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Nordic cities: pathways towards climate neutrality

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Aarhus. Photo: Kasper Hornbaek/Science museerne

EXECUTIVE SUMMARY

This report is the culmination of the Nordic Climate Neutral Cities (NCNC) project, which examines how cities in the Nordic Region are striving to achieve climate neutrality through spatial planning. Funded by the Nordic Council of Ministers, the project ran from 2021 to 2024 in the scope of the Nordic Thematic Group for Green and Inclusive Urban Development (TGA).

Based on a multilevel governance approach and in-depth analysis of nine case studies – Aarhus and Vejle (Denmark), Tampere and Oulu (Finland), Reykjavík (Iceland), Trondheim and Kristiansand (Norway) and Lund and Växjö (Sweden) – the report provides new insights into governance challenges, financial constraints, regulatory barriers and spatial planning trade-offs. The report also highlights Nordic cities' leadership, strong climate commitments and innovative local solutions. The findings underscore the need for improved governance coordination, stronger financial support and policy adjustments to accelerate climate action.

While Nordic cities have demonstrated strong commitment to sustainability, they also often grapple with outdated national regulations that limit their ability to implement ambitious climate policies. In Denmark, for example, Aarhus and Vejle face obstacles due to restrictive national building codes and a lack of road pricing mechanisms to reduce emissions. Similarly, Trondheim in Norway is struggling to introduce zero-emission zones due to legal barriers. Financing green/sustainable initiatives poses another challenge. While state funding is crucial for large-scale sustainable projects, it is often considered inadequate for local governments. Cities such as Växjö in Sweden and Oulu in Finland find it difficult to secure financial support for sustainable transport and green construction. In Iceland, Reykjavík's reliance on national funding complicates efforts to implement major climate-friendly infrastructure.

Urban development presents additional hurdles. Balancing densification with environmental conservation is a common challenge across the region. Lund in Sweden emphasises a compact urban form but faces pressure to preserve green spaces. In Finland and Norway, greenfield developments involve sustainability trade-offs, while local preferences for detached housing complicate densification efforts. In the buildings sector, one issue is that regulations on energy requirements mainly apply to new construction and public buildings, while the energetic retrofitting of the existing housing stock remains a matter of private initiative, as in Norway. Finally, in the transport

sector, despite strong cycling and public transport networks, car reduction policies remain politically sensitive in several Nordic municipalities. Cities across the region struggle to implement effective car-reduction measures due to public resistance and national policy gaps.

On the other hand, the analysis shed light on several strengths. Nordic cities benefit from well-established sustainability policies, robust climate expertise and a high level of local political commitment. Cities like Växjö are leaders in sustainable wood construction, while Aarhus actively advocates for more stringent national climate regulations. In addition, the Nordic Region is a global leader in green technology and energy solutions. Iceland's renewable geothermal energy potential, Sweden's investments in sustainable construction materials and Finland's smart mobility solutions present scalable opportunities for climate-neutral urban development. Furthermore, many Nordic cities are embracing densification and a transit-oriented development approach to reduce emissions, investing in compact, well-connected urban structures and integrating housing with sustainable transport options to lower car dependency. Finally, public initiatives such as participatory planning and citizen-driven sustainability programmes create local momentum for progressive climate policies.

Against this backdrop, this report offers new insights into the challenges, strengths and opportunities of Nordic cities in their climate efforts. It also highlights future measures for local, regional and national governments to take. Key takeaways for action include:

- **Strengthen multilevel governance:** Enhance alignment between vertical and horizontal levels of governance to combat siloed thinking, reduce inefficiencies and ensure cohesive strategies for climate action.
- **Prioritise public engagement:** Future efforts should focus on engaging the public through targeted communication campaigns to raise awareness and inspire behavioural change. Helping citizens understand the benefits of sustainable choices can increase support for bold policies.
- **Boost mobilisation for climate efforts:** Strengthen climate networks and cross-sectoral collaboration to help local governments and stakeholders align their policies with climate ambitions, fostering a unified approach to sustainability.
- **Expand taxation and regulatory frameworks:** Introduce mechanisms to hold polluters accountable by implementing fees and regulatory instruments that reflect the true environmental cost of emissions. Such measures can generate revenues to fund sustainable projects while incentivising greener practices.
- **Harmonise emissions calculations:** Standardise emissions calculations across Nordic countries to ensure consistency, transparency and comparability in tracking progress. Such alignment will also foster cross-border collaboration, policy coherence and effective allocation of resources towards the goal of climate neutrality.

Overall, achieving climate neutrality will require Nordic cities to unite the efforts of diverse stakeholders, align frameworks and incentives with a shared vision, address knowledge gaps and collaborate closely with other levels of government.



Aarhus. Foto: Kasper Hornbæk/Science museerne

SAMMENDRAG

Denne rapporten oppsummerer prosjektet *Nordic Climate Neutral Cities* (NCNC), som har undersøkt hvordan nordiske byer arbeider for å oppnå klimanøytralitet gjennom arealplanlegging. Prosjektet ble gjennomført i perioden 2021–2024 med støtte fra Nordisk ministerråd, og inngår i det nordiske tematiske samarbeidet for grønn og inkluderende byutvikling (TGA).

Med utgangspunkt i prinsipper for flernivåstyring er det gjennomført ni dybdeanalyser av byer i Norden: Aarhus og Vejle (Danmark), Tampere og Oulu (Finland), Reykjavík (Island), Trondheim og Kristiansand (Norge), samt Lund og Växjö (Sverige). Basert på disse analysene gir rapporten innsikt i styringsutfordringer, økonomiske rammebetingelser, juridiske barrierer og sentrale avveininger knyttet til klimanøytralitet og arealplanlegging. Rapporten løfter også frem nordiske byers lederskap, forpliktelser til ambisiøse klimamål og innovative, lokale løsninger. Funnene understreker behovet for bedre samordning mellom forvaltningsnivåer, økt finansiell støtte og justering av nasjonale rammeverk for å styrke byenes klimaarbeid.

Til tross for høye klimaambisjoner møter nordiske byer utfordringer knyttet til nasjonale regelverk og krav som kan begrense gjennomføringen av ambisiøse klimatiltak. For eksempel trekkes nasjonale byggetekniske forskrifter i Danmark frem som en barriere for klimavennlig utvikling i byggesektoren i Aarhus og Vejle. I Norge møter Trondheim juridiske hindringer i arbeidet med å etablere nullutslippssoner. I tillegg er finansiering av klimatiltak en sentral utfordring: Växjö og Oulu rapporterer om vanskeligheter med å sikre midler til grønne transportløsninger og miljøvennlig bygging, mens Reykjavík er avhengig av statlig finansiering for å gjennomføre større, klimavennlige infrastrukturprosjekter. Generelt er statlig økonomisk støtte avgjørende for gjennomføring av større klimatiltak i byene, men oppleves ofte som utilstrekkelig.

Byutviklingen gir også opphav til dilemmaer, blant annet knyttet til balansen mellom fortetting og bevaring av grøntområder. Lund har satset på kompakt byutvikling, men står overfor press for å verne om bynære grøntarealer. I Finland og Norge representerer utbygging på tidligere ubebygde områder krevende avveininger, og etterspørsel etter eneboliger gjør fortetting utfordrende i flere kommuner i hele regionen. Innen byggesektoren er det særlig utfordrende at energikrav i hovedsak gjelder nybygg og offentlige bygg, mens energieffektivisering av eksisterende bygningsmasse i stor grad

overlates til private aktører, slik tilfellet er i Norge. På transportområdet finnes det gode eksempler på sykkelinfrastruktur og kollektivsystemer, men tiltak for å redusere bilbruk er ofte politisk kontroversielle. Kommuner over hele Norden rapporterer om motstand i befolkningen og manglende statlig støtte for tiltak rettet mot personbiltrafikk.

Samtidig peker analysene på flere styrker. Nordiske byer har etablert ambisiøse klimaplaner, høy faglig kompetanse innen bærekraftig byplanlegging og stort politisk engasjement. Eksempelvis er Växjö ledende innen bærekraftig trebyggeri, mens Aarhus arbeider aktivt for skjerpede nasjonale klimakrav. Videre er de nordiske landene ledende globalt innen grønn teknologi og energiløsninger. Islands bruk av geotermisk energi, Sveriges satsing på bærekraftige byggematerialer og Finlands innovative mobilitetsløsninger er eksempler som kan ha overføringsverdi til andre byer. Mange nordiske byer investerer også i kollektivorientert og kompakt byutvikling, hvor bolig og transport sees i sammenheng for å redusere transportrelaterte utslipp. Offentlige medvirkningsprosesser og innbyggerinitierte tiltak bidrar til lokal forankring og støtte til gjennomføringen av ambisiøse klimamål.

Med utgangspunkt i prosjektets funn løfter rapporten frem både utfordringer og muligheter knyttet til byenes arbeid for å nå sine klimamål. På bakgrunn av dette presenteres følgende anbefalinger til lokale, regionale og nasjonale myndigheter:

- **Styrk samordningen i forvaltningen:** Forbedre samspill mellom forvaltningsnivåene og sektorer for å motvirke silotenking, fremme helhetlige løsninger og effektivisere gjennomføringen av klimatiltak.
- **Prioriter bred samfunnsinvolvering:** Mobiliser innbyggerne gjennom målrettet kommunikasjon og bevisstgjøring for å sikre lokal støtte til bærekraftige løsninger.
- **Styrk klimamobilisering og samarbeid:** Forsterk klimarelaterte nettverk og tverrsektorielt samarbeid for å fremme koordinert innsats og enhetlige tilnærminger på tvers av aktører og nivåer.
- **Utvid virkemiddelapparatet:** Innfør økonomiske og regulatoriske virkemidler som reflekterer reelle miljøkostnader og ansvarliggjør forurensere. Dette kan bidra til økte investeringer i grønne løsninger og stimulere til bærekraftige praksiser.
- **Harmoniser utslippsregnskap i Norden:** Standardiser beregningsmetoder for klimagassutslipp for å fremme sammenlignbarhet, transparens og samarbeid på tvers av landegrenser.

For å realisere målet om klimanøytrale byer må myndighetene samordne innsatsen mellom ulike aktører, utvikle helhetlige og støttende rammeverk og styrke det vertikale og horisontale samarbeidet i forvaltningen.



Photo: Apelöga/imagebank.sweden.se

1. INTRODUCTION

Cities are at the forefront of the global fight against climate change. With urbanisation remaining a dominant trend – seven out of ten people are projected to live in urban settlements by 2050 (UN, 2018) – cities are central to both the challenge and the solution. Urban areas currently account for 70% of global greenhouse gas emissions and are rapidly expanding, with urban land consumption often outpacing population growth (UN, n.d.). This expansion poses significant risks to climate goals but also presents a unique opportunity for innovation and sustainable development. Indeed, urban areas generate over 80% of global GDP (World Bank, 2023), making them ideal hubs for implementing scalable policies and measures to achieve climate neutrality goals. By redesigning and managing urban spaces with a focus on sustainability, cities can transition to climate neutrality while maintaining economic vitality and enhancing quality of life.

Nordic cities, in particular, have emerged as leaders in this transition. With a strong tradition of environmental governance, access to abundant renewable energy and progressive policies, these cities are well-positioned to lead by example. Their focus on compact urban development, green infrastructure and carbon-neutral transport networks showcases how emission reduction can be aligned with inclusive and sustainable urban growth. Furthermore, Nordic cities have been at the forefront of energy-efficient construction techniques, circular economy models and intelligent mobility systems, offering valuable insights into urban sustainability on a global scale. By integrating climate goals with broader sustainable development strategies, they demonstrate effective pathways towards climate neutrality.

This report examines how Nordic cities are pursuing climate neutrality, highlighting both the challenges they face and the available opportunities. It is the final output of the Nordic Climate Neutral Cities (NCNC) project, commissioned by the Nordic Council of Ministers and conducted by Nordregio as part of the Nordic Thematic Group on Green and Inclusive Urban Development (2021–2024). The NCNC project adopts a multilevel governance perspective, exploring how local, regional and national actors collaborate to advance urban climate goals. This approach underscores the interplay between different governance levels in shaping policies and practices that drive sustainable urban transformation.

The core focus of this report is the role of spatial planning in enabling climate-neutral urban development in Nordic municipalities. The study examines three key sectors where spatial planning plays a pivotal role:

- **Land use:** Strategies that encourage compact urban growth, limit sprawl and integrate nature-based solutions to reinforce climate resilience.
- **Buildings and construction:** Efforts to improve energy efficiency, implement climate-smart building regulations and adopt circular economy principles in construction materials and methods.
- **Transport and mobility:** Policies and infrastructure investments that support active mobility, the electrification of transport and the expansion of low-carbon public transport networks.

To support this analysis, the report presents nine in-depth case studies from Denmark, Finland, Iceland, Norway and Sweden. The selected cities – Aarhus and Vejle (Denmark), Tampere and Oulu (Finland), Reykjavík (Iceland), Trondheim and Kristiansand (Norway) and Lund and Växjö (Sweden) – offer diverse perspectives on how Nordic cities are navigating the complexities of spatial planning and governance to progress towards climate neutrality. These cities were chosen for their varied approaches, illustrating different challenges and strategies in implementing climate goals through spatial planning.

To guide this exploration, the report is structured into three main parts:

PART 1. Climate Neutrality and Spatial Planning: Concepts, Definitions and Governance provides a conceptual overview of climate neutrality in cities and examines the policy landscape at both European and Nordic levels. It explores the role of spatial planning in achieving climate neutrality by focusing on the three key sectors – land use, buildings and transport – while also introducing the multilevel governance framework used to analyse climate efforts in Nordic cities.

PART 2. Climate Neutrality in Nordic Cities: A Multilevel Governance

Perspective presents case studies of selected Nordic cities, analysing their policy and institutional capacity to launch and develop spatial planning strategies for climate neutrality. It further explores governance mechanisms at local, regional and national levels that influence urban climate policies and discusses the challenges these cities face in implementing climate policies, alongside the innovative solutions they have developed.

PART 3. Key Learnings and Recommendations

synthesises insights from the case studies to identify key opportunities and areas for improvement. It provides actionable recommendations for policymakers, urban planners and stakeholders at various levels to boost the effectiveness of climate neutrality strategies. Additionally, it highlights future research needs and emerging trends in urban climate governance and spatial planning.

By addressing the presented topics, the report provides a comprehensive understanding of how spatial planning and governance mechanisms can facilitate the transition towards climate-neutral cities. The findings offer valuable insights for policymakers, urban planners and stakeholders seeking to implement effective and scalable climate strategies in urban settings.

PART I

CLIMATE NEUTRALITY AND SPATIAL PLANNING: CONCEPTS, DEFINITIONS AND GOVERNANCE



Photo: Laura Vanzo/Visit Tampere

2. CLIMATE NEUTRALITY AND CITIES

What is a climate-neutral city?

The concept of climate neutrality has been interpreted in various ways, with no universally accepted definition. The IPCC (2018) defines climate neutrality as *"a state in which human activities result in no net effect on the climate system. Achieving such a state would require balancing of residual emissions with emission (carbon dioxide) removal as well as accounting for regional or local biogeophysical effects of human activities that, for example, affect surface albedo or local climate"*. This definition emphasises the need to reduce residual emissions to a level that is in equilibrium with emission removal practices (e.g. carbon sinks, carbon sequestration, carbon capture and storage). It also highlights the role of human activities, both in contributing to the current climate emergency and in alleviating the crisis, focusing on anthropogenic emissions produced and anthropogenic removal processes alike.

Building on the concept of climate neutrality, a *climate-neutral city* can be described as one that minimises the negative trends of urbanisation while leveraging cities' potential to address climate change. The Global Protocol for Community-Scale Greenhouse Gas Inventories defines a carbon-neutral city as one that has achieved net-zero greenhouse gas emissions – within its defined territory and accounting year – in three areas, namely citywide fuel use, grid-supplied energy and waste treatment (World Resources Institute et al., 2019). The global network ICLEI – Local Governments for Sustainability) defines climate neutrality in the context of local and regional governments as *"the targeted reduction of greenhouse gas (GHG) emissions and GHG avoidance in own operations and across the community in all sectors to an absolute net-zero emission level at the latest by 2050"* (ICLEI, 2020). The United Nations Economic Commission for Europe (UNECE, 2011) states that *"Climate neutrality presupposes a change from fragmented sectoral interventions to an interrelated matrix of comprehensive actions integrated at an urban scale."* Wang et al., 2023 define carbon neutrality at the urban scale as a *"state in which*

urban carbon emissions and carbon sequestration are in balance” within a particular territory and accounting year.

In addition to these definitions, several related terms have emerged, such as “low-carbon city”, “zero-carbon city” and “negative-carbon city”, which cover both the implications climate change has for cities as well as the responsibility cities have in combating the climate crisis (Jong et al., 2015). What these definitions and terms have in common is the notion that climate neutrality is inherently dynamic – requiring constant adaptation to evolving circumstances and challenges, as emissions can fluctuate due to economic activities, population growth or changes in energy sources, necessitating constant adjustment to maintain neutrality.

Determining carbon footprints in cities

Calculating emissions is a complex endeavour. As mentioned above, climate neutrality has territorial and temporal limitations and can be measured at global, national, regional or local levels and across specific periods (C40 et al., 2019). As measurements are limited to a fixed time frame to determine whether neutrality has been achieved within a given period (typically one year), there is no guarantee that once carbon neutrality has been achieved, the inventory boundary in question will remain climate neutral.

In the GHG and carbon accounting literature, territorial limits for measuring emissions are considered inventory boundaries (World Resources Institute et al., 2019, p. 145). An inventory boundary defines the relevant gases, emission sources, geographical area and time frame, providing clarity on emission origins and guiding actionable or influenceable areas for change (World Resources Institute et al., 2019). In the literature, the inventory boundaries approach is roughly divided into two broader categories: production-based emissions (PBE) and consumption-based emissions (CBE) (Franzen & Mader, 2018). Production-based emissions (PBE) refer to the CO₂ emissions generated within a specific geographical area (e.g. city, region or country), primarily from the combustion of fossil fuels to support urban services. However, the PBE indicator excludes emissions associated with trade and the carbon embedded in goods and services consumed locally but produced elsewhere. By contrast, consumption-based emissions (CBE) refer to the CO₂ emissions tied to the goods and services consumed within a specific geographical area. Unlike PBE, the CBE indicator adjusts for trade by including emissions from imported goods and excluding those from exports. However, it does not account for emissions from land use change and forestry (LUCC).

Climate-warming GHG emissions are classified into three scopes, which were introduced in 2001 as part of the Greenhouse Gas Protocol, a global initiative by the World Resources Institute and the World Business Council for Sustainable Development to standardise the measurement of greenhouse gas emissions (see text box 1).

BOX 1. SCOPE 1, 2 AND 3 EMISSIONS

SCOPE 1 (direct emissions): Refers to direct fuel combustion generated by mobile and stationary sources (e.g. industries, transport, buildings, agriculture and forestry). Direct emissions occur from sources owned or controlled by the reporting entity (city, company etc.)

SCOPE 2 (indirect emissions): Generated by the consumption of electricity or heat grid within a geographical boundary or due to the consumption of grid-supplied heat or cold within a geographical boundary. They occur at the facility where the energy is generated (i.e. they exclude emissions from electricity purchased). Indirect emissions account for at least one-third of global GHG emissions. Lowering electricity demand and shifting energy supply to low-carbon sources present significant opportunities to reduce these emissions.

SCOPE 3 (Indirect value chain emissions): Also termed out-of-boundary emissions, these are associated with other indirect emissions (processing of products, waste management) not included in the indirect emissions account. They occur in the value chain of a reporting entity (city, company), including emissions from both the upstream value chain (from production or extraction of purchased materials) and downstream value chain (resulting from use of the organisation's products or services).

Analogous to Scopes 1, 2 and 3 for emissions above, Lwasa et al. (2022) outline three general frameworks for urban GHG accounting, based on the urban metabolism concept, which traces energy and material flows into, within and out of urban settlements (see Text box 1).

BOX 2. GHG ACCOUNTING FRAMEWORKS FOR CITIES

Territorial accounting (TA) focuses solely on direct in-city GHG emissions released into the atmosphere within a selected geographical area (Scope 1). This approach requires less data and is therefore simple to employ. It is best suited for informing policies related to energy consumption and mobility activities within urban boundaries (Lauvaux et al., 2020; Mueller et al., 2021).

