United Nations ECE/HBP/2020/Inf. 8

Economic Commission for Europe

Committee on Urban Development, Housing and Land Management

Eighty-first session
Geneva, 6-8 October 2020
Item 4(a) of the provisional agenda
Review of the implementation of the programmes of work 2018-2019 and 2020: sustainable smart cities

Implementation of the United for Smart Sustainable Cities programme

Smart Sustainable City Profile: Trondheim, Norway

Note by the Secretariat of the Committee

This Smart Sustainable City Profile was developed as part of the project "Improving sustainability of 17 Norwegian Cities" by the United Nations Economic Commission for Europe (UNECE) in collaboration with the Geneva UN Charter Centre of Excellence on Sustainable Development Goals City Transition in Trondheim. The project supports the transition of 17 cities in Norway towards becoming smarter and more sustainable with a view to achieving Sustainable Development Goal (SDG) 11 and other urban related SDGs of the 2030 Agenda for Sustainable Development.

This Smart Sustainable City Profile presents the outcomes of the evaluation of the city against the Key Performance Indicators (KPIs) for Smart Sustainable Cities (SSC) and suggests actions on how the city could improve progress towards the SDGs. It also offers guidance for the development, review and implementation of urban policies, programmes, and projects, as well as for building partnerships with a view to reinforcing the implementation of the 2030 Agenda for Sustainable Development and SDG11 in Norway.

Accelerating progress towards the SDGs and the implementation of the 2030 Agenda for Sustainable Development are political priorities for Trondheim. Over the last decade the municipality has established a range of ambitious targets, developed and implemented a range of projects and solutions, and built partnerships that focus on climate, transport, and digitalization agendas. It aims to reduce direct climate gas emissions by 30 per cent by 2023 and 80 per cent by 2030, and the city has made the SDGs a central part in local planning and programming.

Taking into account the KPI evaluation of the city and other documentary sources, this profile makes a series of recommendations to further accelerate the progress of Trondheim towards achieving the SDGs. These recommendations suggest improvements in areas such as public transport infrastructure, water and sanitation infrastructure, and social inequalities.

Contents

Preface

The Sustainable Smart City Profile for Trondheim (Trondheim City Profile) was developed as part of the project "Improving sustainability of 17 Norwegian Cities" by United Nations Economic Commission for Europe (UNECE) in collaboration with the Geneva UN Charter Centre of Excellence on Sustainable Development Goals City Transition in Trondheim. The project supports the transition of 17 cities in Norway towards becoming smarter and more sustainable with a view to achieving Sustainable Development Goal (SDG) 11 and other urban related SDGs of the 2030 Agenda for Sustainable Development. The implementation period for this project is from August 2019 to July 2021.

The Trondheim City Profile presents the outcomes of the evaluation of the city against the Key Performance Indicators (KPIs) for Smart Sustainable Cities (SSC) and suggests actions on how the city could improve progress towards the SDGs. It also offers guidance for the development, review and implementation of urban policies, programmes, and projects, as well as for building partnerships with a view to reinforcing the implementation of the 2030 Agenda for Sustainable Development and SDG11 in Norway.

The KPIs for SSC is a public and free of charge standard developed by the UNECE and the International Telecommunications Union (ITU) in the context of the "United for Smart Sustainable Cities" (U4SSC) initiative. U4SSC is coordinated by UNECE, ITU and the United Nations Human Settlements Programme (UN-Habitat) and supported by fourteen other UN agencies.

This City Profile was developed taking into account documentary data sources, including the "U4SSC Verification Report – Trondheim, Norway" and a survey[1] completed by the city that is dedicated to the city policies, programmes, projects and partnerships to improve city smartness and sustainability. UNECE and the municipality of Trondheim engaged in multiple meetings to discuss what are the most important areas of urban development to be targeted in the recommendations section of this City Profile and to consider the priorities and key areas of the city that need further improvement.

This profile consists of five parts: Part I focuses on the geographical situation, the administrative and political framework, population and demographic situation, and socio-economic conditions of the city. Part II outlines the legal and institutional framework for urban development at the local level and city administrative structure. Part III provides information about the outcomes of the evaluation of the city performance against the KPIs for SSC and highlights the relevant actions and initiatives (e.g. policies, projects, programmes) that the city is taking and Part IV outlines the financial framework for urban development. The profile concludes with recommendations.

[1] The survey was designed by UNECE and disseminated to the city, and requested information on the policies, projects and programmes that the city is currently implementing, as well as the future projects it plans to implement, in relation to the city's economy, environment, society and culture.

Acknowledgements

UNECE wishes to acknowledge the following people for their contributions to the completion of this study.

The UNECE secretariat would like to express its gratitude to the municipality of Trondheim for providing data and information used in this City Profile.

Ms. Paola Deda – Director, Forests, Land and Housing Division, UNECE

Ms. Gulnara Roll – Secretary to the Committee on Urban Development, Housing and Land Management, UNECE

Ms. Cecilia Batac – Editor, UNECE

Ms. Agata Krause – Consultant, UNECE (author)

Mr. Liam Buckley – Consultant, UNECE

Executive Summary

Accelerating progress towards the Sustainable Development Goals (SDGs) and the implementation of the 2030 Agenda for Sustainable Development are political priorities for the municipality of Trondheim. Over the last decade the municipality has established a range of ambitious targets, developed and implemented a range of policies, projects, programmes and solutions, and built partnerships that focus on climate, transport, and digitalization agendas. It aims to reduce direct climate gas emissions by 30 per cent by 2023 and 80 per cent by 2030[2]. The city makes the SDGs a central part in local planning and programming, including as targets in the annual budget.

Trondheim not only invests in renewable energy sources and storage solutions, it is also paving the way towards sustainable transportation with its green transport and mobility programme. A total of NOK 25 billion (EUR 2.34 billion) is dedicated to this programme for the maintenance of roads, facilities for pedestrians and cyclists and public transport between 2010 and 2029. The city is a part of the award-winning Greener Trondheim[3] partnership for sustainable transport.

