would include a stronger stand for a more sustainable and safer transport sector. Rosqvist (2019) further argues that the most urgent need for change is in the dissemination of knowledge to increase the level of competence among policy-makers and planners in the transport sector, to contest prevailing norms and to raise consciousness on gender impacts.

There is general agreement among experts that the transport sector desperately needs an efficient climate policy including efficient strategies to reduce unsustainable levels of car use. Then, we need to know which groups will be affected by policy instruments targeting this reduction. Smidfelt Rosqvist and Winslott Hiselius (2019) demonstrate, by using Swedish national travel behaviour data, that in line with international research, a minority produces the majority of all passenger mileage by car. Adding an analysis of the national attitudinal study to the national travel behavioural data reveals that the high mileage producers further belong to groups with a low inclination to adopt sustainable behaviour, i.e. men, the middle aged and frequent car users. The authors emphasize that policy

instruments proposed to reduce unsustainable levels of car use need to be tailored to those groups in order to be efficient.

Levin and Faith-Ell (2019) argue, that working systematically on gender mainstreaming in transport infrastructure entails implementing a gender perspective in all stages of decision-making, planning and execution. In light of the sustainability goals introduced through the UN's 2030 Agenda for Sustainable Development, the researchers present a model for how to address gender mainstreaming in transport planning in a more systematic way. They also suggest a way of exploring the model in an international context. It is influenced by the fields of Social Impact Assessment (SIA) and Strategic Environmental Assessment (SEA), combined for integrating gender equality into transport planning. Levin and Faith-Ell (2019) call it Gender Impact Assessment (GIA), and they argue that GIA is objectives-led, goal-oriented, and particularly adapted to planning practice.

5.4. Examples of gendered mobility and differences among age groups

The diagrams below give a few examples regarding daily trip length, age, gender and mode.

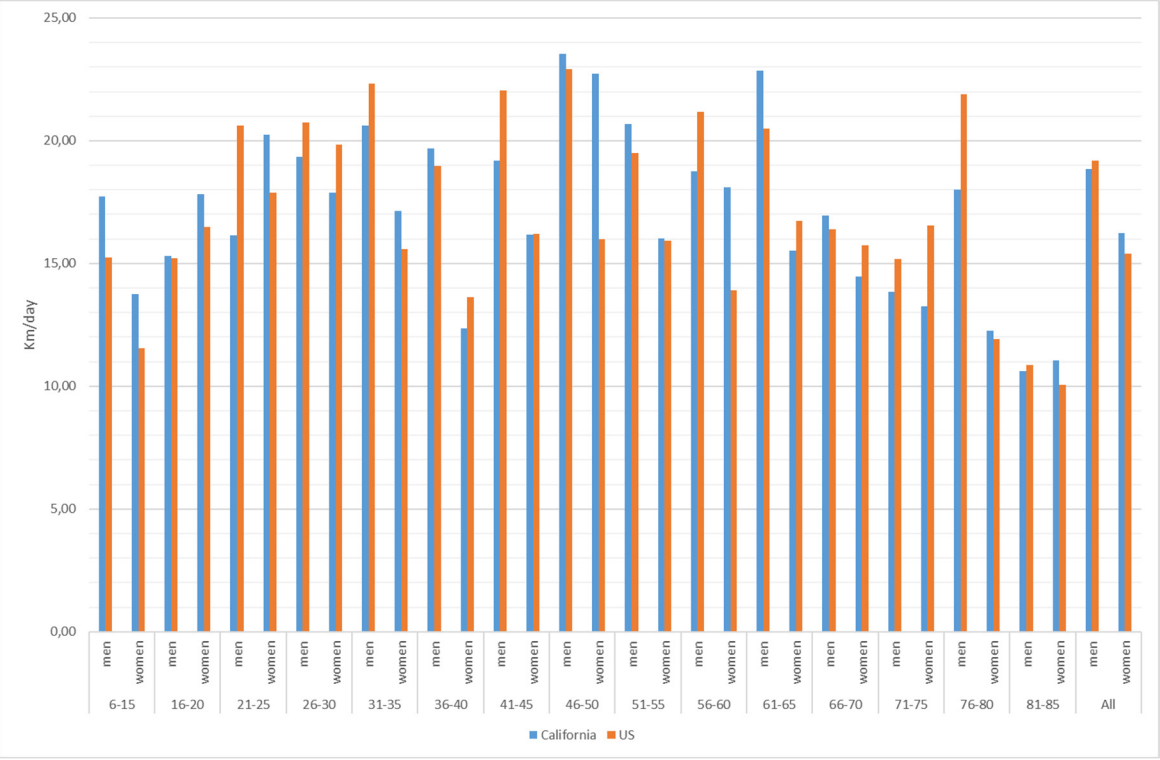

Figure 5.1: Average trip length, California and US. Source: Federal Highway Administration, 2017 National Household Travel Survey (NHTS)