Community-wide infrastructure supply chain footprinting (CIF) is more robust than TA as it includes GHG emissions associated with electricity imports and life cycle GHG emissions associated with key infrastructure provisioning activities in cities, serving all homes, businesses and industries (Scopes 1 and 2). This expands both the number of emitting categories and the responsibility for those emissions by including infrastructure-related supply chain emissions. The CIF framework enables individual cities to connect community-wide demand for infrastructure and food with their transboundary production, strategically aligning their net-zero emissions plans with larger-scale net-zero efforts (Ramaswami & Chavez, 2013)

Consumption-based carbon footprint accounting (CBCF) provides information on the emissions caused by residents and users of certain geographical areas, including cross-border emissions. This category is further divided into:

- *Personal carbon footprint, PCF:* This refers to the consumption activities of residents within a specific area, regardless of where the consumption occurs. It excludes the consumption activities of visitors to that area (Guðdísardóttir, 2021)
- *Areal carbon footprint, ACF:* This encompasses the consumption-based carbon emissions of economic activities within a defined geographical area, along with the global production and supply chain emissions associated with consumed goods and services (Guðdísardóttir, 2021)

A comprehensive GHG emission inventory – comprising Scopes 1, 2 and 3 – provides an accurate picture of the actual magnitude of the emissions, which can drive meaningful reductions and help to achieve various GHG-related goals. Scope 3, however, is particularly complex as it concerns emissions released before and after a product is delivered or consumed. Its measurement is crucial to determine who is responsible for the emissions.

A study comparing production and consumption-based emissions across 79 cities in the world (C40, 2018) revealed that, especially for European, North American and Oceanian cities, consumption-based GHG emissions are substantial and

significantly higher than production-based GHG emissions. This indicates the need to incorporate transboundary emissions into the emission inventories to inform policies that can effectively reduce GHG emissions. Nevertheless, while cities can directly influence and estimate Scope 1 and 2 emissions, their power over the manufacturing process of an imported product is limited. For example, though requiring substantial investments, cities can transition a thermal plant to a wind or photovoltaic plant and purchase clean energy, but their impact on consumption-based GHG is restricted to using a blend of resource efficiency strategies and consumer-focused policies (e.g. campaigns and public procurements) to foster more sustainable urban lifestyles.

In addition, consumption-based inventories (Scope 3) have uncertain and expansive boundaries that overlap with production-based approaches (Scopes 1 and 2). For example, those in charge of accounting for carbon neutrality must decide whether to include carbon produced, carbon consumed or both produced and consumed by each actor. This can also lead to complications with double counting given that many CO₂ emissions are not merely the byproduct of a single actor, but result from multiple actors engaged in a common process. This issue also arises when determining inventory boundaries given that carbon emissions produced in one territory may be for the benefit of those in another territory. The same fluidity is true of timing as well, particularly when it comes to industrial processes that are completed during one year for use or consumption in the following year.

Considering the challenge of assessing and managing the contribution of urban consumption, which results in greenhouse gas (GHG) emissions outside city boundaries, most of the cities use the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) as a guideline tool to estimate their annual GHG emissions. (World Resources Institute et al., 2019). The GPC provides principles and rules for calculating emissions consistent with IPCC Guidelines but does not require specific methodologies. Cities collect activity data and emission factors (EFs) based on availability and consistency with their country's national reported emissions. Since 2014, C40 cities have reported GPC-based GHG emission inventories to the Carbon Disclosure Project (CDP), enabling cross-city emission comparisons, emission mitigation policy assessments and consumption-based carbon footprint estimations (Wiedmann et al., 2020).

Mitigation and adaptation strategies

Despite the difficulties in calculating emissions, cities are in a strong position to take action advancing climate change mitigation and adaptation. Curbing GHG emissions (mitigation) and reducing climate vulnerabilities (adaptation) are strategies that, if well aligned, can bring several co-benefits (Sharifi, 2021). For example, the insulation of buildings can simultaneously reduce demand for energy (mitigation) while providing better protection from extreme weather (adaptation) (Golubchikov, 2011). Similarly, planting and maintaining forests or green areas can

improve the carbon sink potential of cities while also regulating temperature and improving stormwater management (Chen et al., 2022).

Nevertheless, trade-offs with unfavourable consequences may also arise, with mitigation strategies impacting negatively on adaptation measures and vice-versa (Sharifi, 2020). For example, the implementation of a hydroelectric power plant may help to curb GHG emissions as it produces energy from renewable sources, but it may increase competition for water with local communities, jeopardising adaptation (Chen et al., 2022). In fact, mitigation and adaptation serve different purposes, with the former aiming to tackle the causes of climate change (reduce emissions) and the latter aiming to minimise the effects of climate change (reduce vulnerabilities). Their distinct nature requires careful analysis to ensure that co-benefits rather than negative impacts result.

In addition to the positive and negative interrelations between mitigation and adaptation strategies, the systemic nature of cities should not be overlooked. Cities are not isolated entities; they are deeply interconnected across various scales, including regional, national, continental and global levels. Cities are complex systems of interconnected sectors, activities and governance structures and are susceptible to carbon lock-in because of the interrelated dynamics between urban infrastructure, technologies, institutional frameworks and individual and collective behaviours (Lwasa et al., 2022).

As cities do not produce all of the services and goods they need to function within their boundaries and are connected across different scales (locally and globally), mitigation approaches may have cascade effects in urban surroundings and in the functional hinterlands that they are dependent on, such as global impacts through supply chains, resource flows and institutions (Rocha et al., 2018). Similarly, sectoral strategies that optimise resource use (e.g. improving energy efficiency of appliances) or infrastructure efficiency can generate mitigation efforts that span various scales, from households and neighbourhoods to entire districts and city regions, leading cities to reduce emissions both locally and beyond their boundaries (Lwasa et al., 2022). Mitigation efforts undertaken at broader governance levels or in sectors that extend beyond urban boundaries, such as energy and transport, can enhance mitigation outcomes within urban areas.

Besides occurring across different urban systems and being triggered by sectoral initiatives and larger scales of governance, cascade effects also arise from the longest-lasting physical capital of cities (e.g. street networks, buildings, infrastructure), which can be locked in for generations, shaping unsustainable practices and increasing emissions. Cascade effects across multiple sectors (e.g. land use, buildings, transport) must be taken into consideration to inform policies aimed at reducing the climate impact. For example, prevailing low-density urban growth and car dependency require mitigation strategies aimed at overcoming the lock-in to fossil fuel consumption.



Aarhus. Photo: Adam Mørk

Key reflections on climate neutrality in cities

In this chapter, we have underscored the pivotal role of cities in the global pursuit of climate neutrality. As many urban areas continue to expand and contribute to climate emissions, they present both significant challenges and unparalleled opportunities for advancing climate goals. The discussion has highlighted the need for cities not only to address their substantial contributions to greenhouse gas emissions but also to act as centres of innovation and leadership in sustainability.

One key reflection is the inherent complexity of achieving climate neutrality in urban contexts. The distinctions between production-based and consumption-based emissions highlight the difficulty of accurately calculating and tackling emissions that extend beyond city boundaries. These challenges emphasise the need for comprehensive frameworks that consider the interconnected nature of cities in their regional and global contexts as well as the trade-offs and synergies between mitigation and adaptation strategies.

The chapter also reflects on the importance of long-term planning to avoid carbon lock-in, with decisions about infrastructure, land use and urban form potentially shaping emission trajectories for generations. The cascade effects of urban policies across sectors and scales reinforce the need for integrated approaches that transcend traditional boundaries to ensure that urban growth is aligned with climate goals.

As critical actors in the climate transition, it is crucial that cities address the complexities of emissions accounting, balance mitigation and adaptation and adopt integrated, forward-looking strategies. In the next chapter, we will explore such strategies at both the European and the Nordic level.



Amsterdam. Photo: Unsplash.com

3. POLICY LANDSCAPE OF CLIMATE NEUTRALITY

This chapter provides a comprehensive overview of the policy landscape surrounding climate neutrality, focusing on European and Nordic frameworks. It discusses major EU initiatives, such as the European Climate Law, the "Fit for 55" package and the Cities Mission, highlighting their goals and impacts, particularly on urban areas. The chapter also examines Nordic countries' ambitious climate targets and their alignment with European policies, emphasising the role of national networks and local associations in supporting municipalities' transitions to climate neutrality.

Overview of policy in Europe

Climate concerns and the establishment of targets to reduce carbon emissions have been among European goals for more than a decade. Adoption of the Climate Law in 2021 (European Parliament and European Council, 2021) was a milestone in establishing Europe's legally binding commitment to become the first continent to achieve net-zero CO₂ emissions by 2050. This decision also influenced revision of the EU's interim emissions target for 2030, with the target increased from a 40% to a 55% reduction in emissions compared to the 1990 level. Since then, the EU has updated existing legislation and introduced new laws to achieve that target by 2030. One such effort is the "Fit for 55" legislative package, which encompasses measures such as emission trading regulations, national emission reduction targets, carbon removal in the land use sector and transport emission standards (European Parliament, 2023).

The EU has several key documents and initiatives that steer the reduction of greenhouse gas (GHG) emissions across Europe. These documents and policies include measures specifically relevant to cities, which play a critical role in achieving climate targets due to their high population density and economic activity (see Appendix 1 for an overview of key EU documents on climate neutrality, with an emphasis on those impacting urban areas). Additionally, the European Commission

launched the EU Mission for 100 Climate-Neutral and Smart Cities in 2022, reinforcing the heavy interdependency between climate mitigation and urban action. This programme forms part of the five EU Missions under Horizon Europe (2021-2027), which are designed to meet ambitious goals and deliver concrete solutions by 2030 to challenges related to (1) adaptation to climate change, (2) cancer, (3) restoration of oceans and waterways, (4) climate-neutral cities and (5) soil deal for Europe. With a budget of EUR 360 million (2021-2022), the Cities Mission provides support for 100 cities across Europe to become testbeds for innovative solutions, including in the fields of clean mobility, energy efficiency and green urban planning, with the ultimate aim of achieving climate neutrality by 2030.

NetZeroCities is a key component of the Cities Mission. It acts as the Mission Platform, providing tailored support, expertise and services to the selected cities. Managed by a consortium of organisations with the participation of 33 leading city networks, researchers and urban stakeholders from 13 countries, NetZeroCities assists cities in overcoming structural, institutional and cultural barriers to achieving climate neutrality. This includes offering technical assistance, facilitating knowledge exchange and helping cities develop and implement their Climate City Contracts.

CapaCITIES is a noteworthy project funded under the Horizon Europe programme that focuses on building capacities for urban climate neutrality. Operating within the broader context of the Cities Mission, CapaCITIES advances national support for climate-neutral cities and specifically aims to enhance the abilities of cities to plan and implement effective climate actions. This involves providing training, developing tools and fostering collaboration among cities to share best practices and lessons learned.

In summary, the Cities Mission sets the overarching goal of achieving climate-neutral and smart cities by 2030. NetZeroCities acts as the operational arm, delivering direct support and resources to the participating cities. CapaCITIES complements these efforts by strengthening the skills and capabilities of city stakeholders, ensuring they are well-equipped to meet the mission's ambitious objectives.

Other campaigns and initiatives worldwide have been implemented to support climate action at the city level. Text box 1 lists some of them.

BOX 3. MAIN GLOBAL NETWORKS AND CAMPAIGNS SUPPORTING CITIES IN ACHIEVING CLIMATE NEUTRALITY

Race to Resilience (2021) is a global campaign to boost leadership and help cities to build resilience and adapt to the impacts of climate change. It is a branch of the broader "Race to Zero" network (which was launched in 2020 and is part of the Climate Ambition Alliance: Net Zero 2050). It includes the "Cities Race to Resilience" initiative, under which cities pledge to integrate climate change adaptation and resilience into all aspects of urban planning, ground decision-making in climate knowledge and scientific evidence, take action and periodically report on their progress. Currently, 733 cities worldwide are signatories

Global Covenant of Mayors for Climate and Energy (GCoM) is the largest coalition with over 10,000 cities and local governments committed to climate leadership. Founded in 2016, through the merger of the Compact of Mayors and the EU Covenant of Mayors, the GCoM focuses on a long-term vision of supporting voluntary action to combat climate change. It includes three core initiatives (1) Data4Cities; (2) Innovate4Cities and (3) Invest4Cities, aiming to help cities bridge the gap between ambition and action in their efforts towards climate neutrality.

Cities Climate Leadership Group (C40) is a network of mayors collaborating to lessen GHG emissions in cities and influence the global climate agenda. Numerous C40 cities have signed the "Race to Zero" commitment.

Nordic policy context for climate neutrality

Despite differences in the Nordic countries' affiliation with the European Union – with Denmark, Finland and Sweden being EU members while Norway and Iceland are integrated with the EU through the European Economic Area (EEA) – all the Nordic countries support the European policies for tackling climate change by reducing GHG emissions. Indeed, some Nordic countries have ambitions of becoming frontrunners in the transition to a carbon-neutral future and have set goals exceeding the European goal of achieving a 55% decrease in emissions by 2030 (see Table 1).

The national goals also reflect the Nordic Region's declarations and ambitions for climate neutrality as expressed by the Nordic Council of Ministers (NCM). Following the Katowice Climate Change Conference (COP 24), the NCM launched a

Declaration for Climate and Environment (Nordic Council of Ministers, 2018), stating that all countries, in line with the Paris Agreement, had set bold emission reduction goals for 2030 and were establishing visions for 2050. In the following year, with its Declaration on Nordic Carbon Neutrality (Nordic Council of Ministers, 2019), the NCM reiterated its commitment to pursuing carbon neutrality and delivering solutions with impacts on global emissions. Such objectives were further restated in the "Nordic commitment for the climate agenda" (Nordic Council of Ministers, 2019), with carbon neutrality and climate adaptation being crucial objectives in the vision of becoming the most sustainable and integrated region in the world by 2030 (Nordic Council of Ministers, 2020). Table 1 lists the Nordic countries' climate goals and the authorities responsible for their implementation.

TABLE 1. OVERVIEW OF THE NORDIC COUNTRIES' CLIMATE GOALS

COUNTRY	CLIMATE POLICY AND RESPONSIBLE NATIONAL AUTHORITY	CLIMATE GOALS (BASELINE 1990 GHG EMISSION LEVELS)
Denmark ^[1]	<i>Climate Act (Lov om klima)</i> Ministry for Energy, Utilities and Climate	2025: 50-54% reduction 2030: 70% reduction 2050: climate neutrality*
Finland ^[2]	<i>Climate Change Act (Ilmastolaki)</i> Ministry of Environment (responsible for medium-term Climate Change Policy Plan – CCPP) Ministry of Economic Affairs and Employment (responsible for long-term CCPP)	2030: 60% reduction 2035: carbon neutrality** 2040: 80% reduction 2050: 90-95% reduction
Iceland	Climate Change Act (Lög um loftslagsmál) Ministry of Climate and Environment	2030: 40% reduction 2040: carbon neutrality**
Norway	Ministry of Climate and Environment	2030: 55% reduction 2050: 90-95% low-emission society
Sweden	Climate Law Ministry of Climate and Enterprise Swedish Environmental Protection Agency	2030: 63% 2040: 75% 2045: carbon neutrality** After 2045: negative net emissions

*Carbon neutrality: CO₂ emissions are offset by natural sinks in its own territory

**Climate neutrality: GHG emissions are offset by natural sinks in its own territory

1. [During the COP, Denmark passes Climate Act with a 70 percent reduction target \(kefm.dk\)](#)

2. [Finland's national climate change policy – Ministry of the Environment \(ym.fi\)](#)

The strong political commitment, backed by robust climate policies and ambitious targets, and coupled with long-standing commitment to international climate agreements, is undoubtedly a key strength of the Nordic countries' pursuit of decarbonisation. The abundance of renewable energy also places the Nordic Region in a strong position, with Iceland making use of geothermal resources, Norway deriving most of its electricity from hydropower and Denmark^[3] being a global leader in wind energy, with the highest share of wind in its total primary energy consumption and electricity among all IEA countries (Nordic Energy Research, 2021). However, the cold climate results in higher energy demand for heating in winter, leading to increased energy consumption.

Despite technological innovation and investments in clean technologies such as carbon capture and storage (CCS), green hydrogen and electrification and advanced waste-to-energy systems and circular economy models, the Nordic Region is home to resource-intensive industries like forestry and mining as well as oil and gas (notably in Norway), which have significant environmental impacts, making it a challenge to balance economic benefits with emission reduction targets. Trade-offs with global supply chains, including high imports of goods with large carbon footprints, also offset domestic progress (Nordic Council of Ministers, 2024). In addition, the pressure to ensure that exports such as Norwegian oil and gas align with global decarbonisation goals also presents a struggle (Korsnes et al., 2023). Difficulties in decarbonising long-distance transport – particularly aviation and shipping, which are important in Nordic countries with dispersed populations and export-driven economies – and the dependence on fossil fuels in heavy transport sectors also hamper the countries' progress towards climate neutrality (Sovacool et al., 2018).

Key Nordic networks and associations for the implementation of climate neutrality goals in cities

The networks of municipal associations perform an important role in guiding Nordic municipalities towards climate neutrality in the various countries. These associations represent local governments at national level and provide support for local development in a range of ways. Table 2 lists and describes the associations in each country.

3. [Denmark – Countries and Regions – IEA](#)

TABLE 2. NETWORK OF MUNICIPAL ASSOCIATIONS AND THEIR EFFORTS TO PROMOTE CLIMATE NEUTRALITY

COUNTRY	NETWORK OF MUNICIPAL ASSOCIATIONS
Denmark	Local Government Denmark (KL ^[4]) is the association and interest organisation representing all 98 Danish municipalities. It assists the municipalities by providing information and advice to enhance service provision and local development. The support services include: knowledge sharing and best practices, clarification of legal issues, improving cooperation between municipalities through regional networks, providing practical tools and guidelines, representing local interests in European forums, providing physical and digital forums for dialogue and collaboration.
Iceland	SAMBAND, ^[5] the Union of Icelandic Municipalities, serves as the body representing the municipalities at the level of the national government and parliament as well as at international level (including foreign associations). SAMBAND advocates for and works towards the municipalities' common interests and promotes cooperation in several areas, such as labour market issues (handling collective agreements and wage issues, delivering research and information) and provision of information and educational opportunities on municipal politics (e.g. through conferences, seminars, meetings and publications).
Finland	KUNTALIITTO ^[6] stands for the Association of Finnish Local and Regional Authorities, a knowledge-based organisation that supports local governments by providing background information and conducting research (e.g. comparative information to increase awareness of municipal activities, operating conditions and challenges in the changing role of local authorities) to equip municipalities to manage change and plan for future activities.
Norway	KS ^[7] is an organisation that strives for independent and innovative municipal sectors. All Norwegian municipalities and county councils are members and enjoy access to knowledge in various areas including municipal finances, wage development, climate improvements, working environment, childhood and care. KS also represents and safeguards local interests in dealings with other levels of government and provides legal support to meet the needs of the local public sector (e.g. formulation of laws and regulations).
Sweden	SKR, ^[8] the Swedish Association of Local Authorities and Regions, acts as a network for knowledge exchange and coordination among all the Swedish municipalities and regions. SKR provides services such as courses and conferences and advice on a range of issues to strengthen local self-government with strong civil support. SKR's aims including fostering collaboration among members, representing members' interests in national and international forums, providing expertise for the development of municipal activities and serving as a national political arena for local and regional policy.

Equally important in supporting municipalities' mission to decarbonise their administrations and territories are national networks, which also contribute to the progress towards a fossil fuel-free future in cities (see Table 3).

4. [English \(kl.dk\)](#)

5. [Association Icelandic Local Government \(samband.is\)](#)

6. [Association of Finnish Local and Regional Authorities | Kuntaliitto.fi](#)

7. [KS – KS](#)

8. [Swedish Association of Local Authorities and Regions \(SKR\)](#)

TABLE 3 CLIMATE CITY NETWORKS

LEVEL/COUNTRY	NATIONAL CLIMATE CITY NETWORKS AND INSTITUTIONS SUPPORTING THE LOCAL LEVEL
Nordic	The Nordic City Network^[9] contributes to the development of sustainable cities through knowledge sharing between medium and small-sized cities in the Nordic countries. The network facilitates events, implements studies for sharing and learning and collaborates with other Nordic institutions in implementing Agenda 2030.
Denmark	DK2020,^[10] which is run by KL and the CONCITO climate alliance, supports local climate sustainability transitions and counts on the commitment of all Danish municipalities. DK2020 provides municipalities with guidance on developing ambitious plans and implementing measures to neutralise carbon emissions. Through ambitious goals and processes, DK2020 applies the same standards used by the C40 international urban network (such as the Climate Action Planning Framework, CAPF) to the context of small and medium-sized Danish municipalities.
	CONCITO^[11] is a climate think tank established in 2008 that strives to accelerate the green transition by translating knowledge into action. The organisation focuses on systems and structural and behavioural changes that are necessary to meet the climate goals. To this end, CONCITO focuses on conducting analysis and developing new knowledge, bridging science and politics, providing a platform for dialogue on green transitions and supporting decision-makers with concrete pathways for achieving climate neutrality.
Finland	HINKU^[12] – Towards Carbon Neutral Municipalities began in 2008 as a network of five small municipalities, bringing together local authorities, businesses, experts and citizens to identify cost-effective ways to reduce emissions, especially in the transport, housing and food sectors. Municipalities belonging to the network must fulfil several criteria (e.g. develop a plan for investments to reduce CO₂, formulate strategies for mitigating emissions, implement and publish mitigation measures, submit annual reports detailing progress made and provide information to various sectors of society. HINKU's members can benefit from sharing of best practices, support for planning of sectoral climate projects, assistance with project preparation and visibility for partners companies' products and services.
Sweden	Viable Cities^[13] is a strategic innovation programme that supports municipalities in the transition to climate neutrality. It fosters cooperation among various sectors of society (cities, industry, academia, research institutes and civil society) to drive change to meet the climate goals.
	Klimatkommunerna,^[14] founded in 2003, is an association for municipalities and regions that promotes exchange of experiences, good practices and advocacy. It highlights the opportunities, barriers and driving forces for municipalities to reduce their GHG emissions. Currently the association represent over five million residents.