Trondheim is home to the Norwegian University of Science and Technology (NTNU) and SINTEF - one of the largest independent research institutes in Europe, as well as being home to a considerably-sized community of start-up businesses. In 2019, the city was recognised as the most innovative city in Norway by the Ministry of Local Government and Modernization[4], receiving the KMD Innovation Award 2019. The city is the coordinator of the Geneva UN Charter Centre of Excellence on Sustainable Development Goals City Transition. The role of the Charter Centre is to generate and disseminate innovative approaches to SDG 11 implementation, such as outlining methods for pursuing environmental sustainability (including improving air quality and environmental quality), and providing the technological basis for innovative business practices and start-ups. The Charter Centre of Excellence plays an important role in the dissemination of good practices in the above-mentioned fields at both national and international levels.

The results of the Trondheim's performance against the Key Performance Indicators for Smart Sustainable Cities, carried out between 2019 and 2020, shed light on the challenges and opportunities for the sustainable development of the city. Furthermore, the results showed that the strong economy of the city is grounded in the availability of and access to ICT infrastructure, innovation-generating facilities, universal electricity supply, and very strong employment rates, all of which make significant contributions to the economic development and quality of life of Trondheim.

The evaluation also reaffirmed the development priorities of the city of supporting innovation, further developing the public transport infrastructure and improving the urban planning of Trondheim. A well-designed and efficient public transport system is the backbone of sustainable and smart urban development. It prompts equal distribution of the benefits of urbanization and facilitates the reduction of spatial socio-economic inequalities. The actions taken by the city to improve the modal split share of travel is important, as currently half of all journeys in Trondheim are taken by private vehicles, while only 12 per cent are made through public transport.

It is essential that economic development is combined with lower rates of resource use and energy consumption, and higher rates of resource reuse and recycling. Therefore, the city of Trondheim is

[2] Trondheim Climate Plan – https://www.trondheim.kommune.no/klimaplan/
[3] https://miljopakken.no/om-miljopakken/organisasjonen/resultater
[4] https://www.regjeringen.no/no/aktuelt/gratulerer-til-trondheim--arets-vinner-av-innovasjonsprisen/id2660969/

encouraged to develop, implement and promote circular city solutions by means of sharing, recycling, refurbishing, re-using, replacing and digitizing the use of resources. For instance, improving the lifespan of the water and sanitation infrastructure by investing in renovation and taking other actions that decrease water supply loss, such as investing in better information and communications technology monitoring of urban water networks, will have a considerable impact on the quality of life and the environment.

Improving the smartness and sustainability of Trondheim requires further improvements in public safety and security, including the access to emergency services[5]. It is also recommended to take steps towards addressing social inequalities in the city as the gender pay gap remains high (females earn 27 per cent less than males on the average) and 5.7 per cent of the population remains in poverty[6]. Further action to address the inclusion of vulnerable groups in society and the income balance between men and women in the city are encouraged.

Last but not least, given that cities play an important role in accelerating progress towards SDGs, and that Trondheim has made substantial innovative contributions to the 2030 Agenda at both national and international levels, the city is encouraged to review its progress towards the SDGs, to further develop innovative policies, projects and programmes in collaboration with UNECE.

In the coming years, Trondheim plans to further invest in ICT and social innovation, urban planning and transport, as well as public services and the sustainability of buildings. As the national government has made the SDGs the main priority for all 356 municipalities in Norway, Trondheim will ensure that they are incorporated into plans and annual budgets, as well as taken into account in the city's climate budget. Trondheim will also use the findings from the evaluation of the city's performance against the Key Performance Indicators for Smart Sustainable Cities to improve local planning and programming, with a view to identifying the greatest returns on investment across a number of domains, especially in relation to energy, mobility, and healthcare.

[5] The KPI evaluation showed that it takes 14 minutes on the average to reach the location of an emergency in the city, whereas the average response time of emergency services in Europe is 9 minutes.
[6] Poverty here is defined by the national poverty threshold, available at www.worldbank.org

Part I General overview

Trondheim was founded in 997, which makes this Viking city more than a thousand years old. The rock carvings found in the surrounding region prove that people have lived there for thousands of years. The city became a trading post due to its strategic location along the Trondheim fjord and Nidelva river. Trondheim has a number of sights that are among the most visited in Norway each year.

Trondheim is well-known not only for its history but also for research and innovation. Modern Trondheim is an important technology hub in the Nordics. The city is home to the largest university in Norway, the Norwegian University of Technology and Science (NTNU) and the research institute SINTEF, one of the largest independent research institutes in Northern Europe. Numerous technology innovations form the bases of spin-off companies that thrive in the impressive start-up scene of the city. Greater Trondheim[7] and the County of Trønelag are used as an arena for testing autonomous vehicles, ships and aircraft. The waters outside of Trondheim offer a test bed for autonomous vessels, with the first autonomous ferries beginning to move people between points in the city.

Trondheim has a population of 206,000 and is the third largest city in Norway. The wide range of things to do may be attributed in part to its large number of students totalling more than 35,000. The students leave their mark on the city by arranging many events, as well as attending the cultural events that the city offers.

Greater Trondheim has close ties to the sea, making it a world leader in marine harvesting and in exporting seafood to the global market. The city has a strong focus on local food and many establishments, including pubs, cafés and restaurants, serve a wide range of excellent locally brewed beers matched by food especially developed to accompany the beer. The Country of Trøndelag, where Trondheim is located, was awarded European Region of Gastronomy 2022.

In 2019 Trondheim was recognised by the Ministry of Local Government and Modernisation[8] as the most innovative city in Norway. The jury emphasised the system-wide changes implemented by the city. The benchmarks of the city are the United Nations SDGs. To systematize the approach of Trondheim, the "University City TRD 3.0"[9] was created. Furthermore, Trondheim was recognised and awarded status as a Geneva UN Charter Centre of Excellence on SDG City Transition by the United Nations Economic Commission for Europe (UNECE), also in 2019. The Trondheim Centre of Excellence was created on 1 October 2019 to support the transition of the 56 UNECE member towards smarter, more sustainable and attractive societies.

[7] Greater Trondheim, also known as the Trondheim Region, is a group of municipalities surrounding and including Trondheim, in the Trøndelag County.
[8] https://www.regjeringen.no/no/aktuelt/gratulerer-til-trondheim--arets-vinner-av-innovasjonsprisen/id2660969/
[9] This is a holistic approach to innovating by doing, using the greater region of Trondheim as a playground to unravel new ways of becoming a city. Together with NTNU the city demonstrates and documents ways of speeding up our transition towards a smarter, more sustainable and attractive society.

