the New Logic of
Urban Innovation

How The Nordics May Transform Urban Mobility By 2030

Nordic Urban Mobility Ecosystem

WALCC
World Alliance for Low Carbon Cities

synocus

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Preface

The World Alliance for Low Carbon Cities (WALCC) and Synocus Group initiated, in early 2019, the Nordic Urban Mobility 2030 project (NUM2030) to explore the changes the coming decade will see in Nordic urban mobility. The project, sponsored by the Nordic Urban Mobility Ecosystem (NUME), explored what the future may hold by evaluating how changes in the industry, operating environment, and wider world may affect future mobility.

The NUM2030 process consisted of three parts: i) general information gathering, ii) the interactive scenario building process, together with the NUME members, and iii) reflecting upon the results of the workshops and writing this report. Appendix 1 provides an overview of the scenario building process and the resulting scenario descriptions.

The last task of the final scenario workshop was to reflect upon how the different scenarios might converge. These discussions resulted in three main observations. Firstly, the complexity is of such magnitude that no single activity will be enough to make a breakthrough, a concerted set of actions across businesses, geographies, and groups of individuals will be needed. Secondly, individuals will still matter, both as opinion leaders and role models, as the example of Greta Thunberg has shown. Thirdly, implementation will be local. Each city has its unique context, culture, and history, so the path forward must

be localized. Technologies may be perceived as ingredients for the meal, but each city will decide which meal to offer.

These insights posed a challenge for the writing of the report. If actions must be localized, a key question, not addressed in the scenarios produced during the workshops, was how cities are different and how this impacts the possibilities to act? At the outset of the scenario process we had described the objectives the following way:

We are using a scenario development approach in which we hypothesize alternative future visions for how probable trends and events will affect mobility in the Nordics. In addition to describing how these future states differ from today's environment, we will also construct plausible pathways for how markets, technologies, companies, and regulations co-evolve to create the conditions conducive for the emergence of these new future states. This can serve as both a proactive stimulus to imagining new opportunities and as a reactive warning system, which signals we are on a different path than the one we had imagined.

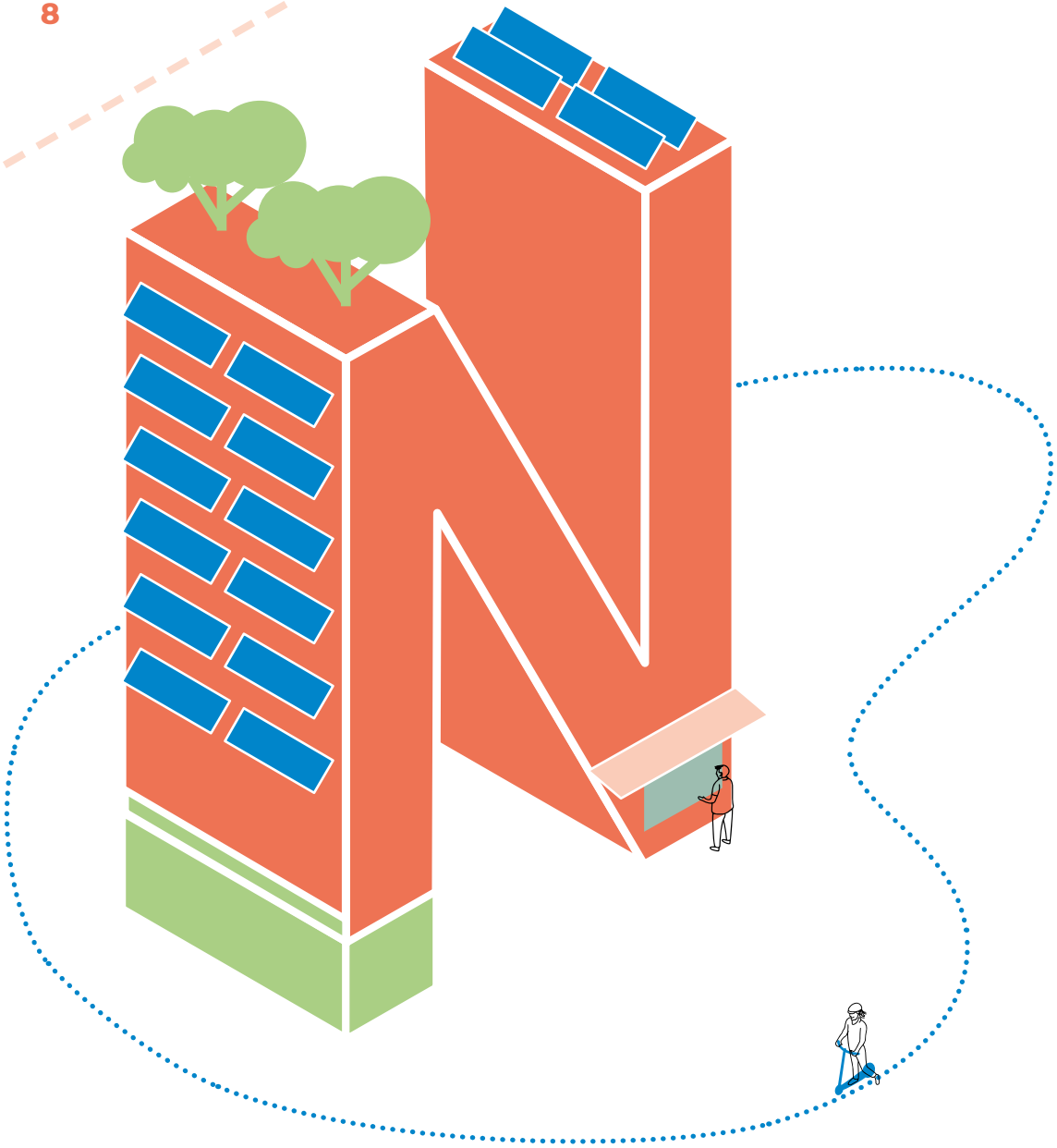
With the outcomes of the scenario work at hand, we realized that context matters. But we had very little to say about context. Therefore, we had to go back to our original question: how will urban mobility in the Nordics evolve over the next ten years? The scenario process had provided us with deep insights about the different elements through which a city can mold and steer the future development paths. What was missing was an understanding of what different approaches are available for a specific city when considering how to move forward.

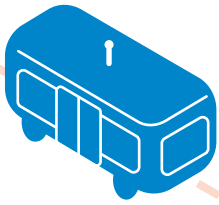
The insights on the need for a deeper understanding of how urban innovation differs in the Nordic countries resulted in the decision to add this aspect to the report. During the summer of 2019, quite extensive desk research was carried out to characterize the points of departure for each Nordic capital. This report has unfolded from a desire to offer something of practical value for those who are engaged in bringing urban mobility to the next level. In this respect, the report mirrors the strategic shift of the NUME community that sponsored the NUM2030 process.

When NUME was established in the spring of 2017 it was financially supported by Business Finland, and, subsequently, its initial steps were taken on Finnish soil. However, when the NUM2030 process was initiated it was seen that the next phase of the ecosystem implied shifting the emphasis from Finland to the Nordics. This was also supported by changing the name of the community from Autonomous Vehicles and Mobility Services to NUME in the spring of 2019.

This report is the outcome of collaboration with members of the Nordic Urban Mobility Ecosystem who have contributed to the thoughts presented in the report. This report serves as a reference document to establish a roadmap for how the Nordic Urban Mobility Ecosystem can best align with and, hopefully, contribute positively to the development activities in urban mobility across the Nordic countries.

Providing that the ecosystem will succeed in establishing an in-depth relationship with all Nordic capitals as a partner in innovation, the next step is then to actively promote the Nordic model internationally. This will be based on using the principles, presented in this report, of citizenship responsibility, logic of care, networks of trust, and slow architecture, as the underlying framework for how cities can better drive the transition of transport.





Introduction

This report supports those who want to make the Nordics a leader in the transformation of urban mobility. We see that individuals unified through this mission share three traits. Firstly, they genuinely see ***combatting climate change*** as an integral part of their professional identity and are constantly looking for ways to learn more about how they, as individuals and citizens, can positively contribute. Secondly, they see ***urban mobility as a catalyst for change*** and one in which the Nordics, with a history and culture that support it, can make urban mobility an attractive field of experimentation and implementation to show the rest of the world how to take the lead. Thirdly, they have ***a bias for action***. They want to get engaged with likeminded people to mobilize concrete activities, on the ground, in cities mobilizing governments, researchers, companies, and citizens to speed up the change and deliver results. Hopefully this report can provide some intellectual stimulation, both through facts and projections, for individuals engaged in making this Nordic urban mobility transformation happen.

The next section argues that the Nordics can take the lead in the transformation of urban mobility through a new type of innovation process we call ***transcendent innovation***. This describes how we must produce a continuous stream of improvements in collaboration with others. Constantly looking to the

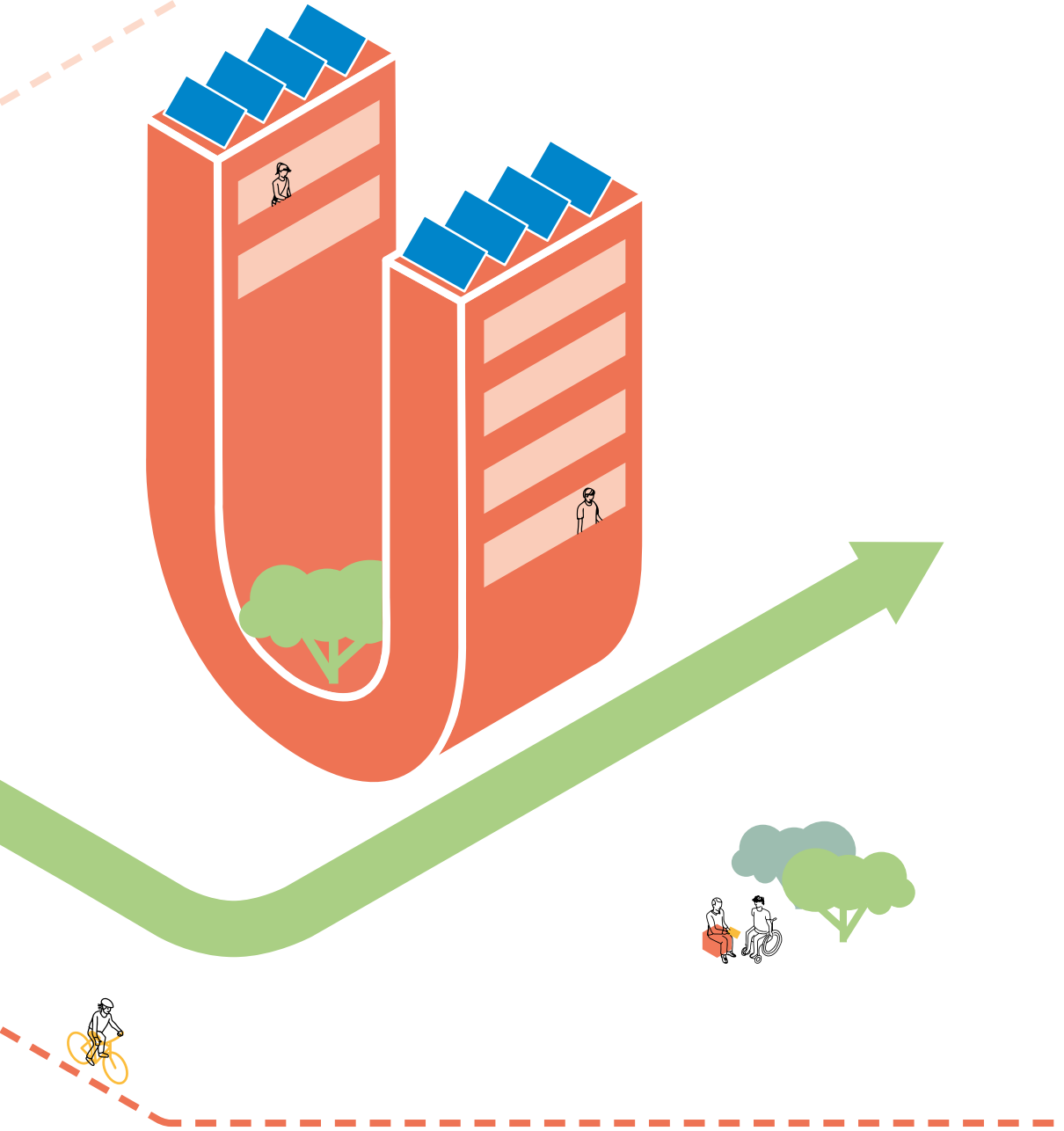
outside world to better understand what can be done, and at the same time introducing new experiments and pilots to quickly learn how to move forward are the key ingredients of ***transcendent innovation***. Three ways to lead such development are presented: ***visionary leadership, strategic management***, and ***enabling orchestration***. Each approach needs a new interpretation to meet the challenges of ***transcendent innovation: logic of care, responsible citizenship***, and ***networks of trust***. This implies that cities must become more innovative and entrepreneurial to drive the needed transformations.

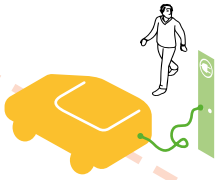
In the follow we will show what progress Copenhagen, Oslo, Stockholm, and Helsinki have already made towards transforming urban mobility, and present some ideas about how each city could build on its strengths to speed up urban transformation. The studies of these cities have been set in their respective contexts to provide a more comprehensive understanding of their evolution. The context for Copenhagen was very clear as the word ***Copenhagenize*** has emerged as the term illustrating how Copenhagen has taken a systemic long-term view on making it a city for people. Copenhagen has also been a pioneer in providing good conditions for bicycling in the city. Oslo, ***the EV capital of the world***, also has a very distinct story to tell with high relevance for our project. Stockholm was the first Green Capital of Europe in 2010 with the motivation of being a city that has an integrated administrative system that guarantees that environmental factors are considered in budgets, operational planning, reporting, and monitoring. ***Hammarby Sjöstad***, a formerly industrial inner-city area of Stockholm, is here the showcase, which has received global acclaim. Helsinki, in turn, has been an example of a city where ***technology has been integrated*** into city development in many different forms, thanks to its symbiosis with Nokia, the origins of Linux, and, more lately, being the venue for Slush, Europe's leading startup event.

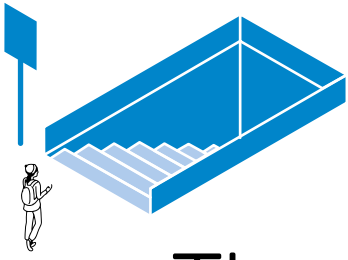
This foundation has a long history and the combination of the unique, complementary strengths of the Nordic capitals provides a strong case for developing something in the field of mobility that could resemble what was achieved in telecommunications sector with NMT nearly fifty years ago.

The report then concludes by suggesting some concrete ways the Nordic

Urban Mobility Ecosystem could be a catalyst for this transformation and we use the notion of ***slow architecture***, a sustainable approach which works with the natural environment, to symbolize the unifying theme of the Nordic way of transforming urban life.







