Nordregio

Integrated land-use and transport analysis in the Nordic Region

Summary and outlook

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Table of Contents

Introduction

The integration of land-use and transport planning can play a crucial role in achieving sustainable development. Land-use and transportation systems are closely interlinked: transport planning affects the patterns of urban development and location choices of households and businesses, while changes in land-use patterns influence the number of trips, their destinations, and modes of transport (Waddell, 2011). The rise of new transport technologies brings about additional challenges to decision-making processes and requires effective methods for predicting changes based on new patterns of movement in urban environments (Sarri et al., 2023). Thus, it has been argued that better integration of interventions within transport and land-use planning could help establish better policy alignment for dealing with complex challenges, such as achieving sustainability goals (Rayner & Howlett, 2009; Duman et al, 2022).

In the Nordic countries there are various national policy initiatives supporting sustainable urban development. For example, urban growth agreements (*byvekstavtaler*) in Norway, MAL agreements (*Maankäytön, asumisen ja liikenteen sopimukset*) in Finland, and urban environmental agreements (*stadsmiljöavtalen*) in Sweden all aim to facilitate sustainable urban development, achieve national objectives, and better coordinate transportation planning and land-use planning, as well as housing development and collaboration between various planning and sectoral authorities (Lidmo et al., 2024). In the context of national support initiatives, the role of data and indicators as well as analysis and modelling are central for developing and following up on policies and plans. Achieving better integration of land-use and transportation planning in earlier phases could help produce shared policy goals, which would promote mutually reinforcing, rather than obstructing, land use and policy measures (Te Brömmelstroet & Bertolini, 2010). However, the integration of land use and transportation remains scarce in planning practice.

Simultaneously, a need for a more integrated approach to better understand the interconnections between land use and transport has been acknowledged within modelling, and many computer-based tools and instruments have been developed over the years to provide a common land-use/transport language for integrated visioning and strategy development. One approach to this is through Land-Use and Transport Interaction (LUTI) modelling, which is used by transport analysts and planners to understand how land-use activities create transport demands, and how transport, in turn, influences the location of those various activities (see Figure 1; Simmonds, 2024). Simply put, LUTI models are forecasting tools that help planners make strategic decisions for planning effective transport service and land-use developments. LUTI models may, for example, help planners to estimate how the change of location of workplaces might lead to a change in transport demand or choice of travel mode, to understand how implementing a parking fee might affect transport to an urban area, or to show how alternate changes to land use may result in different volumes of traffic and thus different levels of emissions.

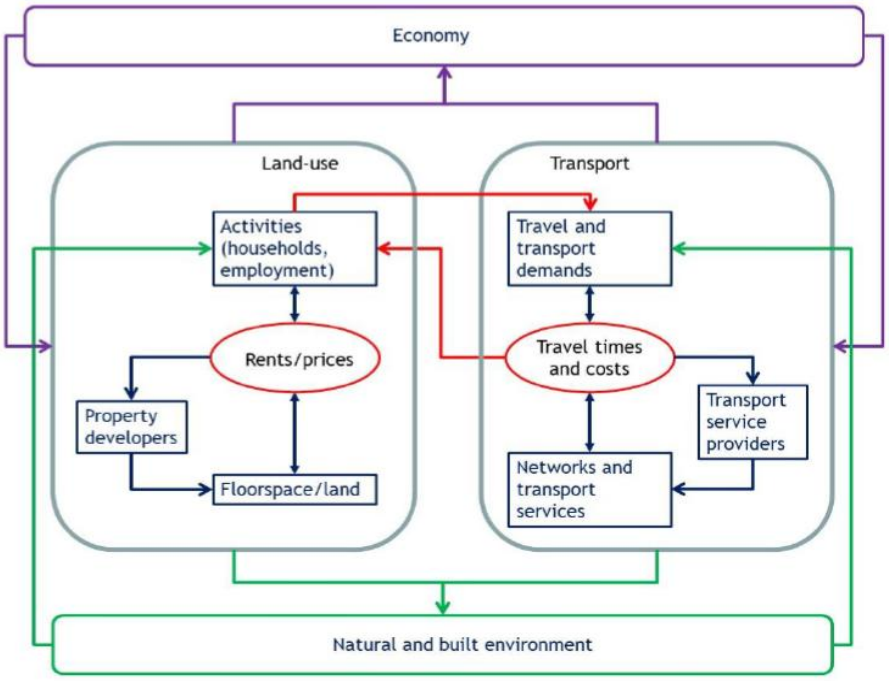

Figure 1. Land-Use and Transport Interaction modelling concept as described in Simmonds (2024).

It is important to recognize that neither land-use nor transportation planning happens in a vacuum, and factors such as the economy and the natural and built environment (among others) play an influential role in these processes (Simmonds, 2024). Furthermore, LUTI models can provide predictions or showcase what may happen based on changing variables, but it is the planner who makes the analysis and takes the decision regarding which changes should be made in alignment with wider objectives of the city, region, or state.

While these instruments can provide useful inputs in decision-making processes, they face various implementation barriers. For instance, the gap between instrument development and daily planning practice seems to be one of the main bottlenecks (Te Brömmelstroet & Bertolini, 2010). Other concerns include data collection and sharing. Finally, patterns of silo thinking remain a barrier for developing and maintaining successful land-use and transport planning, and greater understanding of the interlinkages between transportation and land use, among other areas, is needed to identify which measures to take for reaching sustainability goals.

This report reviews how land-use and transportation analysis is made in four Nordic countries—Norway, Sweden, Finland, and Denmark. Based on presentations from local and national-level actors at an Integrated Land-Use and Transport Analysis workshop (16 June 2025), the report shows that much potential remains for developing effective tools that combine land-use and transport decisions in the Nordics. LUTI models are just one of many tools that can be utilised for making strategic planning decisions. Some Nordic public agencies use a simplified version of a LUTI model, while others do not use such models at all;

therefore, this report emphasizes a range of land-use and transport planning tools at the forefront of planning in the Nordic Region. These tools range from separate migration models and transportation demand models used to test future scenarios and identify their fulfilment of regional planning goals, to spatial planning-related tools like transport-oriented development strategies and comprehensive plans which provide guidelines regarding where development should take place in relation to transportation, housing, and other land uses.

The Norwegian and Swedish sections in this report take the technical modelling tools as their point of departure while the Danish section focuses on their key land-use and transport plan. The Finnish section integrates both modelling and planning related aspects. While these tools all support the work of achieving sustainable development, they vary in their form and functionality and answer different questions for planners seeking solutions to development conflicts and concerns. Furthermore, some of the tools are employed at the local or regional level, while others require collaboration across governance levels and can be used across scales, from local planning work to developing planning instruments at the national level.

Overall, all four of the countries included in this report acknowledge the integration of transportation and land use to some degree in the tools they use, but they do not do so with the same indicators, data inputs, evaluation metrics, or predictive capabilities. In most cases, they lack the tools to forecast transportation demand to the extent that a LUTI model might offer. Therefore, this report reveals potential for further knowledge exchange and innovation so that Nordic urban areas can adopt the most effective tools and planning practices that lead to more sustainable development.

Research questions and methods

The aim of this project was to learn about experiences with land-use and transport planning and interaction analysis in the Nordic countries. We sought to understand:

- Are land use and transport analysed together in the Nordic countries of Denmark, Finland, Norway, and Sweden? If so, how?
- Are there possible pathways for future cooperation and learning in this area?
- How might Nordic urban areas include and develop models for integrating transport and land use to support strategic decision-making?