Part II Legal and institutional framework for urban development

The legal and institutional framework for urban development in Norway is defined by the Municipal Act, Planning and Building Act, Civil Protection Act and Public Health Act. The Planning Act mandates the municipalities to develop a 12-year masterplan and requires all cities to have a 4-year action plan and an annual budget.

Norway's municipalities have considerable self-governing powers. They provide education for children up to the age of 15 and other child services. They oversee the functioning of schools, day-care institutions (pre-schools), and healthcare facilities in the city. Urban planning, including the provision of infrastructure and water and sanitation, is one of the key responsibilities of the municipality.

The vision, goals and actions for the urban development of Trondheim are spelled out in the 12-year masterplan of the city (*Kommuneplanens Samfunnsdel*), approved by the 67 councillors of the City Council.[10] Within this framework the city has freedom to direct local development as it sees fit. Under the current masterplan, approved in 2009 and to be revised in 2021, the city has 4 main goals, which are for Trondheim to become:

- An Internationally recognized technology and knowledge city
- A sustainable city where it is easy to make environment friendly choices
- An inclusive and diverse city
- An active urban developer and attractive employer

In May 2019, in a Royal Decree, the SDGs were introduced to the overall framework of all regional and local planning.[11] The municipality of Trondheim implements the Decree by working closely with citizens to the extent that in 2019, the city revised its policy on citizen engagement and adopted a series of guidelines and principles. The municipality collaborates with the European City Economic and Financial Governance (CEFG) Group to improve financing for sustainable development. Since 2014, the CEFG Group has united Chief Executive Officers /Chief Financial Officers and Directors of Finance from Amsterdam, Barcelona, Bordeaux, Hamburg, London, Milan, Trondheim and Vilnius to develop best practices in the field of economic and financial governance to improve the management and fiscal sustainability of the European public sector at local level. Notable initiatives have been the development of a climate budget as well as an SDG budgeting model.

[10] https://www.trondheim.kommune.no/globalassets/10-bilder-og-filer/11-politikk-og-planer/planer/kommuneplanen/kommuneplanens-samfunnsdel-2009-2020.pdf
[11] https://www.regjeringen.no/no/dokumenter/nasjonale-forventninger-til-regional-og-kommunal-planlegging-20192023/id2645090/

Part III Evaluation of the city performance against the Key Performance Indicators for Smart and Sustainable Cities

To support the commitment to building a smart and sustainable Trondheim, in 2019/2020 the city of Trondheim was evaluated using the Key Performance Indicators (KPIs) for Smart Sustainable Cities (SSC). The KPIs for SSC is a United Nations standard on smart sustainable cities developed by UNECE and ITU in 2015.[12]

The KPIs for SSC have been tested and implemented in over 150 cities worldwide.[13] In the period 2019 to 2023, UNECE foresees the evaluation of 17 Norwegian cities, as well as of Grodno (Belarus), Bishkek (Kyrgyzstan), Tbilisi (Georgia), Tirana (Albania), Podgorica (Montenegro), Almaty (Kazakhstan), and Nur-Sultan (Kazakhstan).

The 91 KPIs for SSC are at the intersection of three dimensions of sustainability (economy, environment, and society), and information and communications technology (ICT). The KPIs for SSC are outlined in the "Collection Methodology for Key Performance Indicators for Smart Sustainable Cities"[14]. In the process of the evaluation of the city against the KPIs for SSC, the KPI values are verified[15]. The outcome of the data data provided by Trondheim is the "U4SSC Verification Report – Trondheim, Norway".

In line with the verification report, the graph below visualizes the performance of the city against the KPIs for SSC. Succeeding discussions outline the performance of the city in relation to the three dimensions of the KPIs – economy, environment, and society and culture, and the relevant city actions, with a view to identifying the challenges and opportunities to make Trondheim smarter and more sustainable.

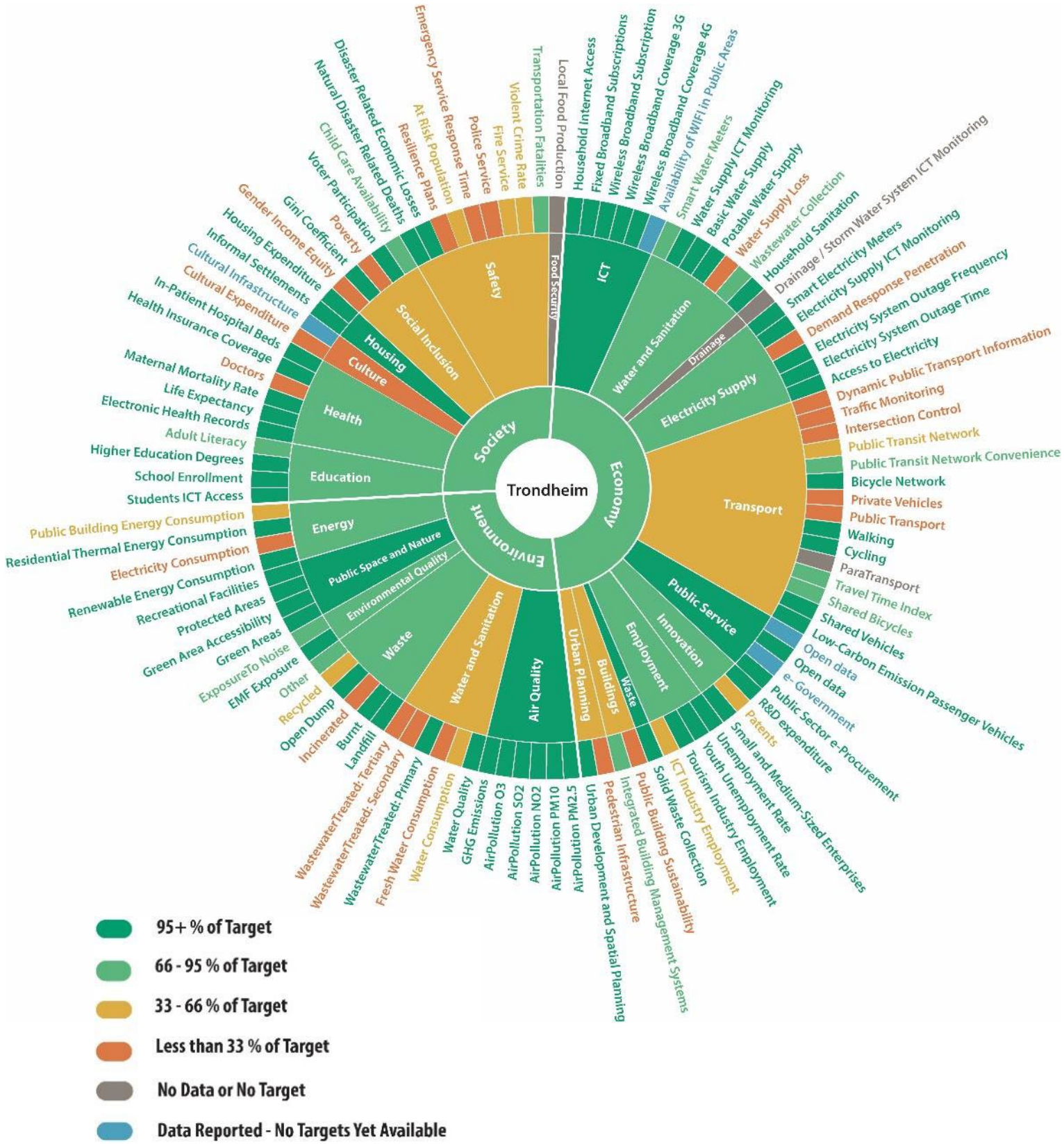
[12] The KPIs for SSC standard developed by UNECE and ITU was endorsed by the UNECE Committee on Urban Development, Housing and Land Management in 2016 (ECE/HBP/2016/4) and was brought under the United for Smart Sustainable Cities (U4SSC) initiative. U4SSC has 16 United Nations partner agencies and supports the evaluation of performance of cities using the KPIs for SSC and the implementation of smart sustainable cities solutions through the development of guidelines, studies, city action plans and capacity building events.