The New Logic of Urban Innovation

With 2020 on the horizon, the number of efforts seeking routes towards lowering the carbon footprint in cities is only growing. The efforts must result in a breakthrough similar to Henry Ford revolutionizing the transport sector when launching the T-Ford. However, this time the innovation request is framed by the environmental conditions required to mitigate climate change. This type of innovation can be called ***transcendent innovation***, which embodies the necessity to solve our grand challenges and raise innovation to new levels. Beyond considering merely the interests of individual consumers or enterprises, the innovation process must provide solutions that are sustainable and radically reduce the compound emissions from energy production, buildings, and the transport sector. This cannot be achieved by one single organization alone but calls for collaboration involving citizens, authorities, researchers, and companies.

Climate change and congestion are forcing cities to radically rethink mobility. Whether the new mobility paradigm will be driven by entrepreneurs or will be the outcome of public-private co-creation remains to be seen. Uber is a strong candidate to lead the transformation if the private sector will be in the driver's seat. Travis Kalanick, the co-founder of Uber, has said that his goal is not simply to conquer the taxi market but to make ridesharing so cheap and convenient that using Uber becomes an alternative to owning a car. Investors have been backing these ambitions. At the time of listing Uber's USD 60 billion valuation placed it above such traditional automotive heavyweights as Ford or General Motors. Still numerous cities across the world are highly critical to the way Uber tries to avoid local rules and norms.

Another company with a strong ambition to reform the transport market is Tesla, which is the poster child for electric cars. However, both Uber and Tesla are struggling to make a profit, and many are doubtful whether they can drive the transformation to make transport less dependent on fossil fuel. Some of the most relevant technological opportunities to radically reduce the carbon emissions of urban mobility are presented in Appendix 2.

Three main routes to less pollution from transport exist. One way is to reduce the carbon emissions per transport unit e.g. by using biofuels or batteries instead of gasoline. Therefore, there is legislation supporting a shift from fossil fuel to renewables as the energy source for transport. The second approach lies in increasing the number of passengers per vehicle and reducing the number of emissions per traveler or transported good per kilometer. Ridesharing, mass transit, and the use of rail transport are examples of solutions in this approach. The third option is radically changing the way we think about travelling and minimizing the amount of travel supported by vehicles. City planning favoring walking and bicycling, together with building more compact city districts where housing, work, and basic services are found within walking distance, illustrate such thinking. These three routes can, respectively, be labelled ***low-carbon vehicles, transport services***, and ***distributed cities***.

There are different forms of public-private collaboration to deal with the above objectives. Purely private interests are strongly focused on the vehicle

as the catalyst for change, whereas the public sector is taking a broader view and is re-evaluating how to think about cities. A key question is whether the hundred-year tradition to plan cities for cars will have to be replaced with some new concepts.

The change necessary to overhaul this century-old tradition calls for a new scope of innovation, one which exceeds the bounds of past efforts. The ***transcendent innovation*** activities needed to reshape urban mobility will start in the most progressive cities. Mobility is one of many services orchestrated by the city; mobility serves as a module within the entire system. Nobel laureate in economics Edmund Phelps has recognized that cities have an important role in innovation. They represent diversity, which breeds originality and innovation. Phelps has also noticed that the Nordic countries have "modern values", which characterizes innovative nations.

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A crucial concern upon entering the 2020s is how to come up with new technologies that can reduce our dependence on fossil fuel. What is also needed is a rethinking of urban life, enabling us to develop cities in such a way that there will be fewer private cars. This in turn will ask for innovative approaches by individual cities, finding ways for how they can provide residents with a good life and at the same time meet their carbon emission targets.

However, cities cannot act in isolation. The surrounding world dictates a lot of things that city management cannot avoid. The trade dispute between the United States and China, Brexit, and the relationship between Russia and the rest of the world are examples of global realities that also impact the maneuverability of individual cities. Such a world has been called a VUCA-society. The notion of VUCA started to be actively used by the US Army in the 1990s to address a world more *volatile, uncertain, complex,* and *ambiguous* than in the past (dubbed VUCA). It was seen that for leaders to deal with these new circumstances they had to employ an active learning process, with emphasis on

how to think as opposed to what to think. The ambition with a VUCA mentality is to integrate historical understanding, conceptualization, creativeness, and originality. Organizations must rethink how to build relationships with other organizations, not just to deliver competitive products and services but also secure that they stay innovative.

The request for continuous innovation implies that enterprises must support two new types of processes that we will call ***collaborative intelligence*** and ***configuring experimentation***. These two processes together provide the basis for ***transcendent innovation***.

Collaborative intelligence means network activities which sharpen the capacity of the participants to register signals about changes in their environment. Such networks should enable firms to act quickly upon changing circumstances. Here, diversity in thinking is of value. However, if the group is too heterogenous there is the risk of discussions becoming unproductively superficial. Therefore, finding the ideal composition of partners is a key success factor in spurring collaborative intelligence within a network. Furthermore, a self-organized network is most efficient when aiming to support intelligence. The social relationships should then evolve based on the complementarities of the participants.

Configuring experimentation, on the other hand, calls for a different type of network. Here, the agenda is set by a nodal organization with a clearly defined problem or goal to be addressed. This nodal enterprise then invites partners to cooperate. While orchestrated by the nodal organization, the complementing partners can influence the outcome as the orchestrator does not possess all the necessary capabilities. Here too, success is dependent on establishing the right type of partnership.

The expertise necessary for ***transcendent innovation*** in the development of new products and services for urban transportation increasingly calls on companies to include the public sector in both aforementioned processes. City organizations engaging with the private sector to innovate must deal, in turn, with their own legal and political public-sector constraints. What can then a city do to improve its image as a place to live and work? One possibility is to

define some clear objectives and then apply principles of ***strategic management*** in the execution. ***Visionary leadership*** by the city mayor is another way to engage partners around initiatives that will enhance the attractiveness of the city. Relying on market forces by applying ***enabling orchestration*** is a third way to initiate innovation collaboration. ***Strategic management***, ***visionary leadership***, and ***enabling orchestration*** are three different ways city managers can involve external partners in innovation efforts.

Digitalization accentuates the demand on cities to collaborate with the private sector to create new markets and ecosystems to speed up innovation. The OECD has suggested that cities should take leadership positions in innovation systems, preferably becoming the node of the network. City managers can then help collaborating firms to grow based on the results of the collaboration. This requires the city to nurture an entrepreneurial climate and using public procurement to co-create markets for new technological innovations. By acting as a "public entrepreneur" a public-sector actor can be critical in supporting innovative ecosystems.

A city can become the driver for transformation if the city can express a clear vision and establish an architecture that supports the implementation of that vision. As the city has the monopoly rights on land development, the transportation infrastructure is an area where the city management can push development activities. If the city decides to steer the innovation process, the city must anticipate and influence the change process and guide future actions. Seizing the potential requires the formation of appropriate policies and programs that will take into consideration the benefits the programs can provide for the network partners.

Each of the three management approaches (***strategic management***, ***visionary leadership***, and ***enabling orchestration***) have their own strengths and weaknesses. In the following the respective approach will be separately presented, where after what will be discussed is in what way the Nordic countries are different from other parts of the world, and what are the possible benefits the Nordic approach could offer to innovation activities in the mobility area.

Strategic management and responsible citizenship

When applying principles of ***strategic management***, the key to success is the development of a project portfolio consisting of both longer-term initiatives and smaller projects with rapid impact. Such an approach can be called city entrepreneurialism. Interventions must be selective and orientated towards improving the efficiency of the city. Cities can orchestrate ecosystems built around individual projects. If a project is successful, this may lead to new projects, and gradually a new more permanent network of partners will evolve. In this spirit cities can cultivate the formation of new ecosystems. This can be even more efficient if the city can use public capital to encourage private investments in projects.

Three viewpoints need to be integrated in the strategic efforts:

- how to position the city in the broader geographical context wherein it is located;
- how the actions will improve the quality of life and offer progress for the city residents; and
- how the initiatives can support industries and businesses with whom the city is collaborating.

Different types of construction projects are an often-selected method to implement a city strategy and encourage private-sector involvement. Here the city needs to be careful as property developers may easily exploit immediate short-term opportunities but not commit to the longer-term transformational objectives sought for by the city. If the city is looking for ecologically and socially sustainable development, it is difficult to combine these objectives with the economic growth ambitions that are normally connected to various property development projects. Economic growth objectives such as increasing the density of employment and workspaces to attract new tenants and knowledge

workers may easily outweigh other softer objectives. This may also lead to overlooking the implications this may have on the residents in the area. An example of the challenges related to this form of development is the way the 22@Barcelona city district development evolved.

Research funded by the Spanish government addressed the issue of how much the development of 22@Barcelona had been guided by property speculation. The view was that the original knowledge-related objectives had had to give way to more mundane financial objectives and it had become challenging for the city government to truly instill a knowledge-based business community in the 22@Barcelona district. Financial interests had led to compromises regarding the composition of tenants in the properties. A significant portion of the tenants consisted, as a matter of fact, of companies that had relocated within Barcelona to secure lower rents. Some observers also argued that the holistic approach of the 1990s had disappeared. This had led to a relaxation of regulations, with the development largely left to private investors with limited civic participation.

Barcelona later reformulated its strategy and launched its Smart City approach. This was expected to lead to social innovations and extended cooperation between research centers, universities, and private and public partners catalyzed by the Smart City Expo World Congress launched in 2011. This became an annual event with more than 10,000 participants each year. Barcelona gained recognition when the city was named the first European Capital of Innovation in 2014. According to Máire Geoghegan-Quinn, European Commissioner for Research, Innovation and Science, the award was given to Barcelona thanks to its *'ability to introduce the use of new technologies to bring the city closer to citizens'*.

Barcelona's Smart City concept was implemented based on a detailed architectural design and roadmap, which also was aligned with the European Union's Strategy 2020. To foster competitiveness, Barcelona established its Innovation Platform to apply new forms of information and communication technology to support the emergence of a smart city. The Smart Barcelona approach emphasizes international promotion, international collaboration, and

local projects. The development has been based on a predefined legal framework for public-private partnerships, and various means to create new types of collaboration, such as living labs, facilities for experimentation, and the provision of international linkages.

The strategies pursued by the Barcelona city council under what has been labelled the 'Barcelona model' has resulted in increased competitiveness. Barcelona has been able to not only attract but also proactively engage and connect the international community with local firms and institutions.

However, Barcelona has scored less well on social sustainability. The implementation of the 22@Barcelona plan created tension between the city council and community groups. Later residents have been demonstrating as they perceive that the city management has put tourists ahead of residents in city planning. In 2017 demonstrations used the slogan "Barcelona is not for sale" to voice the concern about the rapidly increasing number of tourists.

The Barcelona case thus suggests that the ***strategic management*** approach must also engage the residents. Public administration researcher Eran Vigoda has suggested that city managers should meet the new situation by getting used to be "one lady with two hats". This means that depending on the situation the city may either swiftly and efficiently respond to suggestions from residents, i.e. being customer responsive, or invite residents to more in-depth problematizing about how to bring certain development initiatives forward. The issue of responsibility differs depending on the situation. The notion of ***responsible citizenship*** implies that the division of responsibility should be reflected upon in each type of situation, and the possibility to increase the responsibility of the residents is a key enabler to implement ***transcendent innovation***.

Visionary leadership and the logic of care

A ***visionary leadership*** style asks for a holistic attitude. The leader will have to state his or her goals on a high level and make sure that those necessary for success cooperate with each other and with the outside. Ecological development goals should be combined with goals for economic growth and social innovation. To integrate these ambitions, it is necessary to get the commitment from a broad set of external stakeholders.

An example of a visionary city leader is Mayor Ilmar Reepalu of Malmö, who was city mayor 1994-2014. One of his first initiatives was the city architecture exposition, the European Housing Expo (Bo01) in 2001. Reepalu knew that major projects and large exhibitions could be catalysts for transformation. Therefore, he was very active in preparing this exhibition.

Bo01 was a great success for Malmö, the significance of which continues to be recognized. The Western Harbour district, where the Expo was organized, became a leading example of the environmental adaptation of a densely built urban environment. The sustainability accomplishments of Bo01 are attributable in part to the control the city exerted through ownership, goal formulation, and planning. This involved the architect, city officials, departments, and developers through a "creative dialogue."

Despite the visible success of individual projects, which have made Malmö a more sustainable city, Malmö has remained a city of social divide and high unemployment. This also been accentuated by the fact that the city population grew from 262,000 in 2001 to 340,000 in 2019. There has also been an increase in the number of immigrants to Malmö.

Aware of the growing tensions, the city government of Malmö established a commission for a socially sustainable Malmö in November 2010. The commission's task was to produce a scientific basis for reducing the health inequalities in Malmö.

The Malmö Commission published its report in 2013. The report recognized that there were two ways of portraying Malmö: a bright and dark image. The bright image presented Malmö as a creative city which could be likened to Berlin or New York. The success story often related to the investments in the Öresund bridge, the high-rise Turning Torso, and the City Tunnel. The dark image included tales of poverty, alienation, and growing tensions between groups.

The Malmö Commission emphasized that knowledge and learning should be linked to management, involvement and influence, or governance. Knowledge alliances should focus on combining excellence and relevance and deal with sustainable development and welfare, with focus on the connection between economic growth and health. The Malmö Commission also addressed the leadership needed for sustainable development:

Modern and courageous leadership is required at all levels to create good prerequisites for all Malmö residents. Leadership that understands the meaning of promoting the work for a sustainable city for everyone who lives in the city. Leadership that contributes to visions and development goals, which perceives the city with all its opportunities and challenges as a whole, and which regards itself and its activities as a tool to use in conjunction with others. Furthermore, leadership which is value-based and therefore goal-orientated, brave and diligent. In order to create this, long-term development work on leadership is required. (The Commission for a Socially Sustainable Malmö, Final report, 2013, p. 132)

The Malmö approach thus suggests that city leadership should be able to mobilize and engage residents around a common purpose. In this respect the care metaphor, as introduced by Dutch philosopher Annemarie Mol, implies going back and forth in an ongoing process. What matters is the outcome, the result. In healthcare the outcome is improved health, which means an improved anatomical system. In city planning, we should get a more livable city. In both cases this implies an open-ended process. What is required is persistent efforts to improve the situation. The art of care is to figure out

how different actors might best collaborate in order to improve the situation. In doing this the residents have to be intimately involved. However, the new requirements imposed on cities by climate change mean that residents must also make certain accommodations to ensure that the emission targets can be reached. Therefore, exploring new ways of shaping a good life becomes the common task. The 'balance' sought is something that needs to be established actively, by attuning viscous variables to each other. Annemarie Mol has noticed that "In the ***logic of care***, it is impossible to separate management and implementation. Care is not a matter of implementing knowledge and technology, but of experimenting with them. Good care means being knowledgeable, accurate and skillful. But added to that it also involves being attentive, inventive, persistent and forgiving." (Mol, The Logic of Care, 2008, p. 64)

Enabling orchestration and networks of trust

The ***enabling approach to city management*** means that the city management develops various possibilities that it offers to its users, its residents, and other city actors, but leaves the selection of which initiatives to select to the market. An illustration in a smart city context could be the online co-creation of a city service, which enables citizens to interact with their city and enables entrepreneurs to generate business out of this. How this interaction and value co-creation will take place is left to be negotiated by the partners themselves.