9. [About the network – Nordic City Network](#)

10. [DK2020 \(realdania.dk\)](#)

11. [CONCITO – Denmark's green think tank](#)

12. [Carbonneutralfinland > HINKU network – Towards Carbon Neutral Municipalities \(hiilineutraalisuomi.fi\)](#)

13. [Climate-Neutral cities 2030 – Viable Cities](#)

14. [Climate municipalities \(klimatkommunerna.se\)](#)

With the exception of Norway and Iceland, the Nordic countries rely on support from national networks to accelerate climate action in cities. Viable Cities is a frontrunner in that effort. It involves 23 municipalities, which collectively represent 40% of the Swedish population. The programme began in 2017 and was a source of inspiration for the European mission, particularly NetZeroCities, which provides tailored support, expertise and services to several European cities.

HINKU in Finland involves nearly 100 Finnish municipalities and five regions committed to achieving an 80% reduction in GHG emissions by 2030, taking the level of emissions in 2007 as the baseline. The partnership with the Finnish Environment Institute (SYKE) coordinates and facilitates the calculation of annual GHG emission inventories for the participating municipalities, supporting public relations and assisting access external research funding.

In Denmark, DK2020 has progressively supported Danish municipalities in developing and implementing their climate plans. In 2019, 20 municipalities participated in the pilot project, the majority of which completed their climate action plans in the following year. DK2020 subsequently provided support to the remaining 75 municipalities. Currently, all Danish municipalities have developed their climate action plans.



Construction site, Reykjavik. Photo: Johannes Jansson/norden.org

4. CLIMATE NEUTRALITY AND SPATIAL PLANNING

This chapter explores the critical role of spatial planning in achieving climate neutrality by shaping urban form, infrastructure and resource use. It examines how land use, building practices and transport systems in particular can contribute to both climate mitigation and adaptation.

Spatial planning is of particular importance for cities embarking on the pathway towards climate neutrality and responding to the challenges posed by climate change at the urban, regional and national level. As noted by several authors (Davoudi et al., 2010; Lee & Jung, 2023; Nowak et al., 2023), spatial planning is instrumental in relation both to climate adaptation (e.g. measures to adjust to the present and future impacts of climate change) and mitigation measures (action to reduce the impact of human activity on the climate system, primarily through reducing greenhouse gas emissions) (CSE & TCPA, 2023). Accordingly, it plays a pivotal role in achieving climate neutrality in cities by shaping the way land, resources and infrastructure are used and developed.

Spatial planning, as *"the processes through which options for the development of places are envisioned, assessed, negotiated, agreed and expressed in policy, regulatory and investment terms"* (Davoudi et al., 2010, p. 14), has a cross-sectoral nature. That arises from its broad scope, encompassing regulatory frameworks that shape urban form and influence multiple sectors. Urban form comprises the way land is used, density is distributed, transport is organised and housing is developed (Burton et al., 2000). Urban-built forms, particularly buildings and transport systems, are major contributors to global greenhouse gas emissions, accounting for over one-third of total carbon emissions and 71% of energy-related carbon emissions (Huang et al., 2020). Their significant environmental impact highlights the crucial role they play in shaping cities' paths towards climate neutrality. Recognising that, this study focuses on three key dimensions of spatial planning – land use, buildings and construction, and transport and mobility – and examines how these interrelated sectors can drive the transition towards climate neutrality and sustainable urban development.

Land use

When examining the multifaceted relationship between land use and climate neutrality, one of the most enduring debates in the relevant literature centres on the dichotomy between compact cities and urban sprawl. This discourse highlights land use, transport and urbanisation patterns as key factors influencing carbon emissions and broader environmental impacts.

Suburban sprawl, defined as the uncontrolled expansion of urban areas into adjacent agricultural or natural landscapes, is typically characterised by low-density development and limited land use diversity. Historically, suburban sprawl has been most prominent in non-European countries, particularly the United States (Patacchini et al., 2009). Beginning in the early 20th century, this trend was fuelled by extensive suburbanisation, the rise of private car ownership and cultural preferences for single-family homes with private gardens – factors that set it apart from the more compact urban development patterns seen in Europe. However, since the 1950s, suburban sprawl has become an increasingly common phenomenon in Europe as well, particularly in the central and southern regions (Ludlow, 2006). Even Nordic cities, which are often considered leaders in sustainable urban planning, are not immune to the pressures of sprawl. As noted by Madureira & Möllers (2005), common indicators of urban sprawl in Scandinavian countries include the presence of satellite towns functioning as residential suburbs for larger nearby cities, such as Oslo, Malmö, Lund or Copenhagen. These areas are characterised by low-density housing, limited mixed-use development, linear growth along rail lines and railway corridors and a high reliance on commuting and automobile use. Another notable manifestation of sprawl in Nordic countries is expansion of the second-home phenomenon, often referred to as “recreational sprawl”. Recent studies have highlighted the environmental consequences of this trend, particularly in Norway, where modern second homes have been found to significantly impact mobility patterns and housing consumption, contributing to increased carbon emissions and environmental degradation (Xue et al., 2020). This underscores the global relevance of the compact city versus sprawl debate, emphasising the need for sustainable land use policies to mitigate the climate impacts of urbanisation.

Sprawl tendencies pose critical challenges for climate neutrality due to increased energy demand, land and soil consumption, rising car use and, as a result, growing GHG emissions. As a consequence, sprawl is also considered harmful for people’s living conditions and quality of life. It is also worth noting that sprawl has been identified as one of the main drivers behind the strong socio-economic and spatial segregation patterns that are traditionally much more marked in North American cities than in European ones (Arbaci, 2019).

In order to respond to the challenges of suburban sprawl and to the growing need to reduce carbon emissions in the face of the climate crisis, cities in Europe and beyond are increasingly adopting compact city strategies. Indeed, especially since

the Brundtland report (WCED, 1987), discourse around sustainable urban forms has focused to a strong degree on the compact city as – often unquestionably – considered the most sustainable way to develop contemporary cities (Hofstad, 2012; OECD, 2012) and to achieve climate neutrality. The main characteristic of the compact city model is the concentration of development within already built-up areas in order to prevent urban sprawl. Such an approach to land use is considered beneficial primarily from an environmental sustainability perspective. First, it allows for the creation of an efficient transport system, which encourages walkability and the use of bikes and public transport (reducing car-dependent travel and associated emissions) (Næss et al., 2011). Second, it limits development on natural land and farmland (OECD, 2012). This aspect is of great importance considering that 1) land take (i.e. the loss of undeveloped land) is highly relevant to biodiversity, which protects ecosystem services and whose loss is one of the most concerning trends in the context of climate change (European Commission, 2016) and 2) land consumption is a growing trend, even in contexts with declining populations (Sanchez & Arango-Franco, 2018).

It should be noted that while environmental arguments offer the strongest rationale for the adoption of compact city strategies, there are also important benefits with respect to the social and economic dimensions of urban sustainability. From an economic perspective, the compact city model is often regarded as more cost-effective than low-density development, requiring lower investment in infrastructure. Additionally, compact cities are seen as attractive hubs for investment and as catalysts for creative and green industries (OECD, 2012). This makes the compact city approach a key strategy for fostering urban green growth (OECD, 2012). With respect to social sustainability, compactness is linked to spatial and social proximity, improved accessibility of transport facilities and urban opportunities and to better conditions for the creation of more socially mixed communities (Ståhle, 2017) .

While less environmentally detrimental than sprawl for the reasons described above, development of compact cities and related approaches also present some environmental challenges and trade-offs that concern not only the environmental but also the social and economic dimensions of urban sustainability (Westerink et al., 2013). In terms of the environmental dimension, the relationship between the degree of compactness and carbon emissions has not yet been clarified. While there is strong evidence supporting the positive impacts that compactness has on lowering energy consumption in mobility, the effect of the compact city on GHG emissions remains much less clear (Muñiz & Rojas, 2019). Indeed, compactness might lead to an increase of the heat island effect and inner-city pollution due to higher congestion and reduced green areas and tree coverage, leading to an increase in carbon emissions. Furthermore, scholars discuss the rebound effects of the compact city (Næss et al., 2020). For example, higher density, often resulting in congestion and reduced accessibility of natural surroundings, might lead to higher mobility during holidays, with impacts on transport and housing emissions.

Furthermore, social benefits attributed to compact city strategies are highly controversial and the subject of debate in the relevant literature. For example, Bramley and Power (2009) argue that increased density leads to better access to service and amenities, improved interactions with neighbours, a stronger sense of community and reduced segregation based on income and ethnic background. Conversely, other studies identify exclusion as a common outcome of planning approaches that aim to increase density and accessibility but often benefit only the well-off. For example, R  rat (2012), explores how new compact developments in Swiss cities are often accessible only to well-off social groups, leading to social exclusion and to "new-build gentrification", i.e. a gentrification process driven by the development of new areas with poor housing affordability.

Buildings and construction

Spatial planning plays a critical role in advancing climate neutrality within the buildings and construction sector through various mechanisms. One key aspect is its influence on where and how buildings are constructed, achieved through zoning and local planning. By promoting higher-density, mixed-use developments in urban areas, spatial planning can reduce the need for new construction on greenfield sites. This helps curb expansion of the built environment into undeveloped areas, thereby preserving natural habitats and open spaces (N  ss et al., 2020). Moreover, zoning, land use and building regulations can mandate sustainable building practices, including energy-efficient designs, specific energy requirements, the use of green building materials and sustainable landscaping. These measures apply to both new construction projects and ecological retrofitting of existing buildings (Cavicchia et al., 2023).

Buildings are among the largest consumers of energy and contributors to greenhouse gas (GHG) emissions in cities, primarily due to heating, cooling and construction activities. In 2019, the buildings sector was responsible for 21% of global GHG emissions. Of this, 57% were indirect emissions from offsite electricity and heat generation, 24% were direct onsite emissions and 18% were embodied emissions tied to materials like cement and steel (IPCC, 2022). In that same year, buildings accounted for 31% of global final energy demand, with residential buildings consuming approximately 70% of this total (IPCC, 2022).

Poorly designed and inefficient buildings contribute significantly to energy waste and emissions. Retrofitting existing buildings with improved insulation, energy-efficient windows and advanced systems can dramatically lower energy demand. Additionally, planning for net-zero or positive-energy buildings – i.e. structures that generate as much or more energy than they consume – can reduce reliance on fossil fuels. Using sustainable materials such as timber or recycled steel and adopting green building practices further decreases construction-related emissions. However, it is crucial to point out that, despite these strategies, the buildings sector is not on

track to achieve the European goal of climate neutrality by 2050. The EU Buildings Climate Tracker^[15] indicates that, as of 2022, progress was lagging significantly behind the necessary decarbonisation pathway, underscoring the urgent need for accelerated action and more ambitious policies.

Transport and mobility

Transport is one of the leading contributors to urban emissions, particularly due to private vehicles powered by fossil fuels. (Statista, 2022). Car-dependent urban designs perpetuate high emissions, congestion and air pollution, undermining climate goals. Travel patterns are largely influenced by land use arrangement. Spatial planning can influence where transport hubs, such as airports, train stations and bus terminals, are located. Strategic placement of these hubs can reduce the need for long commutes and decrease the environmental impact of private cars, especially for short trips (Huang et al., 2020). Additionally, extensive literature on the compact city model and mixed-use zoning explores how proximity to public transport can encourage people to use that option instead of relying on private vehicles (Ibraeva et al., 2021). Spatial planning can promote transit-oriented development (TOD), which involves designing urban areas and communities to be easily accessible by public transport. TOD typically encourages higher-density development around public transport stops, making it convenient for residents to use buses, trams or trains. This is likely to reduce demand for individual car travel, thus lowering greenhouse gas emissions associated with transport. Further strategic steps include integrating public transport systems, cycling networks and pedestrian zones to reduce reliance on cars, encouraging high-density development near public transport hubs to minimise the need for car travel and planning for charging infrastructure to support the transition to electric vehicles (EVs), thereby reducing transport emissions. Leveraging of technology for shared mobility services, real-time public transport information and traffic optimisation also has the potential to reduce emissions.

Land use, buildings and transport collectively shape the urban environment, influence daily lifestyles and account for a large share of urban emissions. Effective planning in these sectors may allow cities to transition to low-carbon, resilient and sustainable systems. When planned in an integrated way, these sectors can have a multiplier effect, amplifying the benefits of individual measures. As the literature often suggests, compact land use planning supports efficient public transport systems, while well-designed buildings complement sustainable transport by minimising energy demand. Therefore, these sectors have been identified in the project as crucial to understanding how spatial planning can affect climate neutrality.

15. <https://www.bpie.eu/publication/eu-buildings-climate-tracker-urgency-to-close-the-buildings-decarbonisation-gap/>

BOX 5. URBAN MODELS AND CLIMATE NEUTRALITY: EXAMPLES FROM EUROPE

Cities in and beyond Europe are increasingly adopting compact city policies, with diverse approaches, to achieve their environmental and climate goals. The COVID-19 pandemic and the related risks of using public transport have further encouraged cities and local planners to experiment with a range of development models. In the following paragraphs, we discuss different urban models, how they relate to climate neutrality and the various urban sustainability trade-offs that may arise from their implementation.

The 15-minute city and the Paris strategy

The “15-Minute city” is an emerging concept increasingly adopted in major European cities as an effective solution for more sustainable urban development. The model draws on the concepts developed by Jane Jacobs in the 1960s about proximity, functional mix and socio-spatial diversity. The 15-minute city came to particular prominence during the COVID-19 outbreak in Paris, where, with the electoral success of the mayor, Anne Hidalgo, an initiative called “Ville du quart d’heure” – the 15-minute city – was launched. The model revolves around the principle that residents should be able to walk or cycle easily to any given node within a city within 15 minutes. The concept of the 15-minute city is strongly linked to the decarbonisation agenda and the goals established by the IPCC as well as to the SDG 11, which concerns equitable and sustainable cities. The main advantages of this model are connected to proximity. Indeed, proximity of functions allows people to walk and cycle to reach the services that they need. That helps to reduce public transport and car traffic substantially with positive effects on city liveability, congestion and pollution. In addition, the concept of the 15-minute city is connected to three principles: density, diversity and digitalisation (Allam et al., 2022), all of which are crucial for decarbonisation agendas. Indeed, density promotes the idea of the compact city and proximity; diversity concerns multifunctionality, which is considered an important factor in fostering conditions for social mixing and multi-culturalism, and digitalisation includes the use of smart technologies to tailor the characteristics of the 15-minute city to local needs (for example, reducing traffic and congestion by promoting more sustainable means of transport).

The doughnut city^[16] strategy in Amsterdam

In April 2020, the City of Amsterdam became the first municipality in the world to propose the “doughnut city” model as a means of recovering from the COVID-19 pandemic, respecting the Earth’s natural boundaries. By transitioning to a circular city,

16. The doughnut city concept, introduced in 2012, is depicted as a diagram comprising three concentric circles. The innermost circle is the social foundation, which ensures everyone’s basic needs, like housing, food and education, are met. Falling below that threshold leads to social deprivation. The outermost circle is the ecological ceiling, representing the planet’s environmental limits. The space between those two circles, the doughnut, is the safe and just space where cities can thrive, balancing social well-being with ecological sustainability.

Amsterdam aims to achieve a 55% reduction in emissions by 2030 and a 95% reduction by 2050, compared to 1990 levels. The vision has been translated into a five-year strategy (the Amsterdam Circular Strategy 2020-2025), which will allow Amsterdam to become a circular city through 17 policies in three different fields: construction, food and consumer goods (City of Amsterdam, n.d.). Within the construction field, urban form and spatial planning play a central role. The city's focus is on flexible zoning (through "hubs" that can support circular activities and be incorporated into residential areas), climate adaptation, regenerative urban design and operations across different scales, from construction to neighbourhood planning. Spatial planning at the district level – to adapt to area-specific needs – is aimed primarily at mixed-use development, which is considered crucial for more efficient use of space, the development of sustainable transport solutions and the creation of more cohesive, collaborative and sustainable behaviours.

Superblocks in Barcelona

Superblocks are one of the central strategies set out in the Barcelona Climate Plan 2018-2030, which aims to reduce the city's emissions by 45% by 2030 and to achieve carbon neutrality by 2050. Barcelona's superblocks each consist of nine blocks of buildings^[17] and the basic road grid that connects them, thus forming a unit of 400 x 400 m, with approximately 5,000-6,000 inhabitants. While the roads within the superblocks are closed to motorised traffic and above-ground parking, prioritising pedestrian and cycling paths, heavier motorised vehicles are permitted to circulate in the perimeter of the superblock. Superblocks therefore represent an urban model that, by reconfiguring the road network, can substantially reduce traffic and related emissions, thereby helping to enhance green spaces, health and quality of life (López et al., 2020). Another important aspect of superblocks is that they represent a form of "low-tech" urbanism as they do not require investments in hard infrastructure and demolition of buildings.

There are several environmental, economic and social benefits of implementing superblocks. For instance, reducing car traffic and parking spaces increase the areas available for pedestrians, public spaces and green spaces. According to Lopez et al., 2020, a reduction in car traffic of just 13% frees up about 70% of mobility space. That shift leads to improved air quality, especially by reducing the heat island effect, as well as reduced noise and increased street safety. In addition, this spatial pattern allows for an orthogonal public transport system, which is more efficient, shorter, quicker and less expensive than radial systems. There are, however, also significant drawbacks such as a possible increase in regional traffic. Accordingly, the superblock approach is not sufficient to decrease emissions from the transport sector. To reduce the use of private cars more effectively, it is important to plan an improved public transport network in conjunction with the design of the superblocks. Furthermore, as Egginam, 2022 points out, superblocks may cause gentrification.

17. Barcelona has a regular grid structure based on the 1860s city plan designed by Ildefons Cerdà.



Photo: City of Oulu

5. CONCEPTUAL FRAMEWORK: AN INSTITUTIONAL PERSPECTIVE FOR ANALYSING CLIMATE NEUTRALITY EFFORTS

This chapter outlines the conceptual framework employed in the Nordic Climate Neutral Cities project for analysing Nordic cities' climate neutrality efforts through a multilevel governance perspective.

Multilevel governance

Multilevel governance (MLG) is a relevant framework for analysing how regulatory roles and decentralisation influence urban climate policy. The framework underlines the importance of vertical and horizontal governance dimensions in understanding the challenges and opportunities that cities, which are the focus of this report, may encounter on their pathways towards climate neutrality.

MLG is a concept that describes the articulation and distribution of decision-making authority across different levels of government – local, regional, national and supra-national – and its interaction with non-governmental actors (Kazepov, 2010). This approach emphasises coordination and collaboration across various layers of governance and stakeholders and has become increasingly significant in addressing complex policy challenges such as sustainability and climate change, where no single entity can act effectively in isolation (Hickmann, 2021). MLG operates along two key dimensions: horizontal governance and vertical governance.

Horizontal governance refers to coordination and interaction among actors operating at the same governance level. For instance, municipalities within a region, ministries within a national government or organisations within a specific sector collaborate to address common challenges. This type of governance relies on fostering networks, partnerships and cooperative strategies that enable entities to pool resources, exchange knowledge and jointly implement solutions (Polk, 2011). In practice, horizontal governance can be observed in cooperation across different municipal sectors, as exemplified by initiatives such as the aforementioned C40 Cities Climate Leadership Group, where cities collaborate on shared climate goals, exchange best practices and develop common strategies to address global warming. Similarly, regions might coordinate on transport systems or cross-border environmental concerns (Hickmann, 2021). However, horizontal governance is not without challenges. Competing interests, power imbalances and siloed approaches marked by poor inter-sectoral coordination can lead to inefficiencies in decision-making.