[13] This includes for instance, Voznesensk (Ukraine), Goris (Armenia), Pully (Switzerland), Dubai (United Arab Emirates), Singapore (Singapore), Shanghai (China), Buenos Aires (Argentina), Moscow (Russia) and many others.

[14] Available at https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/U4SSC-CollectionMethodologyforKPIfoSSC-2017.pdf

[15] The KPIs "verification" is the process of verifying the accuracy of data that will be used for the evaluation.

Graph 1: **Trondheim's performance against the Key Performance Indicators for Smart Sustainable Cities**



Economy – an overview

The economic development of the city is linked to its highly developed ICT infrastructure and potential to generate innovation. Its economy places a particular focus on small and medium sized enterprises, including start-ups[16]. Trondheim is a major land and sea transport link in Norway, connecting the more densely settled south with the far north regions. It is also a manufacturing centre of metal and paper products, bricks and tiles, and textiles, and places importance on food processing (especially of fish).[17]

Despite a very positive outlook, the city continues developing and implementing initiatives for economic development. The "Strategic Business Development Plan for Greater Trondheim"[18], established at the regional level with neighbouring municipalities and the Trøndelag County Council[19] focuses on: 1) promoting innovative approaches and tools for public procurement[20] and 2) nurturing innovation by supporting entrepreneurs and their start-ups[21]. Innovative public procurement is particularly important for the city as it promotes environmentally and socially responsible urban services and urban infrastructure projects. In Norway, public agencies procure goods and services amounting to close to EUR 58 billion annually.

Trondheim is an innovation hub in Norway because of its effective collaboration with academia, especially with NTNU, SINTEF and other research and development (R&D) related organizations, which not only employ a large number of people (currently, 1 in 5 inhabitants of Trondheim are employed in R&D related activity) but also create opportunities for business development. The city collaborates also through the University City 3.0 programme.[22]

The **University City 3.0** is a partnership agreement between the city of Trondheim and the NTNU university for the period 2018 - 2022. The creation of the University City 3.0 programme was inspired by St. Olav's University Hospital, where it was realised that long-term access to talent and innovation was by no means a given. The objective of the partnership is to improve the innovative potential of the city. The Ministry of Local Government and Modernization innovation award[23] was given to Trondheim in recognition of its holistic approach to developing innovation and its partnership.[24]

The partnership aims to use Greater Trondheim as a playground to find new ways of becoming a sustainable city. Together with NTNU, the city demonstrates and documents ways of speeding up transition towards a smarter, more sustainable and attractive society. This is done through the provision of physical and digital platform to bring people together around upcoming funding opportunities and policy developments. This also serves to help Trondheim attract, retain and develop talented people.

[16] https://startuptrondheim.no/
[17] https://www.britannica.com/place/Trondheim
[18] https://www.trondelagfylke.no/contentassets/b91afe6250b342e9b2d73dc270993796/strategy-for-innovation-and-value-creation-in-trondelag.pdf
[19] Strategic Business Development Plan for Greater Trondheim, 2017
[20] Trondheim's Procurement Strategy - https://www.trondheim.kommune.no/globalassets/10-bilder-og-filer/09-finans/innkjopstjenesten/anskaffelsesstrategi-2018---2023-2.pdf
[21] Trondheim's strategy for entrepreneurship, 2016 - https://www.trondheim.kommune.no/globalassets/70-admin/english/trondheim-municipality---trondheim-nordic-city-labs.pdf
[22] University City 3.0, 2018, Trondheim City Council - https://sites.google.com/trondheim.kommune.no/universitetskommunen/hjem
[23] https://www.regjeringen.no/no/aktuelt/gratulerer-til-trondheim--arets-vinner-av-innovasjonsprisen/id2660969/
[24] University City 3.0, 2018, Trondheim City Council - https://sites.google.com/trondheim.kommune.no/universitetskommunen/hjem

Cooperation between a city and its universities is highly beneficial for the innovation ecosystem[25] and opens multiple knowledge pools for addressing areas of mutual interest such as local housing[26]. The student population can serve as the basis for student-oriented business operations that could bolster the local economy, and offer local organizations a talent pool of people who are willing to live and work in the city after graduation.[27]

The city actively develops and uses ICT solutions to leverage its economic policy and development. Trondheim was among the first cities in the world to launch a 5G network, opening new vistas for revolutionising the shipping industry. In the skies above Greater Trondheim, the first fully electric test space for electric aircrafts known as Green Flyway[28] was opened. Trondheim works with other cities in Norway, most notably within the Smart City Network[29], to set up data repositories. Together with private and public actors, it works towards the development of new business models and innovation.