Finnish researchers interested in the ecological perspective of the urban environment and looking for ways to meaningfully describe environments in which we live have also promoted the enabling approach. In the Finnish context, the enabling approach suited the country very well in the early 2000s, as the success of Nokia had created a symbiosis between Nokia and the leading public sector actors. In the Finnish innovation system, each actor performed its role diligently in accordance with the needs of Nokia. Due to the close collaboration, Nokia trusted its public sector partners and revealed its own strategy also to them, thereby supporting the whole national innovation system.

Even when Nokia changed its strategy, the dynamics of the national innovation system remained the same. It was not until the 2010s that the public-sector organizations realized that Nokia previously had provided the direction for the public-private collaboration in its role as a global orchestrator, whereas the new ecosystems did not have the same international interaction as previous Nokia-led initiatives had had. Therefore, the quality of the orchestration of the innovation system had declined.

As the importance of Nokia diminished, startups and SMEs were seen to be critical to enabling the necessary transformation of the Finnish business sector. This was provided by the emergent, fast-growing startup community originating from Aalto University. Students at Aalto University had formed an international network around the startup event Slush. This became a catalyzing

activity for the city management in Helsinki, as it introduced an international dimension to the innovation ecosystem. Here too, the City of Helsinki could easily support this emergent phenomenon based upon its enabling approach.

The emergence of Nokia as a telecom giant in the 1990s had strongly shaped the Finnish capital region. The positive impact of Nokia on the country, and on the capital region, implied that Finland did not historically promote Helsinki abroad to attract international investments. It was not until the first metropolitan policy document was published in 2009 that a competitiveness strategy for the Helsinki metropolitan area was formed.

The competitiveness strategy recognized the need for the Helsinki metropolitan area to attract more foreign investments into the area. Since 2010 the City of Helsinki has channelled a main part of its innovation activities through Forum Virium, a wholly owned subsidiary of the City of Helsinki dedicated to the promotion of Helsinki. Forum Virium sees new technology and open access to data as the most important tools for building Smart Helsinki. Shared, common standards and replicating successful operating models are key objectives. Forum Virium supports the City of Helsinki to be an enabler by opening its processes, data sets, information systems, and policies.

As early as 2002, a report by the OECD noted that Finland, in general, and Helsinki in particular lacked a focused strategy of economic diversifications (such as developing ICT activities beyond the scope of the mobile phone technology cluster) for securing long-term competitiveness. The risks relating to this very narrow sectoral focus materialized when Nokia got into problems. When Helsinki tried to reposition itself in the 2010s, it had to deal with several drawbacks, such as a shortage of affordable housing and a lack of an 'international climate' or what Kepsu and Vaattovaara called cultural obstacles. During the heydays of Nokia Helsinki and Finland had not been very encouraging for entrepreneurs.

Historically Helsinki has relied extensively on the private sector to provide the direction and content for the innovation development in the area. This mindset was institutionalized in the 1990s through the very successful Nokia collaboration. Today City Mayor Jan Vapaavuori has recognized that there is

a need for a more systemic effort by the city to integrate different viewpoints within and outside the city organization. He wants to initiate new types of dialogue between the city and its stakeholders to secure that the coming innovation initiatives will support the ambition to bring Helsinki to the next level of development.

Linux has institutionalized the positive dynamism Finland had in the 1990s. Linus Torvalds, who started Linux in Helsinki University, has identified ***networks of trust*** as the underlying characteristic for the distributed network forming the Linux community. In distributed networks there are some people that just stand out. These individuals build trust among each other because they have been working together and they have seen what the other persons can contribute. Trust means that you accept the other person's decision. The nice thing about trust is that it does network. You only need to trust a few people. They in turn have other people they trust. In this way a network of trust supports a distributed operational network. Establishing such networks is a key challenge for cities if they want to be successful in ***transcendent innovation***.

How Nordic cities can make a difference

Addressing climate change will ask for a multitude of measures. The technological efforts to find new solutions are not restricted only to the transport sector, but there are also efforts to investigate new types of energy sources as well as carbon capturing. None of these technologies are yet close to commercialization. This implies that the main road forward must be based entering many different initiatives in parallel in order to achieve the magnitude of change that will be needed. What impact will this then have on city management?

The three types of leadership (***strategic management***, ***visionary leadership***, and ***enabling orchestration***) offer different possibilities. ***Strategic management*** integrates different activities but has not much to offer when deciding with whom to do what in the very short-term perspective. Because of the emergent nature of innovation ecosystems, the gradually evolving interaction pattern among the key actors will define how successful the outcome will be.

The ***visionary approach*** is useful when the city itself controls the resources to be mobilized in the development work. New bus lines through which the city will also carry out technology experimentation is a good example. In such projects a strong leader orchestrating the collaboration may add commitment and engagement in the collaboration. However, for developing comprehensive new software platforms a centralized process with a formally authorized visionary leader may be counterproductive. There are great risks that adaptation will be insufficient, and the cross-organizational dialogue will suffer.

The ***enabling approach*** offers many appealing features but is dependent on having enough substantial knowledge among the non-city ecosystem members. Many times, this is not the case due to the public procurement practices based on competitive bidding, emphasizing price and short contracts, which is contrary to the principles of networks of trust. If the companies have the risk of exposing all their knowledge in an open market fashion during the planning phase, and then lose the final contract

when bidding for implementation, these candidates may decide to not participate at all.

The here presented examples have illustrated that city organizations have several hurdles to overcome when mobilizing external partners for innovations. However, as the telecom development in the Nordics starting in the 1970s has shown, the underlying social architecture in the Nordic countries has historically provided opportunities for successful public-private collaboration. The telecom development had a significant global impact and offered the Nordic countries a competitive advantage in comparison with other geographical areas. What characterized the telecom sector was that there was support on national level, both politically and among the leading companies, to pursue a common strategy. The implementation work was then done locally in cities.

The transformation of urban mobility is today in a similar stage as the digitalization of telephony was in the 1990s. This suggests that a collaborative effort with all main stakeholders involved could proceed in the Nordic context. Compared to many other countries the Nordics have a long tradition of balancing economic growth with societal objectives.

Historically taking a collaborative approach to innovation has not been very common outside the Nordic area. It is therefore worth noticing that 180 leading American CEOs including Tim Cook of Apple, Jeff Bezos of Amazon, and Doug McMillion of Walmart in August 2019 published a statement reframing the purpose of business and corporations as stakeholder value, not solely shareholder value. This suggests that the big challenges facing humanity will ask for new approaches. The principles for ***transcendent innovation*** are anchored in a stakeholder view on business.

Making transcendent innovation happen

To reduce carbon emissions cities and companies must address the innovation challenges in a profoundly different manner than during previous phases of transformational change. Three factors ask for deep rethinking: i) how to collaborate for innovation, ii) how organizations learn iii) and the different aspects of time. In the following these transformational change drivers will be briefly addressed.

Traditionally the thinking about how enterprises organize for innovation is expressed in the "make or buy" decision. Two different ways can be used to combine the resources needed for a product or service: mobilize the resources internally within the organization or buy the resources from the market. However, for new mobility services, the offering cannot be pre-engineered in detail before the offering development and resource allocation decisions will be made. The offering will evolve through the collaboration between a multitude of actors, some private and some public. If the actors involved in this collaboration are committed to the collaboration over a longer period, a new business ecosystem may evolve. Here responsible citizenship and networks of trust illustrate how the dynamism of innovation is changing.

How to collaborate for innovation?

How do organizations learn?

Clockspeeds?

Digitalization has added further complexity to the way organizations innovate and learn, as it not only forces them to think differently about the long and the short term but also to get used to how different clock-speeds are intertwined. People expect omnipresent Wi-Fi connectivity in their daily lives, and hence the car is no exception. They expect services across a spectrum of functions. Hence the automobile must be configured as an information-services platform, delivering communications and computing as services. This

forces car companies to coordinate between developments that occur at three different clock speeds. There is one clock speed for the *car platform*, one for *electronic hardware*, and one for *software*. When the offering is not a physical product, but a service co-produced by public and private actors, there is also a need to add a fourth clock speed: the one of *political decision making*.

The reversal of the world's carbon emission trajectory can only happen with a portfolio of solutions. Deploying such a portfolio must take place on the ground. There is no approach that will be applicable to all situations. Progress must be made case by case and city by city. Cities need to engage and leverage networks of complementary partners to be successful. Three types of leveraging can be identified:

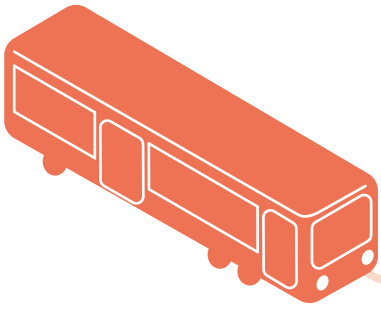
- *Leveraging operations*: benefitting from ongoing or agreed-upon activities so that the development element will become an add-on with minor adjustments/funding needed.
- *Leveraging partners*: supporting partners that can provide a disproportional benefit to the city due to synergies. Companies may offer resources at severely discounted rates to be used by the city, if they can save time or establish valuable references. This can become an embryo to a productive innovation partnership.
- *Leveraging individuals*: building upon relationships with insightful/powerful individuals in the network. It can be extremely valuable to have access to their views on what direction to steer the strategic portfolio or to use their connections to important resources outside the existing network. Influential individuals may also provide positive image effects.

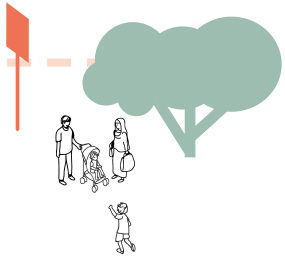
By assembling the project portfolio in such a way that the above-mentioned requirements will be fulfilled the organization will increase its capacity for ***transcendent innovation***. Considering the VUCA-challenges and the legal

constraints relating to public-private collaboration, city representatives must make sure that the most insightful and resourceful private partners in the ecosystem are motivated and committed to engaging themselves in the initiative. As Professor Vigoda has noticed: cities must acutely look for ways to move from a "they" spirit to a "we" spirit when they consider how to involve firms and citizens in their innovation activities. Such a "we" spirit is necessary to support a process of collective learning.

For private sector participants the challenge is to deal with the various clock-speeds and the constraints the public sector has in respect of legalities and budgets. This asks for patience and in-depth understanding of financing models and risk-sharing possibilities in order to make it possible for the private and public interests to converge.

It is very demanding to orchestrate a well-functioning ecosystem for ***transcendent innovation***. As trust will be a key resource for the collaboration to succeed, it is often good if some of the partners involved in the collaboration can introduce a party that already has a proven track record of this type of orchestration. The role of the orchestrator is to secure the integration between immediate value creation, experimentation, and collaborative intelligence. An innovation ecosystem well designed, with a sound social architecture, and properly orchestrated, should have the ability to perform on all these dimensions simultaneously.





Nordic Cities as Transformers of Urban Mobility

The principles of ***transcendent innovation***, outlined in the previous section, offers Nordic cities an opportunity to bring urban mobility to the next level based upon the strongholds respective city has. In the following we will present how the Nordic capitals already today represent global forerunners in many respects. We will also outline some possible pathways forward through which each city may further speed up the development towards reduced emissions and more livable cities.

Copenhagen – a city for people

Foundation

In the late 1970s Denmark was evaluating different alternatives to address the energy challenges facing the world after the oil crisis in 1973. One alternative at this stage was nuclear power. However, strong grassroots movement against nuclear existed and leading individuals started to promote wind power as an alternative energy source in Denmark by organizing the Danish Windmill Owners in 1978. This established a strong collective engagement around environmental consciousness, which also has been visible in the way city planning in Copenhagen has evolved. Denmark didn't deploy nuclear power, and the Danish wind turbine industry is today the leader in the world.

The collective and collaborative Danish efforts to develop new technologies in the energy sector has had a significant impact on the global cleantech markets, with strong support from the national Danish government. During the 1990s the Danish regulators were able to 'modulate' the growth of the wind turbine industry with policies flexible enough to rectify temporary undesirable outcomes. This resulted in the blurring of boundaries between design and production, planning and executing, rulemaking and rule following. In this respect, the formation of the ecosystems of e.g. Vestas and Siemens was supported by the actions taken by the government. Similar efforts have later been applied in the transport sector.

In 2009 "A Green Transport Policy" agreement was put in place in Denmark. This policy included a "Drive Green" campaign, energy labelling of vans, certification for green transport, recommendations for green procurement, green taxies, continuation of tests on module trains, trials for energy-efficient transport solutions and so on. The agreement also included significant investment in expanding the railway system and initiatives to make cycling a more attractive, safe and widespread mode of transport. By 2025 Copenhagen aims to be net carbon neutral, meaning it plans to generate more renewable energy than it consumes energy. This would require that by 2025 75 % of all trips in Copenhagen are to be by bike, by public transport or on foot. Still, the transport sector continues to increase its share of the total city carbon footprint. This illustrates a common dilemma in many countries: how to balance the interests of the people who live in cities and those who live outside.

Copenhagenization

In promoting the use of public transport Copenhagen has been highly successful. The expansion of the metro will put the vast majority of the city's residents within 650 meters of a station, and bicycle paths are already three lanes wide on busy routes, and 43 percent of Copenhageners commute to work and school by bike. Further developments have been identified in the action plan

for better mobility in Copenhagen published in 2014. An important topic in this action plan is the ambition to build an IT system handling “Big Data” so that searches can be carried out across data types, both of current and historical data. The system will be based on open standards and protocols.

The importance of improving the livability of cities by supporting cycling and waling has been a main argument by Jan Gehl, an architect who has become world known for his concept of Cities for People, which also was the title of a book he wrote in 2010.

Gehl’s philosophy advocates an incremental approach to urban planning. His main concern is that the human dimension has become an overlooked urban planning topic, while other issues such as accommodating the rise in car traffic has been more in focus. What is needed is taking public space, pedestrianism and the role of city space as a meeting place for urban dwellers more into consideration in city planning. There must be a more systemic view on urban planning, and not just focusing on the architectural features of individual buildings. By relating to the book The Death and Life of Green American Cities by Jane Jacobs in 1961, Gehl urges urban planners and architects to reinforce pedestrianism as an integrated city policy. There is a need to develop lively, safe, sustainable and healthy cities and strengthen the social function of city space as a meeting place for urban dwellers. Gehl recognizes that the sustainable objective is particularly relevant for transport planning, and therefore he promotes the concept of “green mobility”, travel by foot, bike or public transport. Increased walking and biking will also have a positive health impact.

The philosophy proposed by Jan Gehl has led to the notion of Copenhagenize, meaning efforts to bring utilitarian cycling to the heart of city planning. There is also evidence of the benefits of Copenhagenizing. It has been shown that for every kilometer commuted by bike instead of by car in Copenhagen, society saves around 1 EUR per km. The main part of this saving is due to the health benefits of cycling.