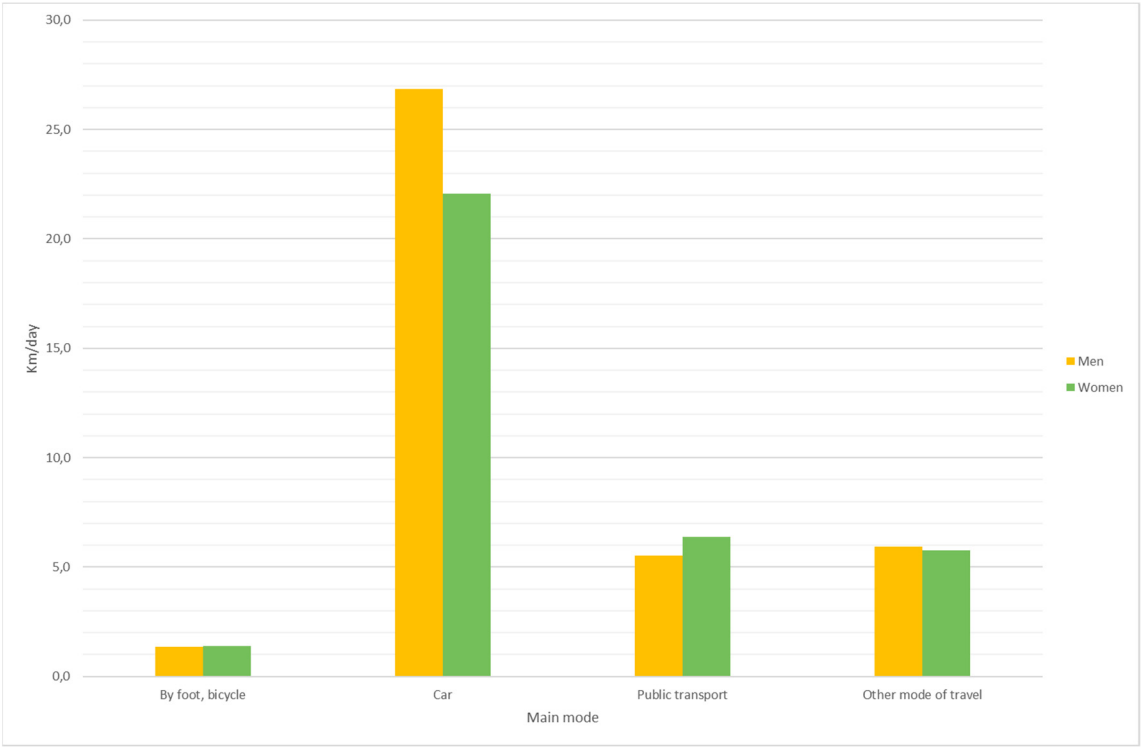

Figure 5.2: Average trip length, Main mode, Sweden. Source: Transport Analysis, RVU 2015.