To answer these research questions, a seminar and workshop event[1] was planned through a collaboration among the Nordic research institute Nordregio, the Norwegian Ministry of Local Government and Regional Development (KDD), and the Norwegian Public Roads Administration. This project was initiated by the previously mentioned national authorities and funded by the Nordic Council of Ministers. The starting point for the project was the Norwegian land-use analysis tool ADV (*arealdataverktøyet*) with the aim to uncover if this modelling tool, or

[1] To view the full agenda of the event, visit https://nordregio.org/integrated-land-use-and-transport-analysis-experiences-from-nordic-urban-areas/

something similar, could be applied in other Nordic countries. This report is a summary of the findings from the event, held on 16 June 2025. The workshop involved individuals representing Denmark, Finland, Norway, and Sweden, with presentations from civil servants working in various roles and levels of governance within transport or planning authorities (see Table 1). The workshop also included an expert in LUTI modelling from the United Kingdom. The event was held in a hybrid format, with some participants and all presenters attending in-person in Stockholm, while other participants attended online.

Table 1. List of agencies and authorities participating in the land-use and transport analysis seminar (* indicates in-person workshop participation; ** indicates presenter)

Finland	City of Helsinki**
	Kaponieeri Oy*
	Finnish Environment Institute
	City of Lahti
Denmark	Danish Planning and Rural Development Agency (Plan- og Landdistriktssytrelsen)**
Norway	Norwegian Ministry of Local Government and Regional Development (KDD)**
	Norwegian Public Roads Administration (Statens Vegvesen)**
	The Norwegian Association of Local and Regional Authorities (KS)**
	Trondheim Municipality*
	Norwegian Rail Directorate (Jernbanedirektoratet)*
	City of Oslo
	Ruter AS
	Ramboll
	NORCE
	Institute of Transport Economics (TØI)
	Norwegian Environment Agency
	AT Arkitektur AS
Sweden	Swedish Transport Administration (Trafikverket)**
United Kingdom	Allanfield Consulting**

Land-use and transport modelling tools

Norway

Background

The Norwegian land-use analysis tool ADV (*arealdataverktøyet*) was developed to make better calculations of land use and parking in transport modelling for urban areas. ADV is both a digital tool for analysis and a platform for cooperation between national agencies, regional authorities, and municipalities. Essentially, ADV was created to improve knowledge on the effects of land use on transport demand and to show how municipalities can influence transport demand through land-use planning.

ADV was developed in response to the Norwegian Parliament zero-growth goal for passenger car transport in major urban areas, adopted in 2012, and the urban growth agreements that are in place to implement this goal. The zero-growth goal implies that any growth in passenger transport shall be absorbed by public transport, cycling, and walking (Ministry of Transport, 2024). Land-use development in urban areas and their suburban areas is considered crucial for whether the objective can be reached (Tennøy et al., 2025). Important for achieving this goal are the urban growth agreements that have been made between the national government and major cities and their surrounding municipalities. Through these agreements, the state allocates funding for environmentally friendly transport solutions, such as co-financing new investments in public transport infrastructure, and municipalities committing themselves to a land-use policy which corresponds to the zero-growth target (Leite et al., 2023). The zero-growth goal has been credited with reduced car traffic volumes in Norway's major cities, which has contributed to reducing greenhouse gas emissions, air and noise pollution, and congestion, as to improving the quality of life in cities (OECD, 2021).

The project to develop ADV began in 2015, and its development has relied on close collaboration between key national and local level actors. In 2022, a permanent working group was established in connection to the National Transport Plan 2025–2036, with involvement from public institutions such as the Norwegian Public Roads Administration, the Norwegian Association of Local and Regional Authorities, and the Norwegian Ministry of Local Government and Regional Development, among others (Ministry of Transport, 2024). This was part of the government's aim to better incorporate land use into transport analyses carried out in relation to the National Transport Plan. ADV was first tested in five major urban areas after which technical improvements were made to the tool. Since 2024, ADV is in use or has been used for urban analysis in major urban areas such as Oslo, Trondheim, Bergen, Stavanger, Grenland, Tromsø, and Kristiansand to calculate the effects of measures as a basis for the urban growth agreements and to provide a coherent basis for the negotiation of urban growth agreements. Other areas such as Drammen and Fredrikstad/Sarpsborg are also scheduled to work with the tool in the future.

How the tools/plans are used and technical components

The Norwegian Regional Transport Model (RTM) can be used to analyse the effect of different policy instruments and measures, such as land-use planning, enhanced public transport, road capacity management, parking, road charges, and cycling and pedestrian measures (Leite et al., 2023). According to the Norwegian representatives who presented at the seminar, RTMs have traditionally relied on municipality-level population forecasts from Statistics Norway as the basis for estimating future population levels. These models assume that future population would be distributed based on current population patterns within each municipality. However, in urban areas where there are formal land-use plans and zoning regulations, such models fail to reflect how these plans can significantly influence where *actual* future population growth will occur. ADV helps to address these gaps. The tool can be used for systematic analysis of how land use, based on existing local land-use plans, influences transport demand and modal shift.

By entering different options for land use and transport into the system, ADV can be used to make forecasts for traffic volumes in a future year, based on different land-use scenarios. It is possible to combine the vehicle kilometres and regional forecast for vehicle fleets with emission factors from the Norwegian Environment Agency to then obtain forecasts for emissions to air, including greenhouse gases and particle emissions (Leite et al., 2023).

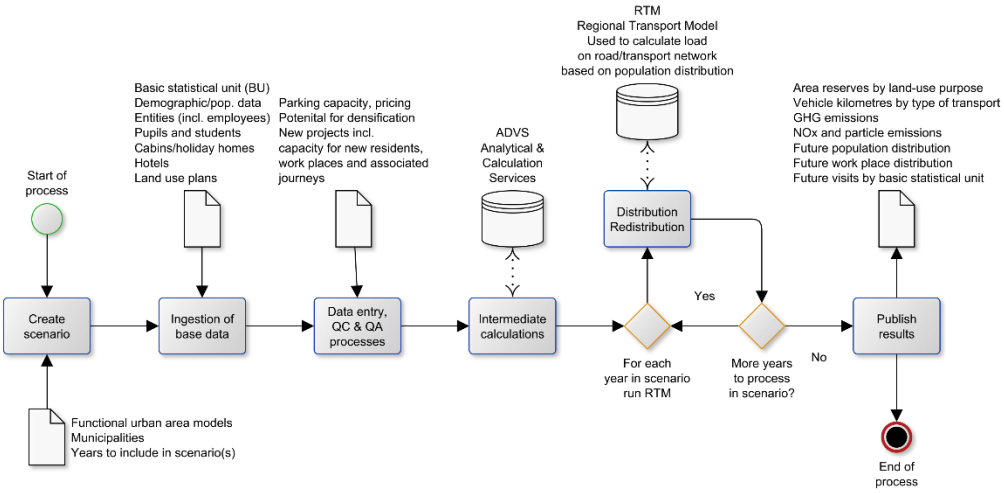

Figure 2. Process for using the Norwegian ADV with regional transport model (Asplan Viak, in Leite et al., 2023).

One of the key functions of ADV is that it takes municipal population forecasts and distributes these within the municipalities based on where we find existing built-up areas with capacity for further growth by densification as well as new areas available for residential purposes. As the ADV tool can be used in conjunction with the RTM tool, this allows for systematic area assessments that include the municipalities' land-use plans and provides a better opportunity to calculate future transport volume and emissions from road traffic (see Figure 2; Leite et al., 2023).