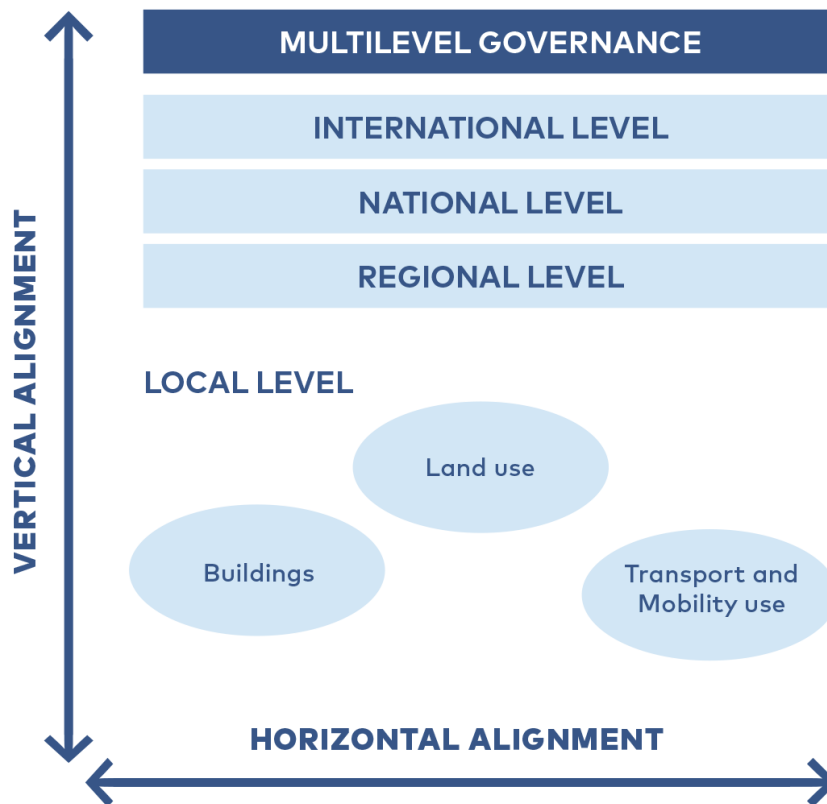
- Vertical governance, by contrast, focuses on the interactions between different governance levels – local, regional, national and supra-national. It concerns the alignment of policies, resources and strategies across those scales. For example, translating broad goals like the United Nations Sustainable Development Goals (SDGs) into actionable plans requires cooperation across governance levels (Bouwma et al., 2015).

One of the primary mechanisms of vertical governance is the transfer of resources, expertise and regulations from higher levels to lower ones. For instance, national governments may set regulatory frameworks for environmental protection while providing funding and technical support to local governments to implement sustainability initiatives (Olsson et al., 2019). At the same time, regional authorities can act as intermediaries, adapting national policies to local contexts and conveying local needs and challenges to higher governance levels (Trygg & Wenander, 2022).

Nevertheless, vertical governance also presents challenges. Misalignment between governance levels, bureaucratic inefficiencies and limited local policy capacity can create obstacles to effective implementation. For example, local governments often struggle with insufficient resources or autonomy, making it difficult to meet national or international policy objectives (Bouwma et al., 2015).

As explained in the previous chapter, land use, buildings and construction, and transport and mobility are important spatial planning sectors for achieving climate neutrality as they are significant sources of greenhouse gas (GHG) emissions. Therefore, as illustrated in Figure 1, multilevel governance challenges and opportunities of Nordic cities will be emphasised in relation to these sectors in the empirical analysis of local cases (see Chapter 7).

FIGURE 1. MULTILEVEL GOVERNANCE ACROSS LAND USE, BUILDINGS AND TRANSPORT AND MOBILITY



Created by the authors

Policy and institutional capacity for climate neutrality

Cities are key players in addressing the challenges related to climate change and curbing GHG emissions. One of the reasons is that local governments have wide-ranging responsibility for land use planning, which, as previously explained, plays a crucial role in achieving climate neutrality goals. Notwithstanding the relevance of MLG relations and negotiations, it is also crucial to acknowledge that the extent to which local governments can mitigate climate change effectively depends heavily on their institutional and policy capacity (Figure 2). In this section, these crucial concepts and their components are explored.

Policy capacity pertains to the ability (and political will) to respond to and manage current social and environmental challenges through decision-making, planning and implementation processes. According to Cucca and Ranci (2022), three main aspects characterising local autonomy within MLG settings can be identified:

Political will refers to the commitment and determination of political leaders or institutions to pursue, support and implement specific policies, reforms or actions. It signifies their readiness to allocate resources, take risks and prioritise efforts to achieve desired outcomes.

- **Financial dependence** of local authorities on the state refers to the level and nature of public funding provided by central governments and the degree of central limitations imposed on sub-national financing and expenditures. This dependence exists on a spectrum, ranging from contexts where local authorities benefit from strong central financial support to those where resources are predominantly locally sourced, with minimal state funding.
- **The degree of regulatory autonomy** granted to local or regional authorities reflects the extent to which urban or regional policy is governed by national regulations or direct political decisions. This autonomy is shaped by specific legal frameworks and the degree of central oversight in policy implementation.

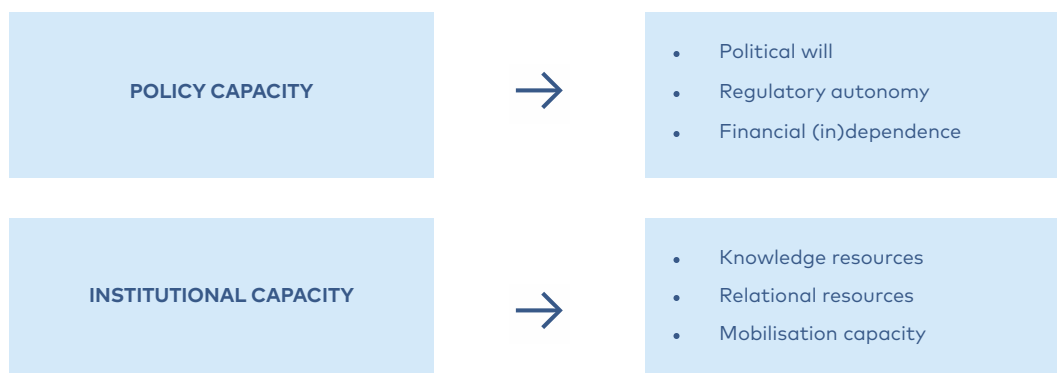
As far as institutional capacity is concerned, within the literature on collaborative planning, Healey (2020) defined three dimensions:

- **Knowledge resources** are types of knowledge used by planners and practitioners centred around what should be done, why it should be done and how it should be done in a specific planning context such as a municipality (Trygg & Wenander, 2022). With reference to sustainability and climate neutrality, knowledge resources can refer to the awareness among planners – and other relevant key actors working on climate neutrality strategies – of the complexity of such strategies and their possible implications. That encompasses both multi-dimensional aspects – i.e. social, environmental and economic sustainability – and multilevel aspects from a governance perspective (Polk, 2011).
- **Relational resources** refer to the social networks linking various actors (at different scales and in different sectors of society) and how those actors build up mutual levels of trust in the given networks (Polk, 2011). Additionally, this dimension highlights where power to drive change is located and possibly obstructed. In relation to climate neutrality, as noted by Wretling & Balfors, 2021, it is important to take into account the function of governance networks for interacting with various stakeholders. This is also reflected in the literature on climate planning and governance, as there has been a rise in both the number of authorities participating in municipal networks for local climate governance – chiefly transnational networks such as Covenant of Mayors and Cities for Climate Protection – and the research interest of such networks. According to Gustavsson et al.(2009), municipal networks *"have the potential to function as vital channels for the dissemination of information, best practice and knowledge and thereby speed up the process*

of capacity building, not least at the local level". Kern and Alber (2009) emphasise that, despite the attention given to transnational municipal networks, horizontal and vertical collaboration is particularly crucial within metropolitan regions. They argue that effective mitigation efforts must go beyond municipal boundaries, especially when it comes to urban form and planning. This highlights the potentially significant role municipal networks can play at regional and sub-regional levels.

- **Mobilisation capacity** describes how knowledge and relational resources are used to challenge power structures and facilitate change processes (Polk, 2011). Mobilisation capacities capture both the structural pre-conditions for action and individual stakeholders' capacities to develop learning, trust and action space. Being able to mobilise knowledge and networks is tied to the capacity to challenge and change the current direction. In summary, institutional capacity allows us to analyse whether local actors have, and can mobilise, the resources they need to plan for sustainable development.

FIGURE 2. POLICY AND INSTITUTIONAL CAPACITY



Created by the authors

Building on the conceptual framework outlined in this chapter and illustrated in Figure 2, we applied it to develop our case study analysis and guide interpretation of our data. In the next chapters, we will illustrate how, using a multilevel governance perspective, we examined both policy and institutional capacity of selected Nordic cities across the three spatial planning sectors: land use, buildings and construction, and transport and mobility.



Photo: Lars Thulin/Scandinav/imagebank.sweden.se

6. METHODOLOGY

In this chapter, we explore the methodological approach adopted in the project. The study design is based on case studies, representing a robust research strategy for answering complex questions about contemporary issues within their real-life context (Yin, 2009). The case studies can potentially uncover new findings and inspire further research, especially in unexplored or insufficiently studied areas (Berg, 2001). Such a study design was deemed most appropriate to produce contextualised knowledge about Nordic municipalities' institutional capacity to drive the transition to carbon neutrality. The case study analyses were mainly based on qualitative methods, which will be explained in detail in this section, but a quantitative approach provided a robust framework for selecting the cases.

Case study selection

The selection of case studies was guided by two key criteria:

First, the focus was on medium-sized cities, excluding both large cities and small settlements. Among the 1,123 municipalities in the Nordic Region, only five have populations exceeding 500,000, making them unrepresentative of the region as a whole. Conversely, small settlements with populations below 40,000, while also facing the challenges of a changing climate, may lack the institutional and political capacity to address these issues effectively and are less likely to have climate plans in place. As a result, the study excluded municipalities with populations of over 500,000 or under 40,000, narrowing the selection to 75 municipalities (see Table 4).

Second, we further narrowed the selection to cities with populations of between 40,000 and 500,000 that exhibited pronounced densification trends. Specifically, we focused on cities that had experienced urban population growth of at least 15%

between 2008 and 2022 (see Table 5). This analysis was facilitated by the Nordic urban-rural typology (Stjernberg et al., 2024), which provides detailed population density data at a 1 km x 1 km grid level and categorises land use into several classes: (a) inner urban area, (b) outer urban area and (c) peri-urban area. This classification enabled us to identify where population growth occurred within these municipalities and to infer varying patterns of spatial development, such as compact growth or urban sprawl.

TABLE 4. NUMBER OF MUNICIPALITIES WITH A POPULATION BETWEEN 500,000 AND 40,000 INHABITANTS (2022)

NUMBER OF MUNICIPALITIES COUNTRY	DK	FI	NO	SE	TOTAL
Total per country	99	311	422	291	1123
Criteria 1: With a population between 500,000 and 40,000 inhabitants	16	17	15	27	75
Criteria 2: With at least 15% urban population growth (2008- 2020)	3	2	5	11	21

While the quantitative criteria shortlisted the options, further discussions with the members of the Nordic Thematic Group for Green and Inclusive Urban Development (TGA) guided the final choice of the cases. To facilitate a robust analysis of ambitions and strategies for achieving climate neutrality, the case study cities were categorised into two typologies: (1) **Frontrunner cities**, which meet all selection criteria and are participants in the European Programme for 100 Climate-Neutral Cities and (2) **Striver cities**, which also meet all the established criteria but are not part of the programme. Table 5 provides a detailed list of the case study cities.

TABLE 5. SELECTED CASE STUDY CITIES

	DK	FI	IS	NO	SE
Frontrunners	Aarhus	Tampere	Reykjavík ^[18]	Trondheim	Lund
Strivers	Vejle	Oulu		Kristiansand	Växjö

Data collection and analysis

Several strategies were employed for collecting data, including a review of scientific and grey literature, semi-structured interviews, a workshop and document analyses of policies and strategies.

Document analysis

In addition to local climate plans and strategies, the document analysis included planning documents relevant to the three analysed spatial planning sectors: land use, transport and mobility, and buildings and construction. While these documents outline visions and strategies to address key challenges, they often lack detailed performance data. To bridge this gap, technical reports served as a crucial resource, providing insights into implementation measures, outcomes, challenges and opportunities related to achieving climate goals. The policy documents and reports included in the case studies are listed in Appendix B.

Semi-structured interviews

To gain insight into the factors that influence institutional capacity and political will in each of the case study cities, interviews with municipal representatives were conducted. The interviewees were planners and officials with relevant responsibilities for integrating climate issues into their departments and thematic areas. Each case study involved four interviews with civil servants possessing competencies in: (1) defining and implementing the overarching climate strategies in the municipality (2) land use planning, (3) buildings and construction and (4) transport and mobility. The case study interviews were conducted in the local language, except for the Norwegian and Swedish cases, which were conducted in English. The interviews for the Icelandic case study were conducted in person, while the remainder were conducted digitally. All the interviews lasted about one hour and were recorded and transcribed. The participants' answers were anonymised, stored and treated confidentially.

18. Given Iceland's relatively low level of urbanisation - Reykjavík has approximately 300,000 inhabitants, followed by Akureyri with around 190,000 - it was considered appropriate to focus the analysis on a single city. This decision was discussed and validated in consultation with stakeholders from the Nordic Thematic Group for Green and Inclusive Urban Development (TGA).

Furthermore, to gain an understanding of how national climate networks help municipalities to transition to climate neutrality, interviews were also conducted with representatives of these networks (i.e. K2020 and CONCITO in Denmark; Viable Cities in Sweden; HINKU in Finland). The drafts of the case studies were sent for review to all the interviewees. A comprehensive list of interviews and the interview guide can be found in Appendixes C and D.

The text based on the interviews was submitted to the interviewees for review to ensure that their views had been accurately interpreted and to avoid any potential misunderstandings in the representation of their perspectives. Given that the information provided by the interviewees reflected their personal opinions and experiences, it was deemed critical to approach these insights with caution. To enhance the reliability of the findings, complementary document analysis (explained above) and an in-depth examination of the local context were conducted.

Workshop

To gain input on the policy messages in this report (see Chapter 8), a workshop was held during the Nordregio Forum 2024: *Nordics Turning Green*. The workshop was attended by practitioners and researchers from Nordic and Baltic countries. During the workshop, participants were invited to discuss the challenges, barriers and potential solutions and measures for the three sectors covered in the report (land use, buildings and construction, transport and mobility). The key recommendations and actionable insights presented in this report draw on the research findings and the discussions held during the workshop.

PART II

CLIMATE NEUTRALITY IN NORDIC CITIES: A MULTI LEVEL GOVERNANCE PERSPECTIVE



Trondheim. Photo: Martin Håndlykken/Visit Norway

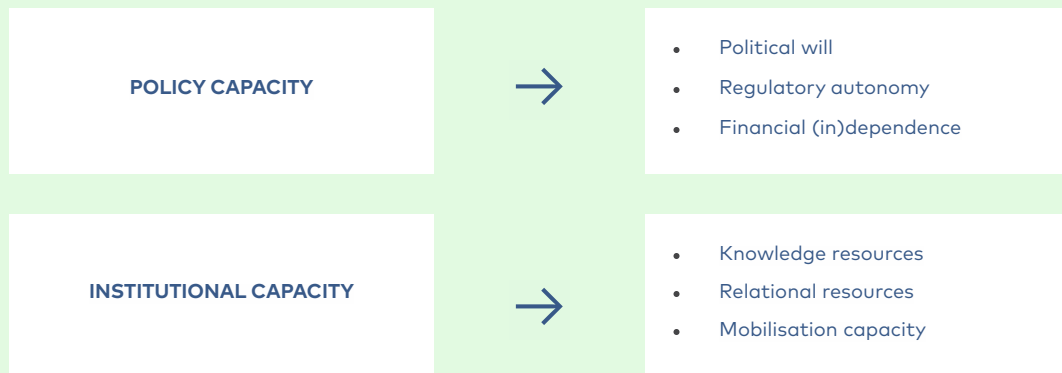
CLIMATE NEUTRALITY IN NORDIC CITIES: A MULTI LEVEL GOVERNANCE PERSPECTIVE

Part II of this report explores the policies, strategies and tools Nordic cities use to pursue climate neutrality through spatial planning. It is organised into five subchapters, one for each Nordic country. For each country chapter, the analysis highlights two case study cities: one identified as a frontrunner (Aarhus, Tampere, Reykjavík, Trondheim and Lund) and the other as a striver (Vejle, Oulu, Kristiansand and Växjö). For each case study, we apply our conceptual framework (see Figure 3) to demonstrate how an institutional perspective can shed light on the diverse challenges that Nordic cities face in their efforts to achieve climate neutrality.

For each case study, we first present the overarching local climate strategies and key policies for the three sectors: land use, transport and buildings. Second, we apply a multilevel governance perspective to discuss local policy capacity, assessed through financial dependence, regulatory autonomy and governance tensions at both the vertical and horizontal levels.^[19] We then go on to explore how institutional capacity – i.e. knowledge resources, relational resources and mobilisation capacity – affects local climate efforts. Each country chapter concludes with an overview of the key challenges in achieving climate neutrality, along with broader implications and potential solutions.

19. In our framework, policy capacity also encompasses political will, which we explored in the previous chapter by illustrating the commitment of each city to climate neutrality.

FIGURE 3. CONCEPTUAL FRAMEWORK



Created by the authors

Policy capacity involves both the ability and political will to address social and environmental challenges via effective decision-making, planning and implementation. In multilevel governance (MLG) settings, local autonomy is shaped by:

1. **Regulatory autonomy:** The level of independence that local or regional authorities have in policymaking, influenced by national regulations and central government decisions.
2. **Financial dependence:** The extent of local reliance on state funding, which varies from strong central support to situations where local governments generate their own resources with minimal state aid.

Institutional capacity includes three key dimensions:

1. **Knowledge resources:** This dimension refers to the understanding of complex, multi-dimensional challenges related to climate neutrality (social, environmental, economic) by planners and stakeholders.
2. **Relational resources:** Social networks and trust among stakeholders that facilitate collaboration across scales, especially within climate-focused municipal networks that disseminate knowledge and best practices to support local action.
3. **Mobilisation capacity:** This is the ability to use knowledge and networks to enact change by addressing power dynamics and creating conditions for collective action, which is crucial for advancing climate goals.

Both policy and institutional capacity are analysed in the project through a multilevel governance lens, exploring both vertical and horizontal governance tensions.



Aarhus. Photo: Unsplash.com

7. DENMARK



CASE: AARHUS



Aarhus. Photo: Adam Mørk

Background information

Aarhus, the second largest city in Denmark, is located on the eastern coast of the Jutland peninsula. As of 2024, the municipality of Aarhus has a population of 367,663, with 295,688 people living in the city. The population has been growing steadily, with an increase of over 5,000 people in 2023. Over the past ten years (2013-2023), the population grew by around 48,000 people. According to population projections, Aarhus will have a population of almost 400,000 residents by 2033 (Aarhus Municipality, 2024a).

As of 2023, the largest employment sector in the municipality is public administration, education and health. This is followed by trade and transport and business services. Aarhus also has the highest number of industrial jobs in Denmark, within key industries such as machinery (27%), food and drink (26.7%) and the furniture industry (12.5%) (Aarhus Municipality, 2024b). These figures highlight Aarhus's diverse economy, with particular strengths in public services and industry.

Strategic level: municipal goals and policies

Aarhus is considered to be among the most climate-ambitious municipalities in Denmark, driven by a city council that is striving to position Aarhus as a municipality with progressive and aspiring climate goals (Interviewee 5, 2024). The goal of achieving climate neutrality by 2030 was set in 2008, defined as a 70% reduction in emissions compared to 1990 levels (Aarhus Municipality, 2020). Additionally, the municipality aims to become fully emission-free in 2050.

To meet those objectives, a climate strategy was developed in 2020, outlining general principles for reducing emissions. To complement the strategy, a climate action plan setting out detailed efforts was developed for 2021-2024. A new action plan is currently underway, which is expected to reaffirm the emission goals (Interviewee 5, 2024). Furthermore, the climate action plan is supported by a catalogue of measures for six focus areas where emissions should be reduced: (1) energy, (2) transport and mobility, (3) buildings and construction, (4) industry and agriculture, (5) Aarhus transforms and (6) the municipality as a climate-friendly workplace/organisation (Aarhus Municipality, 2020). These six areas are guided by a number of principles, including:

- Focusing on direct emissions (Scopes 1 and 2) but also taking responsibility for collective emissions (Scope 3).
- Not relying on compensation schemes.
- Thinking about the green transition holistically and seeking opportunities and positive outcomes for the urban community.
- Supporting the development of carbon capture, utilisation and future carbon storage.
- Leveraging partnerships to tackle the current issues.

Data from 2022 show that the transport sector (729,000 tonnes) and energy sector (698,000 tonnes CO₂) are the largest emitters. To reduce emissions from energy use, the goal is to transition to renewable energy in all sectors (including transport and buildings) (Aarhus Municipality, 2021c). In the buildings sector, the primary goals are for the city to grow without an increase in energy consumption and to achieve a 70% reduction in greenhouse gas emissions from materials and activities associated with construction. The focus area on transport and mobility is aimed at

minimising demand for transport in general while also creating the opportunity for combining different transport solutions. Aarhus expects to reduce carbon emissions by 282,500 tonnes in 2024 with significantly higher figures by 2030 if carbon capture technologies are successful (Aarhus Municipality, 2021c). Nevertheless, the upcoming climate action plan indicates that the municipality will fall short of reaching its neutrality goal in 2030 by 846,000 tonnes of CO₂ in 2030. Overall emissions are lower than in 2009,^[20] representing a downward trend (Aarhus Municipality, 2024a).

