UNECE

Smart Sustainable Cities Profiles

ÅLESUND, ASKER, BÆRUM, RANA AND TRONDHEIM NORWAY

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Municipality of Ålesund

Municipality of Asker

Municipality of Bærum

Municipality of Rana

Municipality of Trondheim

Geneva UN Charter Centre of Excellence on Sustainable Development Goals City Transition in Trondheim, Norway

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ACRONYMS AND ABBREVIATIONS

2030 Agenda	2030 Agenda for Sustainable Development
A!A	Active in Asker
CDP	Carbon Disclosure Projects
CO_2	carbon dioxide
ekWh.	equivalent kilowatt hour
EMF	electromagnetic field
EUR	euro
FME ZEN	forskningssenter for miljøvennlig energi (environmental-friendly energy research) zero emission neighbourhoods
FTE	full-time equivalent
GDP	gross domestic product
GHG	greenhouse gas
ICT	information and communications technology
ISO	International Organization for Standardization
KPI	key performance indicator
MIP	Mo Industrial Park
NO_2	nitrogen dioxide
NOK	Norwegian krone
NMCC	Norwegian Maritime Competence Centre
NTNU	Norges teknisk-naturvitenskapelige universitet (Norwegian University of Science and Technology)
O_3.	ozone
OECD	Organisation for Economic Co-operation and Development
PM	particulate matter
SDG	Sustainable Development Goal
SINTEF	Stiftelsen for industriell og teknisk forskning (The Foundation for Scientific and Industrial Research)
SLT	Samordning av Lokale rus- og kriminalitetsforebyggende Tiltak (Coordination of Local Drug and Crime Prevention Measures)
SME	small and medium-sized enterprise
SO_2	sulphur dioxide
SSC	Smart Sustainable Cities
U4SSC	United for Smart Sustainable Cities
UN-Habitat	United Nations Human Settlement Programme
VID	vitenskapelig, internasjonal, diaconal (scientific, international, diaconal)
WHO	World Health Organization

EXECUTIVE SUMMARY

The Smart Sustainable Cities Profiles (SSCPs) are data-driven assessments aimed at identifying major city needs and priorities in line with the 2030 Agenda for Sustainable Development. The SSCPs comprehensively evaluate cities' performance across three spheres - economy, environment, and society and culture - through a mixed-methods approach supported by the Key Performance Indicators (KPIs) for Smart Sustainable Cities (SSC), in-depth surveys, interviews, and expert research. Each SSCP contains a chapter on socio-economic impacts of the COVID-19 pandemic at the urban level and provides targeted policy recommendations for inclusive and sustainable urban development. Ultimately, the SSCPs provide objective evidence and support to accelerate the establishment of innovative project preparation and the delivery of sustainable urban infrastructure at scale.

Ålesund

Ålesund is a harbour city with a rich history and long tradition in fishing and shipbuilding. Currently, it is the centre for innovative maritime technologies and home to the Blue Maritime Cluster, a global centre of maritime expertise and a hub for the safe and sustainable commercialisation of advanced technology and operations at sea. The city is highly committed to the implementation of the 2030 Agenda for Sustainable Development (2030 Agenda). It has mainstreamed Sustainable Development Goals (SDGs) into local urban policies and programmes and has developed and implemented projects that make the city smarter and more sustainable.

Ålesund has developed innovative approaches, especially in the field of communication and innovation technologies, that accelerate city progress towards SDGs. It has been expanding high-speed fibre-optic broadband to the rural areas of the municipality and is developing detailed maps of Sunnmøre,[1] which will make the coastal areas of the region among the best-mapped ocean areas in the world and will make harvesting resources from the ocean more sustainable. Ålesund supports youths struggling with the mainstream education system and has reduced the number of students dropping out with a social inclusion programme called "The Bridge". It also runs a successful refugee integration programme, offering integration training and support in finding a job or a place in further education.[2]

The city is committed to limiting its environmental impact and to becoming more climate neutral. It has recently commissioned ongoing research on the quality of water in the city, increased the number of sensors that measure air quality, developed programmes to increase the amount of solid waste that is recycled, and changed procurement rules to promote initiatives fundamental to sustainability.

At the start of 2020, five municipalities in the region were merged into one, giving rise to the new municipality of Ålesund, significantly increasing the population of the municipality. In addition to the merger, the municipality has recently developed the Innovation & Co-Creation LAB that aims to improve collaboration between businesses, cities, academia and finance institutions in order to pursue innovation and investment in smart and sustainable solutions, both in the city and in the country. Together, the merger and the development of this new Lab present an opportunity to accelerate the progress of Ålesund towards SDGs and to becoming smarter and more sustainable.

Education and health care make up the largest portion of the budget of Ålesund. Urban planning, the provision of water and sanitation infrastructure are among the key competences of the municipality.

The vision, goals and actions for urban development of Ålesund have to be included in its 12-year masterplan (Kommuneplanens), which is currently under preparation.[3] In line with the masterplan, the city directs local development according to its priorities. In May 2019, in a Royal Decree, the United Nations Sustainable Development Goals were introduced to the overall framework of all regional and local plans.[4]

Zoning plans cover the area of the Ålesund. It includes a zoning plan for the city centre, which is used to protect the historic art nouveau buildings (most historic areas are covered by either a zoning plan or the municipal master plan). Cultural heritage preceding the Lutheran reformation is protected by the Cultural Heritage Act.

Ålesund has established a public company, "Sørsida Utvikling", to make improvements to the city centre and to ensure that the proposed development is sustainable.[5]

The evaluation of Ålesund against the Key Performance Indicators (KPIs) for Smart Sustainable Cities (SSC) carried out in 2019 and 2020 pointed to a range of factors that drive its economic development, such as a high rate of small and medium enterprises (99.7 per cent) and a good access to information and communication technology (ICT) infrastructure (for instance, 96 per cent of all households have internet access). It highlighted that the city relies on renewable energy sources and that it recycles a large proportion of its waste (34 per cent of total solid waste produced). No waste is put into open dump as the practice was made illegal in Norway in 2009. The evaluation results

1 A Norway district where Ålesund is the main city.

2 For more information, see https://alesund.kommune.no/barnehage-og-skole/skole/elevar-med-sarskilde-behov/alternativ-opplaring/broen-praksisbedrift/.

3 Alesund Municipality, "Municipal plan", 27 September 2021. Available at https://alesund.kommune.no/samfunnsutvikling/planar/kommuneplan/.

4 Norway, Ministry of Local Government and Modernization, "Regional and municipal planning 2019–2023", 14 May 2019. Available at https://www.regjeringen.no/no/dokumenter/nasjonale-forventninger-til-regional-og-kommunal-planlegging-20192023/id2645090/.

5 Ålesund Municipality, "Urban development on the south side in the center of Ålesund", 20 August 2021. Available at https://alesund.kommune.no/samfunnsutvikling/by-og-stadutvikling/byutvikling-sorsida/.

also flagged that: i) Ålesund offers its citizens a good access to green areas, ii) access to health-care infrastructure and facilities in the city is easy, and iii) the vast majority of its inhabitants have access to adequate and affordable housing.

The KPI evaluation reaffirmed the development priorities of the city. As a high proportion of mobility in the city is by private vehicles rather than public transport, the city is investing to improve eco-mobility in the city, including access to eco-infrastructure. Ålesund is planning to improve water and sanitation infrastructure to decrease loss of water from the water supply system. The efficiency of water and wastewater infrastructure and facilities has a considerable impact on the quality of life and condition of the environment.

Lastly, the city is encouraged to take steps to develop and implement circular economy policies and to promote circular city solutions and technologies that allow for the sharing, recycling, refurbishing, re-using, replacing, and ICT monitoring of the use of resources.

Additionally, the evaluation points out that Ålesund needs to take steps to decrease its level of energy consumption and to decrease the energy footprint of buildings, and it is encouraged to work with the government and other stakeholders to develop and implement policy solutions and technologies that allow energy saving, recycling and storage.

Asker

Asker was established as a municipality in Viken in 2020 by the merger of three smaller municipalities. Asker is approximately 20 km south-west of the capital of Norway, Oslo. The priority of Asker is to implement the 2030 Agenda and integrate the SDGs into its policies and operations. The Municipal Master Plan 2020-2032 and the 23 Thematic Plans of Asker provide a blueprint to help the municipality improve in areas such as democratic development, action against climate change, school capacity; and ensure smart and sustainable urban development.

Due to the merger, the local institutional framework was subjected to changes, including adjustments to the roles and powers granted to the various subcommittees of the Municipal Council. Asker established several other subcommittees, which focus on, for instance, supporting youth development, welfare, citizenship, municipal services, planning, and construction.

The urban development priorities of Asker are defined in the Planning Strategy and the twelve-year Municipal Master Plan, which define the strategic direction for urban development, encourage active participation of its citizens in the municipal planning process, and set the priorities for investments in infrastructural and societal development. The Strategy and Master Plan cover community strategies, land-use strategies, and the annual financial plan and budget.

In 2020, Asker will adopt the Municipal Master Plan 2020-2032, zone plans, and 23 Thematic Plans,[6] including those on action against climate change, industry, primary schools, and digitization and smart technology.[7] The thematic plans will be adopted by 2024. In 2020-2022, Asker is planning to test new ways of working, to improve local democracy and to strengthen political dialogue and engagement with its citizens. It has developed local community committees to better discuss key concerns and issues with communities.

From 2020 onwards, the Municipal Master Plan, land-use strategies, Thematic Plans, the Financial Plan and Operational Plans of Asker will be based on the SDGs.

In its efforts to promote sustainable economic development, the municipality abides by the principles of responsible investment.[8] The municipality involves local companies in its sustainability work. Businesses in Asker established the Asker Business Council,[9] a business-oriented sustainability network, which hosts events, and collects and shares best practices between organizations on how to combine sustainable development and business competitiveness. In order to finance its development, Asker has also chosen the Kommunalbanken's green loans, which are loans specifically granted to projects that lead to a reduction in energy consumption or greenhouse gas (GHG) emissions, to finance the projects such as the Kistefossdammen day-care centre and the Holmen swimming pool.

Asker is implementing an array of projects and programmes specifically aimed at reducing the environmental footprint of the municipality. The "Action against climate change" Thematic Plan aims to reduce GHG emissions from transport and other areas, and to introduce a circular economy approach to resource management.[10] The municipality implemented the "Climate Hero" campaign, which informed local citizens about their climate footprint. The "Employee mobility strategy" seeks to reduce fossil fuel consumption by encouraging commuters to use public transport, walk, or cycle to work. Asker plans to make all municipal buildings and construction sites fossil fuel-free by 2025.

6 Asker Municipality, *The municipality's service areas*. Available at https://pub.framsikt.net/2020/nyeasker/bm-2020-handlingsprogram_2020-2023/#/generic/summary/146d49ec-5a9b-4fc8-80f8-bc331505ce53-cn.

7 Other Thematic Plans include those on: Citizenship, co-creation, and democracy development; Culture; Physical activity, sports and outdoor life and public health; Employer policy; Communication; School and kindergarten capacity; Kindergartens; Living all your life – People with disabilities, Living all your life – Elderly; Water and aquatic environment and ecotoxicity; and Digitization.

8 Asker implements the United Nations guidelines on the Principles for Responsible Investment (*What are the Principles for Responsible Investment?* (Principles of Responsible Management), https://www.unpri.org/pri/what-are-the-principles-for-responsible-investment).

9 Asker Naeringsforening, "Professional Network Sustainability", n.d. Available at https://www.askern.no/nettverk-nettverk-baerekraft/fagnettverk-baerekraft.

10 Asker commune, "Thematic plan for action against climate change", 4 October 2021. Available at https://www.asker.kommune.no/om-asker-kommune/styring-og-verdier/temaplaner-for-asker-kommune/temaplan-handling-mot-klimaendringene/.

The municipality realizes its social inclusion goals by focusing on improving participatory governance and including the young population in local democratic processes. Asker established community centres and local community committees, which are politically appointed bodies that aim to strengthen local democracy and bring the policy-making process closer to citizens. The Young People's Local Government in Asker supported the national reform which introduced into the curriculum three interdisciplinary topics: democracy and citizenship, sustainable development, and public health and wellbeing.[11] Furthermore, the municipality implemented the "Active in Asker", a public health and social inclusion project that encourages physical activity and provides low-income families with funding to take part in it.

In 2019 and 2020, Asker undertook an evaluation against the KPIs for SSC, to assess its progress towards the SDGs, to further define municipal development priorities, and to explore opportunities for scaling-up successful policies, projects, programmes and partnerships. The evaluation results highlighted strong performance in the economy dimension of the KPIs. This is reflected in a low unemployment rate (1.8 per cent); and good access to ICTs, water supply and electricity supply infrastructure, and effective solid waste collection that benefits all households in Asker.

Several factors contributed to the strong performance of the municipality in the areas of the environment, and society and culture. These include good-quality water, clean air (i.e. a low level of GHG emissions), and high renewable energy provision. There is good access to decent-quality, affordable housing, a very high level of high school enrolment, and high economic equality measured by the Gini coefficient.[12]

Based on the evaluation and the review of documentary data, it is recommended that the municipality: i) improve the quality of the water infrastructure; ii) encourage the use of public transport; iii) decrease energy consumption of public buildings; iv) improve solid-waste processing; and v) improve access to police and fire services . Improving the quality of the water infrastructure is needed to decrease the loss of water from the water supply system, and to ensure responsible consumption.

Reduced private vehicle use and improved traffic monitoring will reduce traffic congestion, improve road safety, and reduce the cost of commuting. Improving the sustainability of public buildings, including the energy efficiency of old housing stock and office buildings, will increase comfort of living, decrease energy costs for households and businesses, and contribute to the reduction of GHG emissions.

Incineration contributes to GHG emissions which can cause adverse effects on the climate. As a large proportion (46 per cent) of solid waste in Asker is incinerated, the municipality is encouraged to: i) develop infrastructure and technologies that enable the use of waste for energy generation; ii) promote sustainable material cycles and design that ensures a more productive use and reuse of materials; and iii) encourage residents and businesses to sort and recycle their solid waste.

11 Norway, Ministry of Education, "Report. St. 28 (2015–2016)". Available at https://www.regjeringen.no/no/dokumenter/meld.-st.-28-20152016/id2483955/.

12 The Gini index measures how much the distribution of income among households within an economy deviates from a perfectly equal distribution. A Gini index of zero represents complete equality, and one of 100 represents complete inequality (*Gini Index* (OECD), https://stats.oecd.org/glossary/detail.asp?ID=4842).

Bærum

The municipality of Bærum has made great strides towards achieving the 2030 Agenda, adopting a wide-reaching range of policies and projects to support its socioeconomic development, reflect its aspirations to reduce impact on the environment, and meet climate goals.

Bærum, with over 127,000 inhabitants, is the municipality with the largest population in Viken County, and the fifth largest municipality in Norway. Its inhabitants work primarily in the health and social services, retail trade and technical services. Technology and energy companies and consulting firms are growing rapidly in the municipality. The administrative centre, Sandvika, is an important local and regional trade and service centre and is developing fast. Sandvika saw a 25 per cent increase in housing construction[13] with nearly 700 homes built in a year.

Urban planning, including the provision of water and sanitation infrastructure, and land-use planning are two of the key responsibilities of municipalities in Norway. As municipalities play an important role in land-use planning, they take decisions on issues such as the development and enforcement of zoning plan proposals. Some responsibilities for urban and spatial planning are attributed to regional planning authorities and relevant Ministries in Norway.[14]

Municipalities are required to develop a Municipal Plan that includes two sections. The first section addresses long-term development targets, plans for achieving the SDGs, and information on the social, demographic, economic and environmental development of the municipality. The second section focuses specifically on land use.

13 Bærum Municipality, "Population Development". Available at https://www.baerum.kommune.no/politikk-og-samfunn/samfunnsutvikling/befolkningsutvikling/ (accessed on 30 September 2020).

14 Municipal autonomy is an important principle in Norway. However, regional authorities and Ministries also have specific professional responsibilities. For instance, Bærum has a County Governor who is a specialized authority in the fields of agriculture, environmental protection and civil security. The County Governor is the "State representative" in the region who ensures that national interests and legal requirements are addressed in municipal planning.

In order to utilize available resources efficiently and effectively, Bærum operates on the basis of a long-term operations and investment plan. The plan plays an important role in preparing the municipal economy for future challenges, and in ensuring a strong financial basis.

Bærum collaborates with various organizations and institutions within the Smart City Bærum partnership, to deliver the "Profitable interaction for a greener future" vision.[15] It works closely with the Norges teknisk-naturvitenskapelige universitet (NTNU - Norwegian University of Science and Technology) and private sector organizations, especially environmentally friendly and profitable business ventures, to develop innovative solutions. For instance, the Bærum Municipality cooperated with NTNU Sustainability, Ålesund Municipality and other organizations to develop the project "Data-driven co-creation - methods and tools for sustainable innovation and development".[16] The project aims to further progress sustainable development of municipalities.

The municipality also implements a long-term operations and investment plan and has a zero-growth vision regarding transport, to ensure that Bærum is an innovative, attractive and environmentally friendly centre for business and economic activity not only in Viken County but also in Norway.

Bærum works to deliver climate-neutral urban development. It is implementing the Climate-Wise Municipality development programme that contributes to the "green shift" of the municipality by mobilizing citizens and actors from all sectors to achieve ambitious national climate goals, such as reducing greenhouse gas emissions by 50 per cent by 2030.[17] Actions under this programme include free energy advice for citizens and businesses and household grants for installing electric car-charging infrastructure. The city is building high-quality, climate-neutral buildings as part of the FutureBuilt programme,[18] in partnership with other municipalities, ministries and organizations.

Bærum has introduced a variety of programmes, projects and plans to improve quality of life in the municipality. Within the Better Learning[19] programme, it pursues a dynamic approach to school development, including an emphasis on life skills and mental health. Bærum also established the Healthy Life Centre to give citizens advice regarding physical activity and diet, and to support those with chronic illnesses. In 2018, Bærum was awarded the settlement and integration prize by the Norwegian Directorate for Integration and Diversity for its good work with refugees and its integration programme.[20]

To support smarter and more sustainable development in Bærum, the municipality was evaluated against the KPIs for SSC. The results showed that the municipality performs well overall in all three dimensions of the KPIs for SSC: economy, environment, and society and culture. Bærum has a low unemployment rate; good access to ICT infrastructure (98 per cent of households have internet connection and 99 per cent of the municipality have wireless broadband coverage); and a good innovation infrastructure, including a high rate of patents (44 per 100,000 inhabitants) and a large number of small and medium-sized enterprises (SMEs) (99 per cent of all enterprises). The municipality reported very good air quality; in particular, greenhouse gas (GHG) emissions is low at 1.27 tonnes of CO_2 equivalent per capita. Hundred per cent of the electricity of the municipality comes from renewable energy sources.

15 Smartcity Bærum (https://smartcitybaerum.net/om/).

16 Bærum Municipality, "Bærum and Ålesund's support for a sustainable project", 15 January 2021. Available at https://www.baerum.kommune.no/politikk-og-samfunn/samfunnsutvikling/barum-og-alesund-for-stotte-til-barekraftig-prosjekt/.

17 Norway, Ministry of Climate and Environment, "Norway steps up 2030 climate goal to at least 50% towards 55%", 7 February 2020. Available at https://www.regjeringen.no/en/aktuelt/norge-forsterker-klimamalet-for-2030-til-minst-50-prosent-og-opp-mot-55-prosent/id2689679/.

18 For more information on the FutureBuilt innovation programme, see https://www.futurebuilt.no/Om-oss.

19 Bærum Municipality, "Better learning – a framework for quality", 9 January 2019. Available at https://www.baerum.kommune.no/tjenester/skole/rammeverk-for-kvalitet-i-barumskolen/.

20 IMDi, "Bærum won the settlement and integration award 2018", 14 February 2019. Available at https://www.imdi.no/arkiv/arkiverte-nyheter/bosettings--og-integreringsprisen-2018/.

Bærum also performed well in other areas of the KPIs for SSC, such as education and housing provision. Inhabitants spend only 16.6 per cent of their income on housing, and all school pupils have ICT access in classrooms. However, Bærum needs to address issues such as the considerable loss of water from the water supply system; the modal split favouring the use of private vehicles; low level of public building sustainability; high amount of municipal solid waste being incinerated; high electricity and water consumption; and limited access to emergency services.

The KPI evaluation showed the need to improve the water and sanitation infrastructure, especially to introduce more smart water metres and to set up a drainage and storm water ICT monitoring system, as only 1.3 per cent of water metres in the municipality are "smart"; 34.7 per cent of water is lost from the water supply network; and the drainage and storm water system is not monitored by ICTs. The quality of water and the efficiency of the water infrastructure and facilities have a considerable impact on quality of life and the environment in the city.

Bærum should improve the sustainability of public buildings and decrease electricity consumption. The evaluation results showed that only 2 per cent of public buildings in the municipality are certifiably sustainable. Electricity consumption is high at 12,872 kWh per year per capita, as is the energy consumption of public buildings at 168 ekWh per m² per year. Constructing, operating, refurbishing and maintaining public buildings consume a high level of energy. The municipality should promote initiatives that aim to decrease electricity waste and loss.

The municipality should also take steps to encourage better use of the public transport infrastructure. The KPI evaluation showed that 57 per cent of commutes are done via private vehicles, while public transport accounts for only 18 per cent and cycling for only 4 per cent. Lastly, Bærum is encouraged to improve its solid waste management, and to promote responsible consumer behaviour to reduce the amount of waste produced.[21] The amount of waste put into sanitary landfills and incinerated should be decreased.

21 Environment Norway, "Waste", 26 April 2021. Available at https://www.environment.no/Topics/Waste/.

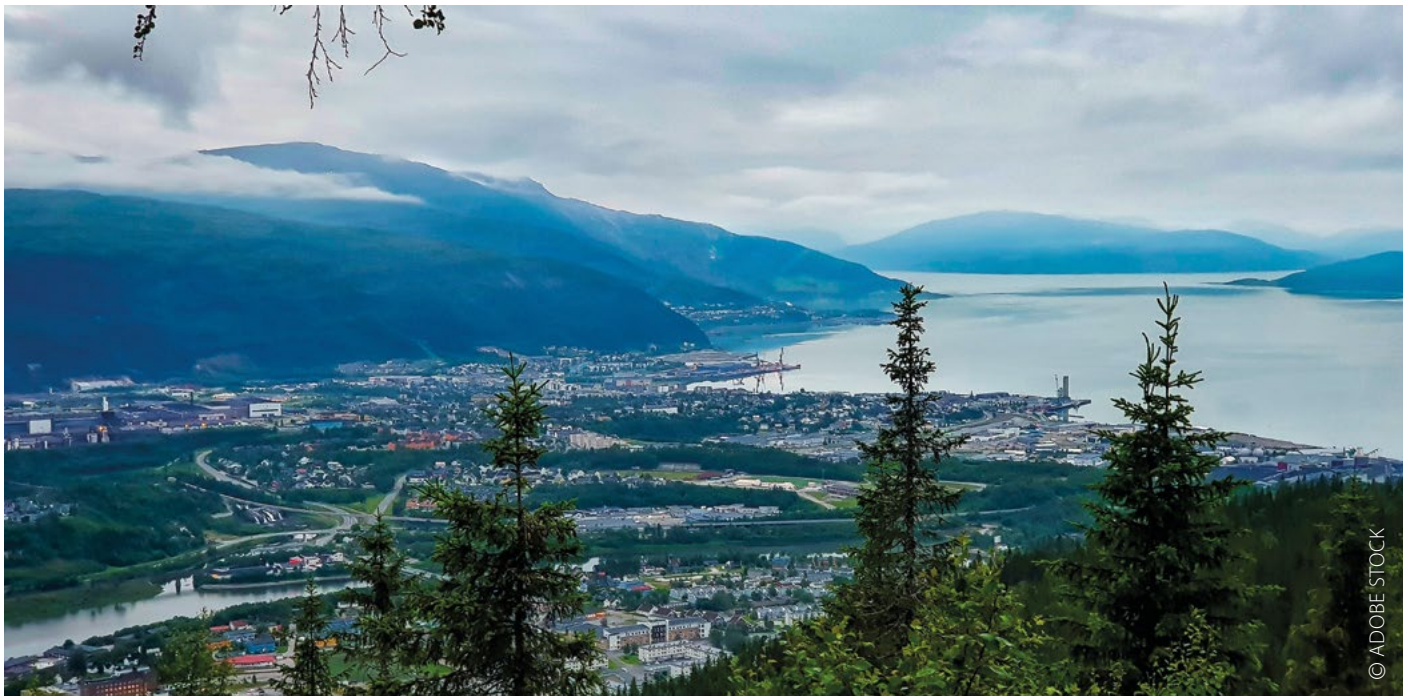
Rana

The implementation of the 2030 Agenda is a priority for Rana, the third largest city in northern Norway (with over 26,000 inhabitants) and an industrial centre for the region of Helgeland. The city uses its capacity to develop and implement innovative solutions and ICTs to leverage progress towards sustainable development. The city's public services programme for the period 2020 to 2024 aims to digitalize public services towards better and more responsible public sector institutions. The town of Mo i Rana is the Arctic host for the Mo Industrial Park, a global leader in green industry, where, cutting edge research is conducted and technology is applied to improve energy efficiency and energy recovery, reduce emissions into air and water, and strengthen the circular economy. Rana is also the home of Freyr, the company targeting the production of next-generation green battery cells in Mo i Rana. Freyr plans to use renewable low-cost energy for producing battery cells for electrification purposes, contributing to a reduction in carbon emissions.