2030 urban mobility potential

Copenhagen has an impressive history as an early innovator in urban planning. As early as 1947, the visionary urban plan, 'the Finger Plan', for the region of Copenhagen was published. A governing principle for this plan was that the distance between housing, jobs, and green areas should be as short as possible and reachable by public transport. By leveraging upon the international recognition of its forerunning abilities in combatting climate change Copenhagen together with its partners has the possibility to take an even stronger international role in transforming urban mobility. There is also a growing number of larger private Danish organizations like Danfoss, Grundfos, Ramboll and Cowi, which are consolidating the Danish experiences and integrating them with the know-how from other parts of the world through acquisitions and alliances.

The basis for Copenhagen's actions over the next ten years is the action plan for the sustainable development goals that was published in 2018. The engagement of citizens is particularly visible in Copenhagen, which has been able to foster a climate-conscious sentiment in the city. Denmark and Copenhagen have good possibilities to further raise their international ambitions in respect of cleantech exports as suggestedby the top scoresthey received in the Global Cleantech Innovation Index 2017 by WWF and Cleantech Group, excelling in commercialized cleantech and cleantech exports

The decentralization degree of public sector spending in Denmark increases the importance of cities as drivers of change. The efforts to provide significant global impact will require the Danish enterprises engaged in promoting Nordic sustainability to collaborate with partners outside Denmark. The gathered experiences from the incremental approach have been very well received internationally. Now what is needed is that Denmark and Copenhagen must evaluate whether the world has the time available that incrementalism needs. If there is demand for quicker measures, new approaches must be found.

Oslo – the world's electric vehicle capital

Foundation

The first experiments related to electric vehicles were done as early as in the mid-1830s. In the early 1900s it was still not clear whether the internal combustion engine or the electric motor would power future automobiles. 1915 Arthur Bjerke, a Norwegian developer of electric cars, wrote to the Norwegian road authorities and asked for reduced fees on electric cars arguing that they were more environmentally friendly than fossil fuel cars. However, despite its environmental advantage the electric car was defeated by the petrol car, and it was not until the oil crises in the 1970s that the interest for developing electric vehicles re-emerged. At that time Lars Ringdal made two EV-prototypes in Norway using a washer motor and plastic hull. Later his son Jan-Otto Ringdal continued the work on developing electric vehicles and the company Pivco (for Personal Independent Vehicle Company) was established in January 1991 in Oslo to produce cars that were branded Think.

Ringdal showed off his car at the 1994 Winter Olympics in Lillehammer. Ringdal had great hopes with Think as California had stipulated a new law on

reducing car emissions. Think cars were therefore well aligned with new automotive trends, and 40 cars were sent to California to be tested after the Olympics. While car manufacturers were looking for ways to develop vehicles according to the new emission requirements Ford decided to buy Ringdal's company in 1999 as it scrambled to meet California's legislation on zero-emission cars.

Ford was able to rapidly build up production of Think cars, and about 400 cars were shipped to the US before the court decision in July 2002 forced the state of California to halt and phase out its car emission regulation efforts. This immediately put a question mark on all American electric vehicle projects, and already in August 2002 Ford decided to sell Think company. The Indian businessman Kamal Siddiqi bought the company in 2003. As the commercial outlook for electric vehicles had now radically changed, Siddiq was not able to bring his own vision for the company forward, and it went into receivership in February 2006. Then Jan-Otto Ringdal together with Jan-Olaf Willums bought Think company for an undisclosed sum. The new Think City was launched in 2007, and the Financial Times wrote that even if Think had modest volumes, the ambitions expressed by Mr. Willums was that Think should "epitomise the car for the city user, and build the 21st-century car company".

In December 2008 Think reported urgent financial distress. In August 2009 new investors entered the company and it was announced that the Think City electric car would be produced by Valmet Automotive in Finland. Production started in December 2009 in Uusikaupunki, Finland. Still the financial situation for Think remained difficult, and the production of the Think City car was stopped in March 2011, and Think company filed for bankruptcy three months later.

The EV capital of the world

Completely unrelated to Ringdal's efforts the develop the Think car a small environmental activist group, called Bellona, including members of the successful Norwegian pop-group A-ha, had started to promote the idea of electrifying the

transport sector. In 1989 they imported a Fiat Panda that was rebuilt into an electric car, and by political lobbying they got the authorities to drop the import tax on the Panda. In 1992 the electric car enthusiasts established the Norwegian EV Association, which the same year organized the first Nordic electric car conference in Oslo. The Norwegian EV-activists were already envisaging a future of electric cars in Oslo and proclaimed that the technology was already there. The optimism was documented by the municipal energy company Oslo Energy in the proceedings from the conference. The following quote illustrates the confidence in the future of the electric car: "Cars with electrical drive systems represent a solution for the future and will in steadily increasing degree be seen on the roads".

In 1995 the city council of Oslo unanimously voted for an exemption for toll road fees for electric cars, which in 1997 was made permanent and nationwide by the Norwegian government. Over the coming years numerous policies were established to support electric cars such as tax benefits, free parking in cites, and as from 2003 the right to use bus lanes for electric cars. In 2012 there was a political agreement not to change electric car privileges before 2018 or 50.000 sold electric cars. That number was achieved in April 2015.

2030 urban mobility potential

Entering the 2020s Oslo has evolved into the world's leading city for electric cars. 62.9 per cent of all newly registered passenger cars in Norway in July 2019 were equipped with an electric or hybrid drive. This has implied that the city management of Oslo is now shifting the emphasis towards making the city more liveable and not just focusing on how to reduce carbon emissions from private cars. In 2017 an area of approximately 1.3 km² was transformed to better accommodate cycling and walking. To improve city life people should still be able to drive by car to the city center, but large areas will be freed for other needs. Car traffic restrictions will be introduced gradually. In this way, the transition to fewer cars in the city will be smooth, and

adjustments can be made along the way when necessary.

When Oslo was elected Europe's green capital in 2019 one of the reasons for the nomination was the improvement in cycling and public transport infrastructure, the introduction of car-free zones, and encouraging the use of electric vehicles. The Norwegian EV-policy has been based upon the view that the only way to address climate change is to start with concrete actions. Norway and Oslo have shown the world that a relatively fast transition can take place when the incentives are right. This has increased the overall speed of transformation of urban mobility not only in Norway but globally.

Thanks to being a pioneer, Norway has the possibility to become the first country in the world with a car fleet approaching zero emissions. By continuing a dynamic approach to steering the whole fleet of cars towards lower emissions, the city of Oslo can continue to offer their residents a more sustainable environment. The electrification of transport will also raise awareness, and this can have additional positive spill-over effects supporting a broader consciousness about the need for a systemic change to combat climate change.

An area where the learning from the electrification of urban transport can be transferred is the maritime sector. Autonomous transport has the potential to become a Norwegian technology spearhead. Norway can use its early mover advantage as the leading market for electric vehicles to build up assets transforming the shipping industry. Yara Birkeland is in 2022 expected to became the world's first fully electric and autonomous container ship, with zero emissions. The vessel will reduce NOx and CO2 emissions and improve road safety by removing up to 40,000 truck journeys in populated urban areas when taken into use. This has the possibility to became a game-changer for global maritime transport, and it will also contribute to the global efforts to speed up measures to reduce carbon emissions. Positive spill-overs from the maritime sector can be expected to further encourage additional experimentation and development efforts also in the urban mobility context.

Stockholm – opportunities shaping the future

Foundation

Based on the 1987 Brundtland sustainability report the Swedish government began to create a new environmental code to secure sustainable development. These ideas were also visible when the first detailed development plan for the Hammarby Sjöstad city district was presented in 1991. The ambition level for the district was considerably increased when Stockholm in 1995 decided to apply to host the Summer Olympic Games in 2004 and the plan was to build the Olympic village in Hammarby Sjöstad. The city management recognized that several aims could be reached by making Hammarby Sjöstad a showcase for urban sustainability and becoming Sweden's role model for ecological planning, building, and living. The city would get a new modern residence area, and at the same time, this would also initiate active environmental efforts in the city.

Hammarby Sjöstad was right from the beginning intended to become a high-density or compact city district. When ready in 2020 there will be 11,000 apartments and 25,000 residents. The planning philosophy was defined as "twice as good". The stated target was that the district's environmental performance should be twice as good as "the best applied technology in new development today".

When the 2004 Olympics were awarded to Athens in 1997 the conditions for the planning of Hammarby Sjöstad changed, and it was uncertain to what degree the new city district could become a global display for Swedish urban housing development. Still the ambition level was kept. The outcome was that Hammarby Sjöstad evolved into a role model of a new perspective on urban planning in Stockholm. It also shaped the coming discussions on how to transform public transport in Stockholm. In this respect Hammarby Sjöstad's environmental program brought the integration of environmental issues in urban district planning to a new level. This is also supported by the fact that Stockholm was the first European city awarded the title of European Green Capital of Europe in 2010. The development of Hammarby Sjöstad has also been an important tool for the international marketing of Swedish cleantech solutions, and there has even been criticism regarding over-selling the environmental achievements of the development efforts.

Leveraging Hammarby Sjöstad

Hammarby Sjöstad was developed based on the principles of system integration. To achieve the ambitious goals, it was agreed that the project management should emphasize goal orientation and encourage and develop creative and innovative solutions. This required new working methods with integrated co-operation between the research, business, national and local government communities, as well as environmental interest groups.

The Hammarby Sjöstad development also made efforts towards new types of mobility solutions. In 2012 the Urban Mobility Strategy for Stockholm

was published. The strategy described what it would be like to live in, work in and visit Stockholm in the future. This was summarized into the concept of the Walkable City. Urban planning was a means through which the overarching objectives of urban mobility would be achieved. A key element of the Walkable City's strategy was to utilize city planning to reduce the need to travel.

The starting point for the 2012 mobility strategy was to see Stockholm as a city with cars but not as a city for cars. The proportion of journeys undertaken by car should be reduced. More people need to choose to walk, cycle and use public transport. This is also necessary to reach the sustainability targets.

The congestion tax, introduced permanently in August 2007, is in Stockholm an important part of the total transport system. It is estimated that without the tax Stockholm would have about 20 per cent more cars on the street and traffic delays would be much more extensive. Considering the environmental impact of transport, the Urban Mobility Strategy considers environmental progress to be mainly driven at national and international levels. The aim is that all vehicular traffic in Stockholm will be fossil-fuel free by 2050.

2030 urban mobility potential

Evaluations of the Hammarby Sjöstad project have shown that the project team was able to 'create' their own situations of opportunity, e.g. they arranged seminars and competitions, and coordinated the development of the Hammarby model. In all these situations, the formal power of the team was limited. Instead, informal persuasion, negotiations and knowledge dissemination were used as policy instruments. This suggests that the Hammarby model has benefitted from all three leadership elements of ***transcendent innovation***. There has been a caring attitude, citizens have been engaged, and the project team created networks of trust. Still, regarding development contracts and detailed plans, the project team had relatively fewer possibilities to influence and shape the development trajectory. It has also been argued that the knowledge and experience gained through the environmental management process

of Hammarby Sjöstad generated very limited learning or spin-off effects. The routines of the roads and real estate office were hardly influenced, and the same applied to detailed planning. This result was not perceived as exceptional; on the contrary, demonstration projects all too often remain 'one-offs'. However, when moving forward these insights may now be used to develop proper mechanisms for knowledge dissemination, e.g. through the formation of knowledge alliances.

Sweden and Stockhom now also have a new opportunity arising from the global attention given to Greta Thunberg, who has emphasized the role of transport as a main area to be addressed when reducing carbon emissions. This is exemplified by her own choice to travel by boat to the UN meeting in New York. Even if Greta Thunberg may be seen as controversial, she exemplifies the entrepreneurial approach that will be needed to properly address the climate challenges.

Compared to other Nordic countries Sweden hosts the headquarters of a many global companies. Engaging these companies more actively in joint efforts to promote new mobility solutions internationally is an untapped potential. Here city pilots and demonstrations should be used more creatively. Some interesting activities are already in the pipeline. IKEA has announced that it will decarbonize its delivery fleet worldwide by the end of 2025. Volvo Cars is planning to not have any diesel alternatives for new car models to be launched after 2019. Simultaneously Volvo Cars is increasing the efforts to promote its mobility services through its M mobility brand.

In a ranking of 100 cities according to sustainable transportation and urban mobility Arthur D. Little ranked Stockholm as number two globally, after Singapore. Stockholm's smart and connected city plan includes a range of initiatives including smart traffic management, traffic-light priority for buses, a congestion-pricing system and smart lighting for bicycle paths. These initiatives are in international comparison providing Stockholm with a rich array of elements for a systemic approach to urban mobility transformation.

Helsinki – where technology meets innovation

Foundation

The Helsinki capital region has succeeded in revigorating its dynamism from the 1990s. However, this time it is not driven by a single large company but is the result of what Nobel laureate Edmund Phelps calls mass-flourishing, meaning a broad involvement of people in innovation down to the grassroots of the society. The seeds enabling this development are epitomized into the spirit of Linus Torvalds, the initiator of the Linux community. The Linux tradition of involving volunteers, who without direct monetary compensation are committed to supporting a cause they perceive important, has later been transferred to the Helsinki startup scene through the formation of the annual Slush event. Slush became in the 2010s a unifying social platform, bringing together individuals and enterprises from all over the world looking for innovations and investment opportunities spurred by new technology.

In the beginning of the new millennium leading Finnish officials and politicians had started to worry about the strong Nokia-dependence of the Finnish economy. In 2005, the Finnish government adopted a new national innovation strategy and the national innovation agency Tekes started to experiment with new forms of innovation collaboration. One such initiative was the 100-million-euro five-year program called EVE – Electric Vehicle Systems, starting in 2011. The main target of the program was to create an electric mobility ecosystem that could generate new knowledge and competences in EV related technologies and services.

The Helsinki Region Transport company (HRT) was right from the start an active member in the EVE program. Helsinki announced a transport-related policy that should reduce the dependence on private cars, and support rail-based solutions for the broader Helsinki region. Walking and bicycling are encouraged, and the city planning guidelines strongly promote ridesharing and aims to lessen the requirements for parking space in the inner city. As a northern capital Helsinki also wants to be an attractive partner for vehicle manufacturers who need to test their technologies in winter conditions, and the early piloting activities related to using autonomous shuttles.

Pioneering mobility as a service

One of the focus areas of the EVE program was new types of mobility services, and an initiative that was financially supported was the Kutsuplus services which started in August 2012 and was launched as a modern Demand Responsive Transport (DRT) system based on state-of-the-art IT infrastructure. The Kutsuplus service was developed in Aalto University as a complementary service to the public transport services offered by HRT. The Kutsuplus service allocated trips for passengers in real time in order to achieve both excellent service to passengers and high efficiency of vehicles. This was possible thanks to real-time communication between a fleet of minibuses, passengers and a central dispatching system. Subsequently the Kutsuplus service operated in

real time, in a fully automatic fashion. The customers could make the requests using their smart phones.