Simultaneously, it gives a greater opportunity to model and quantify the effect of different alternatives for land-use and transport systems in alternative land-use scenarios. For each urban area, ADV allows for a single reference scenario. The resulting scenario describes the land-use and transport system in the base year (current situation) and the most likely land-use and transport systems at selected points of time in the future, allowing analysts to calculate future development scenarios for selected "analysis years" (currently 2030–2050).

Successes

ADV is now used in large urban areas throughout Norway, taking into account capacity in land-use plans and accessibility. An example from Stavanger shows how the tool has been used to determine the effect of densification on growth (Figure 3). First, local expert knowledge on capacity in the municipal land-use plans is included in the tool and can be edited based on densification potential. ADV shows the summary of total capacity in different zones in the urban area, which is used as the base for calculating the distribution of population growth. The tool also shows parking lots and prices to calculate parking resistance—in other words, to see when parking fees begin to make an area less attractive. If there is a shortage of parking lots, they assume resistance and add a cost into the model, estimated based on what kind of enterprises are located in the area.

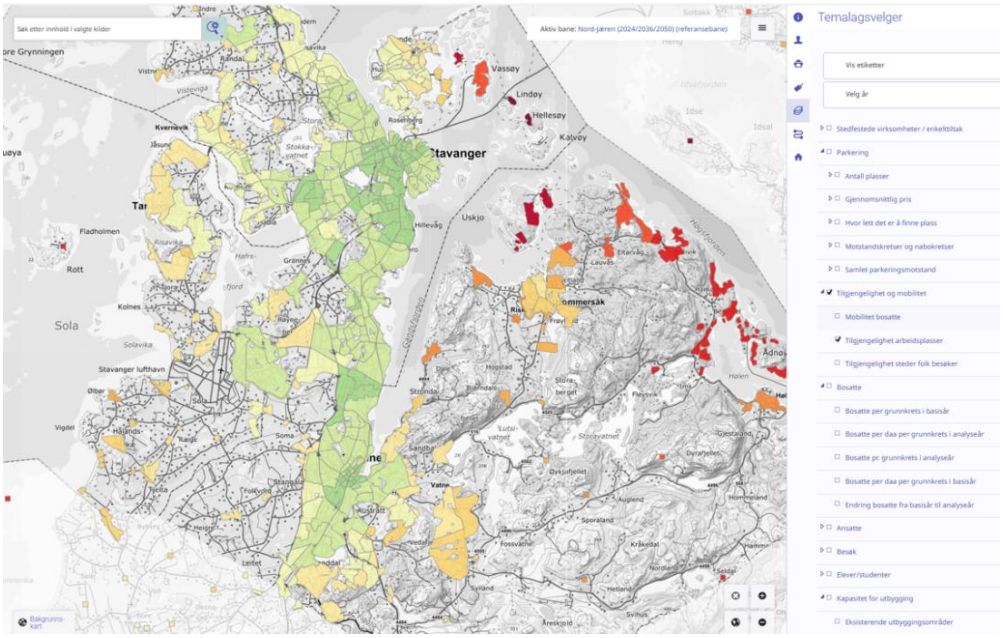

Figure 3. A visualisation from the online ADV tool showing accessibility to workplaces in the Stavanger region based on log sum from the transport model, including all transport modes (KDD).

In combination with the regional transport model, mobility factors are also calculated, like workplace accessibility. In the end, ADV shows the result of redistribution of the growth of population, employees, and visitors from the base year along to the analysis year. Within the online dashboard, planners can assess the results and indicators, which include transport growth, emissions development, capacity in land-use plans, and population growth.

The use of ADV makes it possible to calculate and discuss how different land-use strategies impact upon the zero-growth target for urban car transport. The calculations looking at vehicle kilometres travelled and passenger transport trips by public transport, walking, and bicycling, compared to the car, indicate that, while there will be a significant decrease in emissions from passenger cars by 2030, it is unlikely to meet the targets set in the zero-growth goal. The results help planners to reassess and consider the strength of additional measures and strategies needed for reaching objectives such as these, as well as locating where in the region they need to focus their attention.

Key limitations/challenges

While there are many benefits to both state and local actors who can utilise ADV, the tool also has its limitations. Firstly, there are no feedback loops other than accessibility in the transport system, which means that determining how attractive a building zone would be in the market is not accounted for. Feedback loops are when land-use strategies are put into the model to estimate new accessibility measures, which could, in turn, affect the location pattern for housing. These results could then affect accessibility once more. Furthermore, while a more advanced LUTI model might factor in housing prices as part of the analysis, the current iteration of ADV has no price model for real estate. The tool primarily allocates new residents to areas with high capacity according to the land-use plans (i.e., lower land prices in urban areas with high demand) but does not account for the real estate price. Additionally, it only looks at population growth rather than making a redistribution of the existing population in the region. Finally, existing demographics are maintained in the model, but it is not possible to forecast urban phenomena like gentrification or other large demographic shifts that may concern both land-use and transport analysis.

It is also crucial to note that the tool relies heavily on population projections from Statistics Norway in order to make its calculations, as well as data from the different municipalities. Since the tool has been developed in collaborations with local-level authorities, this is not a current challenge, but it does require sustained dialogues and continued cooperation and trust among all parties to work effectively.

Future developments

The ADV tool is currently used as a basis for urban analysis carried out as part of the urban growth agreements. It is specifically used in support of negotiation of these agreements as well as the next National Transport Plan. ADV works with different packages to measure things like public transport, walking and cycling, car-regulating measures (e.g., road tolls and parking fees), and the densification of residents and employees in combination, and to analyse how the change of some measure reflects against the "business as usual" scenario—for example, densifying land use, doubling parking fees, offering free public transport, or expanding toll systems with increasing fees. This work is still being analysed and assessed to provide the knowledge basis for the next generation of urban growth agreements under the National Transport Plan.

While the tool is quite advanced, it does not yet encompass all the features of a full-fledged LUTI model and, as outlined in the limitations section, is still improving to address its remaining gaps.

Sweden

Background

In Sweden, land-use and transport modelling has historically played a central role in supporting regional planning in the greater Stockholm region. The role of modelling has been an important part of the Regional Development Plans for the Stockholm Region (RUFS), which are updated approximately every tenth year. In preparation of these plans, large-scale land-use and transport models have been used to test and evaluate different scenarios to see how well they fulfil regional planning goals (Region Stockholm, 2019-a).

Over the last few decades, different models have been developed and used for land-use and transport planning purposes. Noteworthy examples include the IMREL model from the 1980s, and the IPM and LuSIM models developed during the 2000s. Another important model has been Samlok (a location model for population and employment), which has been used, for example, to analyse the connection between accessibility and income. According to the representatives from the Swedish Transport Administration (Trafikverket) who presented at the workshop, these models have proven to be useful for sorting out land-use principles; however, the models (e.g., the IMREL model) are rather limited for measuring wider societal impacts of policy.

How the tools/plans are used and technical components

Figure 4 shows the process used to perform integrated land-use and transport analyses in regional planning in Stockholm. The idea is to incorporate land-use data to the transport model to then be able to carry out analyses of both these aspects, and to test and evaluate different scenarios for land use and transport. More recently, steps have been taken to integrate the Samlok and LuSIM models. While Samlok addresses the effect on the location of households and businesses due to changes in accessibility, LuSIM addresses restrictions on land use and location principles at the local level (Trafikverket, 2021). It is relatively straightforward to transfer data between the two models. The interest has been to analyse location impacts on the transport system in order to assess the consequences of changed planning restrictions and policy. A specific aim has been to learn under which circumstances increased accessibility can create conditions for additional housing, and in which locations. Combining the two models has so far been piloted by running different tests, such as examining local impacts of infrastructure investment on accessibility as well as the possible widespread impacts of increased fuel principles, for instance, on net migration.