Rana invests in sustainable and green transport and infrastructure to become a hub for business, trade, transport and tourism in the region and internationally. The European route 6 and route 12 motorways of the international E-road network are being modernized, which will improve the connection between Rana and other cities in Norway, Sweden and Finland. The construction of a new airport is expected to bring new visitors and businesses to the city.

Rana seeks to minimize its impact on the environment to fulfil its aspirations to become a world-class capital of "green industry". It has wide-reaching plans in place to engender "green shift". This entails a reduction in private vehicle use thus facilitating cycling, walking and public transport. The green shift plan would also mean reducing fossil fuel-based transportation; reducing speed limits to optimise air quality; and ensuring the use of sustainable and environmentally friendly materials in upgrading and maintaining city parks and public buildings.

Rana implements a variety of projects to improve social inclusion and to bolster the cultural life of the city. This includes projects that promote safe and affordable housing for vulnerable groups. It has upgraded hiking and skiing trails to facilitate outdoor sports. In recent years, focus has been given to assuring high quality education and preventing dropouts in secondary schools, primarily through early intervention.



To support the smarter and more sustainable development of Rana, between 2019 and 2020, UNECE carried out an evaluation of the performance of the city against the KPIs for SSC. The evaluation points to a good overall performance on the economy dimension. The city has good access to ICT infrastructure (98 per cent of households have internet connection), uninterrupted electricity supply (with only short electricity outages), and very high employment levels (only 1.8 per cent of the population is unemployed).

On the environment dimension, the evaluation showed that electricity in the city is produced from renewable sources (especially hydro power), and there is good access to green space and nature, as 98 per cent of the population has easy access to green areas. The drinking water quality in Rana is excellent with 99.4 per cent of the supply adhering to World Health Organization (WHO) standards.

On society and culture, the evaluation indicated that the population has very stable access to health care and education. Access to affordable housing is good (Rana citizens spend an average of only 15 per cent of income on housing) and economic equality is high (Gini coefficient is 0.2).

Private vehicles remain the primary form of transport in the city, accounting for 71 per cent of commutes; the water supply infrastructure is not widely monitored by ICTs; and the loss of water from the water supply network reaches 37 per cent. Based on these, UNECE draws attention to the need to improve the efficiency and effectiveness of water and wastewater infrastructures, and to further increase a modal split share in the city. Good practices of the city, such as contracts between the national government and municipalities that focus on reducing the reliance on private vehicles should be disseminated internationally.[22]

The city is encouraged to further reduce the quantity of waste produced and to increase the volume of waste recycled, which can be achieved by promoting responsible consumer behaviour such as avoiding single-use plastic. Ongoing investment to improve the energy efficiency of the city's infrastructure should be tailored to focus on sustainability, and the energy efficiency of the old housing stock and office buildings. The development of new technologies and designs that allow the sharing, recycling, refurbishing, re-using, replacing, and digitizing the use of energy, and that stimulate energy savings are also encouraged.

22 Norway, Ministry of Local Government and Modernization, "Planning and urban development - Urban Growth Agreements", 25 March 2020. Available https://www.regjeringen.no/no/dep/kmd/kmd-tilskudd/bolig--areal--og-transportplanlegging-for-en-barekraftig-og-attraktiv-byutvikling/id2548531/.

Trondheim

Accelerating progress towards achieving the SDGs and implementation of the 2030 Agenda 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. Trondheim aims to reduce direct climate gas emissions by 30 per cent by 2023 and 80 per cent by 2030.[23] SDGs are a central part in local planning and programming of Trondheim, including as targets in the annual budget.

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.[24] 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 four main goals, which are for Trondheim to become:

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

23 Trondheim Municipality, "Climate plan and climate work". Available at https://www.trondheim.kommune.no/klimaplan/ (accessed on 13 November 2020).

24 Trondheim Municipality, *The community part of the municipal plan 2009-2020* (September 2010). Available at https://trondheim.kommune.no/globalassets/10-bilder-og-filer/11-politikk-og-planer/planer/kommuneplanen/kommuneplanens-samfunnsdel-2009-2020.pdf (accessed on 13 November 2020).

In May 2019, in a Royal Decree, the SDGs were introduced to the overall framework of all regional and local planning.[25] 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 the local level. Notable initiatives have been the development of a climate budget as well as an SDG budgeting model.

Trondheim not only invests in renewable energy sources and storage solutions but also paving the way towards sustainable transportation with its green transport and mobility programme. A total of NOK 25 billion (EUR 2.34 billion) for the period 2010-2029 is dedicated to this programme for the maintenance of roads, facilities for pedestrians and cyclists and public transport. The city is a part of the award-winning Greener Trondheim[26] partnership for sustainable transport.

Trondheim is home to NTNU and one of the largest independent research institutes in Europe, Stiftelsen for industriell og teknisk forskning (SINTEF - Foundation for Scientific and Industrial Research), as well as 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,[27] receiving the KMD28 Innovation Award 2019. The city is host to 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 performance of Trondheim against the KPIs for SSC, 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 Trondheim in supporting innovation, further developing the public transport infrastructure, and improving urban planning. 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 to work are taken by private vehicles, while only 12 per cent are made using public transport.

25 Available at https://regjeringen.no/no/dokumenter/nasjonale-forventninger-til-regional-og-kommunal-planlegging-20192023/id2645090/ (accessed on 13 November 2020).

26 Miljøpakken, "Are you the last to change your travel habits?". Available at https://miljopakken.no/om-miljopakken/organisasjonen/resultater (accessed on 13 November 2020).

27 Norway, Ministry of Local Government and Modernization, "Congratulations to Trondheim - this year's winner of the innovation award", 7 June 2019. Available at https://regjeringen.no/no/aktuelt/gratulerer-til-trondheim--arets-vinner-av-innovasjonsprisen/id2660969/ (accessed on 13 November 2020).

28 Kommunal- og moderniseringsdepartementet (KMD).

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 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.[29] 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 poverty30. Further actions 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 achieving the SDGs, and to further develop innovative policies, projects and programmes in collaboration with UNECE.

In the coming years, Trondheim plans to further invest in ICTs and social innovation, urban planning and transport, as well as in public services and 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 their plans and annual budgets, as well as take them into account in the climate budget. Trondheim will also use the findings from the KPI for SSC evaluation 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 health care.

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29 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.

30 According to the definition of national poverty threshold (www.worldbank.org).

INTRODUCTION

The Smart Sustainable City Profiles of Ålesund, Asker, Bærum, Rana and Trondheim - cities in Norway - were developed as part of the United Nations Economic Commission for Europe (UNECE) "Improved Sustainable Urban Development in 17 Norwegian Cities"[31] project, in collaboration with the Geneva UN Charter Centre of Excellence on Sustainable Development Goals City Transition in Trondheim, Norway and the governments of the five cities. The project supports the transition of cities and rural municipalities in Norway towards becoming smarter and more sustainable, with a view to achieving the Sustainable Development Goal (SDG) 11 and other urban-related SDGs of the 2030 Agenda for Sustainable Development (2030 Agenda).

The city profiles present the efforts of cities to reinforce the implementation of the 2030 Agenda and provide information on the policies, programmes, projects and partnerships of cities that accelerate progress towards achieving the SDGs. The Profiles are the outcomes of the evaluation of the performance of the cities against the United for Smart Sustainable Cities (U4SSC) Key Performance Indicators (KPIs) for Smart Sustainable Cities (SSC);[32] they suggest actions that will improve progress towards achieving the SDGs.

The U4SSC KPIs consist of 91 indicators at the intersection of three dimensions of sustainability (economy, environment, and society and culture) and ICTs. The KPIs are outlined in the "Collection Methodology for Key Performance Indicators for Smart Sustainable Cities".[33]

The process of evaluation of a municipality against the United for Smart Sustainable Cities (U4SSC) KPIs includes data collection, verification of the KPIs, and benchmarking.[34] The KPI values are verified by the city and the outcome of the data verification[35] are found in the "U4SSC Verification Report" of the city.

The State largely controls the budgets of local governments. The Local Government Act gives the central government the authority to make changes to a local government's budget and financial plan in order to ensure that its activities are financially sound. The revenue of a municipality consists mainly of three sources of income: tax revenues, transfers from the State and income from charges (such as user payment for services).

The revenue of a municipality consists mainly of three sources of income: tax revenues, transfers from the state and income from charges (such as user payment). The transfers from the state are partly general and non-specific, and partly earmarked for special purposes. Tax revenues are generally income tax from inhabitants. Tax revenues and general grants are "unrestricted income" and represent around three quarters of the total income of the municipal sector. How a municipality uses its resources depends on its responsibilities regarding welfare services. Kindergartens, schools and the health and social sector account for nearly 80 per cent of most municipalities' gross operating expenditure. Other local services, taking up less than 20 per cent of the budget, include culture (libraries, cinemas, sports facilities, etc), infrastructure (roads, water, sewage and garbage collection), planning (including land use planning), industry, and housing.

Local governments that balance their budget are allowed to borrow in order to finance capital expenditure. Local governments that have not balanced their budget must follow special approval processes by the county governor or the Ministry of Local Government and Modernization in order to borrow.

31 The implementation period of this project is August 2019 to July 2021 (https://unece.org/housing/norwegian-project).

32 The KPIs for SSC is a public, free-of-charge standard, developed by UNECE and the International Telecommunication Union (ITU) in the context of the United for Smart Sustainable Cities (U4SSC) initiative. Over 100 cities worldwide are already implementing the KPIs. The U4SSC initiative is coordinated by UNECE, ITU and the United Nations Human Settlements Programme (UN-Habitat) and is supported by 14 other United Nations agencies.

33 For details on the key performance indicators, see https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/U4SSC-CollectionMethodologyforKPIfoSSC-2017.pdf.

34 The "ECE protocol on the evaluation of the city performance against the Key Performance Indicators for Smart Sustainable Cities", developed by UNECE, outlines the evaluation process (ECE/HBP/2020/5, http://www.unece.org/fileadmin/DAM/hlm/documents/2020/ECE_HBP_2020_5-E.pdf).

35 The process of verifying the accuracy of data that will be used for the evaluation.

The City Profiles were developed using documentary data sources, most notably the U4SSC Verification Reports and the surveys completed by the municipal administration of each city. The survey provided insights into the actions for improving the smartness and sustainability of the municipality, including ongoing or planned policies, programmes, projects, and partnerships. UNECE and the cities engaged in multiple bilateral meetings to discuss development priorities and to assess the most appropriate areas for action. These areas are outlined in the recommendations of these Profiles.

Each City Profile consists of four parts. Part I focuses on the geographical location, the administrative and political framework, the population and demographic situation, and the socioeconomic conditions. Part II provides information about the outcomes of the evaluation of city performance against the KPIs for SSC, and indicates relevant municipal actions and initiatives (e.g. policies, projects, programmes). Part III outlines the financial framework for urban development. The concluding part, Part IV, contains the recommendations.

The legal and institutional framework for urban development in Norway is defined by the Municipal Act,[36] the Planning and Building Act,[37] the Civil Protection Act, and the Public Health Act.[38] The Planning and Building Act mandates the municipalities to develop 12-year master plans and ensures that all cities have 4-year action plans and annual budgets. Building permit approval is usually delegated to the municipal administration, but the master plans and zoning plans are subject to the approval of the local council. The municipality must adhere to national guidelines, such as the National Expectations regarding Regional and Municipal Planning.[39]

Norway municipalities have considerable self-governing powers. They are responsible for delivering education to children up to 15 years old, and childcare services. They oversee day-care (pre-school) institutions, schools and health care. Urban planning, including the provision of water and sanitation infrastructure, is also one of their key responsibilities.

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36 The objective of the Municipal Act is to determine the responsibilities of municipal and county authorities, and to define how they can cooperate. For more information, see https://www.regjeringen.no/globalassets/upload/krd/tx-23249-kommuneloven-eng.pdf.

37 The purpose of the Planning and Building Act is to "promote sustainable development in the best interests of individuals, society and future generations". This Act defines the functions of the planning and building authorities, and the municipal planning responsibilities.

38 The purpose of the Public Health Act is to "contribute to societal development that promotes public health and reduces social inequalities in health". For more information, see https://www.regjeringen.no/globalassets/upload/hod/hoeringer-fha_fos/123.pdf.

39 Norway, Ministry of Local Government and Modernization, National expectations regarding regional and municipal planning 2019–2023. Available at https://www.regjeringen.no/contentassets/cc2c53c65af24b8ea560c0156d885703/nasjonale-forventninger-2019-engelsk.pdf.

ÅLESUND

Part I General overview

Ålesund is in the north-western part of southern Norway, almost equidistant between the larger cities of Bergen and Trondheim along the coast. Ålesund, along with the neighbouring municipalities of Giske and Sula, make up the Ålesund Region, which is the largest and most populous area of the Møre & Romsdal county. Ålesund Region is home to approximately 82,000 inhabitants. As with other parts of Norway, social and health programmes are universal and state-funded. The main export industries in the region are fisheries and shipbuilding. There are also other mixed industries, as expected for a city of this size. The city hosts a branch of the Norwegian University of Science and Technology (NTNU), the second Smart City Lab developed in the context of the United for Smart Sustainability Cities Implementation Programme. The Norwegian Maritime Competence Centre is located in the city.

The region of Ålesund has just been through an important municipal merger. Five out of the seven municipalities of the region merged into one - Haram, Sandøy, Skodje and Ørskog merged with "old" Ålesund to create the "new" Ålesund. From 47,000 inhabitants, Ålesund grew to 66,000 inhabitants.

Ålesund has a temperate and heavily moderated oceanic climate. Winters are mild, damp and windy, and the summers are typically moderate and wet.

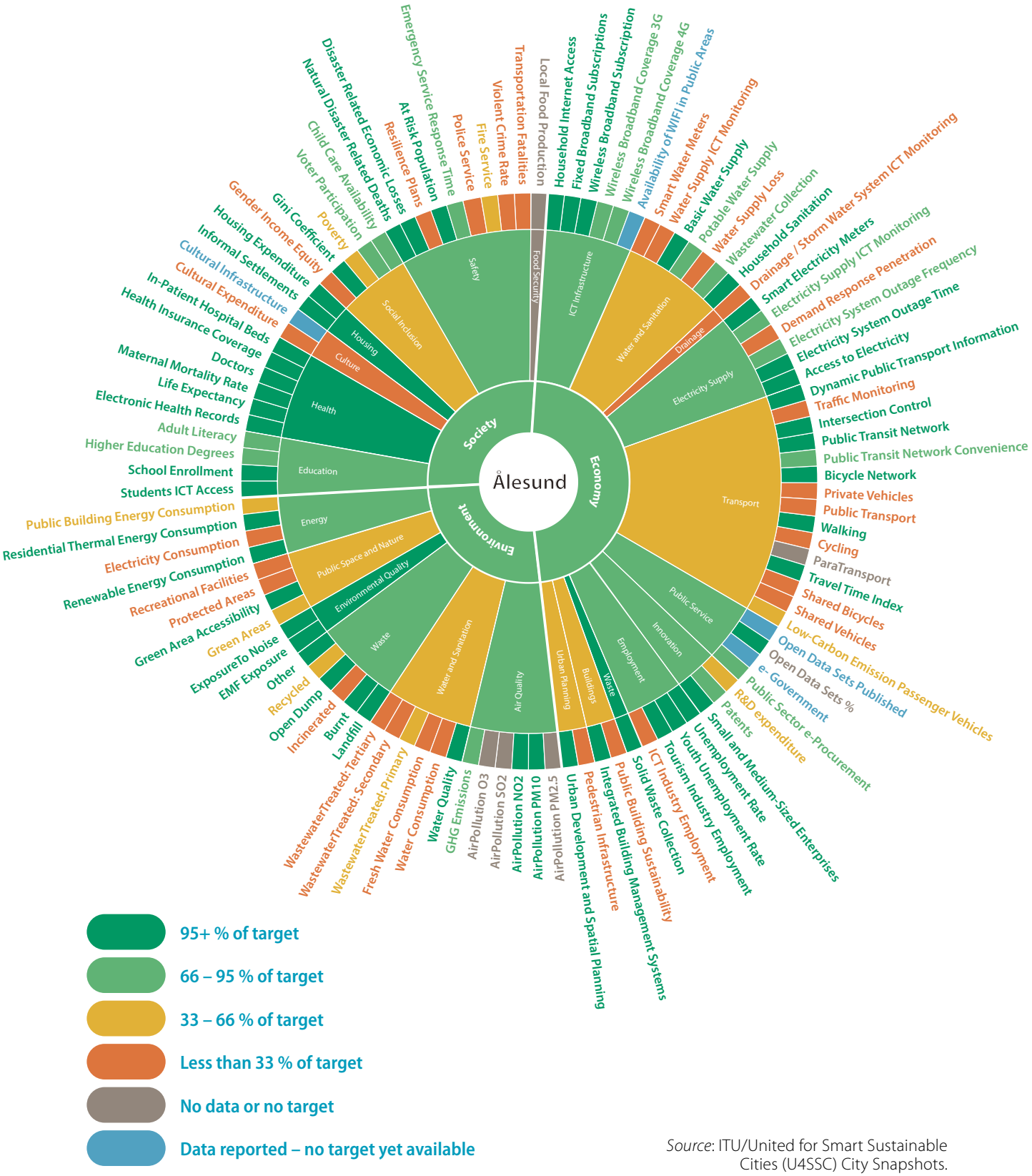
Part II Evaluation of the city performance against the Key Performance Indicators for Smart Sustainable Cities

In 2019/20 the city of Ålesund was evaluated against the KPIs for SSC. The outcome of the data verification provided by the city of Ålesund can be found in the U4SSC Verification Report – Ålesund, Norway.[40]

In line with the Verification Report, graph 1 visualises the performance of the city. Discussions under this part outline the performance of Ålesund in relation to the three dimensions of the KPIs and the relevant city actions, with a view to identifying the challenges to, and opportunities for, making Ålesund smarter and more sustainable.

40 International Telecommunication Union, U4SSC, Verification Report: Ålesund, Norway (Geneva, June 2020). Available at https://www.itu.int/en/ITU-T/ssc/united/Documents/U4SSC%20Publications/Verification%20Reports/Verification_Report_Alesund_Norway.pdf.

Graph 1 The performance of Ålesund against the Key Performance Indicators for Smart Sustainable Cities



Source: ITU/United for Smart Sustainable Cities (U4SSC) City Snapshots.

Economy – an overview

Ålesund specializes in fishing and shipbuilding that supports the development of the oil industry.[41] The fishing fleet of Ålesund is one of the most modern in Europe.

The city carries out infrastructure improvement projects and has invested NOK 37 million (EUR 3.5 million) to expand fibre-optic broadband to rural areas in order to provide every citizen with high-speed internet.

The city is home to the Global Centre of Maritime Expertise, also called the Blue Maritime Cluster.[42] Established in 2006, the centre focuses on the design, construction, equipment and operation of advanced offshore vessels for the global oil and gas industry. Campus Ålesund of the Blue Maritime Cluster is also host to the Norwegian Maritime Competence Centre (NMCC), which provides 800 jobs; the Rolls-Royce Marine Technology and Training Centre; numerous training activities; and the high-tech Offshore Simulator Centre, dedicated to designers and users of offshore vessels and other maritime equipment.[43]

Ålesund hosts the "Ålesund Future Lab" which is a platform for building partnerships between the municipality (and other actors from the public sector), the private sector, academia and other organizations to accelerate progress towards achieving the SDGs.[44] The Future Lab works towards establishing the Digerneset Business Park, a new regional business hub.[45] Within the lab, Ålesund collaborates with the private sector to improve data-sharing.[46]

41 Organisation for Economic Co-operation and Development, "Norway", OECD Better Life Index. Available at http://www.oecdbetterlifeindex.org/countries/norway/.

42 Blue Maritime Cluster (https://www.bluemaritimecluster.no/gce/the-cluster/about-us/).

43 Organisation for Economic Co-operation and Development, "Box 1. The Global Centre of Expertise Blue Maritime Cluster in the county of Møre and Romsdal" in Peer Review of the Norwegian Shipbuilding Industry (2017), pp. 37–38. Available at https://www.oecd.org/sti/ind/PeerReviewNorway_FINAL.pdf.

44 United Future Lab (https://www.unitedfuturelab.no/en/about-us/).

45 United Future Lab, "Digerneset Innovation". Available at https://www.unitedfuturelab.no/en/projects/ended-digerneset-innovation/.

46 United Future Lab, "ATEA – share your data". Available at https://www.unitedfuturelab.no/en/projects/atea--share-your-data/.

The development priorities of Ålesund include further investment in availability and access to transport infrastructure (from 2021 Ålesund will pilot the use of 100 per cent electric buses that employ ICTs to monitor passenger levels), improving waste management, building sustainability, water and sanitation, and ICT infrastructure (including smart water metres region-wide).

KPI evaluation results – Economy dimension

The economy of Ålesund is characterized by very high levels of employment with only a small fraction of the working-age population unemployed at 2.2 per cent. The city has access to high-quality ICT infrastructure - 3G and 4G wireless broadband coverage is 92 per cent, and 96 per cent of households have internet access.

All households in Ålesund have access to a basic water supply and household sanitation, and 92 per cent have a safely managed potable water supply. Access to wastewater collection is also high at 94 per cent.

Ålesund has very reliable access to electricity. As much as 97 per cent of households have access to electricity, and customers experience, on average, only 1 electricity system outage per year, which lasts for an hour on average (67 minutes). Most of electricity metres installed are "smart".

Public transport network length and the availability of dynamic public transport information and presence of bicycle paths, the evaluation showed a good performance. The city has just over 150 km of cycling paths and 755 km of public transport routes per 100,000 inhabitants. In comparison, per 100,000 inhabitants, Paris has over 200 km of public transport, Belgrade has over 400 km, and Budapest has roughly 175 km.

However, despite the wide availability of public transport, private petroleum-fuelled vehicles still account for a large share of the travels made in Ålesund - currently, 71 per cent of commuters use personal vehicles to travel to work. The shares of cycling (3 per cent), public transport (6 per cent), and low-carbon transport (3.91 per cent) are also relatively low. There are no shared cars or bicycles schemes implemented in Ålesund, and only 10 per cent of the major streets in the city are monitored by ICTs.

The evaluation of Ålesund indicates that there is a high level of water loss from the water supply network at 32 per cent and a need to monitor the water supply in real time. Furthermore, only 1 per cent of the water metres are smart, and only 21 per cent of the water supply system is monitored by ICTs. The city scored low in the public building sustainability indicator - only 13.7 per cent of public buildings in Ålesund have sustainability standards for ongoing building operations.[47]

Environment – an overview

Ålesund is taking steps to reduce its environmental footprint and collaborates with various entities to this end. It cooperates with Norwegian university of Technology (NTNU) on drinking water management.