Due to financial constraints on the municipal budget the Kutsuplus piloting was not continued after the three-year pilot ended. The evaluation of the Kutsuplus pilot reported that the Kutsuplus pilot was a success, both technologically and from the perspective of customer satisfaction. The pilot resulted in numerous rewards. The system worked well, the efficiency in combining trips grew as expected, and the subsidizing level of transport decreased as the vehicular capacity was gradually increased due to the increasing popularity of the service. Customer satisfaction was exceptionally high despite the small service area and the low number of 15 vehicles. The evaluation concluded that HRT will use the results of the experiment in its own work and will look at the possibility to implement a market-driven Kutsuplus service in the future.

Besides bringing the city of Helsinki and HRT valuable experiences from new types of mobility services, Kutsuplus also inspired many startups to enter the mobility sector. When entering the 2020s several Finnish mobility startups have secured venture capital financing.

In July 2018 the new Finnish Transport Code entered into force. This new law embraced all transport modes into one unique law, eliminating all specific laws referring to means of transportation. The ambition with this law is to make it easier for mobility service providers to get access to public transport information in order to integrate data enabling the provision of seamless travel chains that could be paid by one mobile system. Such solutions would then be able to integrate all transport modes into one holistic system.

2030 urban mobility potential

A major technology achievement in Finland relates to connectivity development. Finland was one of the first countries in the world to auction 5G-licenses in 2018, and this spurred different forms of experiments and trials. In June 2019 ABB and Telia announced the world's first industrial artificial intelligence

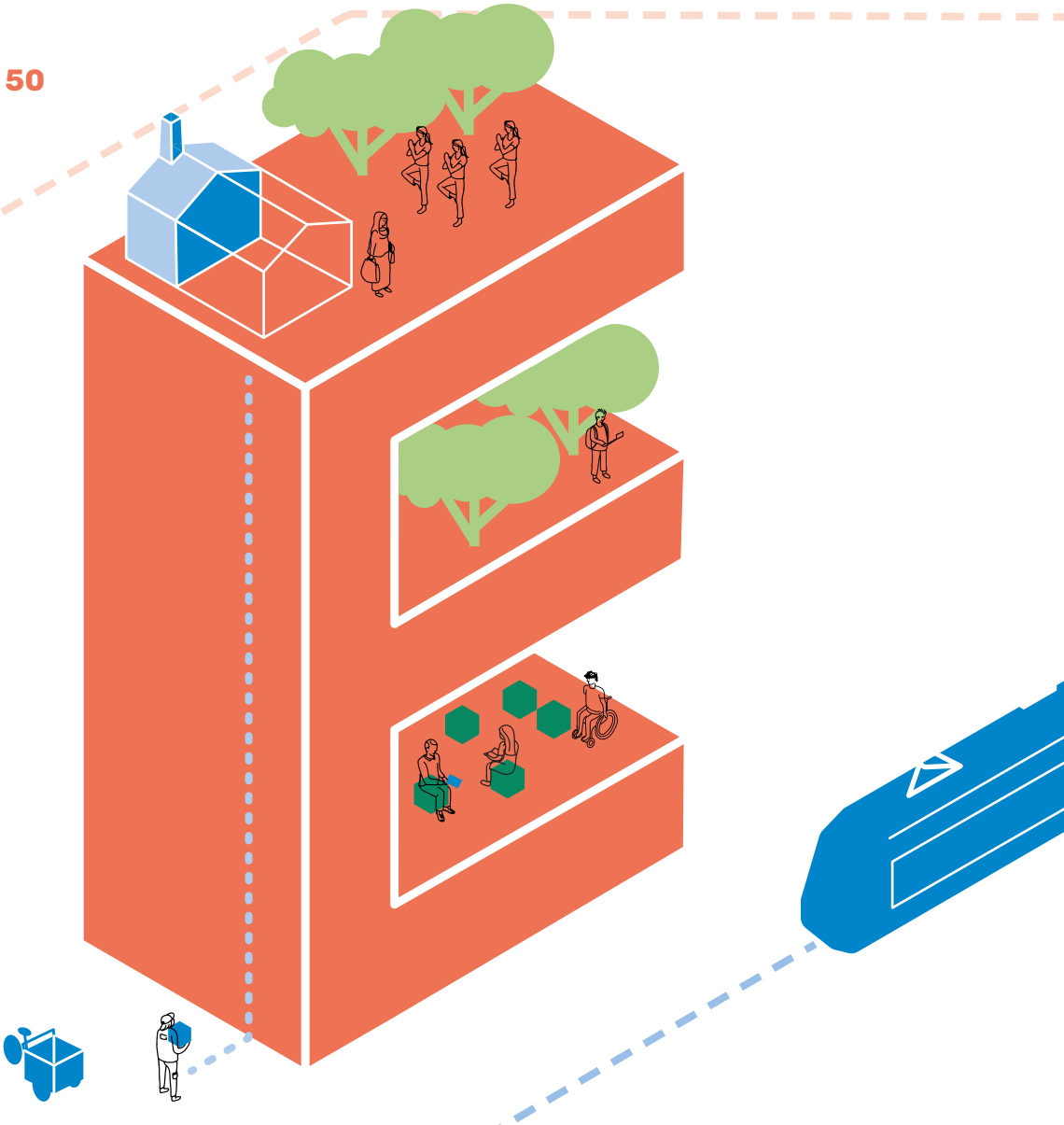
application using 5G technology to assist the assembly of drives at ABB's Helsinki plant. Simultaneously there were developed different projects looking to benefit from the new 5G technology also in the transport sector.

Here the contribution of the city of Helsinki could be to take a more active role in new ecosystems that will be formed to build the capabilities that will be needed for integrated mobility services. Based on its strong technological basis Finland offers good opportunities for multi-disciplinary development efforts in trying out new radically different ways to provide mobility to urban residents.

Helsinki must be able to form networks of trust to establish longer-term trustful collaborative relationships with leading private actors, from academia, research and business. It is paramount that the key individuals become committed to a longer-term journey. This way the innovation efforts will have a chance to really contribute to the systemic change needed. The collaboration should encourage such long-term engagement.

Two pillars provide opportunities for Helsinki to drive the mobility transformation. The strong technological legacy, e.g. visible in the ongoing development related to 5G is the historical foundation that Finland can build upon. The second more recent phenomenon is the vibrant startup community, best illustrated through Slush. Helsinki as the Slush venue has the possibility to integrate these two strengths when it launches the next generation of development initiatives. When doing so, there must be enough opportunities for different stakeholders to physically meet and reflect upon how the process shall proceed. Getting the residents integrated into the process is also important.

By establishing new ***transcendent innovation*** practices Helsinki can more broadly support system level innovations that undoubtedly are needed if the emission targets are to be achieved. Collaboration should also take place between cities. One example in the metropolitan region in Finland is the development of personal carbon footprint tracers, originally developed for the city of Lahti. This is an opportunity for Helsinki to set an example of successful collaboration between city authorities, researchers and startups. If successful, this may later result in outcomes that will gain as much international attention as the Kutsuplus initiative generated when launched.



Conclusions

Based on the analyses of Nordic capitals there are three reasons why the Nordics stand a good chance to become vanguards in the transformation of mobility. Firstly, the transformation has to gain ownership by the people. Here the Nordic welfare society is fertile ground, and the movement initiated by Greta Thunberg can trigger what can become a societal reform. Secondly, the way things are evolving requires access to the latest technologies to keep the momentum going. Thirdly, the path forward has to be anchored in concrete experimentation and collaboration efforts, which requires the active participation of city mangers collectively motivated to support something unique. What our examples have shown that the Nordic capitals are proceeding in the spirit of ***transcendent innovation*** and are applying the principles of responsible citizenship, logic of care, and networks of trust.

What also is evident from the examples is that all cities foresee a transformation of not only the mobility sector, but the way city planning will have to accommodate an urban life less dependent on the private car. This planning approach has been called slow architecture.

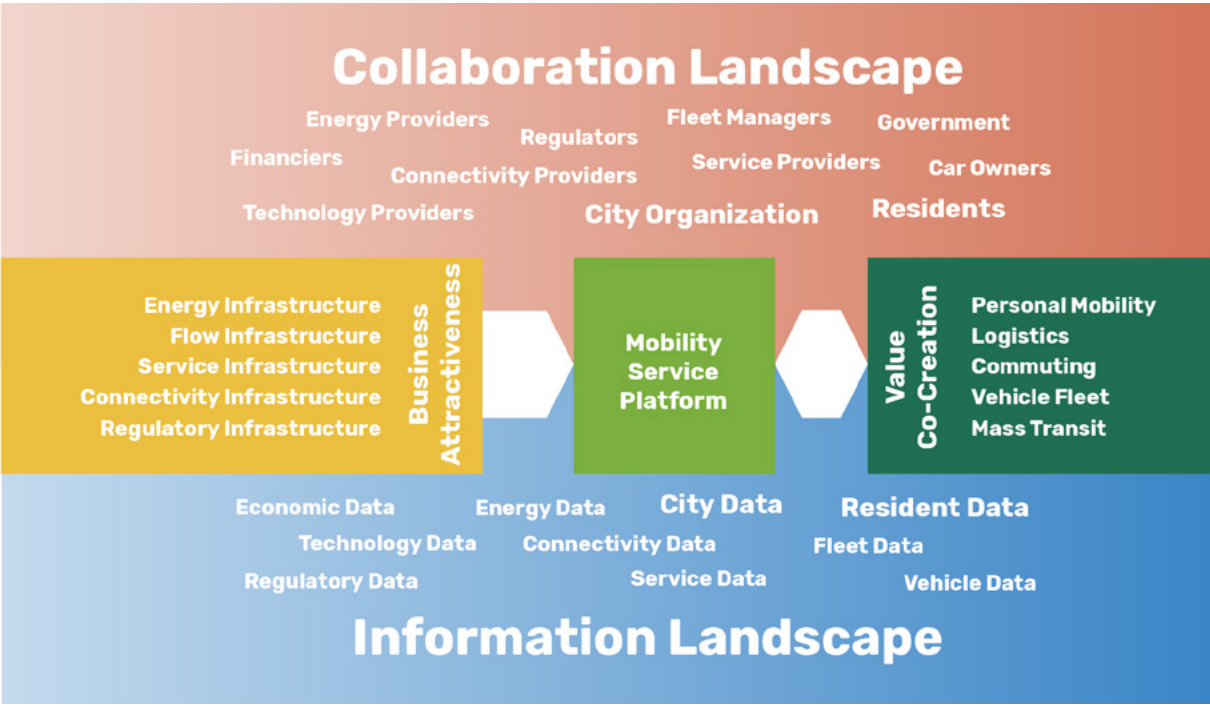
According to Jan Gehl slow architecture makes it possible for pedestrians to walk around cities and have close encounters with each other and with the buildings and the open spaces of the city. The transition zones between buildings and city spaces link the functions inside the building with street life in general: recreation, play, seating, standing, exhibitions and so on. The more irregular the façade the more it invites and supports activities. Designing a city for pedestrians means designing buildings so that walking becomes appealing thanks to the richness of experience offered by the buildings along the journey.

The notion of 'slow' architecture has become a unifying theme for city architecture in all Nordic capitals. It refers to city planning providing an attractive city landscape for pedestrians and cyclists. Respect for people in city space has a key role in the planning. Slow architecture should be contrasted with the 60 km/h architecture along the roads used by vehicles. Here large spaces and signs are a necessity. If pedestrians and cyclists are forced to move in 60 km/h urban landscapes, the experience is not very pleasant. And if existing 5 km/h streets are 'upgraded' with 60 km/h buildings the outcome is equally bad. To encourage people to walk and cycle, encounters between buildings and cities need to be re-evaluated. Lifeless, closed building pacify while open interesting façades activate urban users.

Stockholm was one of the first cites to carry out a process of urban renewal based on 'slow architecture' recommendations of Gehl. Streets with close encounter architecture were modified by building new narrow blocks or shops 4 to 6-m deep outside old car parks and other closed buildings. This way the streets became more intimate, and small units with a diversity of functions replaced lifeless facades. Copenhagen has for decades been removing driving lanes and parking places in a deliberate process to create better and safer conditions for bicycle traffic. Now both Helsinki and Oslo are

looking for similar transformations.

Another opportunity for the Nordics is to engage in cross-border collaboration. Here the Nordic Urban Mobility Ecosystem (NUME) could become a catalyst to develop a pan-Nordic project portfolio which could address the different facets of the mobility landscape based upon its conceptual model called the Nordic Urban Mobility Model, as illustrated below:



The seeds for developing such a community were sown much earlier through the formation of the World Alliance for Low Carbon Cities (WALCC). In 2013 WALCC held its annual forum in Malmö. The alliance has also actively been communicating about city planning and urban mobility with leading experts in all Nordic countries.

Battery technology also offers possibilities for collaboration. There is increasing interest in the cradle-to-cradle approach, whereby battery materials should be seen as elements of a closed recycling loop. The circular economy philosophy already applied in energy management in the Nordic countries can as well be adapted to batteries.

For the cities to take on the increased responsibility for guiding the mobility transformation, crafting the proper information landscape will be of utmost importance. Here the experiences from the telecommunications industry may prove invaluable. By engaging leading tele operators and technology companies in various pilots and demonstrations, the leading Nordic cities should be able to rapidly gain benefits from the new 5G technology.

The Nordics have also had to adjust to fundamental shifts in global values caused by climate change. Iceland is a very interesting case. Due to its arctic location the impact of global warming is very tangible in Reykjavik. The melting of glaciers is a big threat, and this will probably negatively impact the number of incoming tourists. To accommodate to the new attitudes Iceland has put a lot of efforts into reforestation. Isavia, Iceland's airport operator, has decided to instigate the policy to plant trees for every tourist and Icelander that flies in and out of the island. This is a concrete example on how there is a need to find new forms of public-private collaboration in the face of climate change.

What could became a catalyzing factor positioning the Nordic countries into the global spotlight would be the integration of health and transport data to steer daily city activities. Using detailed information from cities across the Nordics could develop new solutions to improve the daily life in a constructive and non-intrusive way using real time data. The principles of networks of trust should then be applied when providing residents with opportunities to become co-producers of the gradually evolving new solutions.

In this new distributed world, there will be no singular organization owning the data nor the architecture. But there has to be conscious efforts to simultaneously work on both the information and the collaboration landscapes in order to gradually provide a possibility to have a platform that can support the institutionalization of the principles of ***transcendent innovation*** at a Nordic level.

The inclusion of residents into the collaboration is of utmost importance. Here the pioneering efforts of trying to establish a personal carbon trading scheme in Finland could offer an important first experience in how to integrate residents in urban mobility development. The emissions trading application is expected to become one of the main attractions in 2021 when Lahti as the Green Capital of Europe will exhibit how residents can become actively engaged in meeting a city's emission reduction targets. By giving each resident access to a weekly renewable emissions budget they can evaluate and select among various mobility modes and lower their emissions. The city will reward environmentally conscious behavior and this way create incentives for residents to get actively involved in the transformation.