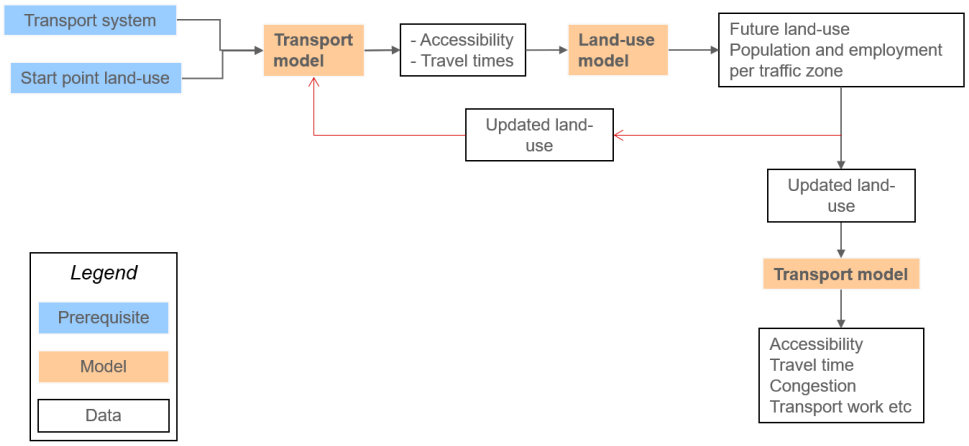

Figure 4. Process for using the Swedish transportation and land-use models (Trafikverket).

Successes

In supporting regional planning in the Stockholm region, a localization index, based on a fine geographical resolution (100 × 100 m), has been used for identifying suitable locations for future development. For instance, in the RUFS 2050, calculations were made on the number of workplaces that can be reached by car versus public transport within a certain amount of time. Calculations were made both for the present situation and for future scenarios (Figure 5; Region Stockholm, 2019-b). Other examples of analysis include calculations of urban density, which were carried out as part of a research project examining the importance of urban settlement patterns on carbon emissions and accessibility (conducted by WSP and Chalmers University of Technology with funding from the Swedish Transport Administration; WSP, 2011). Here different scenarios were calculated to show what density might look like in the Stockholm region based on different development scenarios. In the analyses for RUFS 2050, similar calculations and visualisations of urban density were made. As previously mentioned, there have been some efforts to combine the Samlok and LuSIM models, and this has been used to estimate the probability of construction for additional single-family housing, multi-family housing, or mixed housing in the Stockholm region.

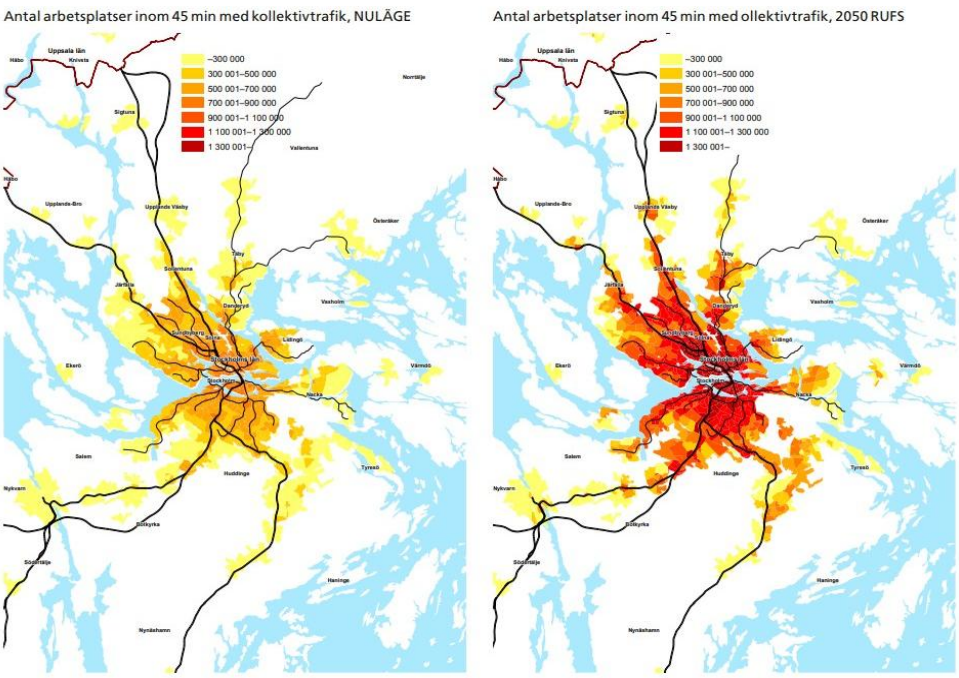

Figure 5. The number of workplaces that can be reached with public transportation in 45 minutes (current situation and estimate for 2050; Region Stockholm, 2019-b).

Key limitations/challenges and future developments

According to a 2021 report published by Trafikverket, the current models used in Sweden provide an initial path forward to meet the needs of the administration (Trafikverket, 2021). Although there are long traditions of working with land-use and transport modelling in Sweden, and especially in the Stockholm region, according to the presenters from Trafikverket, land-use modelling is currently not very active in Sweden, nor will it be used for the final version of the coming regional plan of Stockholm. Unlike in Norway, there are no formal agreements for working and developing modelling to support planning and policy. Although there have been some efforts to combine the Samlok and LuSIM models, this is not yet fully operational, and it is currently only suitable for making relatively simple calculations. Currently, transport modelling in Sweden is, according to the presenters, mainly focused on cost-benefit analysis, and a lack of academic interest in the subject of integrated land-use and transport modelling is one barrier that hinders further development and implementation of different types of modelling tools. Also, from a regional planning perspective, the presenters suggested that less projected population growth in Swedish urban areas in the years to come could be something that explains the lack of interest in modelling as there is the need for housing development is less than expected. Thus, locations identified in earlier plans may suffice also for the coming plans. Nevertheless, although the population in the Stockholm region is expected to grow less significantly than in recent years, it is still expected to grow by more than six percent (or 137,000 inhabitants) until 2033 (Region Stockholm, 2024). Therefore, from a planning perspective, there is a continued need for analysis that can be used to steer urban development in the most appropriate way.

Finland

Background

In the City of Helsinki, the importance of considering land-use and transportation planning in relation to each other is well-acknowledged. This was emphasised by the representative from the City of Helsinki's strategic land-use planning team who presented at the seminar and stated that transportation should be viewed as a form of land use, and that comprehensive land-use plans are, in many ways, the best and most important transport plans.

In Helsinki, the current city master plan is from 2016 (Figure 6; City of Helsinki, 2016). The master plan is the long-term plan for land use in the city, which is used to steer the development of the urban structure. Among its key principles are the expansion of the inner city, infill development of important nodes, creating a public transport network city, and improving the network of green areas. Many different forms of analysis were carried out when developing the master plan, and scenarios are continuously prepared in four-year cycles, corresponding to the city council's four-year terms of office. The presenter from the City of Helsinki underlined that, when conducting modelling and analysis to support urban planning, it is crucial to consider the domains of land use and transportation in connection with each other.