The city developed the 5-year digitalization programme "Digital First Choice", which provides organizations who are looking to rent a space with a self-service booking system. This digitalization programme oversees many different projects including the "ICT in Trondheim Education" project, wherein the city contributes to raising the digital proficiency of both teachers and students, as well as upgrading the whole ICT infrastructure in schools. This has been the key objective of the programme, and Trondheim (and neighbouring municipalities) is a test ground for the using ICT solutions to develop a next generation platform for health care systems. The new platform will offer all health services to patients in a one place, increasing the quality of service and cutting transaction costs.

The plan of the city for digitalization and modernization is currently being updated, and the City Council will agree on a new strategy for further digitalization by the end of 2020. In the meantime, the testing and adoption of smart solutions are ongoing. Interesting examples are smart trash cans, smart parking solutions, sensors mounted on the fleet of service vehicles of the city to measure air quality, etc. Since 2019, the transport system of the city includes new city buses, half of which are electric.

Just as importantly, the County of Trøndelag where Trondheim is located is a world leader in marine harvesting, with world class R&D facilities and communities[30].

KPI evaluation results – Economy dimension

The evaluation of the city performance against the KPIs for SSC reinstated the strong economic performance of Trondheim. Rates of unemployment in general and youth unemployment in particular are extremely low at 1.34 per cent and 1.32 per cent respectively, while 4.71 per cent of the workforce is employed in tourism. Similarly, under the area of innovation, the evaluation showed that Trondheim spends 4.6 per cent of its GDP on research and development, and 99.24 per cent of its businesses are small and medium-sized enterprises, thus showing a very strong performance in this area.

[25] https://www.hel.fi/helsinki/en/administration/enterprises/competitive/university-collaboration/university-cooperation
[26] https://www.britishcouncil.org/sites/default/files/mutual_influence_report-ilovepdf-compressed_2.pdf
[27] https://www.coimbra-group.eu/wp-content/uploads/Productive-cooperation-univ-and-city-in-Turku-KOLA.pdf
[28] https://greenflyway.se/about-green-flyway/index.html
[29] https://sites.google.com/trondheim.kommune.no/smartbynettverket/forsiden
[30] Trondheim is also part of the national programme for Supplier Development (2010) - http://innovativeanskaffelser.no/about/

The KPI evaluation shows that the economic development of the city is grounded in good access to well-developed urban infrastructure, including innovation and ICT infrastructures. The provision of and access to internet is very high. Household internet access is universal and the city has full wireless broadband coverage. There are 116,000 wireless broadband subscriptions per 100,000 inhabitants in Trondheim. One hundred per cent of the public sector services of the municipality are available online and easily accessible.

The results of the evaluation point to a well-functioning waste collection system, as solid waste is regularly collected in all households in Trondheim. However, more than two-thirds of this waste is incinerated and only 29.2% of it is recycled. The electricity supply is universal and widely monitored using smart electricity meters (98.56 per cent of electricity meters in Trondheim are smart meters). The electricity supply is also very rarely interrupted with 0.7 interruptions per year per customer and each interruption lasting less than an hour on the average.

On water and sanitation infrastructure, the water supply and the supply of potable water are at 96.65 per cent and 100 per cent respectively, and access to household sanitation is universal. There is some room for improvement with regard to wastewater collection (as 93.7 per cent of households are served by wastewater collection) and the amount of water meters that are 'smart' water meters (88.9 per cent), and water supply loss in Trondheim is very high at 28.42 per cent, indicating that nearly a third of water supplied is lost in the water distribution system.

Trondheim provides good quality transport infrastructure and its extensive bicycle network permits 10 per cent of all trips to be made by bicycle. A high amount of low-carbon emission passenger vehicles, a strong bicycle- and car-sharing rate, and a high percentage of people travelling by simply walking are all indicators of sustainable transport practices. However, the percentage of people using public transport is rather low at only 12 per cent, while the percentage of journeys done through private vehicles is high at 50 per cent. Concerning building sustainability, only 0.33 per cent of public buildings have been certified as sustainable and a very small part of the city is allocated for car-free pedestrian zones.

Environment – an overview

The city of Trondheim makes considerable efforts to improve the condition of its environment. It has developed strategies, policies and projects dedicated to addressing climate change, especially adaptation and mitigation strategies, as well as improving energy efficiency in the context of a large-scale partnership on transportation, the EU Horizon 2020 lighthouse project "Positive City Exchange" and others.

Trondheim has adopted ambitious goals and strategies to reduce climate gas emissions and mitigate the effects of climate change. The main goal is to reduce direct climate gas emissions by 30 per cent by 2023 and 80 per cent by 2030. The main areas of intervention in the Climate Plan[31] include: 1) zero emission construction sites, 2) mobility/transportation, and 3) carbon capture and storage.[32] To follow up on these policy objectives, the city climate budget was adopted in 2016.

In 2010, the city launched Miljøpakken or the "Greener Trondheim"[33] climate initiative in partnership with the Trøndelag County Council, the neighbouring municipalities of Stjørdal, Malvik and Melhus, and government agencies such as the Norwegian Public Roads Administration and the National agency for

[31] Trondheim's Climate Plan, 2017-2030 - https://www.trondheim.kommune.no/globalassets/10-bilder-og-filer/10-byutvikling/miljoenheten/klima-og-energi/kommunedelplan-energi-og-klima130618.pdf
[32] Trondheim's Climate Strategy, 2016 and updated 2019, Chin Yu Lee - https://www.trondheim.kommune.no/klimaplan/
[33] https://miljopakken.no/om-miljopakken/organisasjonen/resultater

railway services. “Greener Trondheim” is essentially a contract between the local and national government that aims to keep the amount of private vehicles on the roads of Trondheim low. This award-winning programme will run between 2010 and 2029 and envisages investment in main and local roads, public transport, environment, traffic safety and infrastructure for cyclists and pedestrians, in order to reduce greenhouse gas emissions, congestion, traffic noise, and the number of traffic accidents (through better traffic management and increased share of transport on foot, by bicycle, by bus or by tram). The programme also aims at reducing emissions from public buildings. Improving neighbourhood planning and parking is an integral part of the programme, creating routes and shortcuts that encourage citizens to walk rather than drive. The total value of investment is NOK 25 billion (2,34 billion Euros).