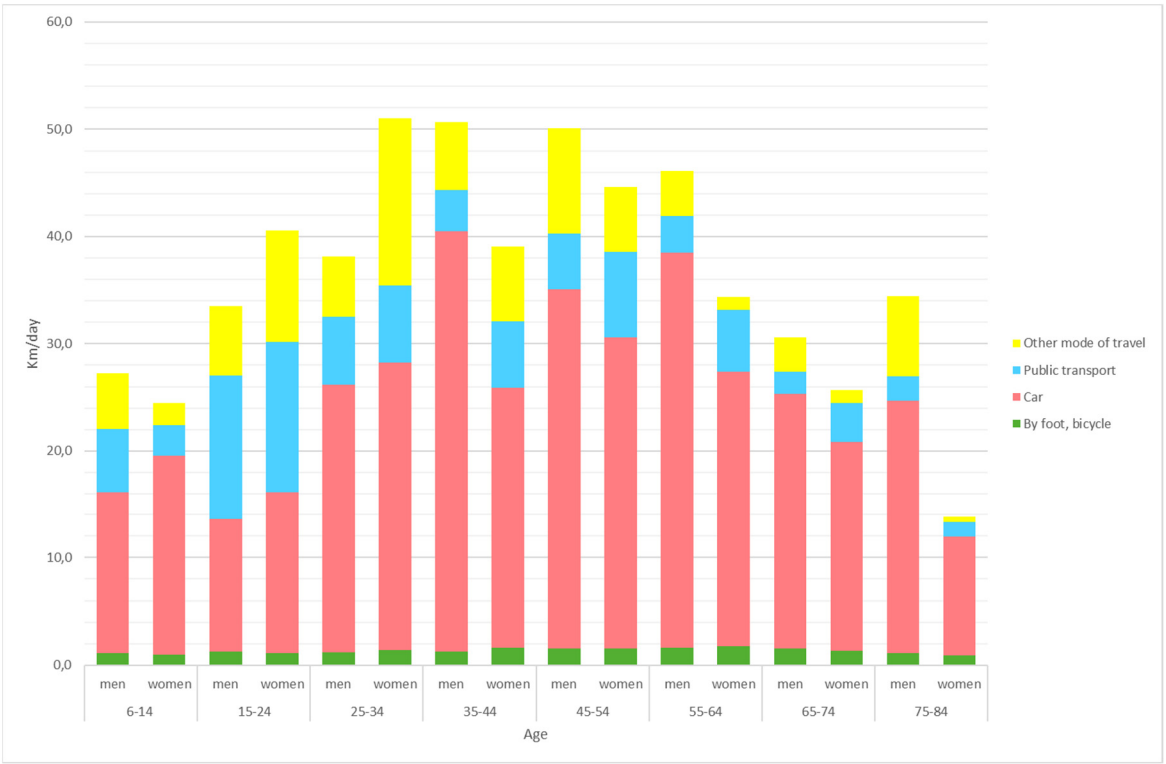

Figure 5.3: Total average trip length, Sweden. Source: Transport Analysis, RVU 2015.

5.5. Towards a framework

In the figure below, a framework for impact assessment of policies and policy instruments is presented. It is developed by Winslott Hiselius et al. (2020) in an ongoing research project (VINNOVA, Sweden's Innovation Agency: "*Styrmedel för accepterad hållbar tillgänglighet och rättvisa*") and builds upon previous work by Lucas and Pangbourne (2014). The idea is to use it for analysing the impacts of a proposed policy instrument (either of economic, administrative or informative character), and how it affects different objectives and aims of a transport policy. In this case, the transport policy objectives refer to the Swedish national policy.

It allows for gender impact assessment, but at the same time, other social impact assessments and equity analyses. As described in the previous sections, gender issues interact with socio-economic factors, pointing towards the need for a holistic approach. In practise, a step-by-step approach is carried out for each policy instrument, which allows for weighting different instruments in case of policy packaging. Each factor (income, gender, age, geography) is assessed in terms of impacts from the "column aims". Thereby, a total assessment could come out as a multi-criteria score.

Policy instrument: economic/ administrative/ informative		Accessibility aims					Environmental aims			Health aims	
		People transportation					Air quality		Noise dB	Active travel	Traffic safety
		Reliability	Quality	Security	Accessibility, macro	Individual economy	NOX emissions	Particle em. (PM 2.5, PM10)	People exposed above thresholds	Person km, walking and cycling	Fatalities, serious injuries
Income	Low										
	Average										
	High										
Gender	**Women**										
	Men										
Age	Children										
	Adults										
	Older										
Geography	Urban										
	Peri-urban										
	Rural										
Total assessment											

Figure 5.4: Framework for policy impact assessment. Source: Winslott Hiselius et al. (2020), based on Lucas and Pangbourne (2014).

6. Summary of similarities and differences between Sweden and California

This chapter first summarizes the similarities and differences between the cases of California and Sweden. Then lessons learned from the respective cases and suggestions for improvement in the future are presented, based on the experiences from the two cases.