The Nordic cities could jointly also aim at industrializing the process of decarbonizing cities. This complex task requires insights and the capacity to scale in the three main components forming the carbon footprint of any city: energy, buildings, and transport. The Nordics hosts progressive international companies capable of providing both products and services needed to drive systemic decarbonization. In addition, the Nordics also host a lively ICT-developer community, which supports the integration of the different system components into customized solutions to be implemented in collaboration with partners all over the world.

The volatility, uncertainty, complexity and ambiguity characterizing today's world has initiated what *The Economist* in August 2019 called an Age of Anxiety. This is attributed to firms and markets struggling to get to grips with uncertainty. This report has touched upon some of the fundamentals of this uncertainty. The anxiety also makes people more alert. If the concerns for the physical world get more attention, this provides possibilities for a more balanced and responsible approach towards climate change. This triggers possibilities for the Nordic countries to step up efforts to set a global agenda towards more responsible environmental behavior based on the principles of ***transcendent innovation***.

These general principles have a strong anchoring in the Nordic city management landscape. All Nordic countries have genuine ambitions to speed

up efforts based on the positive experiences this far. A pan-Nordic approach would further strengthen the individual initiatives in respective countries. In addition, integrating the efforts across countries enhances the possibilities to influence the global agenda for transforming urban mobility.

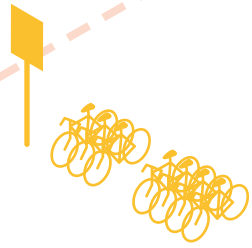
The Nordic Urban Mobility Ecosystem, which has provided both the practical experiences and theoretical research efforts based upon which this report has been written, offers a possibility for individuals and organizations to join a movement which has already been initiated. The Nordic Urban Mobility Ecosystem continues a tradition of bold innovation projects supported by private and public interests. The first project was the Eco Urban Living piloting of electric cars (Think City cars manufactured by Valmet Automotive) in elderly care in the City of Espoo starting 2010. When moving into the 2020s, the ecosystem has a multitude of activities going on enabling a smooth expansion and engagement of additional partners interested in joining forces around the transformation of urban mobility.

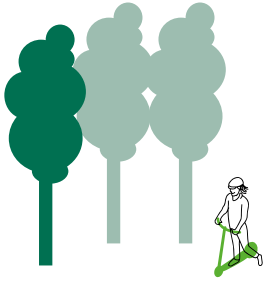
The Nordic Urban Mobility Ecosystem can support cities and companies in their joint efforts to drive innovation in urban mobility through three types of activities:

- Organizing knowledge dissemination activities, events, and training programs in a collaborative spirit to increase the common understanding and expand the movement.
- Engaging ecosystem partners in joint projects offering action learning opportunities for all individuals involved.
- Institutionalizing the principles of ***transcendent innovation*** in urban mobility.

We sincerely believe that the here outlined approach for how to bring the transformation of urban mobility in the Nordics to the next level can become a mission that will unite professionals across private and public organizations. The

initial results that the Nordic Urban Mobility Ecosystem have already achieved suggest that people who find their lives meaningful usually have a goal that that is challenging enough to take up their energies and give significance to their lives. Mitigating climate change represents such a goal. Focusing the efforts on urban mobility offers the Nordic countries the possibility to take a lead in shaping the future. This report invites everybody interested in this opportunity to continue the dialogue and join the movement!





Acknowledgements

The thinking behind the here presented approach to urban innovation has its origins in the mid-1990s. Synocus was then part of the Swedish SIFO Group and we were actively applying the ideas of value co-production in the interface between companies and the public sector. Richard Normann explicated these ideas in an appendix on territorial actors in his 2001 book *Reframing Business*. The main question we tried to address was *how can a location become a good home for value-creation activities*? In line with this thinking we then initiated a project called *Regional Brain Gain*, where we looked into how the capital region, Tampere, and Oulu were perceived in respect of attractiveness by knowledge professionals.

Based on the positive response to the Regional Brain Gain initiative, we worked for several years with the City of Espoo in various development projects, covering the planning of the school campus in Suurpelto, establishing collaboration with start-ups in the health sector together with the Laurea Otaniemi campus, and by initiating the first piloting of electric vehicles in the elderly care service of the City of Espoo together with Valmet Automotive, Fortum, and Nokia. The insights from these initiatives were also used when we worked with Region Skåne in Sweden for the period 2009-2013 in different activities relating to the development of an innovation strategy in the region.

Our collaboration with Region Skåne introduced us to Professor Philip Cooke from Cardiff University, and he later became a co-author for the report we wrote for Tekes about capabilities needed for innovation activities. This work, in turn, spurred two Tekes-sponsored research projects where we were active participants: *Systemic Architectures for Sustainable Urban Innovation* (SASUI) 2014-2016 with Aalto University as the project lead and *Reframing City Districts* 2015-2017 with the University of Tampere and the University of Turku as research partners. In these projects we made in-depth comparisons between different city management approaches and were in active discussion with representatives of the city management in Barcelona, Malmö, and Helsinki.

All the above activities provided a rich conceptual and practical experience of city development and public-private collaboration when we started the NUM2030 initiative. Subsequently, the NUM2030 reflections presented in this report represent a continuation of a thought development with a history of more than twenty years.

Evaluating the potential for the Nordic countries to take a lead in the transformation of urban mobility brought us back to the Nordics. Here we were greatly supported in our work through our partners in the Nordic Innovation sponsored *e-Mobility Systems Architecture* initiative. Sincere thanks to Mats Larsson, Leif Ohlsson, Torun Degnes, Steinar Kristoffersen, and Jón Björn Skúlason! The NUME Advisory Group has also been highly supportive of our work, here the gratitude goes to Peter Lindgren, Marcus Martelin, Pasi Mikkonen, Kalle Erkki-Penttilä, Marko Lepola, Janne Koistinen, Jari Mattila, Jyrki Nurmi, Juha Inberg, Kalle Einola, and Martti Korkiakoski.

My Synocus colleagues Henrik Hultin, Jussi Hulkkonen, and Teija Virtanen were responsible for the scenario building process and the positive atmosphere during all workshops reflected the commitment they showed in their work! When contemplating how to distill the vast material available for the final report we had many internal discussions at Synocus about how to bring the message forward in a comprehendible way. Here the viewpoints presented by Kaj Hulkkonen, Patrik Laxell, Niklas Koski, Antti Laukkanen, and

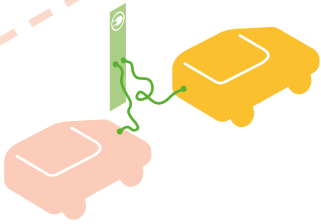
Laura Wirtavuori were very helpful.

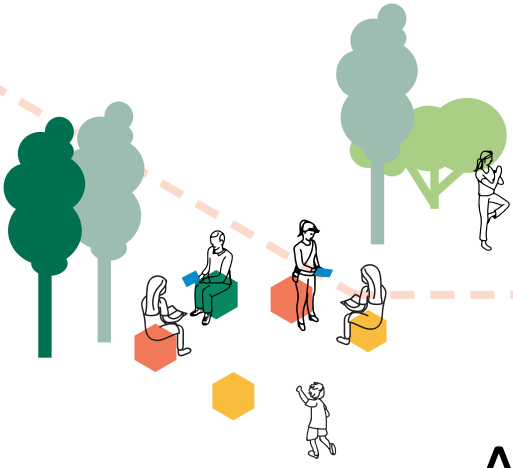
Kirsten Sainio deserves acknowledgement for two reasons. Firstly, she made me aware of the connection between the city management styles and the different ways to engage networks. Secondly, she has made the report much more reader-friendly through the visual design of the report. The proof reading of the text has been taken care of by Glyn Banks and Jussi Hulkkonen. Thanks to both of you for thoughtful comments on earlier versions of the report!

Finally, I want to thank Ghita Wallin who throughout the summer was engaged in lively discussion with me on the dynamics and emergence of ecosystems. She came up with the notion of ***transcendent innovation***. My further development of this view of innovation was strongly influenced by her thinking about ecosystems based on social relationships and a common purpose. Such ecosystems are different in their nature compared to goal driven ones with a clear node as the orchestrator.

The report that emerged as the result of one year of conceptual and practical work related to more deeply understanding the present status of urban mobility, and the potential for the Nordics to drive the coming development, is the result of a collaborative effort. However, as there are so many other observations and facts that also could have been included in the report, I take full responsibility for the content of the report. Having said that, I still, once more, want to extend my gratitude for all those who have supported our work!

Johan Wallin
Helsinki, September 2019





Appendix 1

the Scenario Process

The Nordic Urban Mobility 2030 scenario building process (NUM 2030) was carried out through a number of workshops, which were supported by active information gathering. In the following the information gathering, the workshops, and the resulting scenario descriptions are briefly presented.

Information gathering

The information gathering was carried out with three parallel ambitions. Firstly, there has been continuous gathering of information on the state of the mobility sector globally by Synocus. Secondly, based on the guidance from the NUME partners, specific and targeted information gathering activities were carried out during the spring of 2019 to support selected substance areas considered to be relevant for the scenario process. Thirdly, during the report writing phase, it was seen that more in-depth insights into the strengths and development potentials of respective Nordic capital region was important. This was needed to portray the picture of Nordic urban motility in 2030. Additional information gathering on this topic was therefore carried out during the summer of 2019.

Synocus representatives participated in five different international mobility conferences during the project: in Novi, Michigan (September 2018), Paris (September 2018), Tokyo (November 2018), Oslo (March 2019), and Berlin (May 2019). From each of these conferences an extensive report was written and later used as an input for the scenario building process and when writing the scenario report.

Another important information gathering activity was conducted among a group of leading Finnish cities. Interviews with city leaders and representatives from twenty of the biggest Finnish cities was carried out in February 2019 and continued through June. Additional insights about urban mobility in the Nordics were gathered through interviews and discussions with leading industrial experts as well as through desk research.

The scenario building process

Synocus experience with using scenarios to guide ecosystem development served as the background for the scenario process. These experiences span back to the collaboration with Valmet Automotive and the City of Espoo in 2008, which resulted in the 2009 launch of the Eco Urban Living project. The NUME Advisory Group approved, in its meeting in January 2019, the proposal by Synocus to carry out a scenario building process as part of the NUME action plan for 2019. The kick-off for the scenario process was held in February.

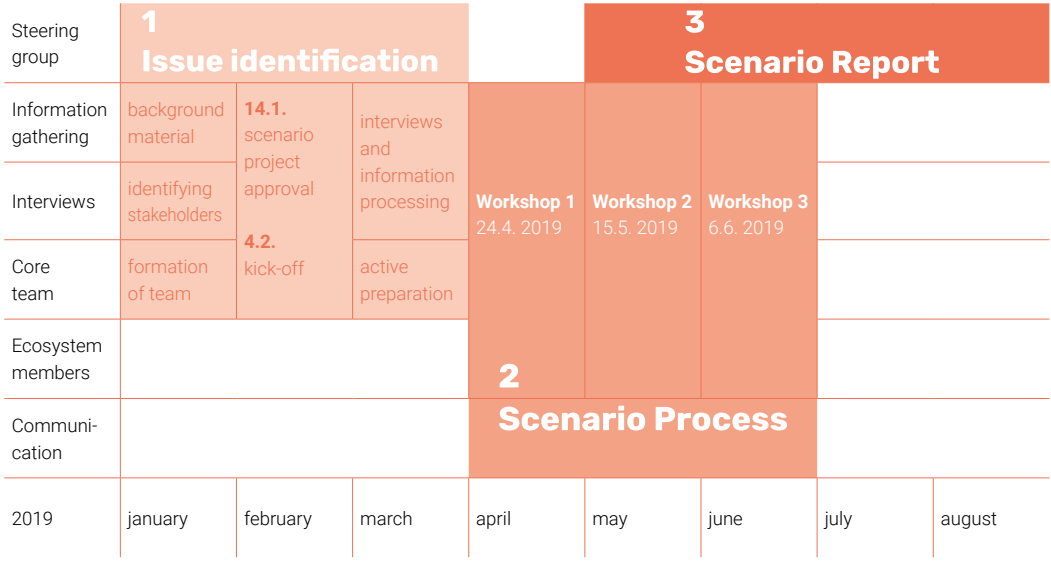
The findings from the background research were used to prepare over a hundred end-state cards which represented the construction blocks for the future scenarios. These end-state cards contained specific descriptions of elements of the future state of the world in the chosen year, 2030. The end-state cards were evaluated and used to craft the first initial scenario descriptions in a workshop in April 2019. At the end of the workshop the most relevant end-states were arranged by the project team into four future scenario embryos which were presented to the participants for discussion.

Based on these discussions, four preliminary scenario themes were agreed upon and labelled Societal dynamism, Responsible cities, Citizens act, and Technology power.

The second workshop was held in May. In this workshop the participants evaluated what types of events would be needed for the future scenarios to unfold. Based on a card selection prepared by the project team, the workshop participants evaluated the events based on their likelihood of occurring.

The final workshop, held in June, brought together the products of the first two workshops to form the final scenarios. For this workshop the project team had further fine-tuned the event cards so that the deck of event cards had been narrowed to roughly 75 cards, to form the building blocks for the final scenarios to be built during the workshop. The final workshop engaged the participants in forming a path towards each individual scenario using the event cards. Following this, the participants considered the implications of these future scenarios and how they may impact urban mobility as well as their individual organizations.

The progress of the scenario process is depicted in the following figure:

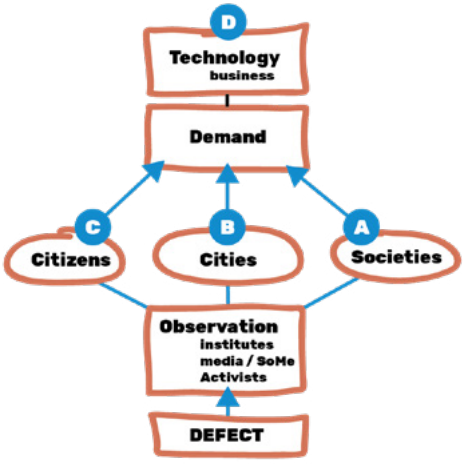


The four scenarios

The scenarios presented at the final workshop are presented in the following.

Societal dynamism

This scenario emphasizes that a rising concern over climate change will incite a strong, collective response where both business and private life is driven by regulations and standards. This is enabled by the widespread use of AI in monitoring of carbon emission targets, combined with a regulatory clamp down on growing emissions. Gradually, a global consensus on the truly dire situation facing the globe will emerge. This will then contribute to a vision of the future wherein society has taken an active role in determining its own fate.