Trondheim, in collaboration with NTNU and the Limerick City and County Council, is the lead city of the *+CityxChange* project that was granted funding from the European Union Horizon 2020 research and innovation programme in the call for “Smart cities and communities”[34]. Within the *+CityxChange* smart city project, the cities of Trondheim, Limerick, Alba Iulia, Písek, Sestao, Smolyan and Võru will experiment on how to become lead cities in integrating smart positive energy solutions. *+CityxChange* creates solutions for positive energy blocks leading to energy positive districts and cities.

Furthermore, the city is planning to make further improvements on access to public spaces and nature, waste management, water and sanitation infrastructure, and air quality.

KPI evaluation results – Environment dimension

The commitment of Trondheim to addressing climate change and improving the condition of the environment translates into a very positive outlook on its performance against the KPIs for SSC in the areas of environmental quality and energy. The air quality and access to public space and nature are both very good. The contribution of Trondheim to greenhouse gas emissions is particularly low at 2.46 tonnes CO2/capita (lower than Helsinki at 7.4 tonnes/capita, Paris at 7.7 tonnes/capita, and Berlin at 10.4 tonnes/capita)[35].

The percentage of the population with convenient access to a green area is 98.7, and 40 per cent of the city constitutes protected natural area. The provision of recreational facilities is also good, indicating a strong contribution to quality of life. The city has no problem with electromagnetic field (EMF) exposure; however, the percentage of city inhabitants exposed to excessive noise levels is slightly high at 44.9.

On energy use and waste management,[36] the evaluation results indicate that the electricity consumption is high (13,424 kWh per year per capita). However, 100 per cent of that electricity comes from renewable sources. Energy consumption of public buildings is slightly higher than ideal. Regarding waste management, the city puts very little of its solid waste into landfills (2.82 per cent) and none goes into open dumps or is burned. However, there is room for improvement when it comes to the amount of waste being recycled, which is low at 29.2 per cent. An increase in the proportion of waste being recycled would help reduce the amount that is incinerated, which is very high at 67.9 per cent.

The quality of water is high insofar as there is no need for secondary or tertiary treatment. However, the KPI evaluation indicates a need to take steps to improve water and sanitation infrastructure in the city: the

[34] Positive City Exchange, 2019, Silja Rønningsen - https://cityxchange.eu/
[35] http://citycarbonfootprints.info/
[36] https://trv.no/sorting-tables/information-in-english/ The company that manages waste collection

level of water consumption in Trondheim is high at 230 litres per day per capita there is also a high degree of water loss from the water distribution system (28 per cent)[37].

Society and culture – an overview

A high quality of life and strong social inclusion safeguard the sustainable development of cities. In order to ensure both, the city of Trondheim pursues better education and greater citizen engagement strategies, programmes and projects.

In 2019, the city launched the following: a new strategy for education and social inclusion called "Rock Scissors Paper"[38], a programme for crime prevention among youth and two public health programmes - "Friskliv og mestring" (exercise as a substitute for treatment and medication) and "Hverdagsrehabilitering" (everyday rehabilitation).

In the same year, the city adopted a new strategy for citizen engagement[39] and a series of guidelines stating that: 1) citizen involvement should take place locally, based on local context and conditions, 2) dialogue with citizens should be considered in city planning, management system and budget process, and 3) the city must have a greater presence in digital spaces, as well as physical arenas. In the policy, the use of digital means is seen as a particularly important factor to better engage the younger population. The strategy materialised in the form of 'Borgerkraft' (Power of Citizens), which is a series of digital and physical meetings where citizens share ideas and aspirations on how to make Trondheim a better place for all.

One of the initiatives under the new strategy is the creation of the Centre for Relational Welfare, (Sentralen), which brings together civil society and researchers to share knowledge and practices on how services can be organized in a new and better way across sectors.

Trondheim has pioneered a new approach to addressing crime, focusing on youth aged 12-18 as well as repeat offenders aged 18-23, coordinating initiatives between the city and the police[40]. The strategy was adopted to pre-emptively address issues that could potentially impact the youth population, such as radicalisation, human trafficking and prostitution. The strategy involves identifying individuals at risk and their families.[41]

To improve quality of life and cut down health care expenditure in the process, the city has recently launched early intervention public health care programmes.[42] Two notable examples are the programmes "Friskliv og mestring" (Healthy Living and Coping) and "Hverdagsrehabilitering" (Everyday Rehabilitation). The first programme focuses on the elderly in a home-based care setting and identifies opportunities to make the elderly more self-reliant, so that they carry out everyday activities more independently. Small examples can make a big difference, such as having the elderly walk to their front door to let a health care worker in or simply walking up and down the stairs in a safe way. Healthy Living and Coping involves both

[37] Trondheim is exempt from secondary or tertiary water treatment due to a high quality of water. Source 'Monitoring of Trondheimsfjorden near the discharge points for Høvringen and Ladehammeren sewage treatment plants, Trondheim Municipality 2019-2020; Appendix A- Hydrography- Results Oxygen (my files in the computer)'.
[38] https://www.trondheim.kommune.no/globalassets/10-bilder-og-filer/02-skoler/skoler-p-a/stavset-skole/stein-saks-papir-strategidokument.pdf , https://steinsakspapir.org/
[39] Strategy for Citizen Engagement, 2019, Kristin Næss - https://sites.google.com/trondheim.kommune.no/communityxchange/trondheim?authuser=0
[40] Crime Prevention Strategy, ca 2010, Even Ytterhus - https://www.trondheim.kommune.no/slt/
[41] Crime Prevention Strategy, ca 2010, Even Ytterhus - https://www.trondheim.kommune.no/slt/
[42] Public Health Strategy, 2008, Mette Berntsen

education and exercise programmes with a focus on social interaction and schemes for replacing traditional medicine with exercise, with the end goal of improving health and quality of life and reducing cost.

Trondheim also boasts a very high-quality food industry. Over recent years, there has been an explosion of various food outlets and arrival of Michelin-starred restaurants. The County of Trøndelag has been selected as the 2022 European Region of Gastronomy.