The city is developing maritime base maps for the northern Sunnmøre region, where Ålesund is located.[48] The mapping will provide the information needed to make it more sustainable to harvest resources from the ocean. Ålesund is working together with the town of Tafjord and Sparebanken Møre bank to establish a car-sharing system, with a view to reducing the amount of people using private vehicles to travel to and from work.[49]

By introducing changes to the municipal procurement rules, the municipality will reduce the carbon footprint in the areas of construction, transport, waste, water and sewage. Ålesund is also collaborating with the Norwegian Public Roads Administration and Sunnmøre District to measure the quality of the air and make this information publicly available.[50]

Ålesund is also implementing a project addressing municipal solid waste management.[51] The project aims to develop new and future solutions based on smart circular models to better manage waste, increasing the overall amount recycled.[52]

In the years to come the city is planning to increase the network of trails to make the Ålesund shoreline and surrounding area more accessible to the inhabitants of the city. The city is aware of the importance of improving its water and sanitation infrastructure, waste management, and energy efficiency. Air quality is also an area of priority in Ålesund, alongside improving access and availability of public spaces and nature. The city will increase the number of sensors to produce air quality data, invest in a shore-based power supply for to reduce emissions from large cruise ships, and increase the amount of waste recycled. Ålesund plans to improve wastewater treatment with the construction of a new sewage treatment plant and the renovation of old pipes; and use procurement processes and energy-saving programmes. Furthermore, most municipal buildings built after 2012 were required to be at least low-energy buildings.

KPI evaluation results – Environment dimension

The evaluation of Ålesund highlighted the good overall quality of the environment and its low environmental impact, particularly in areas such as air quality, renewable energy sources, and access to green space.

The evaluation indicates a good performance on exposure to noise and to electromagnetic fields (EMF), as only 6 per cent of the population is regularly exposed to high levels of noise, and there is no overexposure to EMF (all mobile network antenna sites are in line with World Health Organization (WHO) guidelines.

Regarding public space and nature, Ålesund offers a very large amount of green space (67,240 hectares per 100,000 inhabitants), and 99 per cent of inhabitants have easy access to these spaces (inhabitants live within 300 metres of a green area).

47 Public procurement rules and regulation guide the improvements of the city's building standards. Ålesund places sustainability at the heart of its public procurement rules to stimulate sustainable infrastructure investments. This applies to municipal dwellings and public buildings, including sports arenas.

48 Store Norske Leksikon, "Sunnmøre", 11 August 2020. Available at https://www.snl.no/Sunnm%C3%B8re.

49 United Future Lab Norway, "Car pool solution". Available at https://www.unitedfuturelab.no/en/projects/car-pool-solution/.

50 For more information, see http://www.luftkvalitet.info/home.aspx?type=Area&id={1e20ff30-ec54-4443-9301-208a78cdeeb9}.

51 The collection rate of recyclables in Ålesund has considerably increased over recent years, with a 13 per cent rise from 2017 to 2019.

52 United Future Lab Norway, "A Smart Circular City handles waste". Available at https://www.unitedfuturelab.no/en/projects/ended-a-smart-circular-city--handles-waste/.

The quality of drinking water in the city is good, with 99.5 per cent of samples meeting the WHO standard for drinking water quality.[53] Currently, there is no tertiary treatment of wastewater; there are only basic levels of primary and secondary treatment. However, as the quality of water in Ålesund is high it may not require these treatments. The consumption of water is particularly high at 560 litres per day per capita. For comparison, water consumption in Stockholm is 340.4 litres per day per capita, and that of Helsinki is 276.08 litres per day per capita.[54]

The air quality in Ålesund is good with low levels of particulate matter PM10 and nitrogen dioxide (NO_2). Greenhouse gas emissions are also relatively low at 5.7 tonnes of carbon dioxide (CO_2) equivalent per capita. However, the city did not provide data on the level of ozone (O_3), sulfur dioxide (SO_2), and PM2.5.[55] According to evaluation results, a very low level of waste (3.88 per cent) is sent to the landfill and no waste is sent to open dumps or is openly burnt.

Finally, electricity consumption in Ålesund is high at 14,369 kilowatt-hour (kWh) per year per capita, but 100 per cent of this electricity comes from renewable sources of energy,[56] hydropower being the most significant.[57]

The evaluation suggests a room for improvement in waste management, water and sanitation infrastructure and public building sustainability. For instance, only about 35 per cent of the solid waste in the city is recycled compared to 46 per cent average in the EU-28 (European Union Member States from 1 July 2013 - 1 January 2020), Iceland, Norway and Switzerland in 2017.[58] The majority of waste in the city (56 per cent) is processed by incinerating it, which combusts the organic substances contained in waste materials.

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53 As defined in the "Guidelines for drinking-water quality: fourth edition incorporating the first addendum" (*World Health Organization, 2017*, https://apps.who.int/iris/bitstream/handle/10665/254637/9789241549950-eng.pdf;jsessionid=1542B56B761057316A1ACCF373BB981D?sequence=1).

54 International Water Association, "Specific Water Consumption for Households for the Capital Cities", IWA Statistics a& Economics. Available at http://waterstatistics.iwa-network.org/graph/19.

55 Ålesund previously measured PM 2.5 and over three years the sensor never approached the upper limit. As the sensor was expensive to run, the decision was taken to stop measuring PM 2.5 although there are cheaper sensors available now.

56 The energy consumption of Norway is significantly higher than the European average at 22,850 kWh against the European average of 5,511 kWh (*Energy consumption in Norway (WorldData.info)*). Available at https://www.worlddata.info/europe/norway/energy-consumption.php.

57 Norway, Ministry of Petroleum and Energy, "Renewal energy production in Norway", 11 May 2016. Available at https://www.regjeringen.no/en/topics/energy/renewable-energy/renewable-energy-production-in-norway/id2343462/#:~:text=In%20Norway%2C%2098%20percent%20of,of%20most%20of%20the%20production.

58 European Environment Agency, "Waste recycling", Eionet Portal, 2017. Available at https://www.eea.europa.eu/data-and-maps/indicators/waste-recycling-1/assessment-1.

Society and culture – an overview

Ålesund is implementing numerous projects and programmes aiming to improve the quality of life and social inclusion. Projects focus on improving public health, education, elderly care, participatory planning, and crime prevention.

Ålesund provides a digital service (AktivKommune), which allows the inhabitants to locate activities and sports facilities. Users can rent sport facilities and equipment, and find teams and organizations.[59] The "Dinner at the door" service helps those unable to cook for themselves - due to age, illness or disability - to maintain a healthy diet by delivering meals straight to them.[60]

Ålesund collaborates with Møre and Romsdal County authorities to implement the "Livet & Sånn" (Life and how to live it) project which aims to provide training materials to all schools in the country, delivering parenting courses and the trainings for the staff of kindergartens and schools, with a view to improve public health, including mental health,[61] and life skills. In collaboration with NTNU Ålesund, the municipality implements the project "Together for a learning society". The objective of this project is to combine the competences of the municipality and the university to deliver new solutions in the areas of smart health and welfare, and smart and sustainable societies.[62]

Ålesund works towards improving citizen participation in urban planning. The zoning plan for the district of Sjøholt was developed with the participation of local inhabitants who were given the opportunity to voice their views on the plan.[63]

"The Bridge" addresses youth struggling with regular education. It is one of the best in the country and has reduced educational dropouts. Nine out of ten refugees who are part of the programme are able to complete the integration training and start further education or participate in job integration programmes for employment.

Ålesund has adopted the Samordning av Lokale rus- og kriminalitetsforebyggende Tiltak (SLT), a co-operation model for crime prevention used by many municipalities in Norway. The SLT model brings together many actors, including the municipality, the police, other public agencies, the business community, and voluntary organizations to help prevent crime and reduce substance abuse among children and young people. This collaborative approach allows Ålesund to target children at high risk of substance abuse, counteract absenteeism in schools, and ensure that the municipality follows up with young offenders, repeat offenders, and networks.[64]

The city of Ålesund is committed to further improving social inclusion and equality, citizen participation and engagement, and education in the city. The city is planning to develop and implement programmes that address the problems of educational gaps and the difference in income between genders; low voter turnout; the amount of households with low income; and measuring food security despite lack of national standards. Food security and local food production were also noted as areas of priority.

59 Aktiv Kommune, "Ålesund". Available at https://site1.aktiv-kommune.no/1501/bookingfrontend/.

60 Ålesund Kommune, "Dinner st the door", 12 January 2021. Available at https://alesund.kommune.no/helse-og-omsorg/hjelp-i-heimen/middag-pa-dora/.

61 As part of Livet & Sånn project, mental health professionals provide students and teachers with materials to learn about the students' mental health.

62 United Future Lab Norway, "Projects". Available at https://www.unitedfuturelab.no/en/projects/.

63 Ålesund Kommune, "Urban project for Sjøholt center", 21 June 2021. Available at https://alesund.kommune.no/samfunnsutvikling/by-og-stadutvikling/tettstadprosjekt-sjoholt/.

64 Ålesund Kommune, "Crime prevention", 2 July 2021. Available at https://alesund.kommune.no/samfunnsutvikling/beredskap-og-sikkerheit/kriminalitetsforebygging/.

KPI evaluation results – Society and culture dimension

The KPI evaluation of Ålesund also reveals a strong performance in the following areas of society and culture: health care, education, and housing.

The evaluation indicates an easy access to health-care services and facilities. Health-care provision is universal, and the number of doctors and hospital beds available is high at 510 doctors and 343 hospital beds per 100,000 inhabitants (the national average is 460 doctors[65] and 350 hospital beds[66] per 100,000 inhabitants). All city inhabitants have electronic health records; there have been no recorded maternal deaths during childbirth, and life expectancy is long (82 years).

Access to education in Ålesund is very good; school enrolment is universal among the school-aged population, and 100 per cent of students have access to ICTs to support their learning. The KPI evaluation also indicated a high rate of adult literacy (95 per cent) and showed that a large portion of the population has higher education degrees (25 per cent).

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There is a good access to decent quality, affordable housing in Ålesund. Only 0.04 per cent of the population lives in informal or inadequate housing, and inhabitants spend a low 14 per cent of their income on housing on average.

The evaluation suggested that there may be room for improvement in safety and security. The availability of police and fire services is relatively low - about 79 and 60 full-time equivalent (FTE) staff respectively per 100,000 inhabitants. For comparison, Finland employs 137 police officers per 100,000 inhabitants while Denmark employs 186 per 100,000 inhabitants.[67] While the KPIs count FTE staff, there are many part-time firefighters in Ålesund. The national goal for the police service is 2 officers per 1,000 population; currently, there are 0.8 police officers per 1,000 inhabitants in Ålesund.

The violent crime and traffic fatality rates (828 and 2.42 incidents per 100,000 inhabitants, respectively) could be reduced. The violent crime rate figure may be high due to the way crimes are recorded in Ålesund. The municipality records each individual instance of violence as a separate case, and also includes cases that did not go to prosecution. Further, the emergency response time is fast at just over 6 minutes, faster than the average 8.96 minutes among selected European countries.[68]

Finally, Ålesund currently has resilience plans in place for developing and implementing risk reduction strategies against natural and human-induced disasters and risks. However, these resilience plans do not comply with the Sendai Framework for Disaster Risk Reduction. The municipality will ensure the next review of their resilience plans will be guided by the Sendai framework.

65 World Health Organization, "Global Health Workforce statistics database", *Data*. Available at https://www.who.int/gho/health_workforce/physicians_density/en/.

66 Organisation for Economic Co-operation and Development, "Hospital beds", *OECD Data*. Available at https://data.oecd.org/healthcare/hospital-beds.htm.

67 European Commission, "1.6 million police officers in the EU", Eurostat, 04 January 2019. Available at https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/DDN-20190104-1.

68 Statista, "Average answer time of calls made to emergency services in selected European countries in 2019", 7 July 2020. Available at https://www.statista.com/statistics/794483/average-answer-time-of-calls-made-to-emergency-services/.

Part III Funding and financing for urban development

According to the "Action and financial plan 2020-2023, budget 2020"[69] of Ålesund, their operational budget for 2020 is NOK 4 billion. This includes income from taxes on income and wealth (48 per cent), the standard state grant (42 per cent), as well as sources such as other general government grants (4 per cent), property tax (3 per cent), and interest income and dividends (2 per cent). This operational budget is spent primarily on the provision of education (35 per cent), health care (29 per cent), welfare and employment (13 per cent), children family and integration (9 per cent), and environment and urban development (2 per cent).

Furthermore, according to the financial plan, the municipality's investment budget of NOK 650 million for 2020 will be spent primarily on technical services (49 per cent) such as renewing electrical systems, the preparation of a new master plan and redevelopment plan, a new traffic system and construction site, and drainage pumps and many others.[70] The investment budget also accounts for other financing needs such as loans and advances (40 per cent), and other services such as ICT infrastructure (10 per cent).

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69 For further details, see https://pub.framsikt.net/2020/alesund2020/bm-2020-handlings-_og_%C3%B8konomiplan_korrigert/#/home?pid=graphs.

70 "Investments in 2020", in *Action and financial plan 2020-2023, budget 2020*. Available at https://pub.framsikt.net/2020/alesund2020/bm-2020-handlings-_og_%C3%B8konomiplan_korrigert/#/bminvestments?pid=graphs.

Part IV Recommendations

Ålesund is a harbour city with a long tradition of fishing and shipbuilding, which paved the way to becoming a centre for innovative maritime technologies in Norway today. Characteristic to the city is its determination in accelerating progress towards the achievement of SDGs. The city is part of the national programme that aims to upscale efforts to achieve SDGs and is home to the Innovation & Co-Creation lab that aims to improve collaboration between businesses, cities, academia and financial institutions to leverage innovation and investment in smart and sustainable solutions in the city and in the country.[71]

The city invests in innovative ICT solutions and methodologies to become smarter and more sustainable. It is working towards making the coastal region of Sunnmøre the best-mapped ocean area in the world. The maps will also make harvesting resources from the ocean more sustainable by allowing for more informed decision-making when targeting sites for gathering resources. Ålesund is also expanding a high-speed fibre-optic broadband to the rural areas of the municipality. Improving social inclusion is one of the priorities of the city as it supports education for all. To this end, the city launched a successful refugee integration programme, offering integration training and support in finding a job or enrolling in education. Recently, the city commissioned research, that is still ongoing, on the water quality of the municipality; increased the number of sensors to measure air quality; developed programmes to increase the amount of solid waste recycled; and changed its procurement rules to prioritize sustainability.

Based on the U4SSC Verification Report of Ålesund and the review of documentary data, including information provided by the city, Ålesund is recommended to:

71 Intelligent Systems Lab (http://org.ntnu.no/intelligentsystemslab/index.html).

- ***Improve water, sanitation and drainage infrastructure***

Addressing the unsustainable consumption of natural resources is a pre-requisite for the successful implementation of the 2030 Agenda for Sustainable Development in the UNECE region and is one of the key principles of urban management in the circular economy and in the twenty-first century. It requires the need for cities to take decisive action and develop and implement urban policies and solutions that promote the sharing, recycling, refurbishing, re-using, replacing, and digitizing the use of natural resources.

The quality of water and the efficiency and effectiveness of water and wastewater infrastructure and facilities have a considerable impact on the quality of life and the environment in the city. As the evaluation indicated a need to decrease the loss of water from the supply system, the city is encouraged to develop and implement solutions that will improve the efficiency of water and sanitation infrastructure and extending its lifespan. Ålesund is encouraged to further invest in the ICT monitoring of its urban water networks, by introducing more smart water metres and setting up a drainage and storm water ICT monitoring system to improve the efficiency of water management in the city. Last but not least, the city is also encouraged to further engage with residents and to work with planners to decrease the use of water resources by households and to develop designs that allow for instance recycling of water.[72] These design choices may include a water system that only draws on natural water resources to the extent that they can be regenerated, uses standardized pipes and metres to ensure that equipment can be swiftly and easily replaced, and shares infrastructure across sectors, for example telecommunications companies using draining trenches for fibre-optic internet cable.

- ***Improve sustainability of public buildings and decrease electricity consumption***

Improving the sustainability of public buildings also improves the quality of the natural environment and the quality of life in cities. Buildings account for a significant proportion of GHG emissions and resource use in a city. Developing, operating, refurbishing and maintaining public buildings consumes high level of energy.

High use of energy of buildings is associated with adverse effects on the environment, especially when the production of energy is based on fossil fuels.[73] However, it is estimated that existing technologies can reduce energy consumption of buildings by 30 per cent to 50 per cent without significantly increasing investment costs. Improving the energy performance of housing contributes to an increased comfort of living and reduced energy bills, and more broadly, it alleviates fuel poverty and mitigates GHG emissions while creating jobs.[74]

In line with the KPI evaluation, the city is encouraged to take steps to decrease the levels of energy consumption and to improve the overall sustainability of public buildings. This concerns especially the energy efficiency of the old building stock and office buildings, the life cycle energy (primary) requirement[75] of which is in the range of 250–550 kWh per m² per year (in comparison to the life cycle energy primary requirement of conventional residential buildings of 150–400 kWh per m² per year).

The city is encouraged to work closely with the national government, business community and academia to identify opportunities for energy saving (for instance, the reduction of energy demand during the life cycle of the building) and to develop new technologies on the use of energy that allow sharing, recycling, refurbishing, re-using, replacing, and digitizing.

72 United for Smart Sustainable Cities, *A guide to circular cities* (Geneva, 2020). Available at https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-A-guide-to-circular-cities/index.html#p=2.

73 This is not the case in Norway as the main source of energy in the country is hydropower.

74 United Nations Economic Commission for Europe, "UNECE studies and networks will help reduce buildings' energy consumption", press release, 29 November 2018. Available at http://www.unece.org/info/media/presscurrent-press-h/sustainable-energy/2018/unece-studies-and-networks-will-help-reduce-buildings-energy-consumption/doc.html.

75 Life cycle energy (primary) requirement is the assessment of the energy needs of buildings throughout its life cycle.

The city should also work with the national government, business community and academia to promote initiatives that aim to decrease electricity waste and loss. This can include incentivizing the development and households' use of energy-efficient and "smart" appliances (whose functioning can be coordinated with consumer behaviour).

- ***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 distribution of the economic benefits of urbanization and facilitates the reduction of socio-economic inequalities in cities. Over recent decades the development of transport infrastructure has benefitted from access to innovative ICTs and solutions, which help provide public transport information in a more dynamic way, including better traffic monitoring, intersection control, and the development of intelligent intersection management systems in cities.[76]

The evaluation of Ålesund reiterates the city's priorities to further invest in transport infrastructure, especially to improve traffic monitoring and to increase the share of low carbon-emission passenger vehicles (currently at 3.9 per cent of all vehicles). It is also important to improve the modal split share, including increasing journeys made by public transport from 6 per cent to 15 per cent, which in turn requires taking into account a range of factors: the costs of owning, driving and parking private vehicles, as well as the quality and cost of alternative transport modes such as public transport and cycling, to develop relevant solutions.

- ***Improve solid waste management***

Solid waste treatment and waste collection have considerable influence on quality of life and the environment. The disposal and treatment of waste not only consumes land and energy but has a particularly negative impact on air quality.[77]

The city is encouraged to carry out "circular actions" to reduce its quantity of waste. These can include actions that promote responsible consumer behaviour such as avoiding single-use plastic, and promote waste recycling in such a way that waste emerging as a result of one production process can be used as an input (materials or energy) to another production process. This allows the creation of closed loops both within and across industries, which in turn enhances circularity in cities.

The city should decrease the amount of waste produced[78] and the amount put into sanitary landfills, and collaborate with the national government, business community and academia to: i) develop infrastructure and technologies that enable the use of waste for energy generation; and ii) promote sustainable material cycles via design control to ensure a more productive use and reuse of materials.

Finally, urban safety and security are central elements to smart and sustainable development and are determined by the effectiveness of services such as the police service, fire service and medical services. Therefore, the city is also encouraged to improve the access and availability of these services and to develop solutions that take into account their delivery speed, especially considering the additional challenges posed by the COVID-19 pandemic.

As importantly, given the abundance of urban data gathered for the purpose of the evaluation of the performance of Ålesund against the KPIs for SSC and the determination of the city in achieving the SDGs, the city is encouraged to review regularly the implementation of the 2030 Agenda at the local level.

76 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.

77 Open dumps emit a significant amount of methane and, when burned, waste contributes to carbon dioxide emissions. Both methane and carbon dioxide are greenhouse gases, the emission of which should be decreased in line with international standards such as the United Nations Framework Convention on Climate Change (2016).

78 "In Norway waste volumes have increased by 60 per cent since 1995". Available at https://www.environment.no/Topics/Waste/.

ASKER

Part I General overview

Asker is a rural municipality[79] located in the Viken County, approximately 20 km south-west of the capital of Norway, Oslo. It is well connected to Oslo by train and motorway, including the European route E18. The municipality is new; it was established on 1 January 2020 as a result of the national reform of local governments,[80] specifically the merger of the former municipalities of Asker, Røyken and Hurum.

Asker is the eighth largest municipality in Norway. It has an area of 376 km², of which 324 km² is farmland, natural land (including 69 areas of special protection[81]), and recreational areas. The municipality counts just under 95,000 citizens in 2020,[82] approximately 22,000 of whom are under 18 years of age, and about 33,000 of whom live near the Asker town.[83] The municipality has a diverse community, with 20 per cent of the population representing various other nationalities.

Having undergone a merger, the main objective of the municipality is to develop policies, projects, programmes and partnerships taking into account the new administrative context, and that foreground the SDGs within a wide range of areas, including economy, environment, and social inclusion.

There are approximately 37,000 jobs in Asker, primarily in the areas of health and social services, trade, industry, building and construction, and teaching. Many of these jobs are specialized industries requiring expertise, such as in the oil and gas industry. The municipality administration has 6,450 employees. The municipal infrastructure includes 40 schools, 34 public day-care centres, 73 private day-care centres, and 96 cultural institutions. There are 771 places in nursing homes, and 585 places in housing units with employed caretakers on site. The municipality is home to 575 non-governmental organizations, of which 96 are sports clubs.[84] In 2020, Asker managed a budget of over NOK 7 billion (EUR 630 million).

79 Asker is the name of both a rural municipality and a town located in that municipality. The evaluation of the performance of Asker against the KPIs for SSC concerns the municipality.

80 Norway, Ministry of Local Government and Modernization, "Reform of local government", 3 December 2020. Available at https://www.regjeringen.no/no/tema/kommuner-og-regioner/kommunereform/reform-of-local-government/id2548429/.

81 An area of special protection is an area which is protected to preserve its key ecological features and to secure the habitats of endangered animal and plant species.

82 Statistics Norway, Municipality/Asker (Viken). Available at https://www.ssb.no/kommunefakta/asker.

83 The town of Asker is the municipality's administrative centre.

84 There are 12,199 local sports clubs distributed throughout the 430 municipalities in Norway, which suggests that Asker has more than average (Skille, Eivind Å. and Reidar Säfvenbom, 2011).

Asker faces the challenge of a progressively ageing population. The current birth rate, coupled with an overall increase in life expectancy, makes it hard to bridge the gap between the expected public sector service delivery and the future resources available to deliver those services.

In the future Asker may face challenges relating to the restructuring of the Norwegian economy, specifically transitioning from a reliance on oil and gas to other sources of income. This which may result in a rise in unemployment rates and the possible migration of young people to countries with better job opportunities.

There are also challenges linked to multi-level governance, where different levels of the public sector (state, region and municipality) have their own responsibilities. An example is the transport sector, where all levels of public sector administration are involved in designing, coordinating, financing and implementing transport and infrastructure.[85]

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

To support its commitment to becoming smarter and more sustainable, in 2019 and 2020, the municipality of Asker was evaluated using the KPIs for SSC. Outcomes of the evaluation are outlined in the "U4SSC Verification Report – Asker, Norway".[86]

In line with the verification report, Graph 2 shows the performance of Asker against the KPIs for SSC. This section discusses further the performance of the municipality in relation to the three dimensions of the KPIs – economy; environment; and society and culture – and relevant municipal actions, with a view to identifying the challenges to, and opportunities for, making Asker smarter and more sustainable.