The municipality measures emissions in Scopes 1, 2 and 3 (see Box 1 for definitions) resulting from its own operations as well as the overall emissions in the geographical area of the municipality. The data are collected annually and classified according to different sectors. An assessment is being conducted to evaluate the effects of Scope 1 and Scope 2 emissions. This assessment is cross-referenced with national initiatives, with municipal goals subsequently being updated to reflect both local emission levels and national policies. The target figures for 2030 take national decisions and initiatives into account as well as current emissions and local efforts. Consequently, the policy for Scope 1 and Scope 2 will become frozen policy^[21] (Interviewee 5, 2024). While no targets have been set for Scope 3, a report with emissions for 2021 has been published. The city council is currently considering whether to create specific goals for Scope 3 as well.

As an integral part of working with the EU Mission for 100 Climate-neutral & Smart Cities, the Climate City Contract (CCC) action plan and the previous years' municipal climate actions, Aarhus is paying increasing attention to co-benefits of the transition (Interviewee 5, 2024). As the measures required for CO₂ reductions become more difficult and more comprehensive, it is increasingly important to focus on the co-benefits that the green transition brings and thus formulate a value-based vision beyond CO₂ reductions. The green transition of Aarhus should not only contribute to achieving the national and international CO₂ goals but also create value for its citizens, businesses and communities.

Financing Aarhus's climate initiatives has historically relied on mechanisms such as climate funds and climate pools, which provided funding for various programmes. These mechanisms have had mixed success, as not all funded programmes have effectively reduced the city's carbon footprint. While most funding opportunities stem from municipal climate funds, external sources like Realdania have also played a role. For instance, Realdania supported a project that transformed the city's inner harbour from an industrial area into an urban space, incorporating climate protection measures for the city (Realdania, 2017). As the municipality develops new climate plans, it is currently exploring how future financing structures and systems should be designed (Interviewee 5, 2024).

20. 2009 was when relevant data first became available.

21. "Frozen policy" describes a scenario in which no new policies are introduced (Danish Energy Agency, 2023).

The climate secretariat – a technical and environmental department of the municipality (Interviewee 5, 2024) – is in charge of overseeing and coordinating the climate initiatives. Nevertheless, as most initiatives span multiple sectors, nearly all municipal departments are involved in implementing the plans in some capacity. This involvement also extends to municipally owned businesses, such as Kredsløb, an energy company that provides electricity to Aarhus.

An interviewee from the municipality acknowledges that, in retrospect, the goals in the current climate plan might not have been the most appropriate ones to set (Interviewee 8, 2024). While the goals might have seemed correct five years ago, time has shown that different issues need to be addressed, which will be outlined in the upcoming climate plan. On the other hand, the municipality has learned from this experience and has dedicated significant time to setting more concrete and well-thought-out aims in the upcoming climate plan.

The greatest governance challenges to achieving climate neutrality lie in areas where the municipality lacks a mandate. This is especially the case for private industries and agriculture, where the jurisdiction of the municipality ends abruptly (Interviewee 5, 2024). Strengthened regulations may be needed to enforce climate actions across all municipal departments (Interviewee 5, 2024). Another significant barrier is the individual decision-making of citizens when it comes to choosing modes of transport. While the municipality can create a green mobility plan and make green transport methods more accessible, there is no guarantee that residents will change their preferences and habits. Ultimately, the municipality is dependent on the actions of citizens and stakeholders to reach its goals.

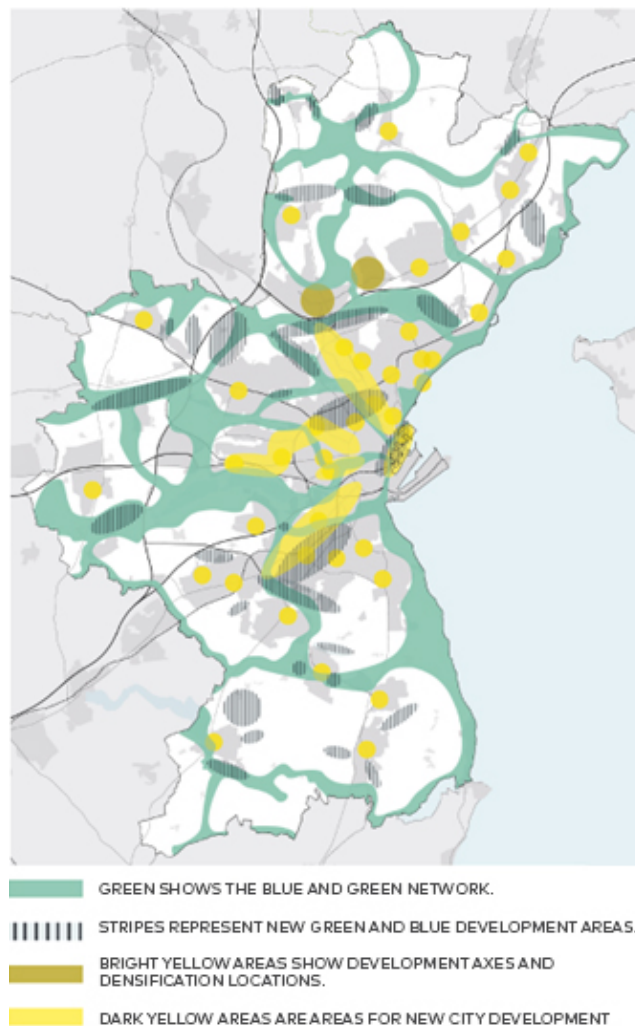
Land use sector

To support the city's climate goals, Aarhus has set a vision of becoming a 15-minute city. By densifying the city into clusters around existing urban areas and traffic hubs and ensuring easy access to necessary amenities, the city aims to facilitate sustainable lifestyles. Densification will primarily occur along key corridors, following the main streets that run in and out of the city (Aarhus Municipality, 2021a). To promote the 15-minute principle, new projects will focus on local needs (Aarhus Municipality, 2023a). To this end, the municipality is using core data to assess the coverage of essential services such as shops, day care centres and medical centres and how residents can access them (Interviewee 6, 2024).

In the municipal plan, cohesive green spaces and nature are considered part of the solution to climate-related issues. Hence, the municipality is focusing on developing a network of blue and green areas, while newly established development areas will prioritise projects that create synergies between climate adaptation, nature and recreation (see Figure 1) (Aarhus Municipality, 2021a). The plan emphasises that new developments and the blue-green network around the municipality should support one another in creating a healthy living environment where local amenities

and natural areas are readily accessible. The municipality acknowledges that it will be more difficult to implement the strategy of combining green areas with already developed city environments. Therefore, the municipality is striving to find solutions that combine the existing landscape of the city with new green areas. Moreover, the municipality is also working on conservation and nature-related strategies, such as where to place surplus soil and where to begin afforestation in relation to groundwater areas (Interviewee 6, 2024).

FIGURE 1. URBAN GROWTH MODEL FOR AARHUS. BLUE-GREEN AREAS AND URBAN GROWTH PRIORITISATION. (AARHUS MUNICIPALITY, 2021B)



Currently, the municipality is preparing a new municipal plan, which is set to take effect in 2025. The upcoming plan builds on the preceding strategy plan from 2024. A key focus of the strategy is to protect natural areas by targeting already

urbanised areas for future development. This includes prioritising existing city growth zones, repurposing brownfields for development and retrofitting old buildings (Aarhus Municipality, 2023a). However, repurposing of existing buildings is, however, seldom practiced with new construction being the more common approach (Interviewee 8, 2024). Repurposing requires political approval and many older buildings fail to meet current safety or emission standards. There is also a bias against reusing buildings due to their perceived low quality or unattractive locations. As a result, the municipality has not developed a strong practice of repurposing, creating tension between plans to reduce construction and the current trend of building new structures. However, the upcoming municipal plan could shift this approach.

To estimate the climate impact of land use, the municipality is currently developing a CO₂ assessment tool. The tool will be used whenever a local plan for a specific area is being developed. As the tool is not fully developed, the current challenge is to decide on the evaluation framework, as the reliability of the tool depends heavily on the method for evaluating the CO₂ impact (Interviewee 6, 2024).

Lastly, the green energy transition requires space, which is rather limited within and around Aarhus. It is therefore necessary to plan for multifunctional land use, such as combining afforestation with the installation of wind turbines (Interviewee 5, 2024). However, current legislation limits multifunctional land use. Such limitations might be lifted in upcoming years, as there is increased political focus on ensuring the right political leeway for the municipalities' green transition, including opportunities associated with multifunctional land use (Interviewee 5, 2024). The "Green Tripartite" (consisting of the Government, Agriculture and Food, the Food Federation NNF, Danish Metal, Danish Industry and the National Association of Municipalities) is working to reach an agreement on principles for recommendations and solutions on how to create areas in the future where agriculture, nature, renewable energy and recreational areas can coexist. For Aarhus, with its blend of urban, peri-urban and rural areas, a legislative change promoting multifunctional land could unlock new opportunities, such as potential renewable energy facilities, biogenic parks and increased afforestation.

Buildings and construction sector

In 2022, 74% of municipal buildings in Aarhus belonged to a low energy class (D, E, F and G). In comparison, the national average in the same year for municipal buildings with a low energy class was 64% (Pedersen, 2022). The municipality is aware of the situation and is actively working to improve the energy efficiency of all municipal buildings. An analysis by the municipality shows that if the municipality is to comply with the Paris Agreement, the energy performance of all buildings needs to be higher than the minimum requirements under current regulations. Therefore, the municipality is also encouraging developers to meet a "voluntary sustainability

class" (Interviewee 6, 2024).

To monitor the emissions and energy efficiency of municipal buildings, Aarhus uses life cycle assessment (LCA). LCA is used for every new municipal building to compare expected and actual CO₂ emissions (Interviewee 8, 2024). Moreover, the municipality has development projects focused on LCA in other domains, including material recycling and transitioning machinery from fossil fuels to electric power (Interviewee 9, 2024)

The main goal for new buildings is for them to be constructed according to low-emission classes (Interviewee 8, 2024). All new municipal buildings should meet the criteria of the voluntary emissions class. In other words, the municipality is more ambitious than current national requirements in making new buildings more climate-friendly (Interviewee 6, 2024). However, existing buildings do not undergo such an extensive evaluation process. Instead, the municipality has an energy management initiative, which monitors and evaluates when a building needs renovation (Interviewee 8, 2024).

Outside the public sector, the municipality has limited influence over the decisions of private building contractors and owners. While building codes set specific requirements, these are regarded by several interviewees as rather weak and lacking ambition (Interviewee 8, 2024). The two municipality departments responsible for municipal buildings and private builders work closely together, since the municipality has observed that leading by example and taking on some risks and challenges by implementing new approaches within its own buildings encourages the private sector to follow suit (Interviewee 8, 2024).

The municipality has its own pool of funds, allocated for purposes including innovation and building in a climate-efficient way (Interviewee 8, 2024). At the outset of a new project, the municipality can allocate additional funds to a specific type of material to increase climate efficiency. The funds can also be used to cover the costs of LCA, since the municipality requires a more nuanced and in-depth evaluation than the average LCA, incorporating data and analysis related to environmental aspects. The municipality has supported projects involving the circular economy and has launched initiatives to promote the construction of high-rise buildings using wood and recycled materials (Interviewee 9, 2024). By doing so, the municipality can support pilot initiatives that may inspire future projects.

Transport and mobility sector

Aarhus municipality witnessed a 6% rise in car traffic between 2012 and 2022. This increase is, however, significantly lower than on the national level, which was around 11%. Bicycle traffic in Aarhus has increased by 12% during the last decade, while on the national level the increase was only 1% (Aarhus Municipality, n.d.-b). As of 2017, the municipality had 675 km of bicycle lanes (Aarhus Municipality, 2020). Between

2020 and 2022, the most popular mode of transport in the inner city was walking, accounting for 37% (29% in the whole municipality), followed by cars at 29% (47% in the municipality) and bicycles at 20% (14% in the municipality). Lastly, tram and buses account for 11% of all transport options (6% in the municipality) (Aarhus Municipality, 2022).

The municipality has set the goal of 60% of all transport choices in the wider municipality by 2030 being either by bicycle, collective transport or on foot (Aarhus Municipality, 2024d). According to Danish statistics, less than 60% of families own a car in Aarhus municipality as of 2023 (below the national average), while less than 15% own several cars (Danmark's Statistics, 2023). In 2021, Aarhus municipality emitted a total of 1,267,457 tonnes of CO₂, while in 2022 the transport sector, as the largest contributor, accounted for 729,000 tonnes of CO₂⁴ (Aarhus Municipality, 2024e). Municipal vehicles emitted 1,819 tonnes of CO₂ in 2021 out of the total 39,495 tonnes of CO₂ emissions produced by the entire municipal organisation (Aarhus Municipality, 2024a).

The general goal for the municipality's transport sector is the same as for the rest of the municipality, namely, to achieve carbon neutrality by 2030. Nevertheless, that does not necessarily entail elimination of all fossil-driven vehicles in Aarhus. This is due to the development of carbon capture and storage, an initiative that Aarhus' heat and power plant is actively pursuing (Interviewee 7, 2024). In simple terms, the system would capture CO₂ in and around the area of Aarhus and store it in designated facilities.

Aarhus does not yet have a green mobility plan, but the transport and mobility department is currently working to have such a plan ready by the end of 2024. The plan is expected to include specific projects and actions for green mobility (Interviewee 7, 2024). Nevertheless, as mentioned, transport and mobility issues are addressed in the climate action plan. Mobility-related measures include reducing the general need for transport (Aarhus Municipality, 2021c). That goes hand in hand with Aarhus' vision of becoming a 15-minute city with all necessary facilities reachable within walking distance. Transport habits also need to change, meaning reliance on transport methods that require high energy or CO₂ consumption must be reduced. Modes of transport such as light rail, cycling and carpooling need to become the natural choice for daily commutes. However, solely changing transport methods is not enough, as residents will still use cars (Aarhus Municipality, 2021c). Therefore, new technologies need to be introduced more broadly in the transport sector. From electric cars to hybrid planes and other forms of sustainable energy sources, innovations need to be developed to tackle the climate crisis effectively.

Finally, the climate action plan underlines the importance of necessary infrastructure as well as incentives to make the transport sector more climate-friendly (Aarhus Municipality, 2021c). These will be expanded on in the upcoming green mobility plan, which will specify the relevant instruments and procedures in

more detail. The latest mobility plan for Aarhus was released in 2018 and addresses the main issues regarding mobility in the city (Aarhus Municipality, 2018).

Aarhus municipality has commissioned a survey, asking people which methods of transport they primarily use and in which situations. Those data are used to build an understanding of local transport habits in the municipality in order to identify the necessary measures (Interviewee 7, 2024). Public transport data are gathered by monitoring ticket purchases made through when the Danish national electronic ticket system *Rejsekort*.

To support mobility planning the municipality has developed a guiding document which divides Aarhus into five area types, from most urbanised to most rural. The area types are used as a reference point to understand social aspects such as residential distribution and area size and transport habits and preferences. The upcoming green mobility plan will include specific goals and procedures for distinct areas, while still ensuring the overall development of mobility in Aarhus. In addition the municipality has developed a "mobility toolbox" (see Text box 1)

The municipality also offers incentives to support more sustainable options. For instance, electric vehicles can park in public parking spaces for free for four hours and three hours at the charging ports (Interviewee 7, 2024). In addition, heavy vehicles that do not comply with the Euro 5 emission standard have to pay a fee to enter the city centre. This fee is managed by *Sund og Belt*, the same company that administers fees for crossing the Great Belt and Öresund (Interviewee 7, 2024). Recently the municipality has also raised the prices for residents wishing to park their cars by their building from 500 DKK per year to 2,500 DKK for the first car and 3750 DKK for the second car. There are already indicators of success, as fewer parking permits have been issued (Interviewee 7, 2024).

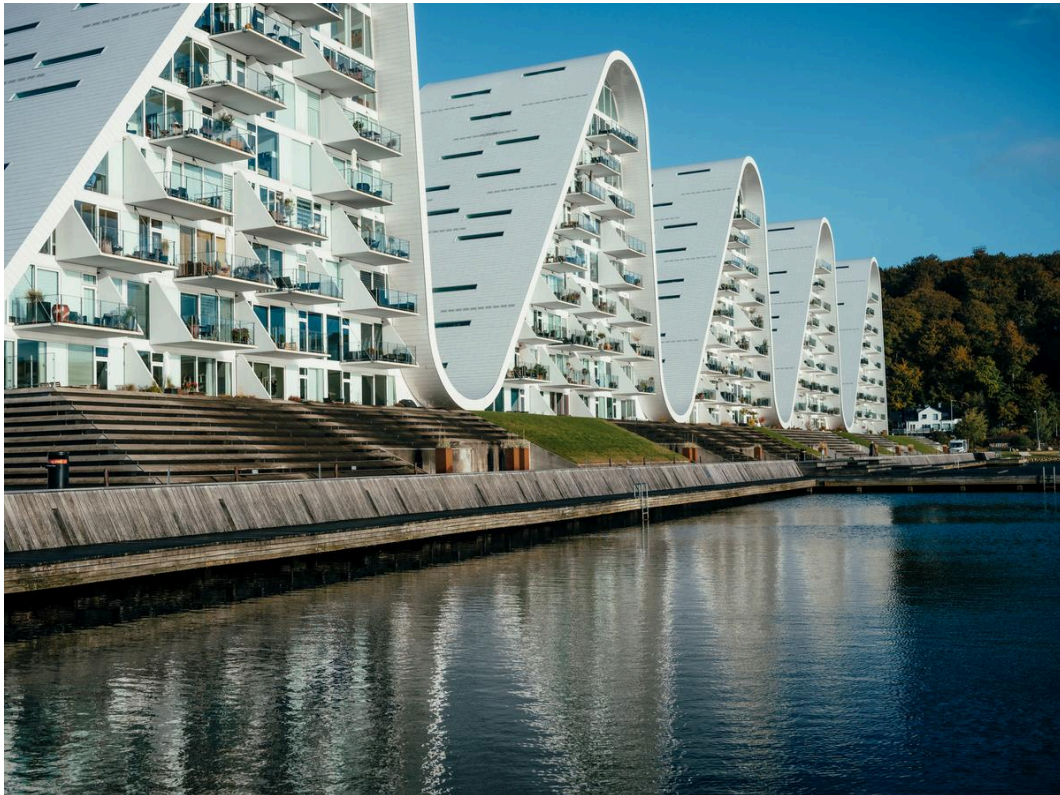
BOX 4. BEST PRACTICE. AARHUS MOBILITY TOOLBOX

The municipality has developed a “mobility toolbox” which provides insights, inspiration and knowledge (Aarhus Municipality, 2023b). The toolbox itself is divided into five distinct domains, namely: (1) road and bicycle lane network, (2) public transport, (3) close proximity to necessary facilities, (4) local meeting centres and (5) parking and shared mobility (Aarhus Municipality, 2023b). Each domain is assigned a corresponding checklist, with relevant plans and strategies. The next part of the toolbox assigns the relevant domains to each of the five geographical areas of Aarhus municipality together with some real-life examples. An example from the toolbox is provided in the table below.

INITIATIVES AND EXAMPLES – CITY CENTRE (ADAPTED FROM AARHUS MOBILITY TOOLBOX, 2023)

Road and bicycle path network	Collective traffic	Parking and shared mobility	Local meeting centres
• Pedestrian streets • Cycling streets • One-way streets • Road closures • Speed reduction • Carriageway conversion • Narrowing intersections • Prioritising cyclists and pedestrians in signalling systems • Temporary traffic and urban space tests	• Expansion of high-end public transport • Mobility hubs with good transfer options • Bus stops brought forward • Bus streets • Bus prioritisation in intersections and signalling	• Accessible bike parking (especially in side streets) • Bicycle parking for carrier bikes • Transformation of car parking • Reserved spaces for car sharing • Installation of charging points	• Parklet⁵ • Benches and seating • Greenery along streets and roads and pocket parks • Ground floors with outward-facing functions and inviting facades • Hubs as meeting places

CASE: VEJLE



Vejle. Photo: Unsplash.com

Background information

Vejle is a harbour city located in the southeast of the Jutland peninsula in Denmark. It is the largest city in Vejle municipality, which includes smaller towns such as Jelling, Give, Børkop and Egtved.^[22] While Vejle municipality covers an area 1,058.43 km², the city of Vejle spans approximately 33 km² (Trap Denmark, 2020; Vejle 24, 2022). The municipality forms part of Denmark's "Triangle Region", which encompasses seven Danish municipalities. In 2022, the city of Vejle had a population of roughly 60,231 inhabitants (Vejle Amts Folkeblad, 2022). The population is expected to grow over the next decade, increasing by around 8,663 people or roughly 15% by 2033 (Open Data DK, n.d.).

22. For practicality, references to Vejle will pertain to the city of Vejle and not the municipality, unless stated otherwise.

The average income of residents in Vejle municipality is higher than the national average. This is due to a strong labour force, low unemployment and a highly educated population (with 83% having a vocational degree or higher). The number of workplaces in the municipality is also increasing, setting high ambitions for the area's future development (Vejle Municipality, 2023c). As of 2023, the largest employment sectors are in private trade and services, followed by the public sector and the industrial sector (Vejle Municipality, 2023d). The agricultural sector has experienced the largest decline in workplaces between 2019 and 2022 (more than 2%). On the other hand, the construction sector saw the largest growth in workplaces in the same period (above 3%) (Vejle Municipality, 2022b).