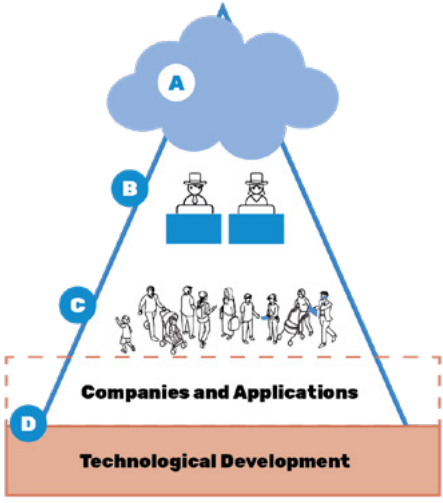
The group assigned to this scenario saw that in this scenario people are left with little choice but must take drastic action. The path towards this future is the result of an initial, laxer period of incentivization, which fails to result in an adequate reduction of carbon emissions. Subsequently, a stricter option is required with heavier restrictions. Alternately, however, the potential for collective action remains if, for instance, the coming UN climate negotiations result in a unified will to tackle the challenges regardless of their national interests.

The major thrust here lies in a new reality incited by resource shortages. This reality sees transportation emissions aggressively restricted, along with other industries. These increased restrictions then direct businesses to tailor solutions to serve the market demand for sustainable solutions. This reality relies on the influence and regulatory strength of governments and decision

makers, yet calls for a responsive, active private sector to develop the solutions required to reach the targets set forth in international agreements.

Responsible & sustainable public actors & acts

This scenario, originally called "Responsible cities", is characterized by an increasing divergence in global opinions on how to address climate change with nations and regions growing ever more focused on their own agendas. Cities thus become both pivotal political decision-makers and societal actors. The growth of city influence is a result of urbanization. To handle their growth, leading cites must be able to take on higher-risk projects and encourage experimentation through public procurement. This increases collaboration among leading cities but also implies widening gaps between successful and deteriorating city regions.



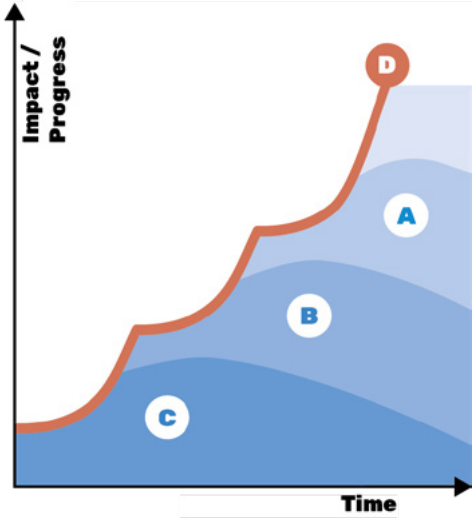
In this scenario, sustainability and efficiency play a significant role in city decision-making processes. The driving force is the global challenge of climate change. Cities support the development of new transport solutions and look for ways to globally share experiences with likeminded cities. Cities also work more closely with innovative companies, increasing their role as active participants in the innovation process, rather than merely serving as enablers. New mobility concepts emerge to mitigate the rising environmental cost of private cars complemented by improved public transportation.

The central challenges to this scenario are achieving the necessary change in mobility patterns and making public or shared transportation more affordable, easier, more flexible, and more liberating. The scenario proceeds with a "first the carrot, then the stick" approach. Technology plays more of a

support role, enabling new forms of social innovations to achieve the sought for emission reductions.

Responsible choices

The scenario was first named “Citizens act”, concerning a future in which individuals have taken a more prominent role in shaping the actions of cities and governments. This scenario sees a more vigorous response to climate change which leads to marked changes such as the mass adoption of Mobility as a Service solutions. Another significant innovation will be the use of personal carbon footprint trackers among citizens voluntarily adopting new, low-carbon behaviors. There is decreased trust in the capacity of political systems to solve the pressing challenges. This leads to a growth of resident-driven movements in city development and urban transport evolution. This is supported by local decision makers who offer new means of engagement. The transformation will be accelerated by activists aggressively promoting sustainable mobility solutions.



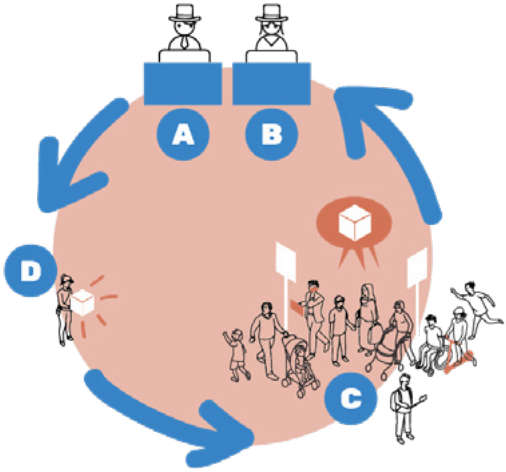
There is a need to learn from past revolutions and their progression. The first wave of action comes with the jolt of awareness and is driven by strong leaders, yet without political mandate or backing. These leaders take charge of the revolution and drive it forward. The first losers are the travel industry, including aviation, which will be socially stigmatized in the early phase of the revolution. The success relies on the commitment of citizens, individuals making responsible choices. This strong commitment drives a rising demand for sustainable solutions in the market and, thus, generates a new wave of solutions that support this social drive.

The inciting incident for this revolution lies in a crisis which increases the cost of individual mobility and generates a strong reaction from a generation of young citizens inspired to prioritize the societal impacts of their decisions over the individual benefits. This is followed by the development of new solutions but is not dependent on technological innovations as the required technologies already exist.

Technology power

Technology is the key factor in the reduction of harmful emissions in this scenario. The challenges call for innovative and progressive companies who show the path towards a more sustainable future, even if the rate of progress is rather slow. Despite strong public advocacy, the fight to reduce carbon emissions has yet to reverse the rise of emissions. However, technological advances enable such leaps as around-the-clock autonomous shuttle service in suburban areas, drones replacing vans or cars for local deliveries, and advances in charging and fuel-cell technology sidelining traditional internal combustion engines in cars.

The successful reduction of carbon emissions relies on three central technologies: i) wirelessness, both in communication as well as in inductive charging; ii) non-fossil energy, its applications and what it powers; iii) autonomous vehicles, the advent of a plethora of small units that transport people and goods. These three technologies make the systems independent and flexible enough to respond to the challenges of the future. The primary driver here is the community of climate-conscious “propeller head” engineers and developers who are



driven to execute the change necessary to ensure the future of our planet.

Three key questions herein are: i) who will fund the innovation, ii) how will the individual solutions be connected to each other, and iii) how to gain support on a social, political, and individual level for these solutions? AI may enable a quicker mindset change, which would be required. Initially, authorities will try to induce change through incentivization, before later turning to harsher restrictions.

Appendix 2

Technology Review

The 2020s are expected to see the biggest transformation in mobility since Henry Ford revolutionized the transport sector more than a hundred years ago. The development initiated by Ford profoundly changed the world, it was truly a disruptive innovation as Professor Clayton Christensen from Harvard has explained. The vision of Henry Ford was not only related to the manufacturing of cars, but his grand vision was the egalitarian idea that everyone could afford a car. Based on this vision he then set out to develop Ford Motor Company using already existing technologies. In his book *My life and work* in 1922 Henry Ford stated his ambition as follows:

I do not consider the machines which bear my name simply as machines. If that was all there was to it, I would do something else. I take them as concrete evidence of the working out of a theory of business, which I hope is something more than a theory of business--a theory that looks toward making this world a better place in which to live. (Ford, My life and work, 1922, p. 3)

Entering the 2000s, attitudes towards cars started to shift. Climate change became a key topic of concern, and the impact of fossil-fuel based transportation was recognized as one of the main sources of carbon emis-

sions. This trend was particularly profound in Europe and in California, which instated stringent laws to reduce carbon emissions from cars.

Europe is facing a new era as car producers must meet the new legislation restricting average fleet emissions to fewer than 95 grams of CO2 per kilometer by 2021, and these rules will be phased in already during 2020. Car producers that will miss the 2021 targets will be in trouble as there will be even steeper targets in 2025 and 2030.

Whereas Henry Ford as an entrepreneur could use his technical skills and societal drive to make the world a better place, he didn't have to consider the environmental implications of his innovation. A hundred years later we have learnt that the internal combustion engine, which was at the heart of his machine, has been a major contributor to the climate challenges we now face. How to deal with the new situation is by no means yet clear. Even if there is an increasing agreement about the seriousness of the problem at hand, there is yet no global consensus on how to address the problem.

Leading observers in the automotive sector seem to agree that the government sector – on national, regional, and local levels - must complement privately founded initiatives with enlightened oversight and intelligent public investment to enable the sought for transition of urban transport. Collaboration and integration will be essential to offer seamless services to consumers. When discussing the future of the car and urban mobility researchers Sumantran, Fine and Gonsalvez suggest that there is a need to encourage behaviors to limit pollution and congestion through targeted user fees, taxes, and subsidies – for roads, bridges, cars, buses, trains, parking space, and even urban access. This will help shape the future mobility services and improve the use of assets and infrastructure. The future mobility architecture for cities must be flexible, affordable, and sustainable. This does not happen by itself. Planning, orchestration, and oversight are obligatory.

Over the next ten years many profound changes will take place reshaping urban transport. Yet it is unclear what the outcome will look like. This transition will be influenced by new technology and adapted and molded in different ways by city governments all over the world. What technological possibilities

there are to enable a new transport paradigm will be discussed next before showing different ways cities can engage with the private sector to support change and make cities the game changers for a better world.

Today there are globally more than one billion motor vehicles. The annual revenues of the car industry exceed USD 3.5 trillion and the automotive industry accounts for more than 50 million employees worldwide. As cars are a major cause for carbon emissions, governments across the world have initiated various measures to reduce the polluting impact of transportation. Car manufacturers and other technology providers must therefore look for new technologies that will support their ambitions towards lower emissions.

Facing these challenges car companies are increasing their R&D efforts and forming new alliances both within the car industry and with new entrants. How quickly the new technologies will change the way cars are operating is still uncertain. The most bullish projections have been proposed by Elon Musk of Tesla, who expects that Tesla cars can become cash-generating robotaxis by the end of 2019, and that Tesla will launch a driverless taxi service in the second half of 2020. This confidence stands in marked contrast to the mood among others trying to launch driverless cars. It seems to be that besides the technical challenges the breakthrough of self-driving cars will also ask for social support, which will require time and effort to overcome the reluctance of policy makers to take on the potential risks related to applying such a new technology on a large scale.

If robotaxis are a significant step forward in applying new technology for urban mobility, another major area for intense development is air-borne urban transport both for goods and people. Uber, Amazon and Wing Aviation (collaborating with Google) have programs to develop food deliveries by drones. In December 2018 it was announced that Wing would start drone deliveries in Finland during 2019. Selecting Finland as the first European test site was due to Finland being known as a country that is forward-looking, with smarter ways of doing things, according to James Ryan Burgess, CEO of Wing. Uber is also envisaging launching flying taxis by 2023. However, here as well safety concerns are raised as a major potential hurdle for this type of service to become commercialized.

The public sentiment is increasingly raising concerns about the possible implications of new types of problems relating to technological innovations e.g. as illustrated by one article in the Financial Times stating that "Flying taxis will bring traffic jams to the sky". – Still technology will strongly influence the future of transport. Servicification, electrification, connectivity and self-driving technologies are all examples of development areas that are expected to influence the way urban mobility will evolve during the 2020s. Each of these technologies has great possibilities to influence the future of technology in a fundamental way as will be shown here.

Servicification

Twenty years ago, Richard Normann observed that offerings were becoming increasingly complex and there were three trends impacting our views on offerings (Normann, 2001:130):

- **Servicification**
  A shift from emphasis on the production process towards seeing offerings as inputs to the value-creating process of the customer and thus from transactional to long-term relationships.

- **Digitalization**
  Unbundling and re-bundling of various offering elements in new ways thanks to internet technologies.

- **Experiencification**
  Linking offerings to the mental and symbolic process of customers including the meaning and purpose of the value-creating activities.

Mobility services provide value on all these three value-adding dimensions in addition to the traditional taxi services that they are disrupting. The possibility

to order the service by your mobile phone implies that you connect to the driver more intimately as you will know exactly when the car is coming, and you can also track the movement of the car on the map. The whole payment process is streamlined as you will not use cash payments anymore. Finally, the experience is evaluated by both the passenger and the driver and this way the quality of the experience has become a key element under constant monitoring and evaluation and will strengthen the relationship between the service provider and the customers.

The Kutsuplus service operating in Helsinki 2012-2015 was a pioneering ridesharing service. It was the first-of-a-kind on-demand real-time shared-ride service in the world. The service was developed by startup Ajelo which later was acquired by Split and similar services were brought to the US markets. In 2017 the company became part of the MOIA business unit of the Volkswagen group. The MOIA services were commercially launched in Hamburg during spring 2019 with a fleet of 100 VW electric vans with a range of 300 km.

Finland has also seen the birth of additional mobility services companies, such as MaaS Global, Kyyti and Wolt. What still is a challenge for these companies is how to make money. On a global scale the performance of Uber and Lyft has become more transparent as the companies became listed in 2019. For the second quarter of 2019 Uber reported a loss of USD 5.2 billion, whereas Lyft posted a loss in excess of USD 600 million. Uber has admitted the ride services market is very competitive, and it may be very difficult to make profits in that market. Therefore, Uber is also looking to expanding into other businesses like food delivery. Whether this will offer improved profitability remains to be seen.

It has been suggested that Finland could leverage upon its early mover advantage in the mobility services market. Finland's extensive competencies could provide a foundation for a strong ecosystem of SMEs and startups developing new mobility services making Finland a "MaaS laboratory". Governmental agencies such as Sitra and Business Finland have financed various initiatives to develop and pilot new mobility services. The formation of the Nordic Urban Mobility Ecosystem, NUME (www.nume.org), with the support

of Business Finland, is one example of efforts to support this ambition. Ultimately the question will be whether the startup companies will be able to make an international breakthrough.

The Finnish Transport Agency actively supports projects for mobility management in order to encourage people to adopt environmentally friendly mobility habits. However, operationally there are still challenges in the interfaces between the public and private sectors when developing new mobility services, such as the mechanism through which private operators could act as brokers for public transport. In July 2019 it was informed that the Helsinki Regional Transport, the local transport authority, will make a legal complaint regarding the way the Ministry of Transport has required municipal transport authorities to provide information to private transport operators.

Another area which lately has engaged the public and private sector to collaborate is e-scooters. The Swedish e-scooter company Voi has publicly stated that there is a need for frameworks and rules regarding such things as parking, licenses and speed limits. Here the private service providers and the transport authorities look for how to find common ground.

From a Nordic perspective the possibility to integrate public and private transport services would be a way to differentiate from the mainstream mobility service providers, who this far have concentrated on providing services by using private cars. In addition to companies like Uber and Lyft car manufacturers like BMW, Ford, General Motors, Mercedes Benz, and Volvo have also developed their own mobility services. Car companies see ride sharing as one component in the future mobility service package that must be provided by if they want to avoid becoming just contract manufacturers for leading mobility service companies as the vehicles will be electrified and increasingly autonomous as well.