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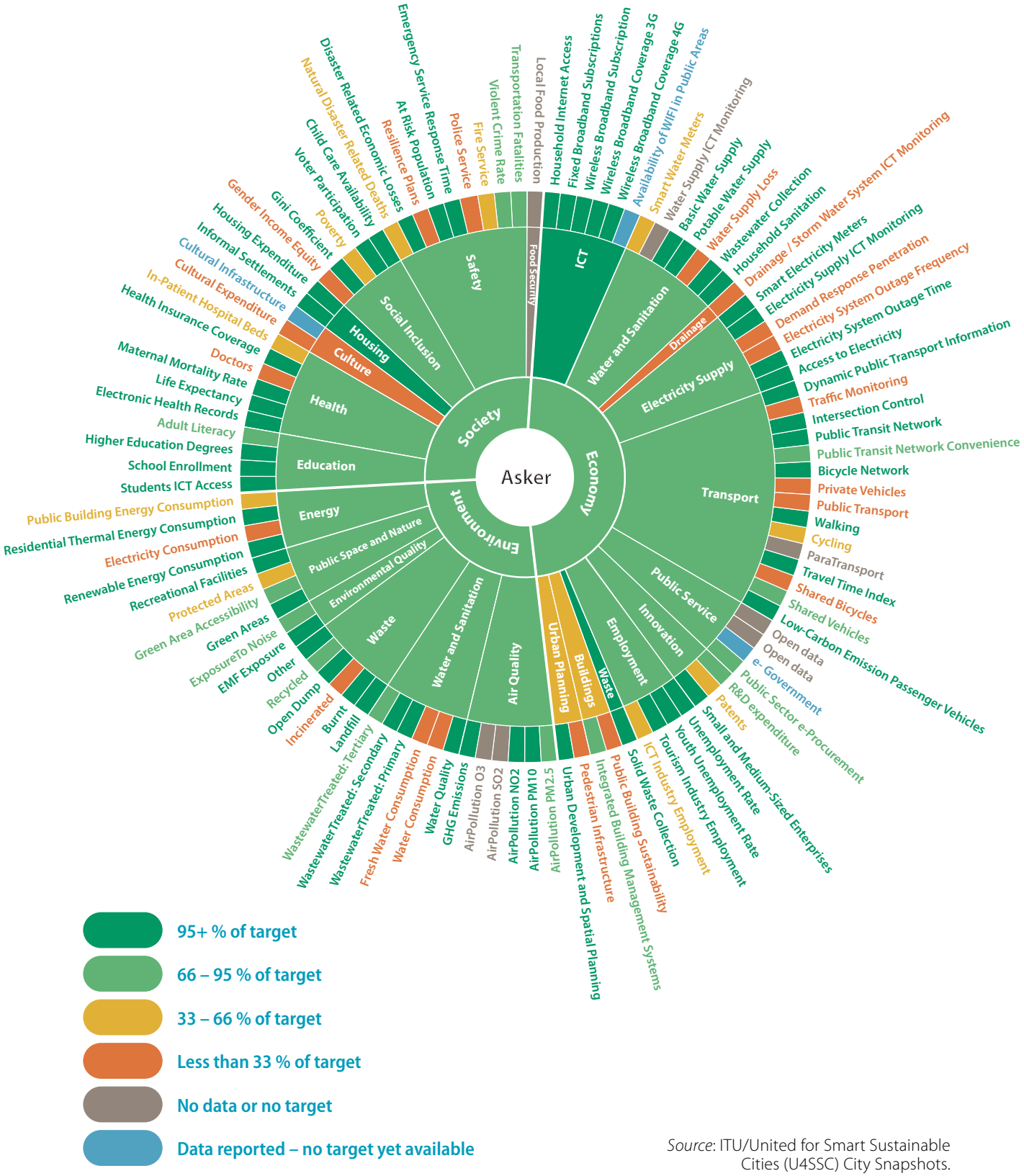
85 A relevant and recent example of this is the new E18 highway, which passes through both Oslo and Asker.

86 International Telecommunication Union, *U4SSC Verification Report: Asker, Norway* (Geneva, 2020). Available at https://www.itu.int/en/ITU-T/ssc/united/Documents/U4SSC%20Publications/Verification%20Reports/September%202020/U4SSC_Asker-Norway_Verification-Report.pdf?csf=1&e=cKh3f5.

Graph 2 The performance of Asker against the Key Performance Indicators for Smart Sustainable Cities



Source: ITU/United for Smart Sustainable Cities (U4SSC) City Snapshots.

Economy – an overview

Since the merger at the start of 2020, Asker has made the SDGs its priority to the extent that they define municipal operations, local policy objectives, and actions and relationships. During 2019, Asker tested a methodology for introducing the SDGs into city operations, based on the assessment of relevant risks and opportunities.[87] The municipality envisions that this methodology will be used as a tool for assessing municipal operations from 2020 onwards. The municipality has worked closely with the private sector to develop a business plan based on SDGs, and to develop municipal statistics focusing on various issues pertaining to sustainable development.

The local business community is also involved in sustainability work. The municipality acknowledges that small and medium-sized businesses have shown leadership and interest in the SDGs. Through the Asker Business Council, businesses established their own sustainability network, and, for two consecutive years, they have arranged networking days around the theme of sustainability. Additionally, the Business Council offers its own competence programme for small and medium-sized enterprises on how sustainability can increase a company's competitiveness.

Asker aspires to develop a robust and sustainable local economy, and it pursues a sustainable and responsible investment strategy that follows the ethical financial management and investment strategy defined in the United Nations rules for responsible investment – the Principles for Responsible Investments (https://www.unpri.org/pri/what-are-the-principles-for-responsible-investment) – and the ethical guidelines of the Government Pension Fund Global.[88] As such, Asker requires that the municipal financial service providers follow these ethical regulations and they have been instructed not to offer the municipality products that violate these regulations.

FutureBuilt Programme

Asker ensures that its urban development projects, programmes and partnerships focus on reducing climate change. The municipality is a partner in the FutureBuilt programme (https://www.futurebuilt.no/Om-oss), which aims to make urban areas climate-neutral while maintaining high-quality architecture. The goal of the pilot projects within the programme is to achieve a 50 per cent reduction of GHG emissions produced from energy, materials and transport compared to current levels. They must also be attractive for local communities and pursue a distinctive architectural design that interacts well with the surroundings. In addition, the projects aim to provide well-designed blue-green infrastructure that contribute to improved condition of the environment and improved well-being and experiences for the local communities.

Projects implemented within the FutureBuilt programme can be financed via loans to the local authorities. The Kommunalbanken AS (communal bank) offers green loans with lower interest rates for investments that address climate change. Some of Asker's public buildings and infrastructure projects are financed with these green loans, for instance Kistefossdammen kindergarten and the Holmen swimming pool. The loan are granted at preferential interest rates so the municipality will save approximately NOK 3 million (EUR 273,000) during the first ten years of the loan period.

The municipality is taking multiple actions to maintain and further develop the services offered to its inhabitants. It is focusing on ensuring a stable and predictable basis to facilitate good quality of services and on fulfilling the needs of users, residents and employees. This also ensures that Asker will continue to benefit from a comparatively high income in comparison to other municipalities in Norway (for instance, tax revenues in the municipality are estimated to be approximately 135 per cent of the national average).

87 The methodology was also tested in the municipality | of Røyken.

88 Norway, Ministry of Finance, Responsible management: Government Pension Fund. Available at https://www.regjeringen.no/en/topics/the-economy/the-government-pension-fund/responsible-investments/id446948/.

Towards the end of 2020, Asker plans to further develop its municipal urban infrastructure. In particular, it plans to improve the transport[89] and water infrastructures by installing smart water metres in all households, and to establish a regional centre for competence on marine waste together with the company Mepex.[90]

Asker used the Nordic Swan Ecolabel, the official ecolabel of Norway introduced in 1989 by the Nordic Council of Ministers,[91] to certify the sustainability of some of its buildings, for instance, the Torvbråten and Sydskogen schools. It is planning to certify another project, a large nursing home in Hurum, as BREEAM Excellent. The municipality has also built several other buildings - high energy standards buildings; near zero-energy buildings and plus energy houses - according to the FutureBuilt definitions. These buildings have a very high energy performance, and use renewable energy produced on-site or nearby. "Plus houses" also offer the possibility to sell excess energy back to the grid.

KPI evaluation results – Economy dimension

The evaluation of Asker revealed a strong performance in the area of economy. The employment rates are similarly high as unemployment rate is at only 1.8 per cent and is even lower among the young population at only 1.7 per cent.[92]

The evaluation indicated that the ICT infrastructure is very strong – 98 per cent of households have internet access, and 99 per cent of the municipality has 3G or 4G wireless coverage.

All Asker households have reliable access to electricity. The use of ICTs to monitor supply is also high - the municipality monitors all of its electricity supply system with ICTs and 99 per cent of electricity metres are "smart". Additionally, on average, customers experience only two interruptions per year to their electricity supply which last less than an hour suggesting a very reliable system. The waste management system is also reliable - 100 per cent of households are served by solid waste collection services.

The evaluation also showed that 99.7 per cent of all enterprises are small and medium-sized enterprises, and that a relatively high 2.2 per cent of the municipal gross domestic product (GDP) is spent on research and development. However, the number of patents granted annually is not very high, at 25.5 patents per 100,000 inhabitants (for comparison, Sweden has 43 patents per 100,000 inhabitants and Denmark has 41 per 100,000 inhabitants).[93]

Regarding water and sanitation infrastructure, all households have access to a basic water supply, and 96 per cent have a potable water supply. All households have sanitation facilities, and 96 per cent are served by wastewater collection services. However, the evaluation indicated that over a third of water is lost from the supply system and less than half of the water metres installed are "smart".

Despite the extensive public transport network, private vehicles remain the preferred mode of travel, with 68 per cent of journeys to work made in private vehicles and only 9 per cent made using the public transport system. The municipality has a large amount of low-emission passenger vehicles that make up 15 per cent of all vehicles.

Lastly, the KPI evaluation suggests that public building sustainability could be improved, as only under a third (31 per cent) of public buildings have recognized sustainability certifications[94] for ongoing operations.

89 A further way of achieving this is through contracts between the national Government and municipalities that focus on ensuring that that the growth of the municipality does not lead to increased use of private vehicles (footnote 22).

90 Mepex is a Norwegian consulting company specializing in waste management and recycling (https://mepex.no/?lang=en).

91 Nordic Ecolabelling. Available at https://svanemerket.no/en/the-nordic-swan-ecolabel/.

92 The numbers given predate the Covid-19 pandemic.

93 European Patent Office, "Statistics and trends: Patent Index 2019", 23 February 2018. Available at https://www.epo.org/about-us/annual-reports-statistics/statistics.html.

94 Sustainability certifications include BREEAM, LEED, CASBEE, BOMA BEST, BCA Green Mark, Passive House etc.

Environment – an overview

Improving environmental quality is an important development objective for Asker. The municipality held the Climate Hero campaign in 2019. Its objective was to make citizens aware of their own climate footprint, and how their actions affected it. As a result, 1,087 people took the Climate Heroes Check, and 379 made climate hero promises.[95]

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Asker has benefited from climate-friendly financial aid schemes, such as the climate-rate scheme, which is a state instrument for initiating climate measures in municipalities.[96] NOK 180 million (EUR 16.3 million) was set aside for the scheme in the State budget for 2020.[97]

Since the start of this climate scheme in 2016, the three former municipalities which are now part of Asker have received funding for 21 projects aiming to improve their climate performance. Funding for these projects came to a total of NOK 8.8 million (EUR 800,000) over 2016 to 2019, applied to improvements in the areas of transport, construction, and recycling. Asker also offers funding to citizens for installing climate-friendly housing upgrades, such as loft insulation.

The municipality has made efforts to decrease waste production and improve waste collection services and to encourage recycling of both household and industrial waste. Asker worked with the Heggedal Local Environment Centre to establish a creative recycling workshop ("Omattatt"). It teaches and inspires citizens to consider municipal waste as a resource.[98] In collaboration with the "No Waste!" industry cluster and Mepex, Asker also carried out a preliminary project to investigate the possibility of a regional centre to address the issue of marine pollution. Asker wants to be a leading municipality on reducing pollution, limiting the release of microplastics into nature, and the circular economy.

To improve its water, sanitation and drainage infrastructure and ensure environmental resilience, a PhD research is carried out to investigate the efficiency of water supply system in the municipality, especially to assess the vulnerability of all its freshwater bodies and to monitor critical municipal surface runoff points and municipal drinking water installations, such as pumping stations and basins.

95 For more information about the campaign and its goals, see https://klimahelt.no/.

96 The Norwegian Environment Agency, "Climate rate – Support for climate measures", 21 September 2021. Available at https://www.miljodirektoratet.no/klimasats.

97 Municipalities in Norway can apply for monetary support for projects that reduce GHG emissions. These funds can go towards planning and investigating climate measures, and towards networks for sharing knowledge on climate impact mitigation.

98 For more information, see https://www.asker.kommune.no/klima-og-miljo/ombruk/omattatt--kreativt-ombruksverksted/.

In the coming years, the municipality will consider increasing its use of sustainability certification schemes as one measure to improve the sustainability of its infrastructure and buildings, as mentioned in the previous section (Economy – an overview). It will also implement the "Action against climate change" Thematic Plan and its "Employee Mobility Strategy", which aims to reduce fossil fuel-based transportation and encourage bicycling, walking and public transport use. Asker also plans to ensure that all construction sites in the municipality are free from fossil fuels by 2025.[99]

KPI evaluation results – Environment dimension

The evaluation suggested that the environment quality of Asker is good. The air quality is high, there is a considerable amount of green spaces available to its citizens, and the municipality endeavours to mitigate its environmental impact through good waste management and renewable energy consumption.

The inhabitants of Asker are not exposed to electromagnetic fields, and only 29 per cent of the inhabitants are regularly exposed to high levels of noise. The indicators that measure air quality show low levels of particulate matter (PM 2.5 and PM 10) and NO_2 pollutants. However, no data was reported on the SO_2 and O_3 levels. This area of the evaluation also revealed very low GHG emissions, at 1.8 tonnes of CO_2 equivalent per capita.

The evaluation showed that the municipality has a very high number of green areas, at 32,195 hectares of green space per 100,000 inhabitants. Additionally, 80 per cent of the population lives within 300 metres of a green area.

Regarding water quality, 99 per cent of the drinking water in Asker complies with potable water standards (by WHO definition). The water-cleaning process is very comprehensive. All wastewater undergoes primary treatment and further wastewater treatment is done - 99.5 per cent undergoes secondary treatment and 82 per cent undergoes tertiary treatment.[100]

The evaluation suggests that Asker mitigates the negative environmental impact associated with solid waste processing. No municipal waste is put into open dumps or is burnt, and only 4.9 per cent of it is put into landfills. This is made possible as 49 per cent of solid waste is recycled, which is above the average of the EU-28, Iceland, Norway and Switzerland.[101] However, 46 per cent of solid waste is still incinerated, and this should be minimized.

Although 100 per cent of electricity in Asker comes from renewable sources (significantly higher than the EU average of 18 per cent[102]), the level of energy consumption is high (at 13,843 kWh per year per capita), as is the amount of energy consumed by public buildings (at 145.5 kWh equivalent per m² per year). Lastly, the total municipal water consumption is high, at 278 litres per day per capita. This encompasses all water use, including both private household and industry.[103]

99 For more information on emission free construction sites, see https://www.greenvisits.no/product/emission-free-construction-sites/.

100 Primary treatment involves screening and sedimentation of sewage to remove grosser debris. Secondary treatment involves the reduction of Biological Oxygen Demand (BOD10) to acceptable levels by microbial oxidation using activated sludge or a trickle filter. Tertiary treatment involves further reduction of BOD through micro straining or filtering, the microbial removal of phosphates and nitrates, and disinfection using chlorine or ozone.

101 European Environment Agency, "Waste recycling" (indicator), 22 November 2019. Available at https://www.eea.europa.eu/data-and-maps/indicators/waste-recycling-1/assessment-1.

102 European Commission, Renewable energy in the EU in 2018, Eurostat Newsrelease, No. 17/2020 (23 January 2020). Available at https://ec.europa.eu/eurostat/documents/2995521/10335438/8-23012020-AP-EN.pdf.

103 Citizen consumption of water is between 130-140 litres per day per capita which is under the target of 165 litres. The installation of smart water metres will help to reduce this further (https://www.asker.kommune.no/politikk/politiske-moter-og-dokumenter/?q=0135/20&c=200200212#result).

Society and culture – an overview

Asker is committed to supporting community development, ensuring a high level of citizen participation in local democratic processes, and improving collaboration between the municipal council and other relevant actors to implement the SDGs. The municipality has established a variety of projects and programmes to improve quality of life in Asker, and to continue its societal and cultural development.

The municipality organized a two-day innovation camp on the SDGs, in 2018, for all lower secondary schools in Asker, Røyken and Hurum. During the camp, the 8th grade pupils worked on how to address the issues of one of the SDGs and presented their proposed solutions. In 2018, the municipality held the Asker Conference on United Nations Day. Fifty-five young people from Asker, Røyken and Hurum participated in workshops alongside youth representatives from UN-Habitat and contributed to the sustainable development planning of the new municipality. In 2017, the Young People's Local Government in Asker decided that all schools should include the SDGs as part of their curriculum.

Asker aims to set a new standard for community development. To improve access to sport and leisure facilities and services, Asker launched an app called Active in Asker (A!A). The app enables purchasing tickets for sport and leisure activities for children and young people at a discounted price (the municipality subsidizes these activities). In addition to this, local community committees have been made part of the municipal structure. In this way, inhabitants can participate in and influence the municipal development priorities. In 2020 and 2021, Asker is planning to establish several community centres in Sætre, Spikkestad, Holmen, Slemmestad, Heggedal, Borgen, and Asker. Both local community committees and community centres will be piloted in Tofte, Slemmestad and Heggedal.

The municipality has set up the Asker Welfare Lab,[104] which aims to raise the living standard of vulnerable individuals. The Asker Welfare Lab proposes a new concept for delivering municipal services centered on the needs of the citizens; and which entails all relevant municipal service departments to "invest" in social development to improve citizen welfare and to treat citizens as co-investors.

Asker has implemented the International Organization for Standardization (ISO) 9001 quality standard (on quality management"),[105] and plans to be certified according to two new ISO standards - ISO 18091 (on quality management systems)[106] and ISO 37120 (on sustainable cities and communities).[107] Being certified will support the efforts of the municipality to make progress towards achieving the Sustainable Development Goals.

KPI evaluation results – Society and culture dimension

Asker performed good in the society and culture dimension of the KPIs for SSC, which points to a good access to health care, education and housing, paving the way towards more cohesive and inclusive communities.

Overall, housing is adequate and on average, households spend only 11.5 per cent of their income on housing, suggesting housing is generally affordable. The provision of education is similarly good, as all students have classroom access to ICT facilities (all students have an individual Chromebook from grade one onwards), and school enrolment is universal, with 99.8 per cent of the school-aged population (up to the age of 16) enrolled in schools. This is reflected in the high adult literacy rate of 95 per cent.

104 For more information about the Asker Welfare Lab, see https://www.asker.kommune.no/sosiale-tjenester-og-boliger/asker-velferdslab/asker-welfare-lab/ and https://www.oecd.org/gov/innovative-government/Norway-case-study-UAE-report-2018.pdf.

105 International Organization for Standardization, Standards: Popular Standards - ISO 9000 Family - Quality Management. Available at https://www.iso.org/iso-9001-quality-management.html.

106 International Organization for Standardization, ISO 18091:2019 - Quality management systems - Guidelines for the application of ISO 9001 in local government. Available at https://www.iso.org/standard/72808.html.

107 International Organization for Standardization, ISO 37120:2018 - Sustainable cities and communities - Indicators for city services and quality of life. Available at https://www.iso.org/standard/68498.html.

Other highlights in the KPI evaluation include a high level of voter participation, with just over two thirds of eligible inhabitants voting in the most recent municipal elections – higher than many other municipalities in Norway. A low Gini coefficient (0.27) suggests a good level of economic equality among residents.[108] Additionally, childcare is widely available, with 98 per cent of all pre-school-aged children having access to it.

All inhabitants are covered by health care and have electronic health records. Life expectancy is correspondingly very high, at 82.9 years. However, the rate of doctors and in-patient hospital beds are slightly low, with 110 doctors and 190 hospital beds per 100,000 inhabitants. The evaluation also showed that Asker had only 1 traffic fatality per 100,000 inhabitants – lower than the national average for Norway at 2.7, and many other countries such as Sweden (2.8 per 100,000), the Netherlands (3.8 per 100,000), and Denmark (4 per 100,000).[109]

The KPI evaluation suggested some areas for improvement. The poverty rate is slightly high, with 4.3 per cent of the population living under the poverty line. Gender income is not equal, as female hourly earnings are just 64 per cent of male earnings (ITU, 2020). Lastly, in relation to municipal safety, the police and fire services employ a relatively low amount of staff, with the police service employing 89 officers per 100,000 inhabitants,[110] and the fire service employing 52 firefighters per 100,000 inhabitants.[111]

While Asker implemented resilience plans, the evaluation showed that these existing plans were not developed based on the Sendai framework. However, according to a resilience index of Norway, Asker is among the ten most resilient municipalities in the country.[112]

108 While this score is low in a global context, Asker is among the five municipalities of Norway with the highest Gini coefficient (p. 193, https://viken.no/_f/p1/i4f0b8206-d207-4524-b400-9200b65ae0f9/kunnskapsgrunnlag-regional-planstrategi-viken-vi-i-viken.pdf).

109 World Health Organization, "Road Safety: Estimated road traffic death rate (per 100,000 population), 2016", 2019. Available at http://gamapserver.who.int/gho/interactive_charts/road_safety/road_traffic_deaths2/atlas.html.

110 There is an ongoing National Police reform "to ensure the presence of a competent and effective local police" (https://www.regjeringen.no/no/tema/lov-og-rett/lov-og-rett--satsing/videreutvikling-av-politiet/narpolitireformen/id2398914/).

111 Other municipalities in Norway also have low scores regarding doctors, hospital beds, police staff and fire staff and this could potentially be attributed to the organization model of health, police, and fire services in the country.

112 Sabrina Scherzer, Päivi Lujala and Jan Ketil Rød, "A community resilience index for Norway: An adaptation of the Baseline Resilience Indicators for Communities (BRIC)", *International Journal of Disaster Risk Reduction*, vol. 36, No. 101107 (May 2019), p. 10. Available at https://sciencedirect.com/science/article/pii/S2212420918312032.

Part III Funding and financing for urban development

The State largely controls the budgets of the local governments. The Local Government Act gives the central Government the authority to make changes to a local government's budget and financial plan in order to ensure that its activities are financially sound.[113] The revenue of a municipality consists mainly of three sources of income: tax revenues, transfers from the State, and income from charges (such as user payments for services).[114]

How the municipality uses its resources depends upon its responsibilities on welfare services. Kindergartens, schools and the health and social sector account for nearly 80 per cent of most municipalities' gross operating expenditure.[115] Other local services take up less than 20 per cent of the budget and include culture (e.g. libraries, cinemas, and sports facilities), infrastructure (roads, water, sewage, and garbage collection), planning (including land-use planning), industry, and housing.[116]

The population growth of Asker municipality is steady, making the tax revenues relatively stable. Expected municipal income levels are high compared to other municipalities in Norway. Tax revenues for 2019, are estimated to be approximately 35 per cent higher than the national average for all municipalities.[117] However, Asker faces a range of challenges, such as an ageing population, the Norwegian dependence on a petroleum-based economy, and difficulties navigating multiple levels of government, all of which can affect municipal finances in the long run.

Furthermore, the municipality is taking on ambitious investments and high loan debt, which will result in increased municipal debt.[118] Asker has budgeted for an investment cost of NOK 3.9 billion over four years[119] (2020-2023), including investments in the areas of water, sewage and waste management.[120]

In 2019, Asker had a 7.0 per cent net operating surplus (as a percentage of gross operating revenues), indicating that municipal operations were conducted without going over budget. In fact, every year for the past five years, Asker has had a positive net operating surplus – 3.8 per cent in 2018; 8.5 per cent in 2017; 7.7 per cent in 2016; and 5.7 per cent in 2015.[121] For the period 2020-2023, Asker will also ensure that it will sustain a minimum 3 per cent net operating surplus, will have a maximum debt ratio of 80 per cent, and will have a minimum 10 per cent disposition fund.[122]

The financial priorities of Asker are defined in the Municipal Plan and include: i) making the municipality a financially robust and sustainable municipality; ii) ensuring the municipality has good financial sustainability; and iii) ensuring that the municipality has good financial management and delivers municipal services in an efficient manner. For instance, Asker will prepare a climate budget and climate accounts that highlight resource needs, priorities, responsibilities and goals to create a climate-friendly society.