Strategic level: municipal goals and policies

Vejle municipality devotes considerable attention to climate-related issues across several plans including its municipal plan, climate plan and specific plans for mobility and transport as well as buildings. The municipality's climate plan was developed in 2020 and established the framework for the municipality's actions from 2020 to 2050 (Vejle Municipality, 2020b). The plan currently incorporates several focus areas, ranging from energy, green transport and education to waste management, climate-friendly agriculture and other sectors. The plan is scheduled for review in 2025 to refine the approach, such as by adding consumption as a focus area.

The overall goal of the climate plan is to achieve a 70% decrease in CO₂ emissions by 2030 and to reach climate neutrality by 2050. The municipality estimates that it has already achieved 47% of the total required reduction in GHG emissions (Vejle Municipality, 2023f). To reach the objective, the goal has been divided into three main areas, each with their own targets, accompanied by actions to support CO₂ reduction. In the energy sector, 65% of electricity should be supplied by renewable sources by 2030 and 100% by 2050. In the agriculture sector, greenhouse gas emissions should be reduced by 20% by 2030 and 80% by 2050.^[23] Finally, in the transport sector, 30% of cars should be electric by 2030 and 100% by 2050 (Vejle Municipality, 2020b). In 2022, the transport sector (including international flights) emitted 274,000 tonnes of CO₂, the energy sector 2019,000 tonnes and the agricultural sector 299,000 tonnes (Vejle Municipality, 2023f).

The municipality chose to concentrate on long-term solutions, with partnerships and local workplaces being crucial for accomplishing the goals. With that in mind, the integration of climate plans should benefit as many people as possible while prevention and adaptation go hand in hand (Vejle Municipality, 2020b). The climate plan aims to mobilise residents to participate actively in the green transition. Since Vejle is growing rapidly, the municipality is striving for clever and sustainable

23. It is noted that this is uncertain and the reduction potential is not included in the calculations.

growth. The municipality supports the engagement of local communities and businesses in climate actions by allowing them to apply for funding. One option is the Citizens' Green Transition Fund (*Borgernes grønne omstillingspulje*), which supports activities and projects aimed at helping Vejle achieve a 70% reduction in its CO₂ emissions by 2030, while backing key focus areas of the municipality's climate plan. The fund is active until the end of 2024 and supports areas such as energy, green mobility, climate-friendly farming and education.

The municipality's climate plan is not the only policy governing climate in Vejle municipality, as both the mobility and the building plans each have additional documents focusing on the impacts on climate, as will be discussed in the relevant chapters below. Since the climate plan incorporates several focus areas, the climate secretariat of the municipality worked together with relevant departments (e.g. education) to incorporate ideas from experts working in various fields (Interviewee 2, 2024). As a result, different municipal departments have developed their own specialised climate action plans. This approach gives agency to each department to develop and carry out their own plans. In short, the municipality's climate plan serves as a guideline that each department uses to tailor its own plan.

In the initial stage of developing the municipality's climate goals, a consultancy company was hired to develop a budget and identify where the municipality's emissions originated from (Interviewee 1, 2023). Both the agriculture and energy sectors were identified as major sources. There is also a national energy and CO₂ calculation mechanism for municipalities in Denmark, which provides annual updates to the municipalities about the sources of their emissions. The goals are adjusted and set on the basis of the results. Furthermore, the municipality tracks its own data from the Danish national statistics database and publishes information on its website about the number of electric cars or gas heaters in houses (Vejle Municipality, 2023f).

The municipality is currently seeking to devise principles to calculate trade-offs, for example to compare building single-family houses with apartment buildings (Interviewee 1, 2023). This will be elaborated on further in the chapter on buildings and construction below. Furthermore, it should be noted that the current climate plan gives minimal attention to the buildings sector, aside from the inclusion of energy impacts (Interviewee 3, 2024). Assessment of building materials, transport of those materials and the construction phase itself, together with other indirect consequences, will be incorporated into the next climate plan in the near future as the municipality develops its knowledge on this topic. There is strong political will overall to accomplish the established goals. While the process relies on learning-by-doing, the municipality is increasingly gaining expertise and adopting new strategies to combat climate change and achieve climate neutrality.

Land use sector

The municipal masterplan states that Vejle and the other cities in the Triangle Region (*Trekantsområdet*) should develop according to densification principles (Vejle Municipality, 2021). Furthermore, synergies between densification, mix of urban functions, traffic hubs and urban spaces should be created when developing the city (Vejle Municipality, 2021). Concentration of retail services in the city centre is designed to make the most efficient use of the current infrastructure and the public transport capabilities, leading to less emissions. Moreover, a dense city core will promote a sense of vitality in the city (Interviewee 2, 2024).

Regarding urban growth, the city is densifying by building vertically, albeit only to a limited extent, in accordance with its internal architecture policies, which underscore the importance of preserving the green skyline in Vejle. Given that the city is situated in a valley, the goal is for people to feel surrounded by nature, with trees visible above the buildings (Interviewee 2, 2024). Nevertheless, since the city is growing rapidly with more inhabitants moving into Vejle, the city is inclined to expand horizontally to a certain extent as well. This creates a dichotomy between Vejle's desire to densify the city and its wish to preserve the green landscape, which should remain visible from the city. The Vision for Vejle Municipality establishes a framework that prioritises nature in the city's expansion (Interviewee 2, 2024; Vejle Municipality, 2023e). In practical terms, that means that the initial focus when determining a new area for city development is on assessing the locations of green and blue spaces. The locations of new buildings are planned only once biodiversity has been considered. The newly drafted Blue Green Strategy (*Blågrøn strategi*) shows in detail where green and blue areas need to be preserved and which areas are unsuitable for building, reinforcing the priority given to preserving the natural surroundings (Vejle Municipality, 2023a). The Biodiversity Plan (*Biodiversitetsplan*) released earlier takes a more technical approach to preserving natural areas, not only in Vejle city but throughout the municipality (Vejle Municipality, 2020a).

FIGURE 5. A TOPOGRAPHICAL MAP OF VEJLE CITY



Important blue-green streams are marked with arrows

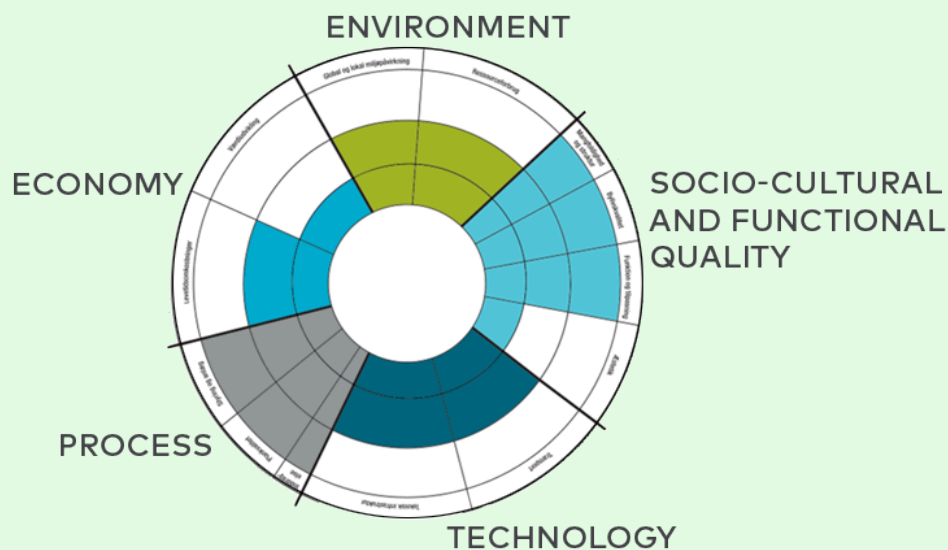
Source: Vejle Municipality, 2023a

Additional strategies to preserve green areas include afforestation outside of Vejle city. As there are both afforestation companies and businesses seeking to invest in afforestation to improve their climate indicators, the municipality is working to coordinate these efforts and identify additional synergies (Interviewee 2, 2024). The goal is not to only to plant forests, but to do so in a way that benefits the natural environment while also creating recreational zones.

To evaluate the consequences of land use the municipality employs a Climate Barometer and Analysis of Climate Impacts (*klimaregnskab*) developed by Climate Alliance (*Klimaalliancen*) (Interviewee 2, 2024). This makes it is easy for municipalities to benchmark and compare with one another, since the method of evaluation is the same.

BOX 5. BEST PRACTICE. LAND USE SECTOR, VEJLE

In cooperation with the other municipalities in the Triangle Region, Vejle has developed a sustainability tool (also referred to as *Hjul* or Wheel) which is used to evaluate a range of parameters when creating local plans (Interviewee 1, 2023). The sustainability tool evaluates proposed local plans across five different topics: environment (global and local environmental impact, resource use), economy (lifetime costs, value development), sociocultural and functional quality (versatility and structure, quality of city life, function and fit, aesthetics), technology (transport, technological infrastructure) and process (engagement, plan quality, management and facilities) (Vejle Municipality, n.d.). Each topic is assessed on a scale from one to three, with one indicating compliance with climate-related legislation, two signifying that work is underway on sustainable initiatives and three denoting exemplary performance. The assessment is illustrated in the circle shown below. The aim of this tool is not to calculate a qualitative sustainability score or accumulate as many points as possible, but rather to show how sustainability is considered in different projects. By illustrating trade-offs between the various parameters, the tool enables dialogue and communication (Vejle Municipality, n.d.).



Buildings and construction sector

The specific goals for the buildings sector in Vejle are based on national guidelines, which in turn follow EU directives (Interviewee 3, 2024). Additionally, the municipality has established its own set of principles as outlined in the *Strategy for Sustainable Building* (Vejle Municipality, 2022a). These are (1) minimising new construction by reducing the overall square meters, (2) taking care of existing buildings to extend their service life and (3) prioritising renovation and transformation over new construction and (4) ensuring that any new construction is carried out sustainably (Vejle Municipality, 2022a). The aim of the strategy is to foster a new mindset geared towards avoiding new construction and to steer the direction of the public buildings sector.

To achieve these goals, a system for estimating emissions needs to be established. Estimation of CO₂ emissions, especially for urban development, is difficult due to the number of factors that need to be taken into consideration (Interviewee 3, 2024). Those include not only the buildings themselves but also elements such as road infrastructure, energy supply and land use. Currently, the municipality is exploring tools to calculate the CO₂ emissions from buildings, which would demonstrate the relative trade-offs in terms of environmental impact e.g. the impact of a specific material versus an alternative. This tool could provide decision-makers with options that predict the environmental consequences of constructing different types of buildings.

Currently, Vejle municipality is monitoring actual emissions from public buildings by measuring electricity, heating and gas consumption, which is then converted into CO₂ emissions (Interviewee 3, 2024). Buildings are checked every three years, ensuring regular updates about the condition of the buildings, costs of renovation, possible investment-related challenges, any backlogs etc. It was underlined that the key issue is the existing building stock (Interviewee 3, 2024). Those buildings that were constructed before 2010, when regulations were not as strict, require most attention and financing. Vejle municipality is therefore working on drawing politicians' attention to the lack of financing for renovation of older buildings.

The national regulations for energy efficiency in new buildings are becoming increasingly stringent, with major updates set to come into force in 2025 (Interviewee 3, 2024). For carbon emissions the threshold requirement is a maximum 12 kilograms of CO₂ per square metre per year, which is expected to be lowered to 7-9 kilograms of CO₂ per square metre per year (Interviewee 3, 2024). Adjustments will be needed in the construction industry to meet this goal, as compliance with the strict regulations may be challenging (Interviewee 3, 2024). Nevertheless, the primary challenge in Vejle lies not in the regulations for new construction, but achieving the targets for retrofitting of old buildings (Interviewee 3, 2024).

Regarding existing building stock, at the national level, evaluation of the energy class of buildings is required before retrofitting. This process is currently underway in Vejle. The results will show where retrofitting is cost-effective in terms of repayment of loans taken out to finance the retrofitting. If the loan repayment period exceeds ten years, it becomes challenging to secure loan financing for the retrofitting that is viable and makes financial sense for the municipality (Interviewee 3, 2024). Moreover, there are no longer incentives for these initiatives. In previous years municipalities could sell CO₂ savings to utility companies to support retrofitting projects (Interviewee 3, 2024). This system was discontinued after utility companies met their green transition requirements.^[24]

Transport and mobility sector

Vejle is paying significant attention to the topic of mobility and transport in the city. The city has developed a mobility plan for the years 2018-2030. In 2023, the Green Vision Annex to the Mobility Plan was also approved, which sets out concrete principles for climate neutrality and mobility (Vejle Municipality, 2023b).

For short trips of under 5 kilometres, which offer the most potential for cycling and walking, in 2016, half of trips were made using a car (compared to 33% on foot and 14% cycling) (Vejle Municipality, 2018). To put this in perspective, one-third of all households in Vejle city do not own a car and are dependent on other forms of transport, while one in four households has two or more cars (Vejle Municipality, 2018). Nevertheless, as of 2021, the growth in electric vehicles has outpaced the growth of other types of car, which has decreased since 2022 (Vejle Municipality, 2023f). Given the evident level of car mobility in the city, the municipality also offers around 1,000 paid parking spaces as of 2018, with varying rates depending on the time of the day and the location of the parking space, in order to help regulate the flow of traffic (Vejle Municipality, 2018). Finally, according to the Analysis of Climate Impacts of Vejle Municipality, the transport sector accounted for 28% of greenhouse gas emissions in Vejle municipality in 2018, with that figure expected to decrease by 2030 (Vejle Municipality, 2020b). Transport sector emissions in Vejle municipality (including international flights) amounted to 274,000 tonnes in 2022 (Vejle Municipality, 2023f).

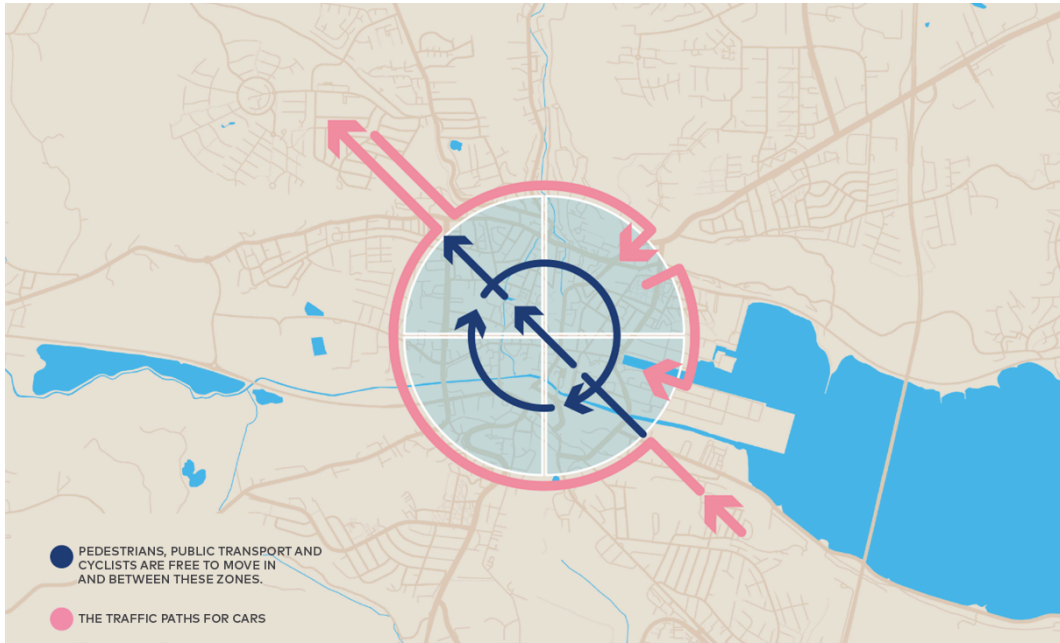
Vejle Municipality's climate plan outlines several goals and plans for mobility. First and foremost, the climate plan states that in 2030 at least 30% of all cars should run on electricity (currently 7% of all cars in Vejle are electric (Vejle Municipality, 2023f). The next tender for city buses will also require those vehicles to be electric (Vejle Municipality, 2020b). The municipality is striving to decouple population growth from an increase in fossil-fuelled transport by ensuring that 25% of all

24. Previously, municipalities could sell reductions in CO₂ emissions – achieved through upgrades like LED lighting – to utility companies, which used them to finance sustainability efforts.

journeys of 5 km or shorter are made by cycling or walking. To this end, the goal is to align the ticket prices for public transport with the cost of using a car. The Green Vision Annex to the Mobility Plan furthers these goals and highlights five focus areas in relation to climate neutrality, including CO₂ reduction, improved health of residents and ensuring future accessibility (Vejle Municipality, 2023b). The five focus areas addressed are as follows:

1. Making Vejle city centre more peaceful by dedicating it primarily to use by pedestrians and cyclists, while those who live in the city centre should be able to park their cars in multi-storey parking houses instead of the street to free up space. Additionally, traffic passing through the city should not be directed through the city centre. That is to be achieved through newly established "traffic islands" dividing Vejle city centre into four different "islands". While cyclists and public transport will be able to pass through the islands, cars will have to drive around the islands. To get from one island to another, cars will have to drive out of the city centre and back in again (Vejle Municipality, 2023b);
2. Ensuring a well-built network of main bicycle routes and super bicycle routes. These routes should not end in Vejle city itself but instead connect to other towns in the municipality. Furthermore, Vejle municipality is cooperating with other municipalities in the Triangle Region to establish cycling routes to other cities (Vejle Municipality, 2023b).
3. Ensuring effective and flexible public transport. This includes both buses and car-sharing services, supported by 50 dedicated parking spaces in Vejle and other towns in the municipality. Moreover, the municipality has established 25 hubs throughout the municipality for switching between different modes of public transport. Finally, a selection of shared bicycles is available in Vejle city (Vejle Municipality, 2023b).
4. Teaching children to cycle and get around the city from the age that they start kindergarten. This not only encourages children to travel to school sustainably but also promotes their health and independence. The goal is to have most pupils cycling to school by 2030 (Vejle Municipality, 2023b).
5. Focusing on green mobility in local planning, construction and maintenance of the municipality. Within this focus area, the municipality is striving for people to think about green solutions like mixed-use facilities and expansion of the city near transport corridors (Vejle Municipality, 2023b).

FIGURE 6. TRAFFIC ISLANDS IN VEJLE



The blue sectors show the four traffic islands in the city centre. Pedestrians, public transport and cyclists are free to move in and between these zones. The pink arrows show the traffic paths for cars (Vejle Municipality, 2023b)

Besides the above-mentioned tools, the municipality published tenders for companies to build electric car charging stations mainly around the city centre in municipal parking spaces, such as multi-storey parking houses (Interviewee 4, 2024). That resulted in three different companies building around 200 charging stations around the municipality. When determining the locations of these stations, priority was given to areas near apartments and cultural buildings such as museums. Finally, the municipality is keeping track of mobility data from Danish Statistics and compiles a monitoring tool, which is publicly available on its website (Vejle Municipality, 2023f). This tool is used to keep track of the municipality's climate goals, including data about the number of electric cars, private cars, transport habits in the municipality, public transport and other parameters.

BOX 6. BEST PRACTICE. TRANSPORT SECTOR, VEJLE. ENGAGING YOUTH AND CHILDREN

In Vejle, each municipal department has a climate action plan, including a climate action plan for youth and children focusing on education. The scope for increasing climate literacy is broad, including the topic of transport and mobility. By organising "Green Teams", with participants from each public school, children and young people gain the opportunity to develop suggestions for politicians. Through this programme, the children also become aware of how decisions impact the environment, helping to contribute to the municipality's goals (Interviewee 4, 2024).

Challenges and opportunities: a multilevel governance perspective

Spatial planning in Denmark is based on a multilevel governance system that integrates land use, transport and buildings sectors to ensure sustainable development. The framework is guided by the Danish Planning Act, which outlines the roles and responsibilities of national, regional and municipal authorities. National authorities are responsible for policy formation, coordination with ministries to align domestic plans with international sustainability targets and deployment of financial instruments to support major infrastructure and environmental initiatives.

The regional level, represented by Denmark's five administrative regions, acts primarily as a coordinating body, bridging national policies and municipal planning. Regions are responsible for large-scale infrastructure projects, particularly in transport, ensuring connectivity across municipal boundaries. While they do not have independent legislative power, they facilitate intermunicipal cooperation on issues such as environmental protection and economic development. They play a pivotal role in aligning local projects with national objectives while ensuring efficient resource allocation and strategic planning.

At the municipal level, local governments hold significant authority in spatial planning, as they prepare local plans and zoning regulations. Municipalities are tasked with developing comprehensive land use plans, enforcing zoning regulations, managing building permits and ensuring that construction practices adhere to established safety and environmental standards.