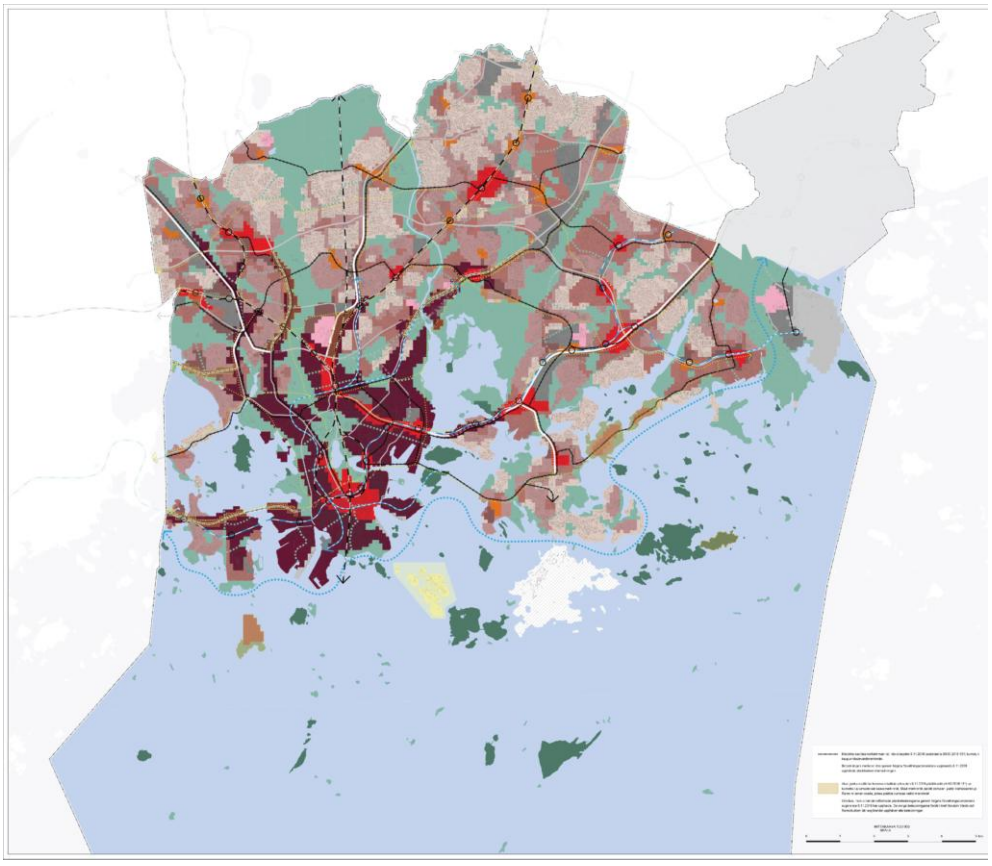

Figure 6. The Helsinki city master plan 2016 (City of Helsinki, 2016).

There is a strong emphasis on using data and knowledge to support planning and policymaking in the City of Helsinki, which is reflected in the current city strategy for 2021–2025, where a key priority is that data and digitalization will be used to help run a smart city (City of Helsinki, n.d.-a). The City of Helsinki has a long tradition of using research and data to support planning and policymaking, and the Executive Office's Urban Research and Statistics Unit conducts research, maintains official statistics and register data, produces statistical publications, and provides relevant information services (City of Helsinki, n.d.-b).

How the tools/plans are used and technical components

An important model that is used at the regional level is the HELMET 4.0 transport forecast model, which covers the whole commuting area of the greater Helsinki region and is based on a modelling software known as Emme (HSL, n.d.). The current version was published in 2020, and a 5.0 model is currently under development. There are also initiatives to develop a national model based on the regional model. The HELMET forecast model can be used to assess the impact of various changes on the transport system, and it was developed specifically for assessing the impacts of the regional MAL agreement. The MAL agreements are urban development partnerships between the central government and Finland's largest urban regions (Helsinki, Turku, Tampere, Oulu, Jyväskylä, Kuopio and Lahti). They include specific objectives for land-use development, housing production, and key transport projects for the coming years (Ministry of the Environment, n.d). The current MAL agreements were signed in 2024, and they are in effect until 2035.

In the Helsinki region, the region's 14 municipalities are engaged in strategic cooperation on land use, housing, and transport within the framework of the MAL agreements (City of Helsinki, n.d.-c). Implementation of these agreements is monitored annually by following up on various objectives and measures, such as reconciliation of land use, housing, and transport; integration of community structure and promotion of public transport; functioning of the housing market; and measures necessary for the overall need for housing production, including affordable housing (Figure 7; City of Helsinki, n.d.-c).

In the City of Helsinki, various analyses are central both at the strategic master plan level and in detailed planning. At different steps in the planning process, impact assessments and comprehensive analysis of all forms of land use are central ways for evaluating how project plans are progressing. Helsinki's current master plan from 2016 combines many different aspects, and preparation of the plan thus included a wide range of data. In terms of land-use data, the city uses a 100 x 100 m grid, which is then aggregated into slightly larger areas to make it more manageable.

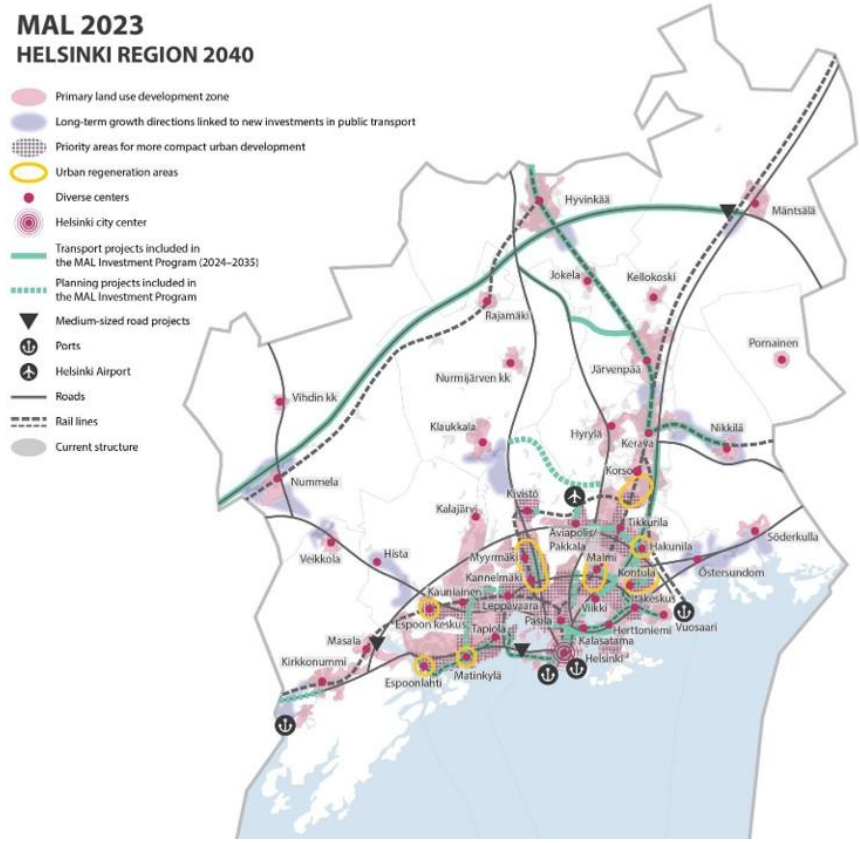

Figure 7. MAL 2023 Plan and development of the Helsinki region to 2040 (HSL, 2023-a).