113 Kommunalbanken AS (KBN), "The Norwegian Local Government Sector". Available at https://www.kbn.com/en/investor/investing-in-norway/.

114 Norway, Ministry of Local Government and Modernisation, "The financing of the local government sector", 19 August 2021. Available at https://www.regjeringen.no/en/topics/kommuner-og-regioner/municipal-economy/financing-of-the-sector/id552048/.

115 Ibid.

116 Lars-Erik Borge, "3.2 Local government in Norway", in *Local government in Denmark, Norway and Sweden* (2012), pp. 95-121. Available at http://folk.ntnu.no/larseb/finnish_paper.pdf.

117 For more information, see https://www.nyeasker.no/globalassets/nye-asker-kommune/kommuneplan/vedlegg/2-langsiktig-drifts--og-investeringsanalyse-mot-2040.pdf.

118 The high level of investment contributes to high borrowing; the debt ratio will increase in 2020 and 2021, and then flatten out.

119 Asker Municipality, *Action Programme 2020-2023* (Asker, Asker Kommune, 2019). Available at https://www.asker.kommune.no/contentassets/33055f6274fd437f858bbc20c074a890/handlingsplan2020.pdf.

120 Asker Municipality, *The Municipal Director Proposal for the Action Programme 2021-2024* (Asker, 2020). Available at https://www.asker.kommune.no/contentassets/33055f6274fd437f858bbc20c074a890/handlingsprogram_asker_2021_2024.pdf.

121 Statistics Norway, "Municipal accounts: 12134: Financial key figures for municipalities (M) 2015 - 2020", Statbank. Available at https://www.ssb.no/en/statbank/table/12134.

122 Asker Municipality, The Operating Budget (2020). Available at https://pub.framsikt.net/2020/nyeasker/bm-2020-handlingsprogram_2020-2023/#/generic/summary/budsum.

Part IV Recommendations

Since becoming a new municipality in 2020, Asker has taken a wide range of steps to accelerate its progress towards achieving the SDGs and has placed the 2030 Agenda at the heart of its action. The SDGs are the basis for many of the most important municipal planning documents, which reflects the ambitious approach Asker has taken to becoming smarter and more sustainable.

Asker has taken a sustainable approach to its economic development, abiding by national and United Nations guidelines on sustainable investment. The local business community also contributes to the efforts of the municipality along this line through the sustainability network of the Asker Business Council. The municipality is also limiting its environmental impact by ensuring that its construction sites do not use fossil fuels; by educating its citizens on recycling to support the circular economy; and by providing funds for inhabitants to make their homes more environmentally friendly. The society and culture of Asker is being improved through the establishment of community centres and local community committees, bringing municipal decision-making closer to citizens. Young people have ample opportunity to have their voice heard, for example at the Asker Conference, and measures are taken to encourage sport in a way that includes all members of society, such as the Active in Asker app.

Asker plans to implement the results of the KPI assessment by analyzing and evaluating its processes to improve policymaking and municipal services. Asker will also use the KPI evaluation as the basis for the "Sustainable Asker" programme.[123]

Based on the U4SSC Verification Report of Asker and the review of documentary data, including information provided by the municipality, it is recommended that Asker takes steps to:

- ***Improve the water, sanitation and drainage infrastructure***

Addressing the unsustainable consumption of natural resources is a prerequisite for the successful implementation of the 2030 Agenda in the UNECE region and is one of the fundamentals of urban management based on the principles of circular economy. It requires cities to take decisive action and develop and implement urban policies and solutions that promote the sharing, recycling, refurbishing, re-using, replacing, and digitizing of natural resources (U4SSC, 2020).

The quality of the water and the efficiency and effectiveness of the water and wastewater infrastructures and facilities have a considerable impact on the quality of life and the environment. As the evaluation indicated a need to decrease the loss of water from the supply system, the municipality is encouraged to improve the efficiency of the water and sanitation infrastructure, and the extension of its lifespan. Asker is encouraged to further invest in the ICT monitoring of its urban water networks, by introducing more smart water meters and setting up a drainage and storm water ICT monitoring system. Last but not least, the municipality is also encouraged to further engage with the residents and to work with planners to decrease the use of water resources by households, and to develop designs that allow for instance the recycling of water.[124]

- ***Improve sustainability of public buildings and decrease electricity consumption***

Improving public building sustainability leads to improving the quality of the environment and the quality of life in cities. Buildings account for a significant proportion of GHG emissions and resource use in municipalities. Developing, operating, refurbishing and maintaining public buildings consumes a lot of energy.

123 Asker Municipality, KPI survey - result for Asker municipality, 16 June 2020. Available at https://www.asker.kommune.no/politikk/politiske-moter-og-dokumenter/?q=0135/20&c=200200212#result.

124 Ibid.

High use of energy for buildings is associated with adverse effects on the environment, especially when the production of energy is based on fossil fuels. However, it is estimated that existing technologies can reduce energy consumption by 30 to 50 per cent in buildings without significantly increasing investment costs. Improving the energy performance of housing contributes to increased comfort of living, reduced energy bills, alleviation of fuel poverty, mitigation of GHG emissions, and job creation (UNECE, 2018).

In line with the KPI evaluation, the municipality is encouraged to take steps towards decreasing levels of energy consumption and improving the overall sustainability of public buildings. This concerns especially the energy efficiency of the old building stock and office buildings, whose life-cycle energy (primary) requirement[125] is in a range of 250–550 kWh/m² per year (compared to conventional residential buildings, which have a requirement of 150–400 kWh/m² per year).

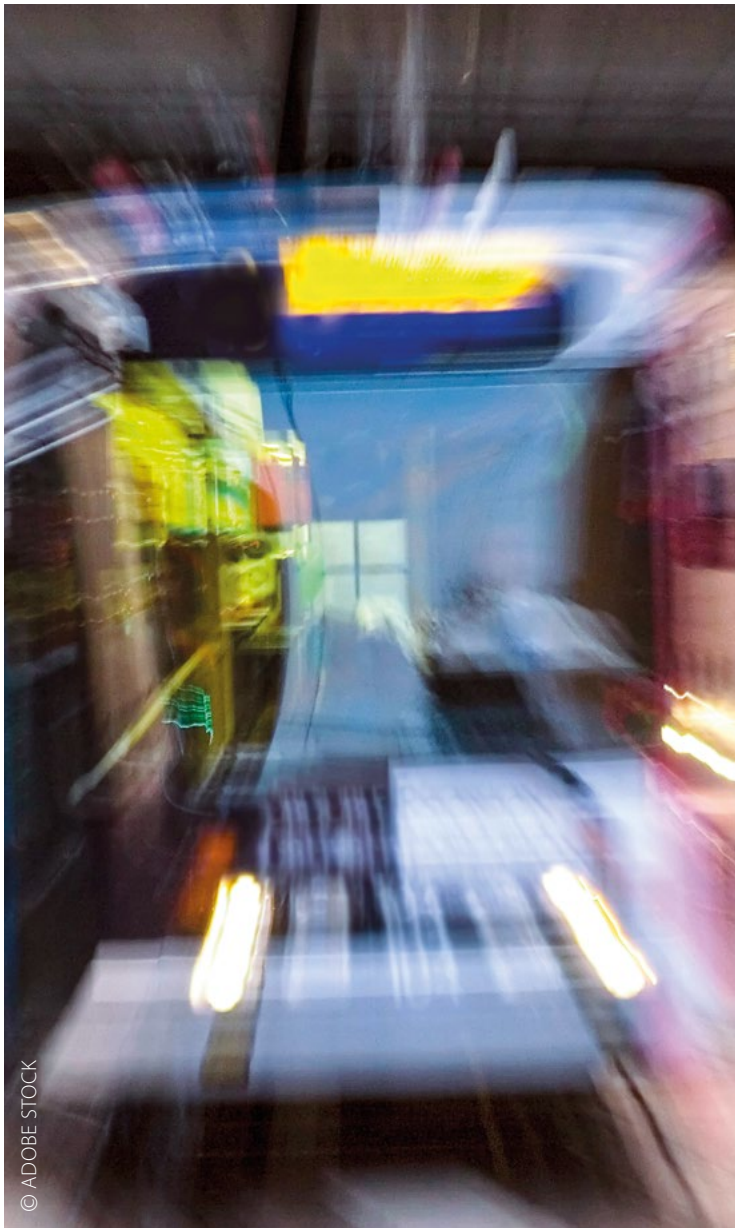
The municipality is encouraged to work closely with the national Government, the business community and academia to develop innovative policy solutions that stimulate a demand for energy savings and energy efficiency. This concerns especially the development of new technologies and designs that allow sharing, recycling, refurbishing, re-using, replacing, and digitizing of the use of energy, on the one hand, and passive and active technologies that allow the reduction of energy demand during the building's life cycle, on the other hand.

The municipality should also promote initiatives that aim to decrease electricity waste and loss, and work with the national Government, the business community and academia to this end. This could include incentivizing the production and use of energy-efficient and "smart" appliances (whose functioning can be coordinated with consumer behaviour) by households.

125 Life-cycle energy (primary) requirement is the assessment of the energy needs of a building throughout its life cycle.

- ***Improve access to the public transport infrastructure***

A well-designed and efficient public transport system is the backbone of sustainable and smart urban development. It prompts equal redistribution of the benefits of urbanization and facilitates the reduction of socio-economic inequalities in cities. Over recent decades, the transport infrastructure has benefitted from access to innovative ICT and solutions, which provide dynamic public transport information, including traffic monitoring, intersection control, and the development of intelligent intersection management systems in cities.



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The evaluation of Asker reaffirms the municipal priorities to further invest in the transport infrastructure, and especially to improve traffic monitoring and increase the share of low-carbon emission passenger vehicles (currently 15.2 per cent of all vehicles). It is also important to improve the modal split, including increasing the amounts of journeys made by public transport. This, in turn, requires comprehensive action to develop relevant solutions, taking into account a range of factors, such as the cost of owning, driving and parking private vehicles, and the quality and cost of alternative transport modes, such as public transport and cycling.

- ***Improve solid waste management***

Effective and efficient waste management is a prerequisite for sustainable development. Solid waste treatment and waste collection have a considerable influence on quality of life and the environment. The production of waste not only consumes resources (e.g. land) and energy but also has a particularly negative impact on air quality.[126] Inefficient waste management can have a negative impact on local climate by blocking drains and causing flooding.

As solid waste pollution causes adverse effects on the environment and health, the municipality is encouraged to reduce the quantity of waste, by influencing patterns of consumption, product development and storage; and promoting waste recycling, in so far as waste emerging as a result of one production process can be used as an input (material or energy) into another production process. This allows the creation of closed loops within, and across, industries, which, in turn, enhances circularity.

The municipality should decrease the amount of waste put into sanitary landfills, and collaborate with the national Government, the business community and academia: i) to develop infrastructure and technologies that enable the use of waste for energy generation; and ii) to promote sustainable material cycles, via design control, to ensure a more productive use and reuse of materials.

126 Open dumps emit a significant amount of methane and, when burned, waste contributes to carbon dioxide emissions. Both methane and carbon dioxide are GHGs, the emission of which should be decreased, in line with international standards such as the United Nations Framework Convention on Climate Change (2016).

BÆRUM

Part I General overview

Bærum is a municipality in the county of Viken. It borders Asker and Lier to the south-west, Hole and Ringerike to the north-west, and Oslo to the north-east. Bærum has 127,867 inhabitants (at the beginning of second quarter)[127] and is the fifth largest municipality in Norway.

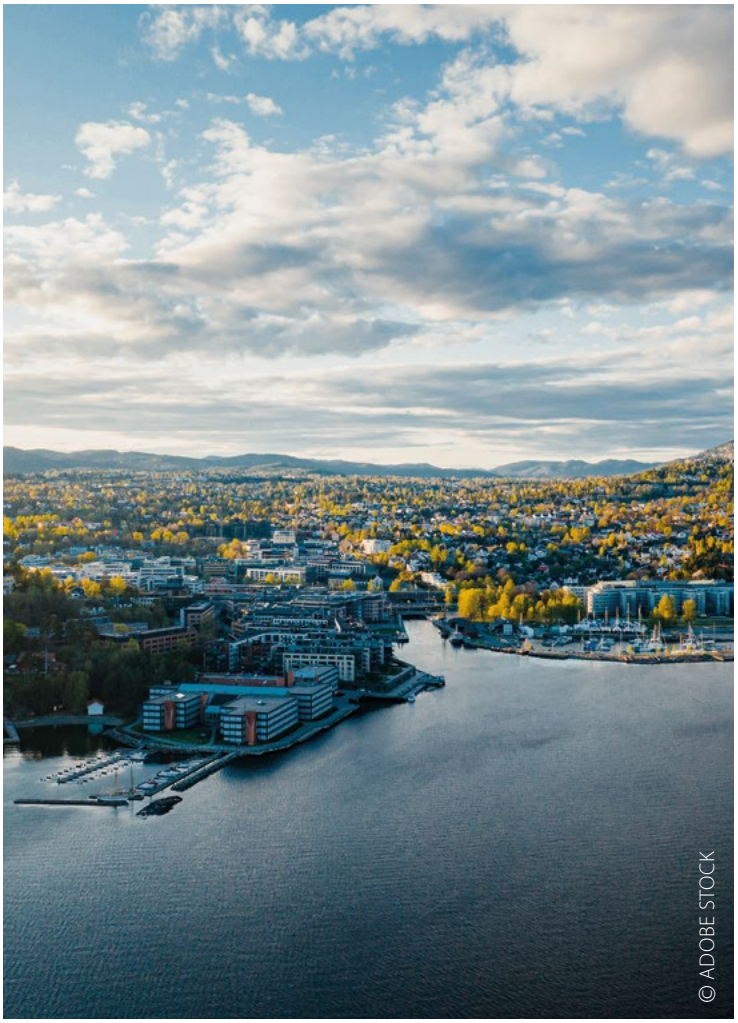
Sandvika is the administrative centre of the municipality and is an important water transportation hub as it is located where the river Sandvikselva meets the Oslofjord waterway. Sandvika is also an important local and regional business and service centre.

Bærum has the highest average income and education level in Norway and is one of the country's fastest-growing municipalities. During the period covered by the study, housing construction increased by about 25 per cent[128] - equivalent to almost 700 homes a year.[129] The rate decreased due to a decline in population growth, attributed to reduced immigration and a low birth rate.

Life expectancy is high in general (80.9 years for men and 84.7 years for women), and is linked to a range of socioeconomic factors, including education and income. Level of education alone can affect life expectancy by as much as 6 years.[130]

Workforce supply is considerably lower than demand, mainly due to proximity of Bærum to the growing labour markets in Oslo and Akershus. In 2016, available jobs were over 8,000 more than the number of available workforce. Most jobs are in the health and social services, retail trade, and technical services sectors.

The business environment can be characterized by a particularly strong expansion of technology and energy companies, and consulting firms. The share of SMEs in all businesses is high, and the SME sector plays an important role in serving big companies, which are located along the European route E18 between Lysaker and the border of Baerum and Asker.



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127 Statistics Norway, Population, Statbank. Available at https://www.ssb.no/en/statbank/table/01222/tableViewLayout1/ (accessed on 16 December 2020).

128 Bærum Municipality, Population Development. Available at https://www.baerum.kommune.no/politikk-og-samfunn/samfunnsutvikling/befolkningsutvikling/.

129 Construction is taking place primarily along roads and public highways, such as in the areas of Sandvika and Fornebu, as well as along the Kolsås Line (a branch of the Oslo metro system).

130 Organisation for Economic Co-operation and Development, "Life expectancy by sex and education level", in *Health at a Glance 2017: OECD Indicators* (Paris, OECD Publishing, 2017), p. 50. p. 50. Available at https://doi.org/10.1787/health_glance-2017-7-en.

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

To support the commitment to building a smart and sustainable Bærum, in 2019/20, the municipality was evaluated using the KPIs for SSC. The outcome of the data verification provided by Bærum is in the "U4SSC Verification Report – Bærum, Norway".[131]

In line with the U4SSC Verification Report, graph 3 shows the performance of the city against the KPIs. This section outlines the performance of Bærum 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 for making Bærum smarter and more sustainable.

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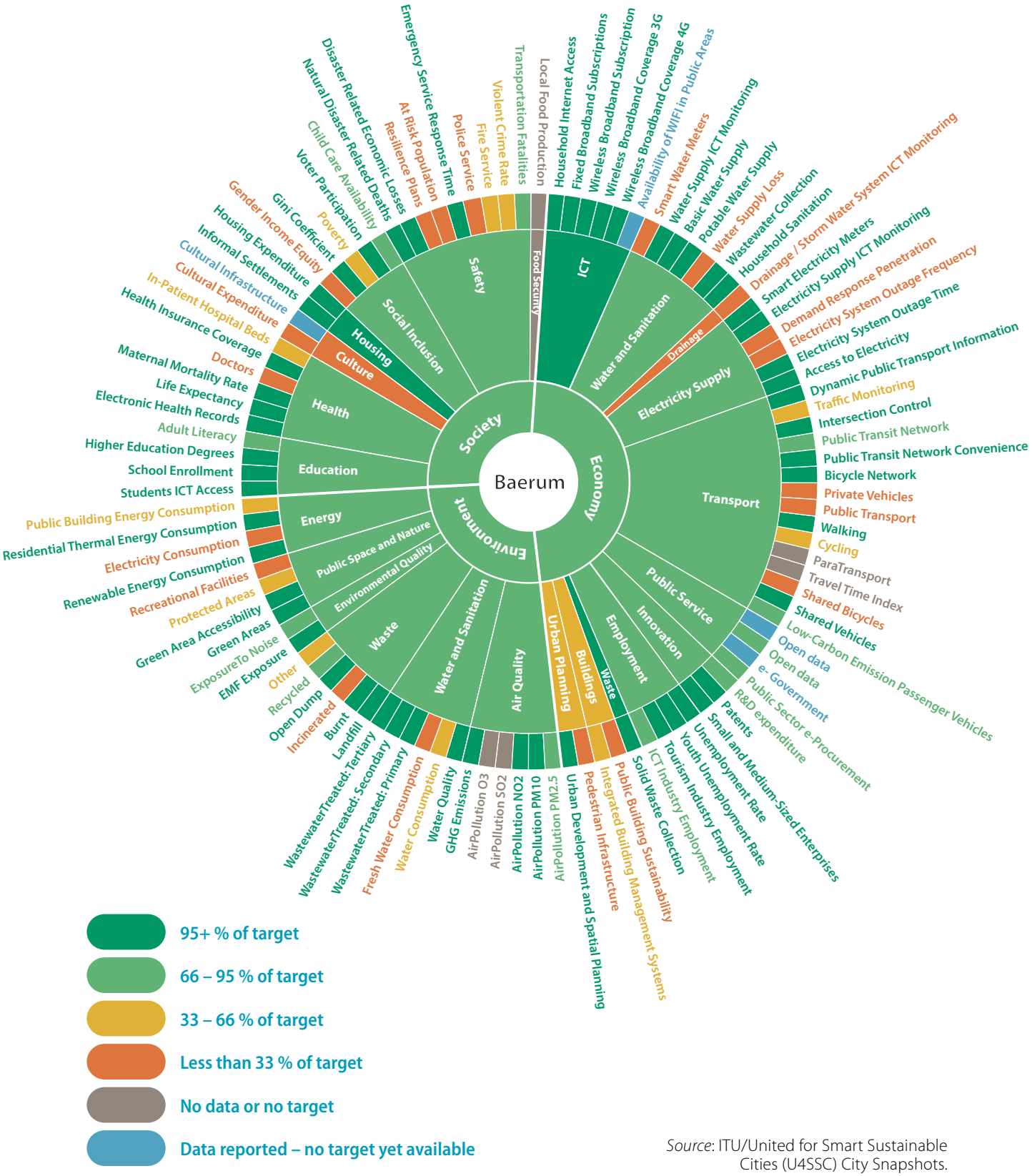
131 International Telecommunication Union, *U4SSC Verification Report – Bærum, Norway* (Geneva, 2020). Available at https://www.itu.int/pub/T-TUT-SMARTCITY-2020-38.

Graph 3 The performance of Bærum against the Key Performance Indicators for Smart Sustainable Cities



Source: ITU/United for Smart Sustainable Cities (U4SSC) City Snapshots.

Economy – an overview

Bærum pursues urban development that is innovative and green, and is collaborating with business communities and the private sector to this end.

Bærum is part of a long-term strategic partnership with the private sector, the business community and the academia to make the municipality smarter and more sustainable. To implement the vision of the Smart City Bærum programme - the "Profitable interaction for a greener future"[132] - the city works with businesses to develop new technologies; to refine procedures and organizational measures in order to establish "green", user-friendly economic solutions and limit GHG emissions; and to create an innovative, environmentally friendly, and profitable economy. The programme assumes that the current environmental and climate challenges must be addressed through constructive public private partnerships.

The municipality works with NTNU to strengthen knowledge base and to prompt competence-based development. NTNU plays a key role in developing innovative solutions through education and research programmes in Norway.[133]

Bærum aspires to making its transport infrastructure the backbone for a sustainable economy. It recently adopted the zero-growth vision in transport, the aim of which is to further reduce the reliance of inhabitants on private vehicles by ensuring that any growth in cities is matched with an expansion of the transport infrastructure, thus limiting the need for private vehicles. This takes the form of an agreed contract between the national Government and the municipality.[134]

To implement the zero-growth vision, the municipality has carried out several pilot projects that aimed to test different modes of transportation; it hopes to generate positive synergy effects based on actions that aim to increase the use of shared vehicles, carpooling and micromobility (for instance, bicycles and scooters) in the municipality.[135] These projects have been implemented with the cooperation of the private sector.[136]

Over the coming years, the municipality is planning to improve public services, improve community cohesion, deliver climate actions, build new partnerships with knowledge communities (universities, research organizations and institutes), encourage voluntarism and resident cooperation, and further invest in innovation development. For instance, Bærum will implement a new strategic plan for the business sector by 2024,[137] and will develop relevant arenas for collaboration, and strengthen its collaboration with NTNU and VID (Norwegian: vitenskapelig, internasjonal, diaconal; English: scientific, international, diaconal) Specialized University.[138] It is also planning to use a new municipal headquarters as a place for dialogue and cooperation with inhabitants and businesses, with a view to becoming a municipality of the future, exploiting new digital forms of work, and promoting activity-based workplaces and interdisciplinary, intersectoral collaboration.

KPI evaluation results – economy dimension

The evaluation of Bærum against the KPIs revealed strong performance in the economy area.

Bærum offers good access to electricity and ICT infrastructure. The per centage of households with internet access is 98, and 99 per cent of the municipality is covered by 3G and 4G wireless broadband. There are 114,399 wireless broadband subscriptions per 100,000 inhabitants, and 85.7 per cent of households have a fixed broadband subscription. All households have uninterrupted access to electricity. They all have smart electricity meters, and 100 per cent of the electricity supply system is monitored by ICTs. While customers experience, on average, 1.75 electricity outages per year, these outages last under an hour on average.

132 Smart City Bærum (https://smartcitybaerum.net/om/).

133 Bærum Kommune, "Business + academia + municipality = true", 13 January 2020. Available at https://www.baerum.kommune.no/nyhetsbrev2/naringslivakademiakommunesant/.

134 Urban growth agreements (footnote 22).

135 Carpooling for leisure activities. Available at https://www.baerum.kommune.no/politikk-og-samfunn/samfunnsutvikling/klimaklok-kommune3/samkjoring-til-fritidsaktiviteter/.

136 Smart City Bærum, "Prosjekter". Available at https://smartcitybaerum.net/prosjekter/.

137 Strategy Business Plan 2024. Available at https://www.baerum.kommune.no/innsyn/politikk/wfdocument.ashx?journalpostid=2020032051&dokid=4810853&versjon=1&variant=A&.