KPI evaluation results – Society and culture dimension

As with the economic and environmental dimensions, the performance of Trondheim in the society and culture dimension of the KPIs is broadly positive. In particular, provision of affordable housing and the education system showed very strong performance. 99.93 per cent of the population lives in adequate housing and the average percentage of income that inhabitants spend on housing is low at 16.24 per cent. School enrolment is at 100 per cent and all students have access to ICTs. Correspondingly, adult literacy is high at 94.8 per cent and the presence of higher education degrees in the population is high.

All inhabitants of Trondheim are covered by health insurance and almost all health records are kept electronically. Life expectancy is very high at 81.65 years. Additionally, the city has a high proportion of in-patient hospital beds per person, and there were no recorded maternal deaths during childbirth. The only element of healthcare that performed not as well in the evaluation is the number of doctors in the city; there are only 87.78 doctors per 100,000 inhabitants.

The evaluation results suggested there could be room for improvement in the areas of social inclusion and safety. Voter participation is high with 65.85 per cent of eligible voters having voted in the most recent elections. Childcare provision is also strong with 70 per cent of pre-school aged children covered by day-care centres. While the very low Gini coefficient (0.25) suggests low wealth inequality in the city, the gender income equity measurement paints a different picture with female hourly earnings at only 73 per cent of male earnings. The percentage of citizens living in poverty in Trondheim is also high at 5.7.[43]

With regard to safety, the city does not experience a high threat from natural disasters as there are only 2.7 per cent of the population living in natural disaster-prone areas. Per capita natural disaster-related deaths is only 0.19 per 100,000 inhabitants and no economic losses have resulted from natural disasters. The performance of the city on the provision of emergency services is less strong. The police and fire services are relatively low staffed (at 90.8 staff and 72.5 staff per 100,000 inhabitants, respectively), and the average emergency service response time is at 14 minutes, which can be improved upon (the EU average is just under 9 minutes). Finally, the violent crime rate is at 628 incidents per 100,000 inhabitants – for comparison, Copenhagen had 324 incidents per 100,000 in 2019.[44]

[43] This Key Performance Indicator refers to the number of persons living below "poverty line" in Trondheim as defined in https://www.ssb.no/a/metadata/conceptvariable/vardok/3365/en

[44] Statistics Denmark, https://www.dst.dk/en/Statistik/emner/levevilkaar/kriminalitet

Part IV Funding and financing for urban development

Trondheim has made considerable efforts to develop and implement urban projects and programmes and build partnerships to secure access to funding and finance. In collaboration with the Association of Local and Regional Authorities[45], it has set up the Partnership for Radical Innovation to deliver innovative solutions.

All infrastructure in Trondheim is primarily publicly funded with very little private funding. However, Trondheim does own many buildings in the municipality of a wide variety, including schools and day care institutions. The maintenance of these buildings, along with some ICT infrastructure, account for the greatest resource-consuming elements of the municipal budget.

In the National Transport Plan 2018-2029, approximately NOK 66.4 billion (EUR 6.2 billion) has been allocated to urban environment and urban growth agreements, and to the Rewards Scheme. The national government will contribute rewards and funds for improving public transport, the national highway, and bicycle and pedestrian infrastructure. The national government will co-finance large urban infrastructure projects in the four largest urban areas, including the development of the railway stations and junctions. This type of scheme has been the core of programmes such as Greener Trondheim.

The SWOT (strengths, weaknesses, opportunities, threats) analysis[46] carried out within the University 3.0 programme to identify untapped opportunities for sustainable value creation indicated that there is good funding in the city and that Trondheim has overall quality and legitimacy as a democratic institution. However, the analysis indicated a need to address the complexity of interactions between actors, activities and resources to accelerate progress towards sustainable development. In this regard, the city identified the need to invest in the development of ”knowledge communities” and new partnerships, including public-private partnerships.

The city has been successful in acquiring funding for sustainable urban development from the European Commission, including for the development of the SDG City Transition Framework as part of the Horizon 2020 smart city lighthouse project.[47] Within the project, it is working closely with other European cities and business and academic partners.

The work of Trondheim as a Geneva UN Centre of Excellence on SDG City Transition framework is being shared across the 56 member States of UNECE, and is a cornerstone of a national city programme in Norway supported by the United Nations programme on smart sustainable cities and communities U4SSC. Using the framework, cities that were evaluated using the U4SSC KPIs moved from data to policy, planning and impact.

[45] https://www.ks.no/
[46] SWOT analysis is the process of identifying the strengths, weaknesses, opportunities and threats of a project.
[47] https://smartcities-infosystem.eu/scc-lighthouse-projects

Part V Recommendations

The city of Trondheim has made considerable progress towards the implementation of the 2030 Agenda for Sustainable Development (2030 Agenda). Since 2019, the achievement of the SDGs has been the main priority for the city. The SDGs now inform local planning and programmes, including the annual budget. The city established ambitious climate goals and targets to reduce direct climate gas emissions by 30 per cent by 2023 and 80 per cent by 2030. Trondheim not only invests in renewable energy sources and storage solutions, it is also laying the groundwork towards sustainable transportation with its green transport and mobility programme. For the period 2010-2029, NOK 25 billion (EUR 2.3 billion) has been dedicated to investments in roads, facilities for pedestrians and cyclists, public transport, and Greener Trondheim[48] - an award-winning partnership for sustainable transport.

Improving the quality of life by addressing social inclusion remain a priority for the city. In 2019 the city of Trondheim launched an overall strategy for family services and education called "'Rock Scissors Paper". The strategy focuses especially on supporting the development of children and youth with a view to improving their social responsibility as adults.

The city shows considerable potential to accelerate progress towards the implementation of the 2030 Agenda due to its innovative potential marked by the presence of NTNU, SINTEF and a considerably sized community of start-up businesses. In 2019, Trondheim was recognised as the most innovative city in Norway by the Ministry of Local Government and Modernisation[49].