6.1. Similarities

- In both cases, reducing VKT is mainly associated with reaching the political goal of reducing GHG emissions. California aims for the total GHG emissions to be reduced by 40% by 2030 in comparison to 2010 levels and by 80% in comparison to 1990 levels. While Sweden aims for its carbon emissions to be at least 63% less than the 1990 level by 2030 and at least 70% less in domestic transport 2030 compared to 1990.
- California and Sweden have similar policy pillars for reducing GHG emissions and reaching the transport sector goals. In California, the main three pillars are: (1) replacing fossil fuels with cleaner fuels; (2) encouraging the use of clean vehicles; and (3) reducing the VKT; while in Sweden, the Swedish Climate Policy Council formulated the three pillars as: (1) a more transport-efficient society; (2) accelerated electrification; and (3) a higher share of more efficient fuels and more efficient vehicles.
- Reducing VKT is considered as an effective strategy for reducing the GHG emissions. However, both cases appear to be in an exploratory phase with respect to the development of policy and policy instruments for reducing VKT. The cases appear to be at slightly different stages (although within the same phase) regarding the development of such policy instruments.
- In both cases, many of the instruments are initiated at state or national level in the form of incentives, requirements, or other mechanisms, and implemented at the local level. The regional organizations usually play an intermediary role to support the policy/program introduced at national level. Yet the instruments are usually implemented at the local level. In both cases, most of instruments are implemented either at state/national or local level, and seldom implemented at regional level.
- In both cases, increasing capacity in the road network is recognized as a measure that contributes to increased demand for VKT. As such, investing in a more

effective use of the current road network combined with other policy measures such as a wider adoption of congestion charging, particularly in larger cities, or applying a road diet to reallocate the road space for all the road users could counteract such effects and reduce VKT (Evidence, 2016, cited by The Swedish EPA, 2018).

- In both cases, integrating transport and land use planning is regarded as a key policy with the potential for reducing VKT. In California, in line with SB375, this is emphasized in the Sustainable Communities Strategy, which is an important component of federally-mandated Regional Transportation planning. SCSs support implementing the policy by suggesting the instruments include infill development for densifying the cities, providing funding for improving the conditions for walking, cycling and public transport to reach the local destinations, and building affordable housing next to the public transport stations in order to accommodate all income groups. In Sweden, in some cases, focus is given to measures for redistributing the street and road space in and between dense areas and cities, both for moving and still traffic, from private car lanes to lanes for public transport, walking and cycling (see Malmö City (2016) as an example). In this way, travel times using sustainable transport modes are reduced and the corresponding travel times by car are increased. Incentives also include, for example, the state funding to co-finance both transport infrastructure and the construction of new homes in both existing and newly developed areas. Effective means of densifying urban areas are also under discussion (see the Swedish EPA, 2015).
- In both cases, it is acknowledged that shifting from private vehicles to sustainable modes of transport is an effective policy to reduce VKT. In California, from a land use perspective, instruments for reducing the travel distance are introduced and implemented. These include, for instance, building more houses in areas of high job density in order to reduce commuting distances, providing more local grocery stores and locating public facilities in close proximity to neighborhoods. This is so that people can have travel with other modes of transport (not by car) for non-commuting trips as well. From the transport perspective, funding programs are awarded at state and regional level. In this way, cities and counties have the opportunity to apply for funding in order to improve the infrastructure. In Sweden, from a land use perspective, it is suggested that the residential areas should be designed in such a way that public transport lines are as straight, direct and short as possible; from transport perspective, reducing ticket prices are often cited as a means of increasing the share of trips by public transport. In addition, innovative instruments such as Urban Environment Agreements and the National Negotiation on Housing and Infrastructure are a means that could ensure a tighter coordination of policies between national and local levels, as well as for municipalities to secure funding for projects targeting the reduction of VKT. Campaigns for encouraging people to travel with more sustainable modes of transport are also considered an effective way for bringing about changes in travel

behavior. These campaigns are, however, perhaps not used as often as they could be.

- For both cases, Mobility as a service (Maas) and the appearance of new mobility modes are considered to potentially bring new opportunities and challenges for the future mobility landscape. However, explicit and tailored policy and policy instruments have yet to be fully developed in order to regulate for these modes as a potential means of reducing VKT.
- Freight transport is one of main contributors to the GHG emissions, but no specific and explicit instruments for reducing VKT have been implemented in either case. Although in the Swedish case, it is argued that there should be a deliberate and explicit aim to shift as much freight transport to rail and cargo boat from road, while so-called 'green corridors' are also emphasized. A potential issue in this case is limited capacity in the rail and cargo boat networks, which if addressed, could free up latent demand for such modes of freight transport (see Swedish Climate Policy Council, 2019; see WSP, 2019).