138 VID (https://www.vid.no/om-oss/organisasjonen/).

Results also suggest a healthy economic climate for innovation with 99.3 per cent of all enterprises as SMEs. There are 44 patents issued per 100,000 inhabitants, compared to the EU average of 14 per 100,000 inhabitants.[139] Some 2.5 per cent of Bærum's GDP is spent on research and development, suggesting a strong environment for innovation.

All households in Bærum are served by regular solid waste collection, and unemployment rates are very low - 1.7 per cent of the population is unemployed, and unemployment rate for the youth population (under 24 years old) is only at 1.4. By comparison, the national unemployment rate of Norway was 3.5 per cent at the start of 2020.[140]

Regarding the water and sanitation infrastructure, 99.3 per cent of households have access to a basic water supply, and 99.2 per cent have a potable water supply. Furthermore, 99.2 per cent of households are served by wastewater collection, all have basic sanitation facilities, and all the water distribution system is monitored by ICTs.

The public transport network is extensive, at 150 km per 100,000 inhabitants, and 95.6 per cent of the population can access this network within 500 metres of their home. The fact that there are 284 shared vehicles per 100,000 inhabitants suggests that carpooling is a common practice, and low carbon emission vehicles make up a high 9.2 per cent of all vehicles in the municipality.

However, despite good access to public transport network, 57 per cent of commutes are made using private vehicles and only 18 per cent are by public transport indicating an area for improvement. With only 2 per cent of public buildings certifiably sustainable, municipal performance in relation to public building sustainability could also be improved.

Regarding the water and sanitation infrastructure, only 1.3 per cent of water metres are smart water metres and the amount of water lost in the water distribution supply, at 34.7 per cent, is high. Additionally, the drainage and storm water system is not monitored by ICTs.

Environment – an overview

The municipality of Bærum implements a variety of projects that limit its impact on the environment. One notable example is the "Climate-Wise Municipality" (Norwegian: Klimaklok commune) programme, established by the municipality as a multi-year development programme. The programme aims to achieve climate goals. All parts of the urban community (residents, businesses, organizations, and elected officials) will be mobilized to increase efforts to meet both national and international climate goals.[141]

The Climate-Wise Municipality programme is delivered via: the provision of grants for charging electric cars at home, free energy advice and support for climate measures in citizens' own homes; the "SmartBike resident" project which allows inhabitants to borrow electric bikes for free; and the "Cut food waste 2020" project, to reduce food waste in municipal services. Bærum has partnered with the Research Centre on Zero Emission Neighbourhoods (Norwegian: forskningssenter for miljøvennlig energi - FME ZEN) in Smart Cities to develop sustainable areas with zero emissions in the municipality.[142]

Bærum implements the FutureBuilt programme in partnership with other municipalities, the Ministry of Local Government and Modernization, the Housing Bank, Enova, the Directorate for Building Quality, the Norwegian Architects' Association, and the Green Building Alliance.[143] The vision of FutureBuilt is to show that it is possible to develop high-quality climate-neutral buildings and urban areas; and achieve a 50 per cent reduction in GHG emissions produced from energy, materials and transport compared to levels in 1990. As a part of FutureBuilt, Bærum is implementing pilot projects that aim to deliver buildings with higher quality and lower GHG emissions than the building regulations require.

139 Eurostat, *Patent applications to the European Patent Office*. Available at https://ec.europa.eu/eurostat/databrowser/view/sdg_09_40/default/table?lang=en.

140 OECD, *Unemployment Rate.*, Available at https://data.oecd.org/unemp/unemployment-rate.htm#indicator-chart.

141 Bærum Kommune, "Climate municipality". Available at https://www.baerum.kommune.no/politikk-og-samfunn/samfunnsutvikling/klimaklok-kommune3/.

142 ZEN (https://fmezen.no/).

143 FutureBuilt (https://www.futurebuilt.no/English).

One of the pilot projects in this programme is the Oksenøya Senter development, that Bærum is carrying out in collaboration with FME ZEN. It is the biggest pilot project of the municipality, and will include a primary school, a kindergarten for 300 children, a multi-use hall, a football pitch, a community centre, and a residential and treatment centre for 150 residents. The development is designed to meet the "outstanding" sustainability rating according to BREEAM.[144] Construction of the Oksenøya Senter has already started and will be completed by the end of 2022.[145]

Bærum was analysed by the Carbon Disclosure Projects (CDP), an organization that rates companies and cities based on their journey through disclosure and towards environmental leadership. The municipality features on the A-list of the organization having garnered an A rating, the highest available.[146]

To monitor the air quality in several local locations, while ensuring good quality of the measurement results, the municipality is conducting a research project called IFlink, a research and innovation project that aims to renew air quality and environmental monitoring in Norwegian municipalities.[147]

Bærum will develop climate dashboards for measuring "climate-wise choices" and emissions to raise awareness about climate change and to better engage communities in meeting climate goals. In 2020 Bærum approved a proposal to develop a climate budget plan. The climate budget will be part of the regular budget from the year 2021 onwards. The municipality will also use the climate accounting methodology, which enables the assessment of municipal actions against climate impacts. It will furthermore revise the municipality's climate strategy and conduct a mapping of biodiversity and blue-green structures to use as a knowledge base for planning.

144 BREEAM, "How BREEAM Certification Works". Available at https://www.breeam.com/discover/how-breeam-certification-works/.

145 Bærum Kommune, "Treklang - Oksenøya center", 26 July 2018. Available at https://www.baerum.kommune.no/om-barum-kommune/organisasjon/om-eiendom-i-baerum-kommune/prosjekter-eiendom/oksenoya-senter/.

146 Carbon Disclosure Projects (https://www.cdp.net/en).

147 iFLINK (https://iflink.nilu.no/en/about-iflink-2/project-description/).

KPI evaluation results – environment dimension

The overall performance of Bærum against the environment indicators of the KPIs is good and reflects the municipality's efforts to reduce its environmental impact.

Bærum has good-quality air. The levels of particulate matter in the air (PM 2.5 and PM 10) do not exceed recommended maximum levels (11 µg per m³ and 20 µg per m³, respectively), nor do levels of NO_2, at 29 µg per m³. The GHG emissions of the municipality are also very low, at 1.3 tonnes of CO_2 equivalent per capita – compared to the EU average of 6.2.[148] The municipality did not report data on SO_2 and O_3 rates.

Bærum also offers good-quality water. Hundred per cent of wastewater undergoes primary, secondary and tertiary treatment, and 99.2 per cent of the water supply samples complied with WHO standards.

Furthermore, there is no EMF overexposure, and a relatively low 19.4 per cent of inhabitants are regularly exposed to high levels of noise.

Bærum has a high 10,553 hectares of green area per 100,000 inhabitants, and 99.8 per cent of the inhabitants have convenient access to green areas and live within 300 metres of publicly accessible green spaces.

Regarding solid waste management, Bærum recycles just over half of its solid waste (50.5 per cent, above the EU average of 47 per cent[149]) and no waste is disposed of in open dumps. However, the amount of solid waste incinerated is high, at 44.2 per cent (higher than the EU average of 26.5 per cent[150]), which should ideally be minimized.

Both water and electricity consumption in Bærum is high and could be diminished. Water consumption is 185 litres per day per capita and electricity consumption is 12,872 kWh per year per capita. Public building energy consumption is also high, at 168 ekWh per m² per year. Hundred per cent of the energy in Bærum comes from renewable sources.

Society and culture – an overview

Bærum continuously works towards improving quality of life by delivering high-quality social services and diversifying what it offers to culture. The municipality developed the "Better Learning"[151] programme to improve the quality of education in public schools by better focusing on the role of educational institutions in improving the life skills and mental health of students. The introduction of new digital teaching materials in 2020 supports the implementation of the programme.

The municipality promotes healthy lifestyle and well-being. It encourages the population to change unhealthy behaviours and supports those who are ill so that they can live a normal life. The "Healthy Life Center",[152] run by the municipality, supports people living with chronic illness and their families, and promotes physical activity and the development of good eating habits.

148 Climate Watch, *Data Explorer*. Available at https://www.climatewatchdata.org/data-explorer/historical-emissions?historical-emissions-data-sources=cait&historical-emissions-gases=all-ghg&historical-emissions-regions=All%20Selected&historical-emissions-sectors=total-including-lucf&page=1.

149 Eurostat, *Municipal waste statistics*. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php/Municipal_waste_statistics.

150 Eurostat, *Municipal waste statistics*. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php/Municipal_waste_statistics.

151 Bærum Kommune, "Better learning – a framework for quality", 9 January 2019. Available at https://www.baerum.kommune.no/tjenester/skole/rammeverk-for-kvalitet-i-barumskolen/.

152 Bærum Kommune , "The wellness center in Bærum", 26 January 2017. Available at https://www.baerum.kommune.no/tjenester/helse-og-omsorg/frisklivssenteret-i-barum/.

Among other initiatives that aim to improve the quality of life and social inclusion is the Bærum-run family support programme Home-Start Family Contact (Norwegian: Home-Start Familiekontakten - HSF),[153, 154] with the voluntary participation of inhabitants. The programme offers regular support, friendship and practical help to families with young children in difficult times and primarily in the family's own home. Together with the Oslo District Police, Bærum is a part of the Coordination of Local Substance Abuse and Crime Prevention Measures[155] that aims to prevent substance abuse and crime among children and adolescents.

To improve access to decent quality affordable housing among various social groups, the Labor and Welfare Administration of Bærum participates in a national research project called HOLF (comprehensive follow-up of low-income families). This aims to counteract poverty and its consequences by supporting the finances and improving the work and housing situations of families. Also, Bærum provided housing for people with special needs. In 2020 Bærum developed the Carpe Diem Demenslands,[156] that provides assisted living for people with dementia. It was awarded the prize "health building of the year".[157]

153 Frivillig.no, "Home-Start Family Contact Bærum". Available at https://frivillig.no/home-start-familiekontakten-brum.

154 The Home-Start Family in Bærum is part of the international organization called Frivillig that exists in 23 countries. For more information, see https://homestartnorge.no/om-oss/prinsipper-og-metoder/.

155 Bærum Kommune, "SLT drug and crime prevention", 28 June 2018. Available at https://www.baerum.kommune.no/tjenester/sosiale-tjenester-og-barnevern/slt-rus--og-kriminalitetsforebygging/.

156 Bærum Kommune, "Carpe Diem demenslandsby" (Carpe Diem dementia village). Available at https://www.baerum.kommune.no/tjenester/helse-og-omsorg/sykehjem-og-omsorgsboliger/sykehjem-bo-og-behandlingssenter/demenslandsby/.

157 NOHRCON, "Carpe Diem demenslandsby i Bærum kommune er Årets helsebygg 2020" (Carpe Diem dementia village in Bærum municipality is the Health Building of the Year 2020), 23 October 2020. Available at https://nohrcon.no/informasjon/carpe-diem-demenslandsby-i-baerum-kommune-er-arets-helsebygg-2020/.

In 2018, Bærum won the Norwegian Directorate for Integration and Diversity's settlement and integration prize for its good work with refugees in the municipality. The Adult Learning Center for refugees is part of the national "introduction programme" and aims to secure education and inclusion in the municipality.

In the coming years, Bærum will implement the "Together for Welfare" project, which aims to contribute to the municipality's main goal of sustainable and coherent social services, especially for vulnerable young persons.

KPI evaluation results – society and culture dimension

Much like the economy and environment dimensions, the performance of Bærum in the society and culture dimension is good.

The provision of education is universal; all school-aged citizens are enrolled in education and 100 per cent of them have access to ICTs. Forty-two per cent of the population hold higher education degrees, and 95 per cent of the adult population are literate and numerate.

The provision of housing is also very good. A small 0.04 per cent of inhabitants live in informal settlements, and households spend, on average, only 16.6 per cent of their income on housing costs (in comparison, Organisation for Economic Co-operation and Development (OECD) countries spend roughly 20 per cent of income on housing).[158]

All Bærum inhabitants have access to public health care, and 99.9 per cent have electronic health records. Average life expectancy is correspondingly high, at 83 years,[159] which is higher than the EU average of 81 years.[160] The municipality reported no maternal deaths during birth. The amount of time taken by emergency services to respond to calls is very fast, at an average of 4.7 minutes, and traffic fatalities are low, at 0.8 per 100,000 inhabitants.

158 OECD Better Life Index, *Housing*. Available at http://www.oecdbetterlifeindex.org/topics/housing/.

159 80.9 years for men and 84.7 years for women.

160 Eurostat, *Life expectancy across EU regions*. Available at https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200930-1.

The low Gini coefficient of 0.32 suggests that there is a strong level of socioeconomic equality in Bærum. The participation rate of 70.7 per cent of eligible inhabitants voting in the most recent elections suggests a high level of citizen engagement. The percentage of pre-school-aged children who have access to childcare facilities is 93 per cent.

However, the evaluation indicated that female earnings are only 62 per cent of male earnings, and 5 per cent of the population is defined as living below the poverty line. Furthermore, there is a relatively low number of doctors and hospital beds for the population, at 110 doctors and 190 hospital beds per 100,000 inhabitants. The police and fire services have a relatively low number of staff - the police service has 91.4 full-time equivalent (FTE) staff,[161] and the fire service has 61 FTE staff. Lastly, 455 violent crimes occur per 100,000 inhabitants which is lower than the national average of 713 violent crimes per 100,000 inhabitants in 2019.[162]

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Part III Funding and financing for urban development

In recent years, the municipal finance was in good condition. It demonstrated satisfactory operating results and a moderate level of debt compared to other municipalities in Norway.[163] In the coming years, this may change as a result of a decline in income from taxes (as the working population is expected to decrease) and an increase in spending on pensioners and health care services. Additional pressure on the budget is expected to result from increasing costs of care, a restructuring of the Norwegian economy (especially a reduction in the country's oil revenues), and negative demographic trends such as an ageing population.

Norway recently observed a rise in the level of unemployment, and an increasing number of people leaving working life before the age of 67. The municipality expects that these will have a negative impact on the municipal economy and, by extension, will reduce funding and financing for sustainable urban development.

In the period 2020-23, Bærum will undertake large investments, as there is a growing need for municipal services and social infrastructure due to population growth and delays in necessary infrastructure maintenance. The increased need for investment leads to higher financial expenditure and increasing debt. The debt ratio will approach a worrying level towards 2023. By 2025, the largest investments are expected to be completed, and the debt can then be reduced to an acceptable level.

161 Police officers serve Bærum , Asker and four districts of O`slo: District Vestre Aker, Nordre Aker, Frogner and Ullern. The KPI is reported based on the population of the six areas.

162 Statistics Norway, *Reported offenses and victims*. Available at https://www.ssb.no/lovbrudda.

163 Bærum Kommune, Handlingsprogram (Action Programme) 2021-2024, proposal of the Municipal Director (23 September 2020). Available at https://www.baerum.kommune.no/globalassets/styrende-dokumenter/hp-2021-2024/kommunediretkorens-forslag-til-handlingsprogram-2021-2024-korrigert-for-feil.pdf.

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Demographic changes in the population also represent an important factor in the budget for sustainable urban development. For the last 15 years, the number of inhabitants of working age has been, on average, 4.4 people of working age per inhabitant aged 67 years and over. Towards 2039, the action programme predicts that this will drop to 3.0. Without the relatively high population growth that is expected to come from the predicted housing construction and relocation during this period, this number would be even lower. Less housing construction would thus challenge the municipality's age-bearing capacity and financial framework conditions further.

Climate change also means that the municipality must take the environment into consideration when planning, developing, and operating services. The municipality will face major challenges related to a wilder, warmer and wetter climate. This includes dealing with more concentrated and extensive rainfall, which will require the municipality to address problems pertaining to water management, floods, the quality of drinking and bathing water, and threats to species' diversity.

Societal development is progressing fast and will be characterized by digitalization in the coming decades in a variety of areas. New technologies, such as artificial intelligence, automation, sensors and big data, will enable some challenges to be solved in new, more user-friendly ways. Digitization should help maintain good welfare services and secure sustainable development, even if there are fewer taxpayers per capita on average. It would not be sustainable to solve the problems as we do today.

Part IV Recommendations

The municipality of Bærum made great strides towards achieving the 2030 Agenda. It adopted a wide-reaching range of policies and projects to support its socioeconomic development, reflect its aspirations reduce its impact on the environment, and achieve climate goals.

The municipality cooperates cross-sectorally with organizations as part of the Smart City Bærum partnership, supporting environmentally friendly and profitable business ventures. The municipality is delivering the Climate-Wise Municipality development programme to engender a green shift and meet the national climate targets of Norway, and is building high-quality, climate-neutral buildings as part of the FutureBuilt programme. The Better Learning programme is supporting improvements to schools of Bærum, and the municipality has established the Healthy Life Center to improve the health of its citizens.

Bærum was evaluated against the KPIs for SSCs in 2019 and 2020. The evaluation outlines the performance of the city in relation to indicators pertaining to the economy, environment, and society and culture, measuring its progress towards achieving the SDGs. Outcomes of the evaluation are presented in the U4SSC Verification Report – Bærum, Norway. Based on the Report and the review of documentary data, including information provided by the municipality, it is recommended that Bærum:

- ***Improve the water, sanitation and drainage infrastructure***

Addressing the unsustainable consumption of natural resources is a prerequisite for the successful implementation of the 2030 Agenda in the UNECE region and is one of the key principles of urban management in the twenty-first century and of the circular economy. It requires cities to take decisive action to develop and implement circular approaches to the use of natural resources (U4SSC, 2020).

Water is one of the key natural resources of Bærum. Water quality and the efficiency and effectiveness of the water and wastewater infrastructure and facilities have a considerable impact on quality of life and the environment in the city. As the evaluation indicated a need to decrease the loss of water from the supply

system, the city is encouraged to develop and implement solutions that will improve the efficiency of the water and sanitation infrastructure and extend its lifespan. The considerable quantity of water supply loss is one contributing factor to the high level of water consumption in the city. Bærum is encouraged to further invest in the ICT monitoring of its urban water networks, by introducing more smart water meters and setting up a drainage and storm water ICT monitoring system, in order to improve the efficiency of water management. The city is also encouraged to further engage with residents and to work with planners to decrease the use of water resources by households, and to develop designs that facilitate, for instance, the recycling of water.

- ***Improve access to the 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 socioeconomic inequalities in cities. Over recent decades, the development of the transport infrastructure has benefitted from access to innovative ICT technologies and solutions, which help to provide more dynamic public transport information, including better traffic monitoring.[164]

The evaluation of Bærum against the KPIs for SSCs reaffirms the municipal's priority to further invest in transport infrastructure, and especially to improve traffic monitoring and increase the share of low-carbon-emission passenger vehicles (currently 9.2 per cent of all vehicles). It is also important to improve the modal split, including increasing the number of journeys made using public transport. This, in turn, requires comprehensive action, taking into account a range of 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, to develop relevant solutions.

Good practices, such as contracts between the national government and municipalities that focus on ensuring that that the growth of the municipality does not translate into the increased use of private vehicles, should be disseminated internationally.[165]

- ***Improve the sustainability of public buildings and decrease electricity consumption***

Improving public building sustainability leads to the enhanced quality of the environment and of quality of life in cities. Buildings account for a significant proportion of GHG emissions and resource use in municipalities. Constructing, operating, refurbishing and maintaining public buildings consumes a high level of energy.

Energy efficiency remains a challenge for countries and cities in the UNECE region, and it is essential to address this. High use of energy in buildings is associated with adverse effects on the environment, especially when the production of energy is based on fossil fuels. However, it is estimated that existing technologies can reduce energy consumption by 30 to 50 per cent in buildings without significantly increasing investment costs. Improving the energy performance of housing contributes to increased comfort of living, reduced energy bills alleviating fuel poverty, mitigating GHG emissions, and creating jobs (UNECE, 2018).

In line with the KPI evaluation, the municipality is encouraged to take steps to decrease the levels of energy consumption and to improve the overall sustainability of public buildings. This concerns especially the energy efficiency of old building stock and office buildings, whose life-cycle energy (primary) requirement166 is in the range of 250–550 kWh/m² per year (compared to conventional residential buildings, which have a life-cycle energy (primary) requirement of 150–400 kWh/m² per year).

The municipality is encouraged to work closely with the national government, the business community and academia to develop innovative policy solutions that stimulate a demand for energy savings and energy efficiency. The development of new technologies and

164 Elnaz Namazi, Jingyue Li and Chauro Lu, "Intelligent Intersection Management Systems Considering Autonomous Vehicles: A Systematic Literature Review," *IEEE Access*, vol. 7 (2019), pp. 91946-91965. Available at https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8756239.

165 Urban growth agreements (footnote 22).

166 The life cycle energy (primary) requirement is the assessment of the energy needs of a building throughout its life cycle.

designs that allow the sharing, recycling, refurbishing, re-using, replacing, and digitizing of energy are encouraged, as are passive and active technologies that allow for reducing energy demand during the building's life cycle.

The municipality should also promote initiatives that aim to decrease electricity waste and loss, and work with the national government, the business community and academia to these ends. This could include incentivizing the development and use of energy-efficient and "smart" appliances (whose functioning can be synchronized with consumer behaviour) by households.

- ***Improve solid waste management***

Solid waste treatment and waste collection have a considerable influence on quality of life and the environment. The disposal and treatment of waste not only uses land and energy but has a particularly negative impact on air quality.[167]

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The city is encouraged to carry out "circular actions" to reduce its quantity of waste. These could include actions that promote responsible consumer behaviour, such as avoiding single-use plastics, and waste recycling in such a way that waste emerging as a result of one production process can be used as an input (materials or energy) in another production process. This allows the creation of closed loops, both within and across industries, which, in turn, enhance circularity.

The city should decrease the amount of waste produced[168] and the amount put into sanitary landfills, and collaborate with the national Government, the business community and academia to develop infrastructure and technologies that enable the use of waste for energy generation; and to promote sustainable material cycles, via design control, to ensure a more productive use and reuse of materials.

Lastly, urban safety and security are central elements to smart, sustainable development, and are determined by the effectiveness of services such as the police service, the fire service and medical services. Therefore, the city is encouraged to improve access to, and availability of, these services, and to develop solutions that take into account their delivery speed, especially with the additional challenges posed by the COVID-19 pandemic.

Given the abundance of urban data gathered for the purpose of the evaluation of the performance of Bærum against the KPIs for SSCs, and the determination of the city to achieve the SDGs, the city is encouraged to regularly review the implementation of the 2030 Agenda at the local level.

167 Open dumps emit a significant amount of methane and, when burned, waste contributes to carbon dioxide emissions. Both methane and carbon dioxide are GHGs, the emission of which should be decreased in line with international standards, such as the United Nations Framework Convention on Climate Change (2016).

168 Environment Norway, "Waste", 26 April 2021. Available at https://www.environment.no/Topics/Waste/.

RANA

Part I General overview

The city of Rana is located in the region of Helgeland in Nordland County and is one of the largest municipalities in Norway with a total area of 4,460 km². The Council of Rana is responsible for taking decisions in policy areas such as land use, society and infrastructure projects and development. The Council consists of 37 representatives, elected every four years. The city administration has 1,800 full-time employees.

Rana has 26,000 inhabitants and has long been a home to manufacturing industries. The state-owned Norwegian ironworks was established in the city in the 1950s and contributed to rapid population growth. Between 1946 and 1964, the population of Rana tripled from 9,400 in 1946 to 14,600 in 1955 and 22,500 in 1964. The city is surrounded by national parks, glaciers, agricultural fields, and caves, as well as high and low mountains, fjords, rivers and the Helgeland coast. The climate in Rana allows for skiing in the nearby mountains.

State-owned manufacturing industries had a considerable impact on the development of the city. Since the fall of the industries, more than a hundred businesses have been consolidated into the Mo Industrial Park (MIP). The park includes organizations that are global leaders in "green industry" and that work on such issues as energy efficiency and energy recovery, reduction of emissions into air and water, and the circular economy. Over 30 research and development projects funded within the MIP Sustainability Programme have been carried out on the site of the park.

Rana is a hub for trade, service, leisure, finance, transport and tourism. One of the largest ports in Norway and a number of state institutions, including the National Library and the Norwegian National Collection Agency, are located in the city.