Policy capacity: vertical and horizontal governance tensions

Land use

Vertical governance

As mentioned above, Danish municipalities have significant autonomy in land use planning. Nevertheless, vertical regulatory tensions persist. In Aarhus, early-stage planning requirements are viewed as rigid, forcing municipalities to make detailed decisions – such as on architectural designs and building materials – far in advance (Interviewee 9, 2024). These early plans often become outdated before development begins, undermining environmental performance and architectural quality. This issue is more pronounced in Aarhus than in Vejle, with an Aarhus representative suggesting that increased flexibility in regulating architectural principles during the building application process could help address this challenge (Interviewee 9, 2024).

Horizontal governance

Tensions in horizontal governance are also evident, often due to the many departments and policymakers involved in planning. In Vejle, it was noted that while the involvement of several departments supports a broad-based approach, the distinct specialisations of respective departments can cause friction. Moreover, competition for limited financial resources can lead to conflicts between departments seeking to secure funding for their own activities, sometimes at the expense of collaborative solutions (Interviewee 2, 2024). Nevertheless, there are significant synergies at the horizontal organisational level in Vejle, particularly within the city council. One prominent example is the planning of flood protection for the city. While a conventional concrete wall could resolve the flooding issue, the city council is seeking to ensure that the project delivers benefits to taxpayers throughout the municipality, including those living outside the city (Interviewee 2, 2024). Accordingly, the municipality has explored alternatives that enhance marine and land biodiversity, while also including cycling paths and recreational zones. Such alternative solutions would not have been possible without broad political commitment.

In Aarhus, horizontal tensions may arise from its distinct governance structure. It is the only municipality in Denmark governed by a magistrate system. Comprising six magisterial departments, the municipality is led by the mayor and five chairpersons. The chairpersons oversee their respective departments and can present political matters directly to the city council, allowing issues to bypass committee discussions. As a result, the matters that reach the city council can easily be influenced by the political viewpoint of a single chairperson (Interviewee 6, 2024). Nevertheless, the organisational structure of the municipality is considered conducive to goal-oriented

work, fostering cohesion between climate objectives and practical measures (Interviewee 6, 2024).

In both municipalities, competition for attracting residents leads to sustainability trade-offs, especially as goals for densification and housing preferences can be at odds. Aarhus, for instance, limits the size of single-family houses to reduce emissions to some degree but further reduction could be achieved if these restrictions were tightened. However, political concerns over Aarhus's attractiveness and the risk of discouraging new residents make this unlikely (Interviewee 5, 2024). Similarly, Vejle faces a dilemma between meeting rising demand for housing and pursuing climate neutrality. To raise the municipality's tax revenue, local politicians strive to attract residents, even if urban expansion conflicts with climate goals. To compensate for the expansion, the municipality is seeking to achieve sustainable solutions without restricting the size of households and plots (Interviewee 2, 2024).

Buildings and construction sector

Vertical governance

In the buildings sector, misalignment between national requirements and municipal capabilities is evident, though experienced differently from case to case. In Aarhus, certain national regulations are perceived as outdated. For instance, the application of overly cautious principles in structural calculations leads to excessive use of materials, contradicting sustainable building practices. Moreover, the lack of specific legislative guidelines for climate-smart construction limits understanding of the costs associated with sustainable building methods (Interviewee 8, 2024). Financing of new materials comes with uncertain operational reliability, making long-term expenses difficult to estimate. Without national laws mandating climate-neutral construction, allocation of additional funds as financial buffers is limited.

Another issue raised in Aarhus is that new developments comfortably meet existing sustainability requirements, leaving little incentive to push for further progress (Interviewee 8, 2024). While the municipality could impose stricter standards locally, political concern about deterring contractors – particularly given the more lenient standards in neighbouring municipalities – hinders such action. Currently, constructing new buildings in Aarhus is more expensive and complex than elsewhere, lending credence to fears of reduced investment. In Vejle, the national requirements for sustainable construction are, by contrast, considered to be too stringent and challenging to meet. In particular, a strict national construction cap complicates retrofitting and new construction despite the needs of a growing population. Greater flexibility in this cap could allow Vejle to provide public buildings more efficiently while accelerating efforts to reduce emissions (Interviewee 3, 2024). To bridge these gaps, revision of current legislation and a unified national approach could foster sustainable building practices across Denmark, ensuring a level playing

field for contractors. Establishing a permanent forum for dialogue between municipalities and policymakers could also mitigate vertical governance tensions and enhance climate strategies (Interviewee 9, 2024).

Lastly, it should be noted that the national requirements in Denmark are influenced by EU legislation, adding an additional layer to the vertical governance structure. Indeed, Danish municipalities are anticipating upcoming EU-driven regulations aimed at enhancing energy efficiency in existing buildings and reducing CO₂ emissions in new constructions (Interviewee 3, 2024).

Horizontal governance

Horizontal governance in the buildings sector often reveals tensions linked to cross-departmental coordination. For instance, in Vejle, ownership and management responsibilities are divided, with departments like the Children and Youth Department overseeing institutions such as schools, while a separate building department manages logistical aspects, including energy efficiency. This fragmented approach can lead to conflicts due to differing priorities and budgetary constraints (Interviewee 3, 2024). To address this challenge, the building department in Vejle is working on presenting detailed data on energy, heating and other consumption metrics for each institution. The aim is to influence the decisions and behaviours of leaders across different departments by fostering a shared understanding of energy management (Interviewee 3, 2024). The data-driven approach could also encourage institutions to foster behavioural changes among users, such as teaching children simple energy-saving habits like closing windows when leaving a room. Over time, this approach could help align priorities across sectors while promoting both efficiency and sustainability (Interviewee 3, 2024). In Aarhus, horizontal governance tensions arise when competing sustainability priorities conflict. For instance, the city's 15-minute urban accessibility goal – a commitment to ensuring all residents can reach essential services within 15 minutes – conflicts with the city's climate strategy of limiting new construction activity, revealing a fundamental tension between long-term objectives. These contradictory objectives reflect the difficulty of harmonising urban development and environmental sustainability goals.

Transport sector

Vertical governance

Governance of the transport sector in both cities is heavily shaped by political decisions on both the national and local levels. Measures such as increasing parking rates or closing streets to cars, although aligned with climate goals, frequently generate resistance among residents. These societal attitudes, often amplified through public discourse, exert pressure on both national and local politicians, who are wary of losing political support (Interviewee 4, 2024; Interviewee 7, 2024).

One of the key challenges is the growing number of cars on the roads. Increasing fees and taxes on private cars and roads could address many of the challenges faced by the mobility sector in tackling climate issues (Interviewee 7, 2024). Such measures could generate funds for sustainable infrastructure investments – such as renovating the railway system – and simultaneously reduce the number of cars on the roads. Moreover, increased personal car taxes could alleviate municipal budget pressures by reducing the need for costly interventions, including road closures, redesigns and reductions in parking spaces (Interviewee 4, 2024; Interviewee 7, 2024).

A proposed national law will allow larger municipalities, including Aarhus, to establish zero-emission zones in city centres. These zones aim to restrict fossil-fuel-powered vehicles in designated areas, reserving access for electric cars or banning cars altogether. However, effectiveness of the law may be limited by several exemptions; for instance, residents living within restricted zones will still be allowed to use fossil fuel-driven vehicles. Additionally, this regulatory tool will only apply to larger municipalities, leaving smaller cities like Vejle without access to similar mechanisms.

Horizontal governance

At the local level, governance within the transport sector in both cities are heavily influenced by political decisions. While meetings between municipal representatives, city councils, residents and trade stakeholders in Aarhus are intended to foster dialogue and balance competing interests, these processes are often time-consuming and slowed by political debates over budget allocations (Interviewee 7, 2024). Moreover, measures such as increasing parking rates or closing streets to cars, although aligned with climate goals, frequently generate resistance among residents. These societal attitudes, often amplified through public discourse, exert pressure on local politicians, who are wary of losing political support (Interviewee 4, 2024; Interviewee 7, 2024). This highlights the importance of engaging the broader public to align societal values with long-term sustainability goals.

Institutional capacity: knowledge and relational resources and mobilisation capacity

Knowledge capacity

While both case study cities demonstrate strong knowledge capacities, some knowledge gaps exist, leading to the need for external consultants. Aarhus, as Denmark second largest city, benefits from a substantial talent pool and diverse expertise across its municipal departments. However, the need for continuous learning is evident, especially in the buildings sector due to the rapidly evolving nature of sustainable construction materials and methods (Interviewee 8, 2024). To this end, the municipality has established a dedicated team to update its expertise, including a three-year post-doctoral position focused on reducing CO₂ in the urban environment (Interviewee 9, 2024).

Vejle's buildings sector department is also well-staffed with professionals knowledgeable in energy efficiency, construction standards and climate mitigation strategies (Interviewee 3, 2024). However, specific knowledge gaps in quantitative climate impact assessments remain, with room for improvement in technical climate modelling and scenario analysis in land use planning (Interviewee 2, 2024).

Relational resources

Both Aarhus and Vejle actively engage in international, national and regional partnerships that facilitate the exchange of best practices and foster policy innovation. Despite strong engagement in networks, interviewees note gaps in formalised knowledge-sharing platforms. For instance, in the buildings sector, informal exchanges take place but often do not result in actionable decisions or in-depth knowledge exchange (Interviewee 8, 2024). More structured mechanisms for collaboration could help facilitate deep, technical collaboration between municipalities in sustainable construction practices (Interviewee 8, 2024).

Furthermore, it was observed that ensuring alignment across municipal departments poses a challenge. For example, in Aarhus, conflicts arise between departments that prioritise revenue generation through land sales and those focused on sustainability-oriented densification (Interviewee 7, 2024). These tensions highlight the importance of relational resources, not only between cities but also within municipal administrations.

Mobilisation capacity

Beyond knowledge and collaboration, mobilisation capacity determines how effectively municipalities can translate strategies into action. Aarhus and Vejle have implemented various initiatives to align internal structures and resources with

climate goals. Vejle integrates sustainability into multiple departments, linking mobility policies with public health and education initiatives (Interviewee 4, 2024). Aarhus centralised its municipal property management in 2024 to improve coordination on climate initiatives, aiming for greater efficiency and coherence in sustainability efforts (Interviewee 8, 2024).

However, achieving alignment across all municipal departments remains a challenge, as conflicts arise between revenue-generating objectives (such as land sales for single-family homes) and environmental priorities (Interviewee 7, 2024). In the transport sector, Aarhus and Vejle face challenges in shifting mobility habits towards greener alternatives. While infrastructure investments, such as expanding cycling lanes, are underway, behavioural change remains difficult as long as car use remains convenient and cost-effective (Interviewee 4, 2024; Interviewee 7, 2024).

Financial constraints also limit mobilisation efforts. In Vejle, efforts to retrofit older buildings with energy-efficient solutions are hindered by funding shortages (Interviewee 3, 2024). Similarly, Aarhus contends with the uncertainty of climate impact assessments for new construction projects, since initial projections may not align with final outcomes due to evolving sustainability methodologies (Interviewee 8, 2024). Overcoming such barriers requires continuous learning and adaptive policy frameworks.



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Key reflections and learnings from Denmark

The findings from Aarhus and Vejle reveal dynamic interplay between governance levels, each presenting both opportunities and constraints. Vertical governance tensions primarily arise from misalignment between municipal goals and national regulations, which can limit local sustainability efforts. In the land use and buildings sector, rigid early-stage planning requirements hinder adaptive decision-making, which can lead to outdated or suboptimal developments. Stringent national construction caps can also limit flexibility in retrofitting of older buildings, despite the urgent need for energy-efficient upgrades. Furthermore, a lack of legal mandates for climate-smart construction complicates efforts to finance and implement sustainable building strategies, underscoring the need for clearer national guidelines and a more coordinated regulatory approach. Despite these challenges, Danish municipalities benefit from a strong tradition of municipal autonomy, allowing them to implement ambitious local policies that often exceed national climate targets. Both Aarhus and Vejle have shown innovation in integrating sustainability into urban planning, with Aarhus developing dedicated municipal teams for advancing climate-friendly construction and Vejle implementing energy efficiency measures in public buildings.

In the transport sector, a fundamental tension persists regarding the division of responsibility between local and national governments for achieving climate neutrality. While city councils are politically obligated to pursue climate goals, it remains unclear which level of governance should lead the charge. This uncertainty creates delays in implementing essential measures, as local politicians weigh the trade-offs between environmental benefits and potential voter dissatisfaction. Political resistance to measures like higher parking fees or car use restrictions underscores the difficulty of balancing policy ambitions with societal preferences and public acceptance. Although local governments hold many of the tools necessary to achieve sustainable mobility, the lack of decisive support and political leadership at the national level limits their ability to act effectively. However, with the upcoming introduction of national zero-emission zone legislation, cities like Aarhus have an opportunity to lead the way in transforming urban mobility. This represents an important step towards a more systematic national approach to transport decarbonisation, aligning local initiatives with overarching climate goals.

In addition to vertical governance challenges, horizontal governance tensions arise from competing interests and gaps in coordination between municipal departments. In both cities, competition for residents and tax revenue shapes policy decision-making, highlighting the trade-offs between economic growth and climate neutrality. In terms of land use, Aarhus aims to limit single-family housing to reduce emissions, while also moderating strict regulations to avoid deterring potential residents. Similarly, Vejle is expanding to attract new taxpayers, despite the fact that urban expansion conflicts with climate neutrality goals. These trade-offs underscore the political realities of urban sustainability, where economic viability and environmental objectives must be carefully negotiated. Nevertheless, both municipalities have demonstrated a capacity for cross-departmental cooperation in areas where sustainability priorities align with other urban objectives. Vejle's flood protection project exemplifies this, as the municipality has successfully integrated climate adaptation with biodiversity enhancement, recreational space and cycling infrastructure, showing that political commitment and broad-based collaboration can lead to multi-benefit solutions.

Lastly, institutional capacity gaps exist. In general, both cities benefit from internal knowledge capacity as well as participation in networks such as Concito, DK2020 and international collaborations to strengthen their knowledge base and governance strategies. Aarhus, as Denmark's second-largest city, has a significant advantage in terms of expertise, with specialised municipal teams and a dedicated research position focused on climate mitigation in urban planning. Vejle's approach to using data-driven tools for energy management in public buildings also highlights an emerging strength in leveraging digital solutions to support sustainability efforts. However, formalised knowledge-sharing platforms have demonstrated gaps, suggesting that increased cooperation between municipalities and formalised frameworks could strengthen knowledge development and mobilisation capacity.

In the following boxes, we provide an overview of the key challenges Danish cities face in achieving climate neutrality, along with their broader implications and potential solutions.

CHALLENGE 1: Land use trade-offs.

Implications: Conflicts between climate goals, housing demand and economic considerations affect sustainable land use.

What can be done? Develop integrated land use plans that prioritise climate-smart zoning while addressing housing needs.

CHALLENGE 2: Outdated national building regulations.

Implications: Limits innovation and flexibility in sustainable construction practices.

What can be done? Advocate for national-level policy revisions to allow for more stringent and adaptive green building standards.

CHALLENGE 3: Transport policy limitations.

Implications: Lack of high road/car taxes and decisive action from national government limits emission reductions.

What can be done? Advocate for national tax reforms and implement city-level incentives for low-emission transport modes.

CHALLENGE 4: Competing interests between municipal departments create horizontal governance tensions.

Implications: Reduces interdepartmental cooperation affecting holistic policy execution.

What can be done? Implement cross-department climate taskforces to foster collaboration and align departmental goals.

CHALLENGE 5: Skill gaps in climate-centred policy implementation.

Implications: Lack of specialised expertise hinders the adoption of innovative climate solutions at the municipal level.

What can be done? Invest in training programmes and foster partnerships between municipalities to exchange expertise.



Tampere. Photo: Unsplash.com

8. FINLAND

CASE: TAMPERE



Tampere. Photo: Unsplash.com

Background information

Located in southern Finland, Tampere is the third-largest city in the country and serves as the economic and cultural hub of the Pirkanmaa region. Extending from the city, the Tampere City Region is the second largest metropolitan area in Finland, encompassing seven surrounding municipalities (Kangasala, Lempäälä, Nokia, Orivesi, Pirkkala, Ruovesi and Ylöjärvi). While the city of Tampere covers around 690

square kilometres, the metropolitan area spans 4,977 square kilometres, composed of urban and rural landscapes.

As of 2023, Tampere has a population of around 255,000 people, with the metropolitan area housing a further 160,000 residents (City of Tampere, n.d.). Driven by its economy, high quality of life and educational institutions, the region has seen steady population growth since the early 2000s. Population growth is projected to continue, with the population of the city of Tampere expected to surpass 300,000 residents by 2040, while the metropolitan region will approach a quarter of a million residents.

Demographically, Tampere is a youthful city with a significant proportion of its population under the age of 35, reflecting its status as a major educational hub. The city is home to several higher education institutions, including Tampere University and Tampere University of Applied Sciences. Economically, Tampere has transitioned from its historical industrial roots to a modern economy focused on technology, research and services. The city is home to numerous high-tech companies, particularly in the fields of information technology, health technology and mechanical engineering. Notable global companies, such as Nokia, have established a strong presence in Tampere, contributing to its reputation as a centre of innovation and entrepreneurship.

In addition to its technological prowess, Tampere has a strong cultural sector, hosting numerous theatres, museums and festivals. To add to its reputation as a centre of innovation, education and culture, Tampere has embraced climate leadership as a part of its city brand and is taking great strides towards reaching its goal of climate neutrality by 2030.

Strategic level: municipal goals and policies

The city of Tampere is among the most climate-ambitious cities in Finland and is aiming to achieve carbon neutrality by 2030. Greenhouse gas emissions began to decrease in 2010 and the city has since become a frontrunner in climate change mitigation, both nationally and internationally. In 2019, Tampere became the first city in Finland to publish a climate budget. The city is also a frontrunner in the Tampere City Region, where the eight municipalities cooperate to make the region carbon-neutral by 2030 (Tampere City Region, 2019). While the collaboration is organised through HINKU, it is the city council of Tampere that oversees the strategic work. The regional strategy involves a burden-sharing agreement under which each municipality implements emission reduction measures according to its operational capabilities. Tampere carries a considerable share and is committed to covering 57% of the 80% reduction goal. There is also close cooperation with the Centre for Economic Development, Transport and the Environment (ELY), which leads the local Climate Forum, a common network for sharing information about funding opportunities, research innovations and data on local development scenarios for emissions and carbon sequestration.

In the international context, Tampere has joined several transnational networks, declarations and commitments to curb greenhouse gas emissions and reduce energy consumption.¹ Notably, the city signed the Covenant of Mayors agreement in 2009 and the renewed Global Covenant of Mayors for Climate and Energy in 2017. Another significant commitment was made in 2022, when Tampere was selected to participate in the [EU Mission for 100 Climate-Neutral and Smart Cities by 2030](#) – also known as the Cities Mission, which is coordinated by the EU Net Zero Cities platform. In 2024, along with four cities in Finland, Tampere was granted the official Mission Label for its efforts. The Mission Label is a testament to the resoluteness of achieving carbon neutrality. It provides international recognition and support to help secure EU, national and private funding for achieving the goal of carbon neutrality (Interviewee 10, 2024).

To reach the target of climate neutrality by 2030, Tampere plans to cut emissions by 80%, compared to 1990, the baseline year defined in the Covenant of Mayors agreement. The remaining 20% is to be achieved through offset methods or carbon sinks such as forests and green infrastructure (City of Tampere, 2022a). Specific plans for offsets are to be developed after 2025, once the effectiveness of ongoing measures has been evaluated and possible offsetting schemes have been further assessed. Climate policies are prepared, coordinated and monitored by the Climate and Environmental Policy Unit of the city and are approved by the city council. This enables policy flexibility, with adaptation of strategies and budgets to political priorities. One of Tampere's strengths is that climate leadership has been a shared vision across political parties, enabling collaboration and long-term commitments (Interviewee 10, 2024). Indeed, decision-makers in Tampere view climate mitigation and adaptation as essential both for improving citizens' quality of life and for promoting the city. Accordingly, measures for carbon reduction and environmental sustainability are communicated across the public communication channels and incorporated into the city's broader marketing strategies.

The steps towards achieving climate neutrality have been outlined over the years in various strategic and planning documents. In 2018, the city council approved the overarching environmental policies in the **Sustainable Tampere 2030 Guidelines**, which set the goal of carbon neutrality by 2030. The current **City Strategy 2030** of the governing city council also emphasises carbon neutrality, which is listed as one of four priorities (Tampere City Council, 2023).

Implementation of the strategy is further guided by the [Carbon Neutral Tampere 2030 Roadmap](#), which consolidates all the city's climate efforts and the investments needed to carry them out (City of Tampere, 2022a).