Successes

Within physical planning, the City of Helsinki strives to analyse all land-use forms in a comprehensive manner as part of housing and transportation plans. This is done by conducting extensive and comprehensive studies and assessments at multiple levels of planning and considering a wider range of perspectives. In terms of steering the direction of urban development, the city has been well placed to do this, as they are a major landowner (owning two-thirds of the land) and most of Helsinki's housing production is carried out on land owned by the city (Ronkainen & Eskelä, 2022). However, in the current economic situation, where both housing prices and construction have decreased substantially in the last few years, it has been more difficult to steer this development as developers have been less keen to initiate new projects.

Key limitations/challenges and future developments

A central aspect in the context of land-use and transport modelling is how the results of the analyses are interpreted and what kind of conclusions and decisions are made based on these results. This is particularly important as those who use the results of the analyses and impact assessments are generally not professional modellers, and there is often dissonance between project reasoning and the impacts assessed. Thus, it is crucial to be able to explain what the numbers say and what they do not. In relation to this, the representative from the City of Helsinki stated that a transport model should be viewed as a good servant but a bad master.

This implies that modelling can be useful for creating valuable knowledge to support planning and decision-making but should be done with close consideration to the intended objectives of the analysis, while also acknowledging limitations of the models used.

Cost-benefit analysis (CBA), i.e., comparing the projected costs and benefits associated with a project decision, is widely used in relation to physical planning in Helsinki. From the perspective of the representative from the City of Helsinki who presented at the seminar, CBA is overly dominant in decision-making and often seen as the only relevant metric. Currently, CBA is used both as a ranking tool and as an absolute measure, while the representative from Helsinki argued that it should only be used as a ranking tool for comparing different alternatives. Another aspect that emerged is that CBA frameworks generally fail to grasp the specific characteristics of cities and dense urban areas. For instance, they do not properly consider the impact of the dense urban structure on local emissions, agglomeration effects on tax revenues, the space required for transportation infrastructure, and that the national average value of time is not the same as the value of time in dense urban areas.

While the previously mentioned MAL agreements are in place to facilitate and support cooperation between municipalities in Finnish urban regions in land use, housing, and transport, there are several challenges that remain in terms of achieving cohesive and coordinated strategies and implementation. For instance, in reaching transport goals, it is noteworthy that, while traffic has not increased in the city itself in recent years, traffic has increased in the urban region overall. A reason for this is that many of the municipalities on the outskirts of the region still base their strategies on single-family homes and a 45-minute commute to the city centre by car. While the City of Helsinki aims to reduce the numbers of cars in the city centre, this causes some major conflicts of interest between municipalities. The City of Helsinki is planning to transform the highways that lead into the city into urban boulevards, which would involve lowering speed limits and taking other measures to make driving into the city less attractive, but this has been met with resistance across the local level, which means that only approximately half of these planned projects will go forward. While congestion charges are regarded as the most effective tool for limiting car traffic, since there are no aims to limit car traffic at the national level, nor in the current MAL plan for the Helsinki Region (HSL, 2023b), this is not an approach that the city could use. The previously described examples illustrate the importance of having coherent and aligned policy goals and measures to achieve these goals at multiple levels of governance, if the aim is to achieve a more sustainable urban development.

Finally, for future developments of integrated land-use and transportation analysis to occur through the support of state funding, analyses need to be conducted with national frameworks in mind.

Denmark

Background

In Denmark, the so-called Finger Plan is an important national planning directive that steers urban development in the Greater Copenhagen Area. Since its introduction in 1947, the principles of the Finger Plan have formed the framework for physical planning in the Danish Capital Region, and it has steered the direction of regional and subregional plans over the years. The name of the plan stems from its distinct layout, which resembles a hand with "fingers" stretching out from the "palm" (i.e., central Copenhagen). The aim of the plan is to concentrate housing, retail, businesses, and public institutions around a well-developed infrastructure within the city fingers. The Finger Plan was incorporated into Danish law in the early 2000s, and it has been legally binding as a ministerial order under the Planning Act since 2007. The current Finger Plan is from 2019 (Figure 8). Although there is no fixed schedule for how frequently the plan should be revised, in 2025 the Minister of Urban and Rural Affairs initiated a review of the plan, which is currently underway.

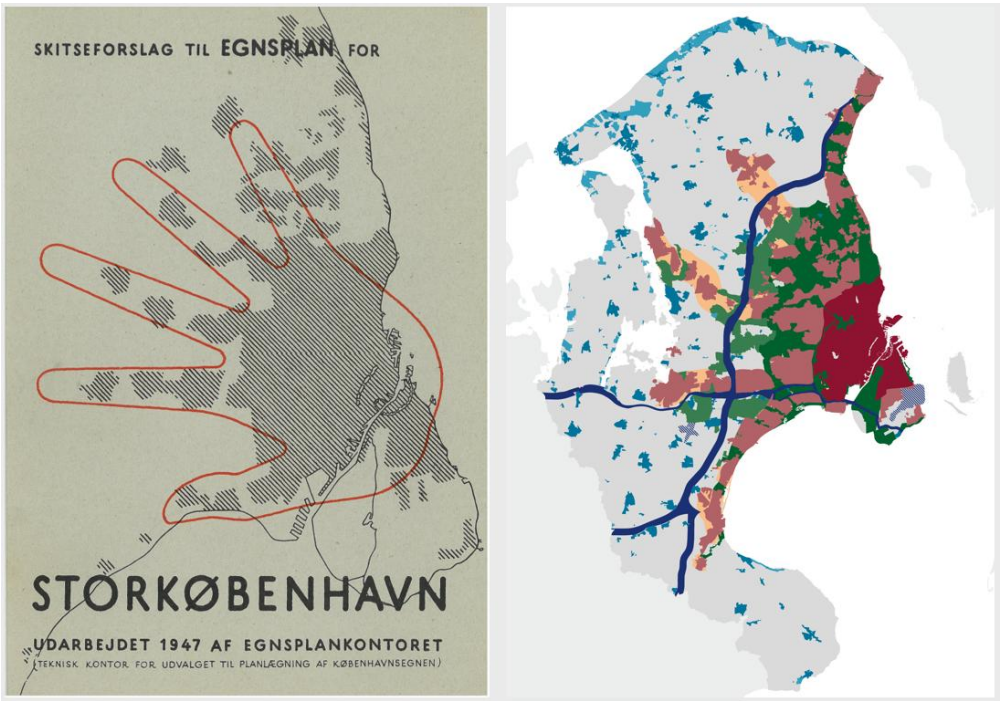

Figure 8. The original Finger Plan from 1947 (left) and the current plan from 2019 (right; Copenhagen Regional Planning Office Stockholm; Danish Ministry of Industry, Business and Financial Affairs).

How the tools/plans are used and technical components

The Finger Plan differs from most of the other examples examined in this report in that it is a fixed spatial planning mechanism rather than a LUTI model (or variation thereof). Rather than forecasting population growth distribution or the like, it is a planning strategy that seeks to steer the development of the Greater Copenhagen Area into "fingers", each with a railway transportation line at its core and reserved

areas outside of the city fingers for green spaces, smaller communities, and agriculture. A core principle of the plan is that urban functions which are intensive based on area use, job density, size, or visiting patterns must be placed within the core areas near train stations. Thus, the Finger Plan seeks to counteract a scattered urban development and steer the development of Greater Copenhagen along transport lines. In the current 2019 Finger Plan, the principle of requiring location near stations is based on the goal of ensuring that as many people as possible use public transportation, thereby reducing congestion and time lost on the roads while also addressing environmental challenges associated with private car use. Public investments in the railway system have supported development according to the principles of the plan.

The success of the Finger Plan can be summarised by the effects of land use in the Greater Copenhagen area today. The overarching principles from 1947 have prevented the area from more scattered urban development and increased traffic and congestion on roads.