Rana faces the challenges of an ageing population. Although it once had the youngest population in Norway, the number of elderly persons between 1980 and 2020 increased significantly while the number of children aged 6-15 years decreased. Developments such as building a large airport, establishing a battery factory,[169] building a deep-water quay and providing an increased number of educational programmes aim to not only reverse this trend but also to create development opportunities and improve growth and prosperity in the municipality and region.[170]

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

To support the commitment to building a smart and sustainable Rana, in 2019/20 the city was evaluated using the Key Performance Indicators (KPIs) for Smart Sustainable Cities (SSC). The outcome of the data provided by Rana is in the U4SSC Verification Report – Rana, Norway.[171]

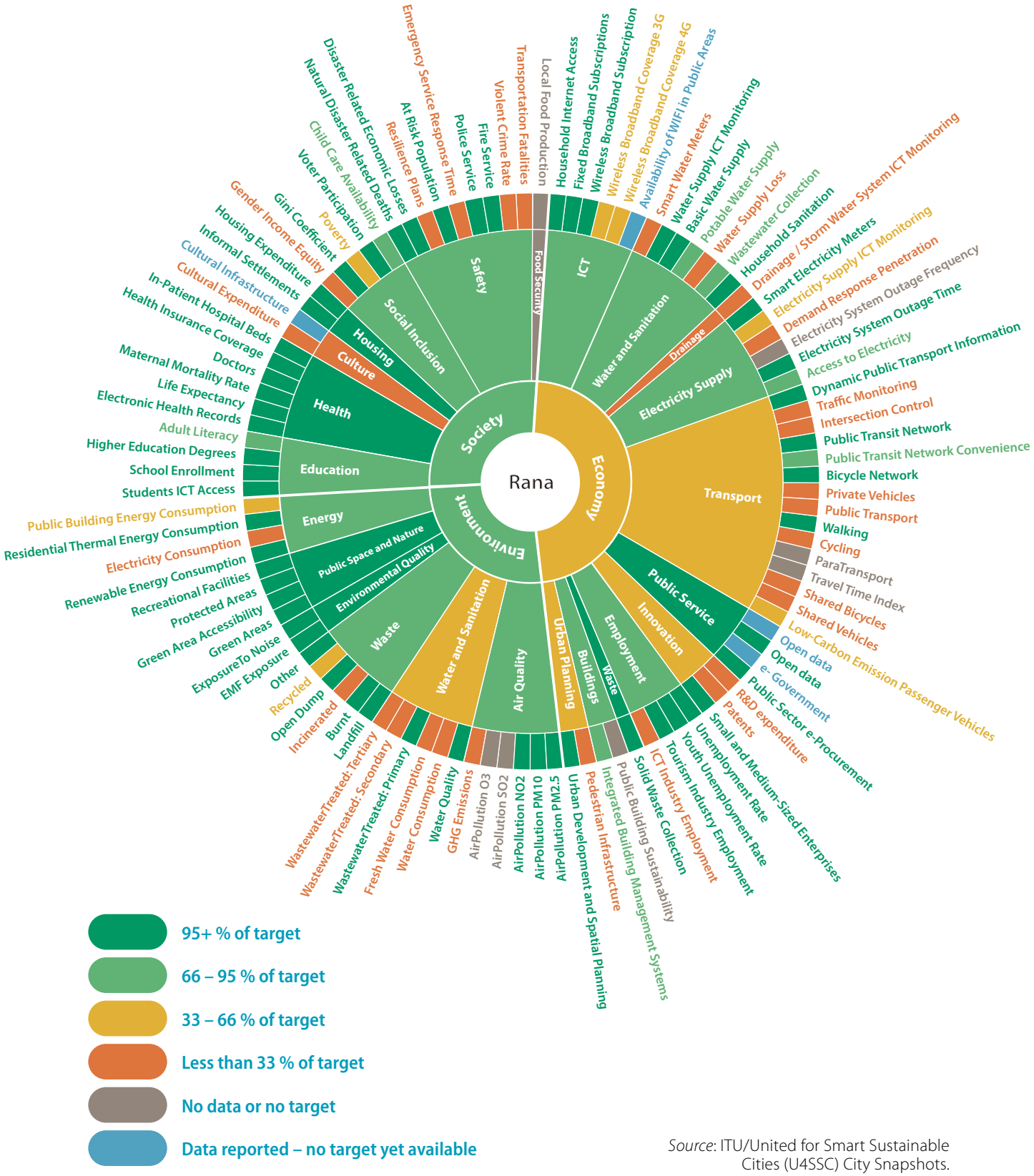
In line with the Verification Report, graph 4 visualizes the performance of the city. This Part outlines the performance of Rana in relation to the three dimensions of the KPIs, and the relevant city actions, with a view to identifying the challenges to, and opportunities for, making Rana smarter and more sustainable.

169 The establishment of a battery factory can provide up to 2,500 more jobs in the municipality. The need for recruitment will be a major task for the community in the years to come.

170 Rana Municipality, *Municipal Master Plan 2017-2027* (Rana, 2021). Available at https://www.rana.kommune.no/vare-tjenester/om-rana-kommune/planer-budsjett-og-reglementer/municipal-master-plan-2017-2027/.

171 International Telecommunication Union, U4SSC, *Verification Report: Rana, Norway* (Geneva, 2020). Available at https://www.itu.int/pub/T-TUT-SMARTCITY-2020-42.

Graph 4 The performance of Rana against the Key Performance Indicators for Smart Sustainable Cities



Source: ITU/United for Smart Sustainable Cities (U4SSC) City Snapshots.

Economy – an overview

The city of Rana plays a key role in initiating and facilitating economic development, both in the city and in the broader region of Helgeland. It develops infrastructure projects that improve regional competitiveness and create green, efficient transport solutions that strengthen the city of Rana and the surrounding region as a hub for business, trade, transport and tourism. Important achievements of the city over recent years include upgrading the European route 6 and European route 12 motorways. The construction of a new airport is expected to strengthen the development of the city and the region in the coming decades.

Rana is the centre for regional hospital services and has recently reorganized the school structure to prioritise high quality education and to prevent students from dropping out in upper secondary school. The city has recently built a new school and a new nursing home. It is also working on the upgrading and maintenance of public buildings, including schools, as well as upgrading and maintaining parks, roads, hiking trails, the water and wastewater systems including a new water supply system for two residential areas and developing a new sewage treatment plant. A regional university campus, student housing, new sport halls and the regional Museum & Science Centre have recently been opened in Rana. The city is also working on the regeneration of three new parks and has recently developed a new seafront recreation area.

The city has made considerable efforts to improve the efficiency of public services and promote the economic development of the city. Digitization, welfare technology and innovation in public services have been important in the most recent development programme and will continue to be so in the period from 2020 to 2024.

The key development priorities of Rana include improving employment levels, innovation output, and the sustainability of buildings, as well as improving public sector services and water and sanitation infrastructure (e.g. it will gradually upgrade the water supply system to reduce water supply loss). The establishment of a battery factory in the city is expected to provide up to 2,500 more jobs. Building a deep-water quay and increasing the number of study programmes at the local campus will also support the economic development of the municipality. In the years to come, Rana will also prioritize a gradual upgrading of the water supply system to reduce water supply loss.

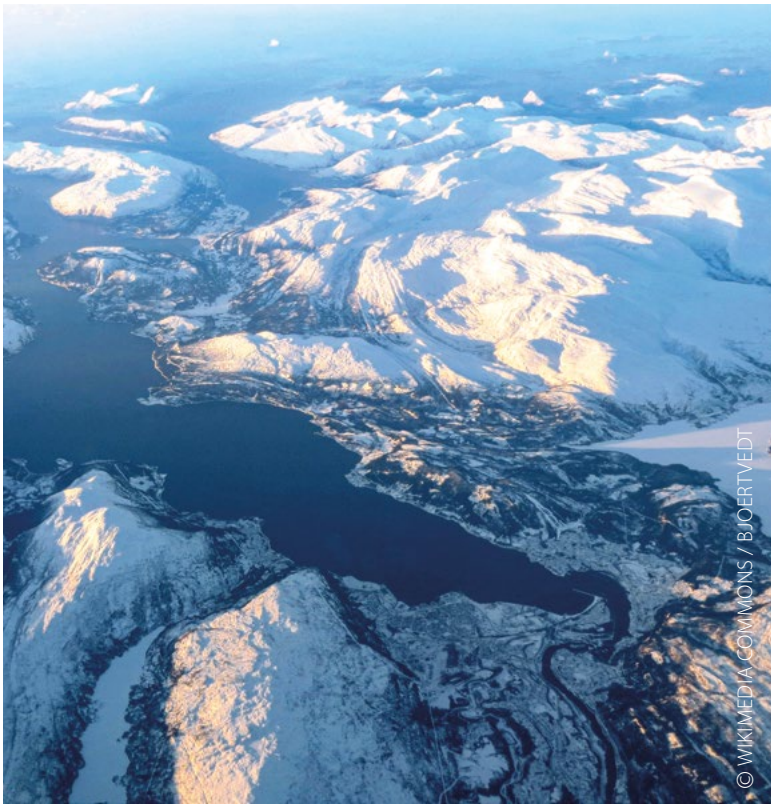
The city aims to further reduce the reliance of inhabitants on private vehicles by ensuring that any growth in the city is matched with an expansion of the public transport infrastructure, thus limiting the need for private vehicles. This particular solution takes the form of an agreed contract between the national government and the municipality.

KPI evaluation results – Economy dimension

The evaluation of Rana revealed an overall positive outlook in relation to the indicators on economy, such as employment levels or access to ICT infrastructure. Unemployment in the city is very low at 1.8 per cent, and youth unemployment is also low at 2.9 per cent. Almost all households (98 per cent) have internet access. The city has a high rate of wireless broadband subscriptions at 144,000 subscriptions per 100,000 inhabitants. While this indicates a high level of accessibility to ICTs, the wireless broadband coverage from 3G and 4G is relatively low at 46 per cent.

On other areas pertaining to the economy dimension of the KPIs, the evaluation showed that citizens have good access to electricity supply and to water and sanitation infrastructure; a reliable waste collection system; and a strong digital public service provision. Access to electricity is relatively high at 87.8 per cent, and the implementation rate of smart electricity metres is very high, as 98.1 per cent of all electricity metres in Rana are smart electricity metres. However, only 42.2 per cent of the electricity supply network is monitored by ICTs. While no data was reported on how frequently electricity outages occur, the average electricity outage lasts for only 33.9 minutes, suggesting a stable electricity connection for the inhabitants.

All Rana households are served with regular solid waste collection. Another well-scoring area is access to public services – 100 per cent of the data sets of the city are publicly available, and many services offered by the city administration are available online, suggesting a high level of transparency in the public sector. A basic water supply and household sanitation are both available to 100 per cent of Rana households, and 100 per cent of its water supply system is monitored by ICTs. Some 90.8 per cent of the water supply in the city meets the WHO criteria for being potable. However, the water supply loss in Rana is very high; 37.1 per cent of water is lost in the water supply network of the city.



On transport infrastructure, evaluation results indicate that the city has an extensive public transport network, with 2,154 km of network per 100,000 inhabitants – for comparison, per 100,000 inhabitants, Paris has only over 200 km of public transport and Belgrade has over 400 km.[172] Inhabitants of the city with very convenient access to this network stands at 79 per cent. Low-carbon emission vehicles make up 3.9 per cent of the vehicles in the city. The bicycle network is similarly extensive, and the highly accessible dynamic public transport information facilitates use of the public transport system. Despite good access to public transport infrastructure, the use of public transport and cycling transport means are both relatively low. Out of the total journeys to work, only 4 per cent are by public transport and 3 per cent are by cycling. The percentage of journeys taken using private vehicles is very high at 71 per cent of the city total. Currently, there is also no scheme for bicycle or vehicle-sharing in the city.

172 This particularly high number is a result of the low population density of Rana being spread out over a large geographic area, necessitating an extensive public transport network.

Environment – an overview

Rana aspires to become a world-class capital of "green" industry. It works together with its inhabitants, industry, and businesses to develop "blue" and "green" infrastructure solutions (i.e., infrastructure that adversely affects neither the sea and ocean nor green spaces and flora) and pursues policies and strategies that address the challenges facing the city in light of extreme weather conditions and climate change.

The Mo Industrial Park uses hydro power as a main source of energy, decreasing the carbon footprint of the site and making it comparatively lower than other global industry sites. The current master plan of Rana envisages a "green" shift, that is, a reorientation of the city development strategies towards making the city climate neutral. It entails the development of climate-friendly solutions for transportation, construction and land use; the reduction of the use of private vehicles; the promotion of the use of electric vehicles; improving public transport infrastructure; and the provision of new pedestrian and cycling routes. The city will also continue upgrading and maintaining city parks and public buildings using sustainable and environmental-friendly materials. Rana is also a global leader in energy storage, and in developing and implementing waste to energy solutions (homes in the city are heated using heat from waste processing). The city is home to Freyr (https://www.freyrbattery.com/), a company that is building next-generation green batteries.

The city launched a programme that aims to reduce air pollution and to improve drinking water quality. The programme entails mapping water recipients to improve water quality in accordance with the requirements of the EU Water Framework Directive.[173] The city established two new parks and redeveloped part of the sea front. Furthermore, the city is constructing energy-friendly primary schools in fossil-free solid wood and in climate-friendly construction sites. To increase waste sorting, it has established a new waste disposal facility, reduced the use of plastic and obtained a new road-sweeper truck to reduce road dust.

In the coming years, the city will prioritize investments in a new sewage treatment plant to upgrade the drinking water pipe infrastructure. It will establish new water supply systems in two residential areas and upgrade the reserve waterworks supply and will use the public procurement rules and climate budget as a tool for inducing investments in sustainable development.

173 European Commission, "The EU Water Framework Directive - integrated river basin management for Europe". Available at https://ec.europa.eu/environment/water/water-framework/index_en.html.

KPI evaluation results – Environment dimension

The performance of Rana in the environment dimension reveals good access and high availability of green areas. Rana has nearly 1.6 million hectares of green space per 100,000 inhabitants and nearly half a million square metres of recreational facilities per 100,000 inhabitants. Some 97.6 per cent of the inhabitants of the city have access to these extensive green spaces.

The percentage of protected natural areas in the city is 91.3 per cent. Concerning air quality, the evaluation points to a low level of PM2.5 and PM10 and NO2 in the city (the levels do not exceed recommended maximum levels). However, no data was provided on the levels of SO_2 and O_3. The GHG emissions in Rana are rather high at 26.9 tonnes of CO_2 equivalent per capita. Regarding energy supply and use, the electricity consumption levels are high at 90,241 kWh per year per capita. The high levels of GHG emissions and electricity consumption likely reflect the energy-intensive nature of the industry of Rana. The energy consumption of public buildings is also relatively high, however 100 per cent of this electricity comes from renewable sources.

On solid waste management, the evaluation demonstrates that none of the solid waste goes to open dumps or is burnt, and very little waste is put into landfills (3.2 per cent of all solid waste). A large proportion of the solid waste in is incinerated (63.3 per cent), and 33.5 per cent is recycled. Finally, on water and sanitation infrastructure, the evaluation points out that drinking water quality in the city is very high and 100 per cent of wastewater receives primary treatment. However, water consumption levels are also high at 462.5 litres per day per capita. The city does not face challenges relating to overexposure to electromagnetic fields, and only 1.43 per cent of the population is regularly exposed to excessive levels of noise.

Society and culture – an overview

The development objectives of Rana focus on improving the quality of life. Over last few years, the city has been working towards the delivery of health-promoting services, facilitation of sport and outdoor activities, investing in new sport halls, upgrading of hiking and skiing trails, and provision of good drinking water quality, all of which have been important achievements. Also, the establishment and upgrading of three new parks and a new seafront in the city are important steps that have been taken for the well-being of the people and public health. The city has also invested in improving the quality of education with a view to preventing students dropping out in secondary schools and to reducing social inequalities.

All the kindergartens and schools in the city are classified as health-promoting kindergartens and health-promoting schools, to promote daily physical activity, social inclusion and access to healthy food. Free and healthy breakfasts and lunches in the upper primary schools have been prioritised. The city has also made attractive cultural activities and meeting places available for all and provided financial support to the foundation "BUA", which lends activity and sport equipment to the city inhabitants free of charge. Last but not least the city has prioritised digital primary school learning; all students are given an iPad for educational use.[174]

In the coming years, the city Rana is planning to further invest in better education, housing provision and safety. The municipality will continue several projects and programmes to promote safe and affordable housing for vulnerable groups. It will encourage the citizens (including new residents) to participate and co-create local initiatives and will establish a "co-creation lab" to improve collaboration and dialogue with businesses, academia and volunteers. Building and upgrading green areas and parks as attractive meeting places will also be prioritized.

174 Rana Municipality, Municipal Master Plan 2017-2027 (20 January 2021).

KPI evaluation results – Society and culture dimension

On the society and culture dimension, the evaluation of Rana demonstrated high scores in areas such as health care, housing provision and education provision. School enrolment in the city is at 99.5 per cent, all students in schools have access to ICTs, and over one third of the city residents hold a university degree.

Another area of very high performance relates to health-care provision. Residents of the city benefit from a universal health-care coverage, have good access to doctors, and the availability of hospital beds is high. These can explain the high life expectancy of 81.2 years and the zero recorded maternal deaths during childbirth in the city.

In addition to education and health care, the housing situation of the municipality is very strong, as only 0.05 per cent of the population live in any sort of inadequate housing and only 15 per cent of income is spent on housing on average.

There are also suggestions of strong socio-economic inclusion in Rana, as the municipality has a very low Gini coefficient of 0.2 (indicating a low level of economic disparity between the wealthiest and the least wealthy). Voter participation is high, with 63.3 per cent of eligible voters having participated in the most recent elections. Additionally, just under 80 per cent of pre-school aged children have access to day care facilities. There are also some suggestions of strong performance in the area of safety; none of the population lives in disaster-prone areas and the fire service is very well-staffed at 128.9 fire service officers per 100,000 inhabitants.

However, the areas of social inclusion and safety (of the society and culture dimension) also showed weak performance in some respects. The KPI evaluation suggests that gender income disparity is an issue, as females earn 26 per cent less than what males earn. Moreover, while the figure is relatively low, it is worth noting that 2.8 per cent of the population lives in poverty. The safety category showed some areas which are less well performing. The average emergency service response time is long at 16.7 minutes and the rates of violent crimes and traffic fatalities are relatively high at 950 per 100,000 inhabitants and 8 per 100,000 inhabitants, respectively. However, due to the way crimes are recorded in Norway (each individual instance of violence is recorded as a separate case and cases that did not go to prosecution are included in the count), the actual violent crime rate may be lower.

Finally, Rana currently does have resilience plans in place, but they do not comply to the Sendai Framework for Disaster Risk Reduction. When the plans are next reviewed, the municipality will ensure that they are guided by this framework.

Part III Funding and financing for urban development

Local governments that balance their budget are allowed to borrow in order to finance capital expenditure. Local governments that have not balanced their budget must follow special approval processes by the county governor or the Ministry of Local Government and Modernisation in order to borrow.[175]

In 2019, Rana had a 5 per cent net operating surplus (as a percentage of gross operating revenues). In fact, every year for the past five years, Rana has had a positive net operating surplus – 5.5 per cent in 2018, 4.9 per cent in 2017, 6.3 per cent in 2016, and 7.1 per cent in 2015.[176]

The 2020 budget for Rana set aside a budget of NOK 1.6 billion for the provision of municipal services, of which 7 per cent was dedicated to support services, 36 per cent was dedicated to education and culture, 37 per cent was dedicated to health care, 3 per cent was dedicated to labour and welfare services, 12 per cent was dedicated to technical services, and 3 per cent was dedicated to projects on public spaces.[177] Rana was approved to borrow up to NOK 297.6 million in order to finance municipal investments.[178]

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Rana has identified a range of challenges which constrain the funding and financing for urban development. These include the inconsistent financial transfers from the national budget to the local budget, as they constrain planning for the delivery of municipal infrastructure and services, and the additional spending incurred by building a new airport. Therefore, upgrading and maintenance to sustainable standards of roads, municipal buildings, water and wastewater system, residential areas and parks poses a financial challenge for the municipality. Measures to prevent increased exposure to extreme weather, landslides and damages from floods present challenges in funding and financing sustainable development. Added to these, digitization of municipal services is also a financial challenge.

Some of the key achievements of Rana on funding and financing sustainable development are the plans to establish a new hospital structure in the region, and the establishment of new large airport and battery factory. Further key achievements include building a new seafront in the city; upgrading parks and recreation areas; investing in new sport halls, gaining a road-sweeper truck and fire engine; upgrading schools, building a new nursing home and a new school; developing measures to improve environmental status in the fjord; and upgrading of public buildings and the water and wastewater system.

175 United Cities and Local Governments and Organisation for Economic Co-operation and Development, "Country Profiles: Norway", Subnational Governments Around the World (October 2016). Available at https://www.oecd.org/regional/regional-policy/sngs-around-the-world.htm.

176 Norway, Statistics Norway, "Municipal accounts - table 12134: Financial key figures for municipalities (M) 2015 - 2020", StatBank. Available at https://ssb.no/en/statbank/table/12134 (accessed on 15 June 2021).

177 Rana Municipality, "Plans, budgets and regulations". Available at https://www.rana.kommune.no/vare-tjenester/om-rana-kommune/planer-budsjett-og-reglementer/.

178 Ibid.

Part IV Recommendations

With over 26,000 inhabitants, Rana is the third largest city in northern Norway and a centre of industry in the region. The implementation of the 2030 Agenda and accelerating progress towards the achievement of SDGs is a key priority for the city as it invests considerable resources in developing its innovation base, improving social cohesion and decreasing its environmental footprint.

Over the last decade, Rana has effectively developed and used ICTs to leverage progress towards sustainable development. It restructured and digitalized public services and made improvements to transport and infrastructure, with a view to becoming a hub for business, trade, transport and tourism. The construction of a new airport is expected to bring new visitors and businesses to the city and to the region.

Rana aspires to become a world-class capital of "green industry". It has wide-reaching plans to reduce reliance on private vehicles powered by fossil fuels, to encourage use of public transport, to improve pedestrian and cycling infrastructure, to improve the system of air quality monitoring and many others. Rana runs several projects and programmes to promote safe and affordable housing for vulnerable groups, and it has upgraded hiking and skiing trails in order to facilitate outdoor sports. In recent years, focus has been given to assuring high quality education and to preventing dropouts in secondary schools, primarily through early intervention.

The outcomes of the evaluation of Rana against the KPIs for SSC are presented in the U4SSC Verification Report – Rana, Norway. Based on the verification report and the review of documentary data, including information provided by the city, Rana is recommended to:

- ***Improve water, sanitation and drainage infrastructure***

Addressing the unsustainable consumption of natural resources is a prerequisite for the successful implementation of the 2030 Agenda in the UNECE region and is one of the key principles of urban management in the twenty-first century and the circular economy. It requires cities to take decisive action to develop and implement urban policies and solutions that promote sharing, recycling, refurbishing, re-using, replacing, and digitizing the use of natural resources.

Water is one of the key natural resources of Rana. The quality of water and the efficiency and effectiveness of water and wastewater infrastructure and facilities have a considerable impact on the quality of life and the environment in the city. As the evaluation indicated a need to decrease the loss of water from the supply system, the city is encouraged to develop and implement solutions that will improve the efficiency of water and sanitation infrastructure and extend its lifespan. The high level of water supply loss is one contributing factor to the high level of water consumption in the city. Rana is encouraged to further invest in the ICT monitoring of its urban water networks, by introducing more smart water metres and setting up a drainage and storm water ICT monitoring system, in order to improve the efficiency of water management in the city. Last but not least, the city is also encouraged to further engage with residents and to work with planners to decrease the use of water resources by households, and to develop designs that facilitate, for instance, the recycling of water (U4SSC, 2020). These design choices may include a water system that only draws on natural water resources to the extent that they can be regenerated, uses standardized pipes and metres to ensure that equipment can be swiftly and easily replaced, and shares infrastructure across sectors, for example telecommunications companies using draining trenches for fibre-optic internet cable.

- ***Improve sustainability of public buildings and decrease energy consumption***

Improving the sustainability of public buildings also improves the quality of the natural environment and the quality of life in cities. Buildings account for a significant proportion of GHG emissions and resource use in a city. Developing, operating, refurbishing and maintaining public buildings consumes a high level of energy.