The city of Trondheim was evaluated against the KPIs for SSC in 2019/2020. The outcomes of the evaluation are presented in the "U4SSC Key Performance Indicators Verification Report". The verification report, together with the review of relevant documentary data including information provided by the city through the survey on Sustainable Smart Cities Profile, is the basis for the following recommendations:

- *Improve access to public transport infrastructure*

A well-designed and efficient public transport system is the backbone for sustainable and smart urban development. It prompts equal redistribution of the benefits of urbanization and facilitates the reduction of spatial socio-economic inequalities. Over recent decades the development of transport infrastructure has benefitted from good access to innovative ICTs and solutions that provide more dynamic public transport information – for instance, better traffic monitoring, intersection control, and development of intelligent intersection management systems in cities.[50]

In light of the transition towards more climate-neutral and efficient public transport infrastructure, Trondheim has some notable practices: 1) the establishment of contracts between the national government and local governments that aim to decrease the number of cars in a city[51], and 2) the use

[48] https://miljopakken.no/om-miljopakken/organisasjonen/resultater
[49] https://www.regjeringen.no/no/aktuelt/gratulerer-til-trondheim--arets-vinner-av-innovasjonsprisen/id2660969/
[50] Elnaz Namazi, Jingyue Li, and Chaoru Lu, "Intelligent Intersection Management Systems Considering Autonomous Vehicles: A Systematic Literature Review," *IEEE Access* 7 (2019): 91946, https://doi.org/10.1109/ACCESS.2019.2927412.
[51] https://www.regjeringen.no/no/tema/kommuner-og-regioner/by--og-stedsutvikling/Byvekstavtaler/id2454599/

of innovative methodologies that link land use and transport planning to evaluate and improve the accessibility of areas by different modes of public transport[52].

The evaluation of Trondheim against the KPIs for SSC indicates a need to further focus on improving the modal split share of the city, which in turn requires comprehensive action, taking into account several factors (such as the costs of owning, driving and parking private vehicles, and the quality and cost of alternative transport modes such as public transport and cycling) and development of relevant solutions.

There is also a need to gather high-quality granular data about the access and availability of transport, and on transport infrastructure that could provide dynamic public transport system in the city.

- *Improve water and sanitation infrastructure*[53]

Twenty-first century urban management is built on the principles of circular economy and requires decisive action to address patterns of unsustainable consumption of natural resources. Therefore, cities need to develop and implement urban policies and solutions that promote sharing, recycling, refurbishing, re-using, replacing, and digitizing of water use, and other natural resources. Water is one of the key natural resources of the city. Thus, improving the quality of water and the efficiency and effectiveness of water and wastewater infrastructure and facilities will have a considerable impact on the quality of life and the environment.

In view of the evaluation of Trondheim against the KPIs for SSC, the city is encouraged to improve the lifespan of the existing water and sanitation infrastructure by investing in its renovation and to take other actions that will decrease water supply loss. This could be done by investing in better ICT monitoring of urban water networks. As circular city initiatives depend largely on the awareness of stakeholders, the city is also encouraged to further engage with the residents and to work with planners to decrease household use of water resources and to better design water infrastructure and facilities[54].

- *Addressing social inequalities*

Since the financial crisis, social inequalities and urban poverty have been on the rise in many cities in the UNECE region. Addressing these issues is a pre-requisite for sustainable development so that "no one will be left behind".

Social inequalities have many faces, for example, income inequalities, immigration and ethnic inequalities, and gender inequality. They manifest themselves in decreased/limited access to urban

[52] "Handbook on Sustainable Transport and Urban Planning," Draft (UNECE, April 2019), 96, https://thepep.unece.org/sites/default/files/2019-04/UNECE%20Handbook%20on%20Sustainable%20Transport%20and%20Urban%20Planning%20draft%20April%202019%20reduced.pdf

[53] The city prepared https://www.trondheim.kommune.no/org/byutvikling/kommunalteknikk/kommunedelplan-vann-i-trondheim-2021-2032/

[54] U4SSC: A guide to circular cities, June 2020 https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-A-guide-to-circular-cities/index.html#p=2

and public services and infrastructure (justice, housing, water, sanitation, education and health services), decreased intergenerational mobility[55] and many others. They particularly affect vulnerable and disadvantaged groups, such as children, large and/or young families, and immigrants. For instance, more and more low-income women face challenges in accessing education and work, being safe on public transport, and in securing land and property ownership, which in turn has a detrimental effect to their health and well-being.

Growing income inequalities in developed countries (and cities) require action to ensure the equal redistribution of the benefits of urbanization. In this context, Trondheim is encouraged to further work towards 1) improving the inclusion of vulnerable groups: immigrants, families with children, single parents and unemployed citizens, into the society and economy; and (2) developing initiatives that balance the income between men and women in the city.

Finally, as urban safety and security underpin smart and sustainable development and are determined by many factors, including the level of crime, access and availability of police service, fire services or medical services, the city is further encouraged to improve access and availability of police service and emergency services, and to develop solutions that correspond to the topography of Norway taking into account the additional challenges posed by the COVID-19 pandemic.

Last but not least, given the abundance of urban data gathered for the purpose of the evaluation of the performance of Trondheim against the KPIs for SSC, and the determination of the city in meeting the SDGs, the city is encouraged to review regularly the implementation of the 2030 Agenda at municipal level.

Resources

On improving water and sanitation infrastructure,

- U4SSC: A guide to circular cities (2020)
- Guide to Implementing the Water Convention (UNECE, 2013)

On improving urban safety,

- Governing Safer Cities: Strategies for a Globalised World" (UNODC, 2016)

On addressing social inequalities,

- Geneva UN Charter on Sustainable Housing" (UNECE, 2015)

On strategies to improve mobility and transport in the city,

- From Amsterdam to Paris and beyond: the Transport, Health and Environment Pan-European Programme (THE PEP) 2009-2020 (April 2014)
- Together with UNECE on the road to safety: cutting road deaths and injuries in half by 2020 (UNECE 2015)
- Riding towards the green economy: Cycling and green jobs (UNEP 2017)
- Transport for Sustainable Development: The case of Inland Transport (UNECE 2015)
- Working together for Sustainable and Healthy Transport: Guidance on Supportive Institutional Conditions for Policy Integration of Transport, Health and Environment (UNECE 2008)

[55] 'Intergenerational mobility' measures 'the extent to which children's labour market outcomes are independent of the outcomes of their parents' https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_649496.pdf.

- Case-Based Reasoning for Improving Traffic Flow in Urban Intersections (Kofod-Petersen, Anderson, and Aaamodt) (Cham: Springer International Publishing, 2014), 215,.

Contact

For any questions or inquiries on the Sustainable Smart Cities Profile, please contact Gulnara Roll, at gulnara.roll@un.org.