6.2. Differences

- In California, reducing VKT has been legislated as a policy by the state government since 2008. Hence, focused planning documents are made for this purpose at the regional level, and relevant instruments have been initiated with the clear purpose of reducing VKT at the local level. In Sweden, reducing VKT has not become an overall policy purpose at an organizational level, but it is instead discussed as a sub-goal for reaching the other policy purposes, including policies for reducing the GHG emissions, alleviating congestion and increasing the modal share of active transport. Those policies can potentially reduce the dependence on cars, and as such, reduce VKT.
- California has a much lower public transport modal share and a higher share of private car driving than Sweden, which indicates that there are more challenges and opportunities for California to reduce VKT by attracting more private car users to travel with more sustainable modes of transport.
- California considers cycling and walking as very important for developing dense and livable communities/neighborhoods in order to reduce car dependency. Such initiatives usually lie at the local level in the case of Sweden, with national funding distributed to selected projects (through e.g. urban environment agreements). It should, however, be noted that a key opportunity would be for some initiatives to be taken at national or regional level as The Swedish Transport Administration is responsible for much of this time of road infrastructure. A considerable amount has been achieved in these areas in some select cities (see the examples of Malmö and Gothenburg described in Section 4). However, a lot is left to be desired in the case of other areas.

- California is facing considerable challenges with respect to accommodating the growing population. Sweden perhaps does not face quite the same challenges, with the exceptions of perhaps the large metropolitan regions (Stockholm, Gothenburg and Malmö). Although VKT by road has grown at a faster rate than that with which the population has grown in Sweden (The Swedish EPA, 2017).

6.3. Learning from each other

6.3.1. Lessons and suggestions for the future based on the California case

- Legislating for the reduction of VKT is considered a clear step towards the tighter integration of more sustainable land use and transport planning. SB375 is a means of ensuring that the housing and transportation organizations better align their goals towards the reduction of VKT. The implementation process has facilitated collaboration between the public and private sectors, non-profit organizations, stakeholders, researchers and professionals. This, in turn, facilitates the development and implementation of the instruments for reducing VKT, in line with SB375.
- However, there is a long way to go in terms of improving the level of implementation of SB375. In the case of integrating housing and transportation, one of main challenges is that the current enforcement mechanism inherent in SB375 is rather weak, which slows down the implementation. Implementation of SB375 relies on the implementation of SCSs at the regional level. While the implementation of SCSs at regional level relies on the local jurisdictions. The local jurisdiction cannot process the SCSs if SB375 is not complete or explicitly addressed. This could be a lesson not only for California, but also for Sweden if legislating for VKT is considered as a future step in the Swedish context.
- The state and the regional authorities could create and develop more funding incentives by developing sustainable funding resources and mechanisms. For instance, collaboration with the private sector could function as alternative means of funding, in turn reducing the reliance on public sector funding. Economic instrument such as road charging could potentially collect funding for such purpose by at the same time reduce the mode share of cars, however, such kind of instrument requires good effort to investigate and experiment before it can be established as an instrument.
- While the state and the regional authorities have the capacity to provide and coordinate the incentive programs, it is important to install the corresponding capacity at local level so that the local level can more effectively make use of the incentives. In California, it is considered that, often the local level (cities, counties) do not have the possibility to compete for such incentives due to the lack for technical assistance. A suggested strategy would be to provide additional technical assistance to the local jurisdictions to help them with the implementation

of the SCSs in order to make good use of the incentives. A recommended reference is the technical assistance program for 'Affordable Housing and Sustainable Communities' provided by the Strategic Growth Council, California[31].

- An explicit evaluation approach which includes good accountability should be prepared before or at the same time as the policy is introduced. The instruments for reducing VKT are mainly implemented at the local level by corresponding to the incentives, with the planning conducted at the state and regional levels. In order to make improvements for the future, evaluations of the policy effects can be carried out. In order to carry out such evaluations, explicit settings for data collection are required. All of the organizations and stakeholders at different levels should be informed about the kinds of data they will be required collect and present before while they commit to the incentives. In this way, they can be properly prepared for such evaluations.