Key limitations/challenges

Various tools and data have been useful for supporting the preparation of the Finger Plan. For example, the Transport Habit Surveys that have been conducted by the Danish Technical University (since 1975) have helped planners better understand traffic behaviour, revealing that if people live closer to stations, they are more likely to use public transit (DTU, n.d.). However, according to the representative from the Danish Agency for Planning and Rural Development (Plan- og Landdistriktsyrelsen) who presented at the seminar, there has not been a systematic use of population prognosis and scenarios for the region overall. Instead, municipalities make these analyses themselves which can lead to a fragmented picture of the situation and perceived development. For instance, the different municipalities generally expect to have a greater population growth than forecasts from Statistics Denmark predict. Similarly, while municipalities can largely steer urban development within their own municipal boundaries (as this is a regional plan that covers over 30 municipalities) potentially conflicting interests between the different municipalities may obstruct implantation of the strategy. This underlines the importance of policy alignment and having shared goals and implementation among municipalities for reaching goals at the regional level.

Future developments

There is an ongoing revision of the Finger Plan, which was initiated by the Minister of Urban and Rural Affairs in 2025. Input has been requested from municipalities, citizens and stakeholders, and so far over 300 responses have been received. These inputs will be used as a basis for revising the current Finger Plan from 2019. The Minister has expressed that he believes there is a need for an open discussion of the overall balance of the Finger Plan, so that strict rules do not unnecessarily hinder the implementation of local projects and so that land can be used in the best possible way. The notion of requiring location near stations is a key principle that the minister believes can be modernized. The Minister has stated that there is a

need to look at how we can accommodate opportunities for new urban development, new industry, stadium expansions, and so forth, while ensuring that everyone living in the area continues to have good access to green and recreational areas close to their homes. It is expected that a new finger plan will be issued before the end of 2026. (Ministry of Urban, Rural, and Ecclesiastical Affairs, 2025). However, with regards to the development and use of some form of LUTI model, there are no plans to make use of a larger integrated transportation and land-use modelling system within the Planning and Rural Development Agency.

Discussion

Based on the presentations and workshop discussions among transport and planning actors in the Nordic Region, several takeaways emerged. This section highlights the distinctions and commonalities among the Nordic countries with regards to their land-use and transport interaction modelling progress, support, interests, and future collaborative potential.

Different points of departure driving political demand for developing models

A key reflection from the workshop was that the different countries and urban areas have arrived at their integrated land-use and transport processes through different means and based on distinct needs. For some countries, like Norway and Finland, national or regional policies have driven the demand to develop integrated land-use and transport processes. In Norway, for example, the urban growth agreements motivated the need for land-use and transport planning to coincide to analyse the effectiveness of specific growth targets—namely, the zero-growth goal. In 2015, a project evaluating characteristics in transportation models was established to improve how public transport, cycling, walking, and land use were dealt with in the regional transport model, with the aim to improve the transport model with regards to the zero-growth goal for urban areas. The project revealed that land use was not sufficiently reflected in transport models, so the ADV tool was developed, in part, as a response to the need to make more accurate estimates of land use. State agencies, the Association of Local and Regional Authorities (KS), and the Ministry of Local Government and Regional Development (KDD) were part of the coordinated effort to implement and finance the development of the ADV tool. Similarly to the urban growth agreements in Norway, the Finnish MAL agreements between the state and the regions provide a basis for land use, housing, and transport measures with development goals. To measure the achievement of the MAL objectives in the Helsinki Region, HSY (Helsinki Region Environmental Services Authority) and the City of Helsinki conduct a comprehensive analysis of land use with housing and transport plans.

Meanwhile, in Sweden, political demand for making integrated land-use and transport analyses currently seems low. The presenters speculate that this may be due to recent predictions that population growth from external migration in urban areas is not expected to increase as rapidly as once assumed: however, there may be other reasons driving the lack of political demand. There is also some lack of policy demand from the Danish perspective, and the primary land-use and transport planning guideline in Denmark—the Finger Plan—does not have specific goals (e.g., lowering carbon emissions) incorporated into it. The plan acts as a spatial strategy, which means that, as a growth tool, it does not inherently make a demand for conducting the same cost-efficiency analyses as do initiatives like urban growth agreements which include a set target to achieve.

Interest remains among planning actors in the Nordic countries to work effectively with transport and land use, and the interest among actors to participate in the workshop also shows the relevance for those working particularly within transportation roles at the local, regional, or national levels to identify better modelling solutions to achieve overarching planning goals. All planning decisions require data input of some kind, and urban areas which lack integrated forecast modelling may miss the opportunity to make more in-depth assessments of the costs and benefits of one land-use or transportation decision versus another.

Differences in development phases and collaboration efforts

While Sweden and Finland also utilise some similar transport and land-use models, the Norwegian ADV appears to be the most advanced across the Nordic Region. For example, the tool can make several different land-use scenarios, which remains burdensome for Helsinki, especially when doing so at the regional level. In Sweden, the planners involved in the workshop expressed that, while they work with some forecast models, they struggle to gain acceptance for developing their modelling further. Norway also struggles with this, but the work is more institutionalised, and the system is already accessible for use by various agencies, which helps to encourage continued innovation and development within land-use and transport modelling. Sweden uses some similar systems as in Norway (e.g., Samlok and LuSIM), but there appears to be a lack of cooperation that limits the extent to which the models are used and therefore supported. Sweden's models also currently remain separate, requiring analysts to run an analysis within the transport model, input those results into the land-use model, then use those results to update the land-use plan before running tests in the transport model once more to analyse things like accessibility, travel time, and congestion. When considering the potential to implement a tool like ADV within their context, the Swedish representatives in the workshop pointed out that there is already a geographical service analysis tool (Pipos) which is established and widely used in the country so, even though the tool does not fill the same gap, it may be difficult to implement a new tool alongside the existing one.

In Denmark, specifically in Copenhagen, the planning authority works with a lot of data in strategic land-use and transport decision-making, but they also lack cooperation among key actors—notably between transport and planning authorities. When there is a demand for analysing land use and transportation, the state or urban-area authorities must start from scratch since they do not have a ready-made model filled with baseline data into which they can input their query and gain results. This makes conducting analyses more cumbersome than if an integrated model already existed. While the Finger Plan in the Copenhagen area is a spatial strategy that links transportation and development normatively rather than a modelling tool, it is also unique from the models described in the other contexts in that it has been around since 1947. While it has been updated over time, the longevity of such a plan (legally binding since 2007) ensures that land use and

housing continue to be developed along transportation corridors, consistently integrating this work. While some argue that land-use plans on their own have a limited impact on transport patterns and modes of travel, estimations from Norway show that land-use strategies can have a bigger impact than policies directly linked to transportation.

Compared to Norway, the land-use and transport modelling work in Helsinki takes place at the local level. While the development of a state-wide model is underway, local level planners express some scepticism over giving the control of the modelling and analysis work to the state since this may limit cities' control over the parameters and decisions made. However, if modelling and analysis is maintained at the local level, it needs to be conducted with national frameworks in mind to argue for state support of the work. By comparison, the Norwegian ADV tool relies heavily on collaboration between the state and local levels.

Despite each of the countries analysing land use and transport in unique ways, urban areas in all four countries work with master or comprehensive land-use plans, which inform transportation decisions.