Car companies are now in a race to develop the capabilities of the future. Part of this is done as in-house development, and in other areas the companies are engaging in various forms of alliances and collaboration agreements. One example of such cooperation is the way the leading German car companies Audi, BMW and Daimler joined forces to buy the HERE business of Nokia in

August 2015 for close to €3 billion. In the beginning of 2019 BMW and Daimler agreed to merge their mobility services businesses into a new company aiming to become a global player providing sustainable urban mobility for customers.

The threat for car manufacturers coming from outside the industry is very tangible. Didi Chuxing, China's Uber equivalent, said in 2018 that it had 400,000 electric cars in its fleet and that its aim for the year 2020 was to have 1million electric cars. For car manufacturers potential orders of hundreds of thousand cars is highly attractive in a stagnant market, but only the largest producers with the lowest costs can offer the price needed to qualify. In China three manufacturers, BYD, Beijing Auto, and Shanghai Auto accounted for half of China's electric vehicle sales in 2018.

Electrification

The last ten years have seen a rapid increase in the number of electric vehicles. The EU CO2 fleet emission targets (-37,5% until 2030 as compared to 2019 for passenger cars) require a dramatic increase of battery-electric and plug-in hybrid electric vehicles. In addition, individual European countries also have their own schemes to incentivize the electrifying of transport, with Norway being the most progressive one. For the first six months in 2019 48.4 percent of all new cars sold in Norway were fully electric, making Norway the global leading country in per-capita electric car sales by a wide margin.

Battery technology is thus of highest economic importance to Europe. The automotive sector alone is home to 13.8 million jobs across Europe and faces a very significant transition. It is projected that electrification will boost the annual demand for battery cells in Europe from 33 GWh in 2019 to 500 GWh in 2030. Furthermore, other markets besides the automotive sector show similar growing demands for their respective battery usage.

The political tensions related to batteries are due to the strong global market position of China. Chinese manufacturers expect to reach an energy density of 250Wh/kg in 2025 at a cost of fewer than 100 US dollars per kWh.

Batteries are also expected to last longer so that the battery life could be equivalent to 600,000 kilometers for a private car. This way second-life batteries can be used on a large scale for energy storage. When the battery reaches the end of its life the recycling efficiency of lithium, cobalt, nickel and other metal resources is expected to exceed 95%. This will further increase the economic value of batteries.

The rapid trend towards electrification has taken some European car manufacturers by surprise as they now have recognized that meeting the strict emission standards in 2021 may be more difficult than initially estimated. Many automotive executives have voiced concerns about the negative impact these standards may have on the European car industry. Carlos Tavares, CEO of PSA, which produces Peugeots, Citroens, Opels, and Vauxhalls, has urged industry consolidation to share the costs of developing technologies for electrification. Tavares is also critical of EU policymakers, bemoaning ill-fitting competition rules and the lack of protection given to EU companies in the face of global trade wars.

How the pressure for electrification is affecting leading car makers is illustrated by the fact that BMW CEO Harald Krüger in July 2019 informed about his resignation as it had been seen that BMW had to catch up with rivals such as Jaguar, Audi and Mercedes-Benz that had surged ahead in areas of new vehicle technologies. BMW also announced that it would accelerate the roll out of 25 hybrid or full electric cars to 2023 from 2025.

As the manufacturing of batteries will become a huge industry, the European Commission wants to develop pan-European initiatives to increase investments by national governments and industry in the battery sector. It is seen that, besides supporting vehicles, batteries will also play an important role in energy systems based on renewables. Using the electric vehicle battery as an auxiliary means of energy storage can help not only the adoption and storage of renewable energy, but also reduce energy costs. Subsequently energy storage based on lithium-ion batteries is a key development area.

When entering the 2020s there are several factors speeding up electrification:

- Tightening emission regulations makes it more and more difficult for traditional fuel-based vehicles to meet the emission standards. In addition, several countries in Europe have committed to a timetable for the ban on the sale of fossil fuel-based vehicles.

- Leading car manufacturers such as Toyota, Volkswagen and BMW have already announced aggressive targets to increase the portion of electric vehicles in the upcoming production.

- On the product level, major auto companies have launched dedicated electric drive platforms implying that the whole manufacturing process will be permanently reconfigured for electrification.

- Future high-power charging with a charging power of over 350kW will become common, implying that charging 80 % of a large EV battery in the 75-100kWh range will take about 10-15 minutes.

Leading industry experts have estimated that by 2025, the life cycle costs for pure electric vehicles will be lower than that of traditional fossil fuel-based vehicles. This will then further accelerate the transition into electric cars. This could imply then that by 2035 the share of electric cars would exceed 70 % or all cars sold globally.

In addition to automobiles, batteries will also be used in electric ships and aircrafts. In Norway the plan is to have all domestic flights electrified by 2040.

The Nordic countries have seen new many initiatives aiming at benefitting from the electrification trend. Nothvolt announced in June 2019 that with the support from Volkswagen, BMW, Ikea and Goldman Sachs it had secured the financing of $1 bn in fresh capital to build a large lithium-ion battery plant with an expected annual output up to 32GWh in Sweden. Northvolt will also start preparations for a second 16 GWh plant in Lower Saxony in co-opera-

tion with Volkswagen. In Finland the government has promoted the concept of Batteries from Finland, and several battery technology related investments have been announced by companies such as Fortum, Keliber, Terrafame, BASF and Valmet Automotive. Volvo Cars has rapidly increased the share of electric vehicles in its product portfolio. Finnish start up Linkker has developed its own technology for electric buses. Electric buses are expected to rapidly increase in popularity. The Helsinki capital region transport agency announced during summer 2019 that in a tender where it was required that the tenderer would offer at least five electrified buses the winning bid contained thirty electric buses.

Connectivity

To improve safety and increase the autonomy of vehicles new communication technologies are needed. However, no standard has emerged for how cars in the future will communicate with each other. The European Commission had planned to adopt a WiFi-based system. In June 2019 this plan was withdrawn due to concerns that it would have meant that 4G and 5G technology would not qualify to be used for driverless cars in the future.

The benefits of the WiFi-based system would have been to immediately implement something and improve road safety in the short term, but several countries, Finland included, argued that a "technology neutral" approach would be better. By allowing the use of both WiFi and 5G-based systems it is possible to offer considerably better possibilities in the future. Due to the change in direction the European Commission is expected to get back to work out a new proposal, which could be up for decision by the end of 2019.

South Korea launched the world's first 5G mobile network in March 2019, and by the end of June more than 1.6m people had switched to the new service, accounting for over 70 per cent of the global population of 5G users according to the GSMA, the industry body. However, the reception by users has been mixed according to a July report by the Financial Times. A key challenge is to rapidly build the network of base stations, and in South Korea the number of 5G base stations was in summer 2019 just 7 per cent of the number of 4G stations.

5G networks will have the advantage compared to traditional radio networks that the core capabilities will be placed at the "very far edge" of the network. This provides the possibility to have instant feedback and no latency for augmented-reality applications. How to benefit from these technological capabilities is expected to unfold once 5G networks become more common. This race may have profound implications on future global technological leadership in a broad area of applications. This technology race is at the core of the trade dispute between the United States and China. The US Defense Innovation Board, providing independent advice to the Pentagon, sated in April 2019 that

the US was behind China in developing the latest technology and in setting global standards for 5G. A main reason for China emerging as a leader is the level of investment. China is estimated to have spent $180bn on 5G during the years 2015-2019 and has 10 times as many base stations as the US.

The future of 5G is influenced by factors on different levels, from the highest level of geopolitical tensions down to the very concrete experimentation by using new technology in various applications. In the transport sector 5G is expected to be a core enabler of self-driving vehicles, but also to support various forms of telematic solutions improving road safety. In Finland Nokia is piloting 5G road networks around its own headquarters in Espoo and has also suggested building a 31-kilometer test area for 5G transport applications on Road 51 in southern Finland between Siuntio and Karjaa.

Teleoperators also see 5G as a game changer integrating applications and communication technology more profoundly than previous communication technologies. This forces the operators to increasingly involve themselves in vertical applications, of which transport is one of the most attractive ones. This implies that the border lines between equipment providers, operators, and application developers get increasingly blurred. Everybody is looking to learn quickly from customers and figure out what will become the logic of the future business models. The traditional strongholds of the tele operators such as communication network access, network performance and design, as well as service models will provide the operators with a strong entry ticket when mobility solutions for the transport sector are developed. Still, it is seen that the solutions will have to be built on a city by city basis, which adds complexity to the implementation, as previous technologies (3G and 4G) have been rolled out on a national level with consumer services as the main driver.

Self-driving

In the Nordic countries self-driving capabilities of vehicles have been developed already since the 1980s in industries such as mining and cargo handling. Today Sandvik offers automation and teleoperation systems for mining, through tele-remote or autonomous operation of single pieces of equipment and multi-machine control and full fleet automation with automatic mission and traffic control capability. In the remote-control room, operators control and monitor the movements of a fleet of driverless loaders or trucks. Cargo handling companies have taken a similar approach in the automation of ports, where automating terminal processes reduce costs and improve the utilization of the equipment fleet.

The underlying technology for autonomous vehicles is artificial intelligence (AI), which makes the handling of the vehicle easier, safer, more cost effective, and more enjoyable. Moving from controlled environments such as mines and ports increases substantially the demands on the software that handles the vehicle. In the case of self-driving cars mixed with normal cars this becomes even more demanding. An increasing number of industry observers therefore expect that the for quite a while AI will complement human judgement and not immediately substitute humans at the helm of the car. An example of the industry becoming more cautious was the announcement by the Cruise unit of General Motors stating that it was delaying commercial deployment of autonomous cars because more testing was needed.

How automation gradually may complement the human being in cars uses a categorization of autonomy in vehicles based on five levels. Levels 1 to 3 in respect of self-driving fall into the category of advanced driver assistance systems (ADAS). The driver maintains full control over the car at Level 1, but the car has some driver-assistance features. At Level 2 the driver still has responsibility, but the technology can control functions such as acceleration and steering. Tesla cars have had this functionality since 2016; the vehicle steers, accelerates and brakes autonomously, but the driver must constantly monitor the vehicle. At Level 3, technology monitors the environment and per-

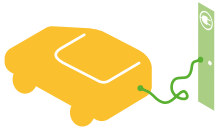
forms the driving, but the driver must be ready to take control of the vehicle.

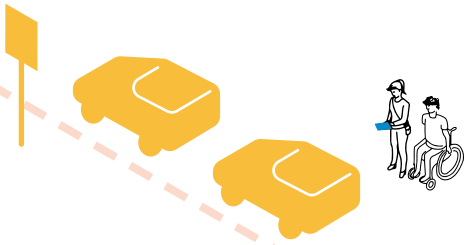
Levels 4 and 5 represent a shift from driver assistance to driver substitution through automated driving systems (ADS). At Level 4 the vehicle is capable of handling all driving functions under certain conditions. Walmart announced a Level 4 pilot in Bentonville, Arkansas in July 2019 to test an autonomous vehicle to move customer orders on a two-mile route in Bentonville between two Walmart stores. Level 5 is then fully autonomous, and no human intervention is required at all. An example would be a robotic taxi, which would be capable of handling driving under all conditions.

Level 4 and Level 5 autonomy or ADS doesn't only have significant technological challenges, but ADS is also dependent on the infrastructure and raises issues about safety. Therefore, there are ongoing development activities to create conditions where Level 4 autonomy could be applied so that the safety concerns could be mitigated. One such application area is the "platooning" of trucks to reduce space requirements, wind resistance and costs. Long-haul trucks operating on highways don't have to deal with as much environmental complexity as do vehicles making their way through dense urban settings.

The challenges related to autonomous vehicles visible in the announcement by Cuise moving away from deadlines and launch was also apparent when Waymo, Renault and Nissan made the announcement of the self-driving alliance in June 2019. Here as well there were no clear indications of the level of ambitions, and the timeframe for introducing self-driving transport services in France and Japan. The potential of this business is, however, huge and e.g. UBS has estimated that "robotaxis" could generate revenues of more than USD 2 trillion by 2030. Computer-run services could then replace public transport as well as conventional taxis. Still, the level of uncertainty is considerable. Deng Wenshuan, Huawei's chief strategy architect, in charge of the self-driving car project in collaboration with Audi and Toyota has voiced the opinion that Level 5 autonomy "will never happen". The Huawei project focuses on achieving Level 4.

Sweden has been actively putting efforts into the development of self-driving technologies. The leading Swedish company specializing in self-driving technologies is the software company Zenuity, which is owned by Volvo Cars and Veoneer, a spin-off from Autoliv, focusing on active safety, autonomous driving, occupant protection and brake control. Zenuity aims to break new ground with world-class driver-assistance and autonomous-driving technologies. Zenuity has been appointed by the Geely Group to be their preferred supplier in autonomous technologies. Illustrative of the way new forms of collaborative partnerships are formed is the MobilityXLab in Gothenburg wherein Zenuity also has its headquarters. The lab is owned by Volvo cars, Volvo Group, Veoneer, Geely, Ericsson and Zenuity. The founders - global brands within mobility and connectivity – combine their strengths to push the boundaries of innovation and offer young companies access to competence, networks, tools and insights from leading subject matter experts, as well as workspace.





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INTRODUCTION

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CONCLUSIONS

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The ideas of cities as regional actors and shapers of strategic coalitions was presented by Richard Normann in his last book:

· Normann, R. (2001). Reframing Business: When the Map Changes the Landscape. Wiley, 2001.
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The work done by Synocus in the field of urban innovation has been published in numerous reports, of which the most relevant are the following:

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APPENDIX 1. THE NUM2030 SCENARIO BUILDING PROCESS

The conferences attended for information gathering for the scenario building process were:

· The Battery Show, September 10-12, 2018, Novi, Michigan, USA
· The 38th Strategic Management Society Annual Conference, September 22-25, 2018, Paris
· The New Mobility: Opportunities and Challenges, November 16-17, 2018, University of Tokyo
· Nordic EV Summit 2019 – Planet Electric, March 21-22, 2019, Oslo
· Innovation in East Asia in Global Context: E-Mobility and Urban Systems, May 9-10, 2019, Berlin

Information gathering:

· Interviewed Finnish cities and city representatives relating to the ongoing transition of urban mobility were Espoo, Helsinki, Hämeenlinna, Joensuu, Jyväskylä, Kotka, Kouvola, Kuopio, Lahti, Lappeenranta, Mikkeli, Oulu, Pori, Porvoo, Rovaniemi, Salo, Tampere, Turku, Vantaa, and Vaasa.

APPENDIX 2. TECHNOLOGIES TRANSFORMING MOBILITY

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Cities as game changers

Cities today must deal with a growing amount of challenges, climate change being a major one. City managers must provide a better place to live for residents here and now while also making decisions about how to address the longer-term challenges. To do this, they must become game changers.

This report introduces transcendent innovation as a new way for cities to combine the immediate and longer-term perspectives in their development work. There are different ways to drive change: visionary leadership, strategic management, and enabling orchestration. By using examples from the Nordic capitals, we offer concrete suggestions for how the principles of transcendent innovation can be applied in urban mobility. We conclude that there is a common Nordic way of working that can lead the way when cities move to the next level of urban innovation.

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