The high use of energy in buildings is associated with adverse effects on the environment, especially when the production of energy is based on fossil fuels. Improving the energy performance of housing contributes to an increased comfort of living and reduced energy bills, and more broadly, it alleviates fuel poverty and mitigates GHG emissions while creating jobs (UNECE, 2018).

In line with the KPI evaluation, the city is encouraged to take steps to decrease the levels of energy consumption and to improve the overall sustainability of public buildings. This concerns especially the energy efficiency

of the old building stock and office buildings, the life cycle energy (primary) requirement[179] of which is in the range of 250–550 kWh per m2 per year (in comparison to the conventional residential buildings, which have a life cycle energy primary requirement of 150–400 kWh per m^2 per year).

Rana is encouraged to work closely with the national Government, the business community and academia to develop innovative policy solutions that stimulate a demand for energy savings and energy efficiency. This concerns especially the development of new technologies and designs that allow sharing, recycling, refurbishing, re-using, replacing, and digitizing of the use of energy, on the one hand, and passive and active technologies that allow the reduction of energy demand during the building's life cycle, on the other hand.

Rana should also promote initiatives that aim to decrease electricity waste and loss, and work with the national Government, the business community and academia to this end. This could include incentivizing the production and use of energy-efficient and "smart" appliances (whose functioning can be coordinated with consumer behaviour) by households.

- ***Improve access to public transport infrastructure***

A well-designed and efficient public transport system is the backbone of sustainable and smart urban development. It prompts equal distribution of the economic benefits of urbanization and facilitates the reduction of socio-economic inequalities in cities. Over recent decades the development of transport infrastructure has benefitted from access to innovative ICT technologies and solutions, which help provide public transport information in a more dynamic way, including better traffic monitoring, intersection control, and the development of intelligent intersection management systems in cities.[180]

The evaluation of Rana against the KPIs for SSC reiterates the city priorities to further invest in transport infrastructure, especially to improve traffic monitoring and to increase the share of low carbon emission passenger vehicles (currently at 3.3 per cent of all vehicles). It is also important to improve the modal split share, including increasing journeys made by public transport and cycling while reducing the number of journeys done by private vehicle. This requires taking into account a range of factors: the costs of owning, driving and parking private vehicles, as well as the quality and cost of alternative transport modes such as public transport and cycling, to develop relevant solutions.

- ***Improve solid waste management***

Solid waste treatment and waste collection have considerable influence on quality of life and the environment. The disposal and treatment of waste not only consumes land and energy but has a particularly negative impact on air quality.[181]

The city is encouraged to carry out "circular actions" to reduce the quantity of waste in cities. These can include actions that promote responsible consumer behaviour such as avoiding single-use plastic, and promote waste recycling in such a way that waste emerging as a result of one production process can be used as an input (materials or energy) to another production process. This allows the creation of closed loops both within and across industries, which in turn enhances circularity in cities.

The city should decrease the amount of waste put into sanitary landfills and collaborate with the national government, business community and academia to: (i) develop infrastructure and technologies that enable the use of waste for energy generation; and (ii) promote sustainable material cycles via design control to ensure a more productive use and reuse of materials.

179 Life cycle energy (primary) requirement is the assessment of the energy needs of buildings throughout its life cycle.

180 Elnaz Namazi, Jingyue Li, and Chaoru Lu, "Intelligent Intersection Management Systems Considering Autonomous Vehicles: A Systematic Literature Review," *IEEE Access*, vol. 7 (8 July 2019), pp. 91,946-91,965. Available at https://doi.org/10.1109/ACCESS.2019.2927412.

181 Open dumps emit a significant amount of methane and, when burned, waste contributes to carbon dioxide emissions. Both methane and carbon dioxide are greenhouse gases, the emission of which should be decreased, in line with international standards such as the United Nations Framework Convention on Climate Change (2016).

Finally, urban safety and security are central elements to smart and sustainable development and are determined by the effectiveness of services such as the police service, fire service and medical services. Therefore, the city is also encouraged to improve the access and availability of these services and to develop solutions that take into account their delivery speed, especially considering the additional challenges posed by the COVID-19 pandemic.

As importantly, given the abundance of urban data gathered for the purpose of the evaluation of the performance of Rana against the KPIs for SSC, and the determination of the city in achieving the SDGs, the city is encouraged to review regularly the implementation of the 2030 Agenda for Sustainable Development at the local level.

TRONDHEIM

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 sites 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 NTNU, the largest university in Norway, 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[182] and the county of Trøndelag 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, cafes 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.

182 Greater Trondheim, also known as the Trondheim Region, is a group of municipalities surrounding and including Trondheim, in the Trøndelag County.

In 2019 Trondheim was recognised by the Ministry of Local Government and Modernisation[183] 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"[184] was created. Furthermore, Trondheim was recognised and awarded status as a Geneva UN Charter Centre of Excellence on SDG City Transition by UNECE, also in 2019. The Trondheim Centre of Excellence was created on 1 October 2019 to support the transition of the 56 UNECE members towards smarter, more sustainable and attractive societies.

183 Norway, Ministry of Local Government and Modernization, "Congratulations to Trondheim - this year's winner of the innovation award", press release, 7 June 2019. Available at https://regjeringen.no/no/aktuelt/gratulerer-til-trondheim--arets-vinner-av-innovasjonsprisen/id2660969/ (accessed on 13 November 2020).

184 This is a holistic innovation approach to unravel new ways of becoming a city, using the greater region of Trondheim as a playground. Together with NTNU the city demonstrates and documents ways of speeding up our transition towards a smarter, more sustainable and attractive society.

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

To support the commitment to building a smart and sustainable Trondheim, in 2019/2020 the city was evaluated using the KPIs for SSC. The KPI values were verified by Trondheim and the outcomes of the data verification are presented in the U4SSC Verification Report of Trondheim, Norway.[185]

In line with the Verification Report, graph 5 visualizes the performance of the city against the KPIs for SSC. This part of the study outlines the performance of the city in relation to the three dimensions of the KPIs and the relevant city actions, with a view to identifying the challenges to and opportunities for, making Trondheim smarter and more sustainable.

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.[186] 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).[187]

Despite a very positive outlook, the city continues developing and implementing initiatives for economic development. The "Strategic Business Development Plan for Greater Trondheim", established at the regional level with neighbouring municipalities and the Trøndelag County Council[188] focuses on promoting innovative approaches and tools for public procurement,[189] and nurturing innovation by supporting entrepreneurs and their start-ups.[190] 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 nearly 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 3.0programme.[191]

185 International Telecommunication Union, *U4SSC Verification Report: Trondeim, Norway* (Geneva, September 2020). Available at https://www.itu.int/en/ITU-T/ssc/united/Documents/U4SSC%20Publications/Verification%20Reports/September%202020/U4SSC_Trondheim-Norway_Verification_Report.pdf?csf=1&e=eKrauA.

186 Startup Trondheim (https://startuptrondheim.no/ (accessed on 13 November 2020)).

187 Britannica, The Editors of Encyclopedia, "Trondheim", *Encyclopedia Britannica*, 18 July 2018. Available at https://britannica.com/place/Trondheim (accessed on 13 November 2020).

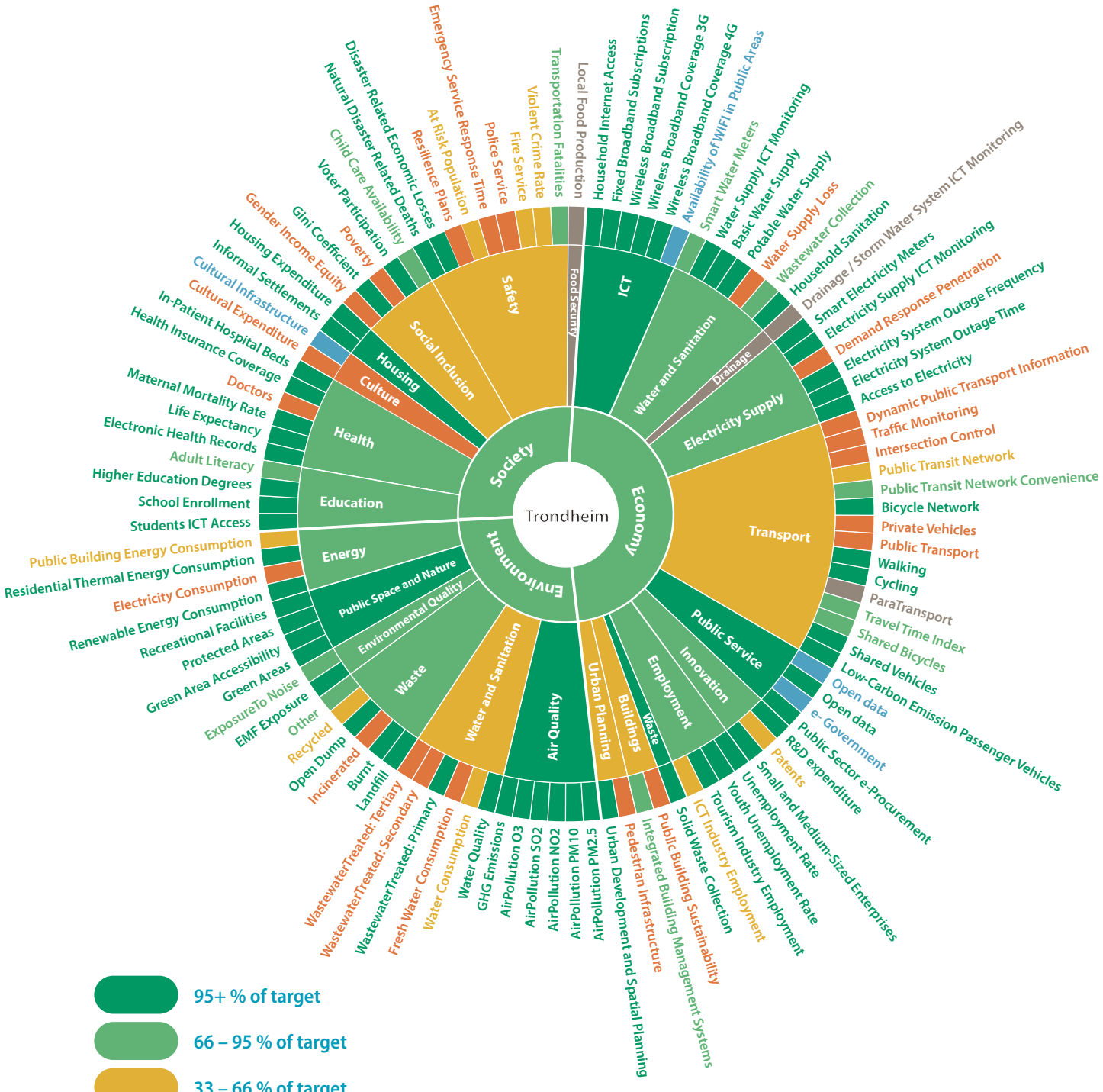
188 Trøndelag County Authority, *Value Creation in Trøndelag: Strategy for innovation and value creation in Trøndelag*, 14 December 2017. Available at https://trondelagfylke.no/contentassets/b91afe6250b342e9b2d73dc270993796/strategy-for-innovation-and-value-creation-in-trondelag.pdf (accessed on 13 November 2020).

189 Trondheim Municipality, "Procurement Strategy for Trondheim Municipality 2018-2023", 13 December 2018. Available at https://trondheim.kommune.no/globalassets/10-bilder-og-filer/09-finans/innkjopstjenesten/anskaffelsesstrategi-2018---2023-2.pdf (accessed on 13 November 2020).

190 Trondheim Municipality, "Trondheim Municipality's Strategy for Innovation and Entrepreneurship", 25 August 2016. Available at https://trondheim.kommune.no/globalassets/70-admin/english/trondheim-municipality---trondheim-nordic-city-labs.pdf (accessed on 13 November 2020).

191 For more information, see https://sites.google.com/trondheim.kommune.no/universitetskommunen/hjem (accessed on 13 November 2020).

Graph 5 The performance of Trondheim against the Key Performance Indicators for Smart Sustainable Cities



Source: ITU/United for Smart Sustainable Cities (U4SSC) City Snapshots.

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 was given to Trondheim in recognition of its holistic approach to developing innovation and its partnership.

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 platforms to bring people together around upcoming funding opportunities and policy developments. This also serves to help Trondheim attract, retain and develop talented people.

Cooperation between a city and its universities is highly beneficial for the innovation ecosystem[192] and opens multiple knowledge pools for addressing areas of mutual interest such as local housing.[193] 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.[194]

192 Helsinki, "Examples of university cooperation", 22 January 2020. Available at https://hel.fi/helsinki/en/administration/enterprises/competitive/university-collaboration/university-cooperation (accessed on 13 November 2020).

193 British Council, "Mutual influence? Universities, cities and the future of internationalisation", *Institutions and Internationalisation* (England and Wales and Scotland, 2017). Available at https://www.britishcouncil.ie/sites/default/files/mutual_influence_universities_cities_report.pdf (accessed on 13 November 2020).

194 Jukka Kola, Productive co-operation between university and city in Turku, presentation at Coimbra Group workshop "Universities as driving forces for change in regions and cities", Brussels, 8 October 2019. Available at https://coimbra-group.eu/wp-content/uploads/Productive-cooperation-univ-and-city-in-Turku-KOLA.pdf (accessed on 13 November 2020).

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 (https://greenflyway.se/about-green-flyway/index.html) was opened. Trondheim works with other cities in Norway, most notably within the Smart City Network (https://sites.google.com/trondheim.kommune.no/smartbynettverket/forsiden), 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 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, and sensors mounted on the fleet of service vehicles of the city to measure air quality. 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.[195] It is also part of The National Programme for Supplier Development – a driving force to increase use of innovative procurement and facilitate practical assistance that increases the innovation effect of public procurement in Norway.

KPI evaluation results – Economy dimension

The evaluation of the city performance 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 per cent of its businesses are small and medium-sized enterprises, thus showing a very strong performance in this area.

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 per cent of it is recycled. The electricity supply is universal and widely monitored using smart electricity metres (98.6 per cent of electricity metres in Trondheim are smart metres). 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 average.

On water and sanitation infrastructure, the water supply and the supply of potable water are at 96.7 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 (93.7 per cent of households are served by wastewater collection). The amount of water metres that are "smart" (88.9 per cent), and very high water supply loss at 28.42 per cent indicate 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 work 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 to work 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.

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195 Innovative Procurements (http://innovativeanskaffelser.no/about/).

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 (Trondheim Municipality, 2017) include: i) zero emission construction sites; ii) mobility and transportation; and iii) carbon capture and storage. 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" (https://miljopakken.no/om-miljopakken/about-miljopakken) 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 Railway Services. "Greener Trondheim" is essentially a contract between the local and national government that aims to keep the number 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 to reduce 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 (EUR 2.34 billion).

Trondheim, in collaboration with NTNU and the Limerick City and County Council, is the lead city of the +CityxChange – Positive City Exchange (https://cityxchange.eu/) project that was granted funding from the European Union Horizon 2020 research and innovation programme in the call for "Smart cities and communities". Within this 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 CO_2 per capita (lower than Helsinki at 7.4 tonnes per capita, Paris at 7.7 tonnes per capita, and Berlin at 10.4 tonnes per capita).[196]

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 the quality of life. The city has no problem with electromagnetic field (EMF) exposure; however, the percentage of city inhabitants regularly exposed to excessive noise levels is slightly high at 44.9.

On energy use and waste management,[197] 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 level of water consumption is high at 230 litres per day per capita, and there is also a high degree of water loss from the water distribution system (28 per cent).[198]

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: i) a new strategy for education and social inclusion called "Rock Scissors Paper";[199] ii) a programme for crime prevention among youth; and iii) two public health programmes - "Friskliv og mestring" (Healthy Living and Coping) and "Hverdagsrehabilitering" (Everyday Rehabilitation).

196 City Carbon Footprints, Global Gridded Model of Carbon Footprints (GGMCF). Available at http://citycarbonfootprints.info/ (accessed on 13 November 2020).

197 Trondheim Renholdsverk provides waste collection services for all private households in Trondheim (https://trv.no/sorting-tables/information-in-english/).

198 Trondheim is exempt from secondary or tertiary water treatment due to a high quality of water.

199 For more information on this strategic document, see https://trondheim.kommune.no/globalassets/10-bilder-og-filer/02-skoler/skoler-p-a/stavset-skole/stein-saks-papir-strategidokument.pdf, and at https://steinsakspapir.org/ (accessed on 13 November 2020).

In the same year, the city adopted a new strategy for citizen engagement[200] and a series of guidelines stating that: i) citizen involvement should take place locally, based on local context and conditions; ii) dialogue with citizens should be considered in city planning, management system and budget process; and iii) the city must have a greater presence in digital spaces, as well as physical arenas. In the policy, "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. The strategy was adopted to pre-emptively address issues that could potentially impact the youth population, such as radicalization, human trafficking and prostitution. The strategy involves identifying individuals at risk and their families.[201]

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. 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 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, the provision of affordable housing and the education system showed very strong performance. The percentage of the population living in adequate housing is 99.9 per cent and the average percentage of income that inhabitants spend on housing is low at 16.3 per cent. School enrolment is at 100 per cent and all students have access to ICTs. Correspondingly, adult literacy at 94.8 per cent and the presence of higher education degrees in the population are high.


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200 For more on what is happening in Trondheim regarding citizen engagement, see https://sites.google.com/trondheim.kommune.no/communityxchange/trondheim?authuser=0 (accessed on 13 November 2020).

201 Trondheim Municipality, "SLT (Coordination of Local Crime prevention Measures)". Available at https://trondheim.kommune.no/slt/ (accessed on 13 November 2020).

All inhabitants of Trondheim are covered by health insurance and almost all health records are kept electronically. Life expectancy is very high at 81.7 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 health care that performed not as well in the evaluation is the number of doctors in the city; there are only 87.8 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 65.9 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.[202]

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 are 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 and for comparison, Copenhagen had 324 incidents per 100,000 in 2019.[203]

202 This KPI refers to the number of persons living below "poverty line" in Trondheim (Statistics Norway, https://ssb.no/a/metadata/conceptvariable/vardok/3365/en (accessed on 13 November 2020)).

203 Statistics Denmark. "Criminal offences". Available at https://dst.dk/en/Statistik/emner/levevilkaar/kriminalitet (accessed on 13 November 2020).

Part III 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,[204] 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, and threats) analysis[205] 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 high 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.

204 KS (https://ks.no/).

205 SWOT analysis is the process of identifying the strengths, weaknesses, opportunities and threats of a project.

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. 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 is 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 Charter Centre framework, cities that were evaluated against the U4SSC KPIs moved from data to policy, planning and impact.

In 2019, Trondheim had a 3.7 per cent net operating surplus (as a percentage of gross operating revenues). Every year for the past five years, Trondheim has had a positive net operating surplus (Norway, Statistics Norway, 2020a) – 1.8 per cent in 2018; 4.8 per cent in 2017; 5.2 per cent in 2016; and 3.1 per cent in 2015.

The approved operating budget for 2020 is NOK 16.6 billion, and the approved investment budget is NOK 10 billion in the period 2020-2023.[206] The municipality earmarked NOK 210 million to cover additional expenses and to compensate for a lower income as a result of the coronavirus pandemic during the first half of 2021.[207] The municipality predicts that the 2021 budget will have a net operating surplus of 0 per cent, and an overall net operating surplus of 1 per cent in the period 2021-2024. The low net operating surplus is related both to expected lower returns from the power fund of Trondheim, and to higher expenses due to the Covid-19 pandemic.[208]

206 Trondheim Municipality, "Adopted action and financial plan 2020-2023: Budget 2020". Available at https://sites.google.com/trondheim.kommune.no/vedtatt-handlings-og-konomipla/innledning.

207 Trondheim Municipality, *The municipal director's proposal for action and financial plan 2021-2024: Budget 2021*. Available at https://trondheim.kommune.no/globalassets/10-bilder-og-filer/11-politikk-og-planer/budsjettdokumenter/m1605-nett.pdf.

208 Ibid.

Part IV Recommendations

The city of Trondheim has made considerable progress towards the implementation of the 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 - an award-winning partnership for sustainable transport.

Improving the quality of life by addressing social inclusion remain a priority for the city. In 2019, 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 Modernization.

Trondheim was evaluated against the KPIs for SSC in 2019/2020. The outcomes of the evaluation are presented in the U4SSC Verification Report of Trondheim, Norway. 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.

In light of the transition towards more climate-neutral and efficient public transport infrastructure, Trondheim has some notable practices: i) the establishment of contracts between the national government and local governments that aim to decrease the number of cars in a city; and ii) the use of innovative methodologies that link land use and transport planning to evaluate and improve the accessibility of areas by different modes of publictransport.[209]

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.

209 UNECE, "UNECE Handbook on Sustainable Transport and Urban Planning," Draft guide (12 April 2019), p. 96. Available at https://thepep.unece.org/sites/default/files/2019-04/UNECE%20Handbook%20on%20Sustainable%20Transport%20and%20Urban%20Planning%20draft%20April%202019%20reduced.pdf.

- ***Improve water and sanitation infrastructure***

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.[210] 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 (U4SSC, 2020).

- ***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 or limited access to urban and public services and infrastructure (justice, housing, water, sanitation, education and health services), decreased intergenerational mobility[211] 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: i) improving the inclusion of vulnerable groups: immigrants, families with children, single parents and unemployed citizens, into the society and economy; and ii) 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.

210 The city has prepared a Municipal Plan for Water in Trondheim (https://www.trondheim.kommune.no/aktuelt/kunngjoring-arealplan/arkiv-igangsatt-planarbeid/Planprogram-pa-hoering_Kommunedelplan-Vann-i-Trondheim_2021-2032/).

211 Intergenerational mobility measures "the extent to which children's labour market outcomes are independent of the outcomes of their parents". For more information, see https://ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_649496.pdf.

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International Organization for Standardization, https://www.iso.org/home.html.

KS, https://ks.no/.

Nordic Ecolabelling, https://www.nordic-ecolabel.org/.

Principles for Responsible Investments, https://www.unpri.org/pri/what-are-the-principles-for-responsible-investment.

Smartcity Bærum, https://smartcitybaerum.net/om/.

Startup Trondheim, https://startuptrondheim.no/.

TRD 3.0, https://sites.google.com/trondheim.kommune.no/universitetskommunen/hjem.

Other resources

For more information on improving water and sanitation infrastructure, please see: *A Guide to Circular Cities* (U4SSC, 2020); and *Guide to Implementing the Water Convention* (UNECE, 2013).

Further information on improving urban safety can be found in the guidelines *Governing Safer Cities: Strategies for a Globalised World* (UNODC, 2016).

More information on ways to address social inequalities can be found in *Geneva UN Charter on Sustainable Housing* (UNECE, 2015).

For more information on strategies to improve mobility and transport in the city, please see: *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); and *Case-Based Reasoning for Improving Traffic Flow in Urban Intersections (Kofod-Petersen, Anderson, and Aamodt)* (Cham: Springer International Publishing, 2014), p. 215.

Smart Sustainable Cities Profiles

Ålesund, Asker, Bærum, Rana and Trondheim – Norway

This publication contains the five "Smart Sustainable Cities" Profiles of the cities of Ålesund, Asker, Bærum, Rana and Trondheim in Norway.

As part of the UNECE project "Improved Sustainable Urban Development in 17 Norwegian Cities", smart sustainable city profiles for five Norwegian cities were developed based on evaluation of their performance against the Key Performance Indicators for Smart Sustainable Cities of the United for Smart Sustainable Cities (U4SSC) initiative, in 2019/20.

This publication presents the efforts of Ålesund, Asker, Bærum, Rana and Trondheim to reinforce the implementation of the 2030 Agenda for Sustainable Development. It provides information on the policies, programmes, projects and partnerships of the cities that accelerate progress towards achieving the Sustainable Development Goals (SDGs). It also contains recommendations that will further improve progress of these cities in achieving the SDGs.

For more information on the Norwegian project and the U4SSC Key Performance Indicators for Smart Sustainable Cities, you may visit our website at https://unece.org/housing/norwegian-project.

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