Differences with land ownership

Differences in land ownership across the Nordic countries also influence how development takes place and how decisions are made. In Helsinki, for example, the city owns about two-thirds of the land area; therefore, the city has more power to determine where development will take place (though the control of this also varies, to some extent, with different economic cycles). The market is generally willing to build according to what has been planned by the municipality. Representatives from Norwegian municipalities and national agencies expressed that Norway, in comparison, is more market-driven with regards to land development; however, the land-use plans provide directions and limitations for where and how dense the development should be.

Indicators

Critical debate continues regarding which indicators are used within forecasting models. Typically, LUTI models operate according to baseline statistical units and data inputs that quantify time and cost-efficiency in order to provide results. This can be especially useful for making cost-benefit analyses or determining the effectiveness of a policy on lowering, for example, carbon emissions. The transportation models in Sweden focus on cost-benefit analysis; however, these may not cover the array of social and spatial indicators necessary for land-use and transport planning as well. The Finnish representative cautions against using cost-benefit ratios as an absolute measure and instead suggests that they serve best as a common measure or ranking tool. Other approaches to this concern would be to bring additional key issues (such as climate issues) into cost-benefit analysis work so that the indicators are more integrated from the start.

Additionally, as expressed by both the Norwegian and Finnish representatives in the seminar, there are many urban phenomena that must be considered when planning

land use and transportation. For example, measuring the value of time in general versus the value of time in dense urban areas, how much space is required for transportation and its infrastructure, and consideration of tax revenues from agglomeration effects. Responding to these requires more complex forecasting tools (beyond, for example, a cost-benefit analysis framework) that account for such particularities or require multiple tools to work alongside one another to make effective planning choices. Other perspectives may also be important, such as accessibility-based planning rather than traditional ways of thinking that focus on cutting travel costs. As there are limitations to cost-benefit analyses in the context of land-use scenarios, planners may need to rethink how they estimate user benefits to make such analyses.

Future collaboration

Multi-governance and cross-sectoral collaboration

The primary actors involved in land-use and transport modelling in the Nordic countries differ. In Norway, the national tool involves a significant amount of support from those working at the municipal level, particularly when it comes to providing data on land use. Land-use plans from several Norwegian municipalities are now integrated into the system, which enables the tool to be more useful. The successful implementation of the ADV has been possible largely due to the support from municipalities and other national actors at the early stages of development, which also means that key actors at the local level were able to provide critical input from the beginning. Such collaboration allows authorities to better understand how land use and transport mobility are incorporated. However, many representatives during the seminar expressed challenges with collaboration. Whereas the ADV in Norway has been developed through joint effort among municipalities, Danish municipalities appear to work more independently when it comes to conducting, for example, population prognoses, and there is an expressed need for better communication across municipalities in this area in order to implement the regional Finger Plan in an integrated way.

Cross-sectoral collaboration is critical, and it is important for policymakers to better understand the points of interaction among areas such as land use and transportation in order to make strategic decisions about which measures to take. For example, while transportation measures may gain greater attention, land-use strategies may be equally or more effective for reaching a particular sustainability goal.

It is evident from the discussions that successfully developing a tool like ADV requires a strong level of trust among all stakeholders, though this is also often a barrier for actors and agencies within planning. Sometimes there are conflicts between national and local-level actors; in other situations, it can be difficult to communicate about forecasting models and tools due to the technical language and competencies required to make its functions and added value comprehensible to multiple parties. When it comes to communication, it is also the case that the spheres of land use and transportation often use different language within their spheres, a point highlighted in other literature on the barriers of integration implementation (see Te Brömmelstroet & Bertolini, 2010). In their research, Te Brömmelstroet and Bertolini (2010) suggest overcoming this barrier by bridging the

"substantive barrier," in other words, connecting the tacit knowledge from different spheres through "social learning processes" that involve more than one domain of knowledge in order to influence future urban or regional development.

One key takeaway is that all actors involved when developing the integration of land-use and transportation planning always have the potential to pose resistance given that everyone likely has a unique agenda. Rather than ignoring this, it may be useful to acknowledge such realities in open and transparent discussions when bringing actors together. Another pathway forward for developing or improving existing tools could be to encourage cooperation among municipalities to start with, in order to build demand for the tool by identifying the needs to which it would respond and support the work of local authorities in their decision-making. In this regard, it seems crucial that the different parties would see the usefulness of having a common tool as opposed to developing separate modelling tools on their own. Having a harmonized system is advantageous from the perspective of creating more comparative knowledge based on similar metrics, which could also benefit local authorities that may otherwise lack the necessary resources and knowledge to carry out analyses on their own.

Cross-Nordic collaboration

Several opportunities for future collaboration among Nordic countries were identified during the workshop. Representatives from Denmark, Finland, and Sweden all expressed ways which they could learn from the Norwegian ADV. For example, in Helsinki, it remains a challenge to make land-use scenarios that everyone can agree upon, so something like ADV could be valuable since it provides systematic area assessments and uses municipal zoning plans as a starting point to show what kinds of patterns could emerge. Some kind of forecasting is also necessary in the Copenhagen context, also to assess the likelihood of different scenarios. Challenges are similar across the Nordic countries and discussions such as those in the June 2025 workshop acted as an encouragement to participants. There is also great opportunity for local-level actors to exchange knowledge and experience among one another, particularly given the cooperation that is required across levels of governance. The Norwegian cities, for example, may be able to share with cities in other countries how they have been able to play a crucial role in the development of the ADV tool and have worked with the modelling scheme in their contexts.

Conclusion

Land use and transportation are closely intertwined when planning sustainable cities and regions, but decision-making involving both domains is a difficult task. Authorities at various levels of government require clear plans, tools, and integrated models to analyse current as well as potential future pathways so they can make strategic decisions that align with local or national sustainable growth objectives. This report is an outcome of a knowledge-exchange workshop on digital planning tools for land use and transportation, where several actors throughout the Nordic Region gathered to share insights and experiences. These discussions helped lay the foundation for a common understanding of how different analyses are made in the countries and provided clarity for possible areas of cooperation.

In the Nordic Region, state authorities in Norway have collaborated with municipalities to successfully develop an analysis tool which helps planners make better calculations of land use and parking in transport modelling for urban areas. The tool is also used for introducing systematic analysis of land use based on local land-use plans by providing enhanced data input to transport models. While some authorities in other Nordic contexts also use forecast models, they are less integrated than the tool used in Norway. There are also major distinctions across the Nordics when it comes to multi-actor collaboration, political demand, and development of such integrated tools. Factors such as land ownership and existing systems for strategic decision-making also distinguish the countries from one another. But all Nordic countries utilise additional land-use tools or plans that influence transportation planning, and vice versa, and the need for these spheres to work together is critical in all countries, and at various scales—from local to regional and national levels.

Crucial to the discussion was the idea that a transport model is, as the Finnish representative suggested, a good servant but a poor master. Models are a tool that need to be developed with the needs and questions of local authorities in mind. The model is only as good as the data it has, so cooperation is key for inputting, for example, local-level plans into the base. And while the models can show the potential effects of one change versus another, the results must be thoughtfully interpreted by decision-makers who maintain the power to choose which pathways best align with the overarching strategies or objectives of the city/region at hand.

There remains a great deal of opportunity for innovation and development in the area of land-use and transportation integration in the Nordic countries. Further exchange among Nordic actors—both local and state levels—could stimulate innovation and encourage development, while engagement beyond the Nordics may also play a role. For example, the UK has a long history of working with LUTI models. Their expertise, along with others, can continue to lend a hand in the discussion for improved technical and governance know-how across the critical domains of land use and transportation, which together act as the foundation of the life of our cities and regions.

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About this discussion paper

Integrated land-use and transport analysis in the Nordic Region: Summary and outlook

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