6.3.2. Lessons and suggestions for the future based on the Swedish case

- The importance of policy packages and synergy is emphasized in the Swedish case. It is widely agreed that combinations and packages of measures are the most effective means of tackling wide-ranging and complex issues (Wicki et al., 2019: The Swedish EPA, 2017; WSP, 2013). A one-size-fits-all approach is ineffective but instead, the tight integration and careful timing of tailored planning and policy measures at different levels is considered more effective in bringing about change. It is argued that synergy effects are present with respect to modal choice when different policy packages are implemented. It is often considered that policy packages that simultaneously or sequentially reduce the demand for car transport while also making sustainable modes of transport more appealing are more effective than individual policy measures which only focus on either reducing the demand for car transport or, for instance, making public transport more attractive (Dickinson and Wretstrand, 2015). In this respect, complementary measures which support each other are necessary, in order to ensure that behavior and norm-changing efforts function as intended (Trivector Traffic, 2017).
- Economic and administrative policy measures in the form of densification, mixed land use and good public transport provision together form a powerful approach to reducing car use, with a tighter integration of physical planning and transport necessary in order to support more sustainable mobility (Bastian 2015).
- It is suggested that policy instruments which would aim to increase travel time and travel expenses for the car in cities and dense areas, relative to more sustainable modes of transport, should be implemented (see Swedish Climate Policy Council, 2019). This approach engages a holistic perspective on the transport system and societal planning.

[31] https://www.surveymonkey.com/r/P8PYRVT

- It is emphasized that municipalities and regional authorities alone can face difficulties in financing large scale policy instruments and policy packages. This issue has arisen for several regional authorities when dealing with the development of policy measures, and when it comes to financing the development and operations of public transport (The Swedish EPA, 2017). Innovative funding mechanisms, as described for the CA case, could also be explored and implemented in order to diversify sources of funding. This could take the form of an expansion of the Urban Environment Agreement and National Negotiation on Housing and Infrastructure frameworks.
- Several of the policy instruments in the Swedish context exist at different administrative levels: local (e.g. land use, parking charges and administration), regional (e.g. public transport provision) and national (taxation, tax rebates and funding mechanisms and incentives). Many of the instruments require relatively tight coordination across and between these levels. This presents several challenges as well as opportunities. In the respect, it seems California has a more established and tighter framework, in line with the implementation of SB375.
- A standardized procedure and a regulatory or institutional framework could be built for more energy efficient transport reducing VKT. An administrative system or department could be established in order to deal with the development of , for example, the Regulatory Impact Analyses. As such, routines and competence within this area could be developed.

6.4. Conclusions

The purpose of this report was to identify, describe and compare policy instruments that have either been implemented or are under discussion for reducing vehicle kilometers travelled (VKT) in the state of California and in Sweden. Knowledge regarding the effects and the potential effects of these instruments is also presented.

In both cases, reducing VKT is mainly linked to reaching the political goals of reducing greenhouse gas (GHG) emissions. In both cases, this is considered an effective strategy for reducing GHG emissions. Several tools and mechanisms exist aimed at e.g. improving opportunities for multimodal mobility, integrating (sustainable modes of) transport and land use and redistributing street space, and investing in and making more effective use of the existing road network instead of expanding the road network. However, both cases appear to be engaged in an exploratory process with respect to the development of both policy and policy instruments for reducing VKT.

In California, reducing VKT is a clear policy purpose. The implementation process has facilitated tight collaboration between many actors in both the public and private sectors. In Sweden, reducing VKT is not framed as a policy purpose in itself, but is instead discussed as a sub-goal for reaching the other policy purposes. Such policy purposes include reducing GHG emissions and alleviating congestion, as well as increasing the modal share of active transport and public transport in order to improve public health and

create livable cities. These policies can potentially reduce car dependence, and hence reduce VKT.

Several of the policy instruments in the Swedish context exist at different administrative levels, meaning that relatively tight coordination across and between these levels is required. This, in turn, presents several challenges as well as opportunities. In the respect, it seems California has a tighter, more established formal framework for coordination between actors.

In both cases, established funding programs are implemented in order to reduce VKT. Further innovative funding mechanisms conducive to collaboration with the private sector could be explored in order to reduce reliance on public funding. Further funding mechanisms (based on e.g. fiscal opportunities arising from distance-based taxation) could also be explored in more detail. Furthermore, while the state and regional authorities have the capacity to provide and coordinate the incentive programs, it is important that the corresponding capacity exists at a local level in order to effectively make use of the incentives.

In both cases, the organizations authorities to investigate/evaluate the effects of certain strategies or instruments suggest that a standardized procedure and regulatory framework including an explicit evaluation approach with emphasis on accountability could be prepared.

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K2 is operated and funded by Lund University, Malmö University and VTI in cooperation with Region Stockholm, Region Västra Götaland and Region Skåne. We receive financial support from Vinnova, Formas and the Swedish Transport Administration.

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