Published for the first time in 2020, the roadmap is updated biennially. In the current version a total of 305 measures are presented under six topics: urban planning, mobility, construction, energy, consumption and urban nature. The measures in the roadmap are based on participation and suggestions from all units

and subsidiaries of the city, under the coordination of the Climate and Environmental Policy Unit. The measures do not adhere to the administrative structure of the city and instead respond to different phenomena across units. This bottom-up approach has proven beneficial in defining actionable steps and fostering commitment within the respective units (Interviewee 10, 2024). For each update of the roadmap, the Climate and Environmental Policy Unit organises workshops and meetings to discuss how the roadmap and its implementation can be strengthened. Progress along the roadmap is monitored by 28 indicators, which are categorised into tactical and strategic indicators. To ensure transparency, the progress along the roadmap and overall emissions are made available to the public through an online service called the [Tampere Climate Watch](#).

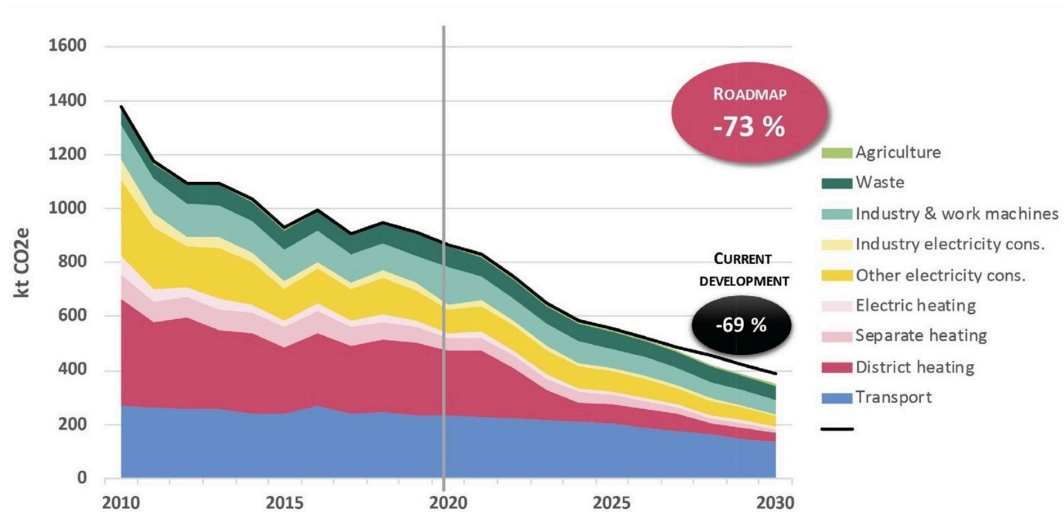
- **16 tactical indicators:** these describe phenomena that the city strives to increase or decrease through various measures. An example is "the share of new residential buildings in energy class A".
- **12 strategic indicators:** these describe the overall greenhouse gas emissions, providing information about the effectiveness of the measures. An example is "emissions from building heating".

The measures in the roadmap are also supported by Tampere's [climate budget](#), which integrates reduction targets into the financial planning of the city. The budget establishes an annual emissions cap, which guides the allocation of funds through to 2030. The budget monitors overall progress on emission reduction targets, as well as enabling rough estimates of the cost-effectiveness of various measures. Emissions are calculated using the "CO₂ report" method (CO₂-raportti), a commonly used method among municipalities in Finland, which follows the reporting standards set by the EU. The calculations cover global warming emissions (carbon dioxide, methane, nitrous oxide) generated within the geographical area of Tampere, aggregated to carbon dioxide equivalents (CO₂-eq). Annual reviews of the climate budget are conducted as part of the city's financial statements, allowing for adjustments to ensure that emission goals are met and funds are used effectively.

Calculations from 2022 estimate that Tampere has reduced total emissions by 35%, compared to the 1990 baseline (City of Tampere, 2022a). Per capita emissions have been reduced by 50% even as the population has grown from 173,000 to 250,000 (45% population increase) over this timespan. According to the latest update of the roadmap, the city will achieve a 77.5% reduction, leaving a small but significant gap to the 80% goal. The greatest challenges to closing the emission gap on time lie within the transport and waste management sector, where reductions are behind schedule. To reach its goals, the city has recognised that more systemic work is needed across sectors. Moreover, engaging residents and private entities will be imperative. In the following sections of the case study, the plans and strategies for

reducing emissions in the land use, buildings and transport sector in Tampere will be explored.

FIGURE 7. EMISSION MEASUREMENT AND FUTURE ESTIMATES FOR TAMPERE.



The figure shows Tampere's actual climate emissions from 2010-2020, a projection based on current development and a projection based on the measures in the roadmap. The current development projection includes key climate measures that are set to be implemented shortly. The Roadmap trajectory shows the estimated reductions that can be achieved through implementation of the measures in the roadmap.

Source: [Climate-Neutral Tampere 2030 Roadmap](#)

Land use

The spatial typology of Tampere is distinctly divided into an urban area in the south, the Inner City (*Kantakaupunki*) and Northern Tampere (*Pohjois-Tampere*), a rural area in the north. While the Inner City has grown and been built up significantly over the last decades, Northern Tampere is characterised by large forest areas (83%), fields (15%) and rural settlements (2%). While Northern Tampere makes up 75% of the total area of the city, it only houses about 2% of its population. With around 4,500 residents, the population density of Northern Tampere is around 11 residents per square kilometre, compared to approximately 1,860 residents per square kilometre in the Inner City area (City of Tampere, 2021a).

FIGURE 8. TAMPERE INNER CITY ZONE OF GROWTH AND VITALITY (CITY OF TAMPERE, 2022A)

City Strategy's zone of growth and vitality.



Image 20. Inner-city phased local master plan – council term 2017–2021, City Strategy's zone of growth and vitality into which the aim is to direct 80–90% of Tampere's population growth. ©City of Tampere/Master Planning 2022.

Tampere is experiencing an annual growth rate of approximately 3,000 residents (City of Tampere, 2022b). To meet the needs of a growing population while meeting climate goals, the main approach to land use is to promote high-density, mixed-use urban functions in central hubs and along existing and planned transport corridors. To address the differences in the spatial typologies outlined above, the city employs two Local Master Plans. Both plans define strategies for sustainable development, but the Inner City Master Plan is most relevant for urban development and climate concerns as the majority of the future construction is planned in this area. Looking ahead to 2040, the zoning focus of the Inner City Master Plan involves densifying areas through infills in the city centre and along the existing tramway lines, as well as developing new areas in connection to future public transport corridors and hubs (City of Tampere, 2024). Together these areas form the city's *zone for vitality and growth*, which is intended to accommodate 80-90% of the future population growth (see Figure 8). To this end, the plan outlines goals for building density in central areas (see Table 6).

TABLE 6. SUSTAINABLE URBAN DEVELOPMENT IN TAMPERE. SELECTION OF GOALS AND INDICATORS. SOURCE: TAMPERE 2030 CLIMATE ROADMAP (CITY OF TAMPERE, 2022A)

GOALS 2030	INDICATORS
• Density: Residential floor area planned for the public transport zones and for the regional centres: 80% (2021), 85% (2025), 90% (2030). • Functional mix: The urban structure will be mixed in the city centres as well as around the major tramway stops and public transport transfer terminals. Tampere city centre will have 15,000 new residents and 15,000 more new jobs in 2030 compared to 2015. • Mobility: The urban structure will support walking, cycling and the use of public transport for everyday journeys. Residents will be satisfied with the comfort and usability of the urban environment.	• Planned residential floor area in the public transport zones and in the regional centres (%). • Share of households (%) with a 300 m or 700 m distance to key public services. • Share of recreational areas of the total inner city town planning area (%).

With public ownership of approximately 70% of land in the urban area, the city of Tampere is well-positioned to reach its objectives. Achieving mixed-use functions and densification is most straightforward in publicly owned or led developments, but the city also leverages its position as a major landowner to influence the private sector (Interviewee 11, 2024). For instance, the city has piloted design competitions and models for plot allocations that include climate-related criteria. Zoning requirements are also used to achieve sustainability goals, such as requiring the use of wood materials in certain areas. It is also worth noting that zoning regulations typically favour construction in locations that do not require extensive underground solutions or high-emission methods, making them both environmentally and economically sound.

While densification in urbanised areas and brown fields is the guiding principle, some developments are located in greenfield areas to meet the minimum target of housing production, which is set at 2,388 new units per year (City of Tampere, 2022b). For instance, the development of new districts in Alajärvi and Hiedanranta requires significant land as they are designed to accommodate 9,000 and 20,000 residents respectively. In addition to its size, the Hiedanranta development is a standout project as it is planned to be a positive energy district (see Text box 7 below).

BOX 7. BEST PRACTICE. LAND USE, TAMPERE: POSITIVE ENERGY DISTRICT.

Hiedanranta District Development

The Hiedanranta district in Tampere is a flagship project aimed at creating a positive energy district that produces more energy than it consumes. The district will integrate innovative and sustainable practices to ensure energy efficiency and environmental sustainability, aiming to attract residents and businesses committed to environmental stewardship. Hiedanranta plans to utilise renewable energy sources extensively, including solar and geothermal energy. Solar panels will be installed throughout the district and geothermal heat pumps will provide heating. Buildings in the district will be constructed or renovated to meet high energy efficiency standards, surpassing typical construction norms. Additionally, Hiedanranta will adopt circular economy practices, focusing on recycling, waste reduction and sustainable water management.

Buildings and construction

Emissions in the buildings sector are primarily due to heating systems of buildings, emissions from the production of construction materials and the combustion of fuel in construction machinery. To address these factors, the city of Tampere has set several objectives for its own building portfolio and construction plans, along with measures aimed at influencing the private sector. For city-owned properties, the focus is on increasing energy efficiency, phasing out oil heating in buildings by 2025 and significantly expanding solar energy capacity. In 2020, the city introduced life cycle carbon footprint assessments for both new construction and major renovations. Significant progress has since been made and all public buildings are now constructed to meet the A energy efficiency class. Energy efficiency has also been improved in the private sector through incentives and regulations. For instance, when the city leases public land for new developments, apartment buildings are required to meet the A energy efficiency standard, surpassing the minimum legal requirements (Interviewee 12, 2024). Moreover, the city offers free guidance on sustainable building practices, incentivising private actors to consider the long-term benefits of energy-efficient construction.

With great improvements in energy efficiency, the focus has shifted towards sustainable materials and construction-related emissions. The city uses wood in new constructions where it is economically viable, typically in smaller buildings,

schools and kindergartens. The objective is to progressively increase the amount of wood used in apartment buildings by 2030. To encourage the private sector to adopt similar practices, the city provides various incentives. For instance, in vertical building expansions, discounts on land use fees are offered if wood or other low-carbon construction methods are used. This supports the goals for the buildings sector while also aligning with the densification objectives discussed in the previous chapter.

To reduce emissions from the construction phase, the city plans to replace work machines with low-emission vehicles, improve soil management and increase material recycling. While the city cannot impose requirements beyond national legislation on private property, by implementing the measures mentioned above and leading by example, the city encourages private actors to contribute to the city's sustainability goals.

TABLE 7. SUSTAINABLE CONSTRUCTION IN TAMPERE. SELECTION OF GOALS AND INDICATORS. SOURCE: TAMPERE 2030 CLIMATE ROADMAP (CITY OF TAMPERE, 2022A)

GOAL	INDICATORS
• The city's service network facilities will be designed to minimise the carbon footprint and life cycle costs. • The city's properties will be 80% climate-neutral in energy terms by 2025. • Infrastructure construction will utilise all materials that can be utilised. • Transport distances will be minimised by ensuring adequate intermediate storage and circular economy hubs. • Renewable materials will be used in all suitable infrastructure construction sites. • Work machines will run on low-emission fuels. • Guidelines will be created for customers and operators to address climate and environmental issues.	• Percentage of new residential buildings in energy class A (%) • Energy consumption of the residential sector (kWh/resident) • Energy consumption of the city's properties (total consumption/m² and consumption/user) • Percentage of energy purchased by the city for its properties that is renewable heat and electricity • Realised percentage for mass economy planning in all town plans (%) • Percentages of recovered materials in construction • Low-emission new materials (%), verification using CO₂ calculations

Transport and mobility

The transport sector accounts for roughly 30% of emissions in Tampere. These emissions primarily come from road traffic, including freight transport, buses and passenger cars. Reducing reliance on passenger cars, which account for the largest share of emissions, is a significant challenge, with approximately 50% of residents' journeys made by car. Transport emissions have not been reduced at a sufficient pace to reach emission goals and, with a growing population and commuter share, transport remains one of the greatest hurdles to reaching climate neutrality by 2030 (Interviewee 13, 2024). To address this challenge, the city aims to increase the use of sustainable transport modes by investing heavily in public transport, modifying urban infrastructure and promoting new and innovative mobility services. A dense, mixed-use urban structure, ensured through planning, further enhances accessibility and supports the development of sustainable mobility options.

Based on the EU's sustainable urban mobility concept, Tampere developed a Sustainable Urban Mobility Programme (SUMP) (City of Tampere, 2021b), which won the SUMP Award the following year. The goal of SUMP is to integrate the principles of sustainable urban mobility more firmly into mobility planning and decision-making. The plan also introduces key quantitative goals, such as increasing the share of sustainable transport modes to 69% by 2030. That includes raising the share of public transport to 21%, of walking to 33% and of cycling to 15%. For the remaining road traffic, the city plans to encourage the shift towards low-emission vehicles by expanding the network of electric charging stations and promoting low-emission zones. Within the city organisation, all vehicles are to operate on electricity or low-emission fuel by 2030, with the same goal for public transport.

TABLE 8. SUSTAINABLE MOBILITY IN TAMPERE. SELECTION OF GOALS AND INDICATORS. SOURCE: TAMPERE 2030 CLIMATE ROADMAP

GOAL	INDICATOR
• Modal share 2030: public transport 21%, walking: 33%, cycling 15% • Percentage of vehicles with alternative propulsion systems in traffic use in Tampere: 5% (2021), 20% (2025), 35% (2030). • Percentage of alternative propulsion vehicles of the city organisation's vans: 0% (2021), 20% (2025), 100% (2030). • Level of outsourced low-emission propulsion transport services (bus and tramway line kilometres): 5% (2021), 35% (2025), 100% (2030). • The increase in car travel will stop by 2025 and will start to decline despite population growth. • Walking and cycling will be easy, attractive and safe mobility modes, with their own designated lanes in the city centres and on the main routes. Cycling will be the fastest mobility mode for journeys of under 3 km. • Tampere will have created a diverse range of services to complement a sustainable mobility system. The need to own and use private cars will have decreased. Most journeys to school and commutes by city employees will be made using sustainable mobility modes. • The city and its partners will implement versatile mobility management as part of transport and community planning. The means of mobility management will be linked to the other means that promote sustainable mobility.	• Modal share of public transport on an autumn weekday (%) • Modal share of walking on an autumn weekday (%) • Modal share of cycling on an autumn weekday (%) • Modal share of travel by car on an autumn weekday (%) • Level of outsourced low-emission propulsion transport services (line km) • Car travel (km/person) • Percentage of vehicles using alternative propulsion systems of all cars owned by Tampere residents (%) • Percentage of all passenger cars in the city organisation that use alternative propulsion systems (%) • Percentage of all vans in the city organisation that use alternative propulsion systems (%)

Achieving emission reductions in the mobility sector relies heavily on changing residents' daily habits and preferences in favour of sustainable mobility. As fiscal incentives to reduce private car use (such as toll fees) lack political support, the city focuses on making other mobility options more attractive, efficient and accessible. By creating cycling lanes and improving bicycle parking, the city aims to make cycling the fastest mode of transport for journeys under 3 kilometres.

Pedestrian-friendly developments in city centres will further promote walking.

The new tramway system, which began operating in 2021, is the most significant project for developing the public transport system. The city plans to extend both the tramway and local train services by adding new stops and integrating train and bus ticketing systems. To encourage behavioural change, the city has also created a scheme where tickets to major events in the city centre cover public transport fares, promoting car-free travel (Interviewee 13, 2024). Additionally, car-sharing programmes, electric scooters and autonomous transport options are being developed to reduce the need for private car ownership and use. Furthermore, Tampere is exploring smart transport solutions like Mobility as a Service (MaaS) to integrate various transport modes into a seamless system, providing residents with flexible travel options.

BOX 8. BEST PRACTICE. TRANSPORT SECTOR: TAMPERE TRAMWAY

Tampere Tramway is the city's largest public transport project and a cornerstone for promoting sustainable urban growth. It offers direct emissions benefits due to its lower energy consumption and indirect emission reductions by enabling a denser urban structure and improving public transport services. The tramway supports job concentration and creates prime locations for city-centre-oriented activities in districts including Hervanta, Turtola, Kaleva and Lielähti. By 2040, approximately 50% of urban jobs will be located within the tramway zone. Each tram can accommodate the equivalent of three busloads of passengers and operates on dedicated tracks, ensuring reliability unaffected by road congestion. The project also enhances bus service reliability on feeder lines and reduces bus traffic in the city centre, freeing up space for walking, cycling and leisure.

CASE: OULU



Oulu. Photo: Unsplash.com

Background information

Situated on the northwestern coast of Finland in the Northern Ostrobothnia region, Oulu is the fifth largest city in Finland. The city has roughly 215,000 inhabitants, while the Oulu region has a total population of 262,736 inhabitants. The total area of the municipality is 3,818 km², of which 2,972 km² is land area. The size of the municipality, with vast rural areas, is the result of the merger in 2013 of the adjacent municipalities of Haukipudas, Kiiminki, Oulunsalo and Yli-Ii with the city of Oulu. The overall residential density is 72 inhabitants per km², with the city centre being the most densely populated area, having 1,015 residents per km² (Statistics Finland, 2023).

Demographically, Oulu has a young population; nearly 25% of its residents are under 15 years old and the median age in the city is 36. As the northernmost metropolitan region, Oulu is the economic and cultural centre of Northern Finland. The leading economic sectors are the technology and IT industries, with the city being particularly renowned for its strong expertise in wireless technologies and software development, making it one of Europe's leading ICT hubs. Health and wellness technology is also a significant sector, with innovative startups and established companies developing new solutions. Traditional industries, such as metal and

forestry, continue to play an important role in the region's economy. The city's university and polytechnic university college support local innovation and contribute to a highly educated workforce.

Strategic level: municipal goals and policies

While Oulu is not among the frontrunner cities in Finland in climate action, its commitment has grown considerably over the last decade. The city joined the Covenant of Mayors in 2011 and pledged a 20% per capita reduction in greenhouse gas emissions by 2020. This goal was reached in 2013 and the city followed up with the CoM agreement for Climate and Energy in 2016, pledging to reduce greenhouse gas emissions by at least 40% compared to 1990 levels by 2030. The agreement includes a Sustainable Energy and Climate Action Plan (SECAP), which defines measures related to building energy efficiency, transport and waste management (City of Oulu, 2018).

In the national context, Oulu has been a long-time participant in voluntary [energy efficiency agreements](#). Significant progress has been made in city-owned properties and operations through energy audits, energy-efficient street lighting and energy guidance for construction in the private sector. The current municipal energy efficiency agreement runs from 2017 to 2025, aiming to improve energy efficiency by 10.5% from 2014 levels by the end of 2025. Building on previous measures, the current agreement includes initiatives for energy efficiency in service buildings managed by the city, municipal transport and machinery as well as water and waste management. It also includes initiatives to increase the use of renewable energy, develop a cohesive urban structure and changes in operational models.

Oulu also participates in several networks, including the national C6 city network, which consists of the six largest cities in Finland (Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu). Cooperating on several urban topics, these cities discuss climate measures, work to find common solutions, share best practices and support sustainable development by influencing national policies. For Oulu, the network acts as an important platform for learning and collaborating with some of the leading climate cities in Finland, including Turku, Tampere and Helsinki, which have greater resources dedicated to climate neutrality (Interviewee 14, 2024).

It should be noted that the other cities in the network are situated in Southern Finland, where distances between urban centres are shorter and population growth is higher. In comparison, the pressure to build urban infrastructure at a high pace is slightly lower and the city does not have the same critical mass to support the development of extensive public transport networks. Accordingly, some of the climate mitigation solutions that may be effective in Southern Finland are not always transferable to Oulu. That requires Oulu to tailor strategies to its unique geographical and demographic challenges, focusing on solutions that align with its specific context and needs.

In early 2022, the city council of Oulu set the goal of achieving carbon neutrality by 2035 in its City Strategy, bringing forward the previous target year from 2040 (City of Oulu, 2022a). Carbon neutrality is defined as a reduction in emissions of at least 80% from 1990 levels (the baseline year in the CoM agreement), with the remaining 20% to be offset or compensated for. Implementation of the climate objectives in the city strategy is further elaborated on in the Environmental Programme (*Ympäristöohjelma*) (City of Oulu, 2022b). The programme combines small-scale initiatives with cumulative impacts, alongside larger-scale guidelines for urban development. The main principle for the latter is to increase density and functional mix around urban centres and to steer future developments around public transport corridors and hubs.

Another key document is the Climate Roadmap, a long-term plan that outlines goals for 2026, 2030 and 2035 (City of Oulu, 2023). Building on the Sustainable Energy and Climate Action Plan (SECAP) from 2018, the roadmap focuses on the sectors of energy, transport and mobility; construction and service facilities; waste management and circular economy; and education, public services and culture. These sectors were chosen as the key areas for climate action as they are the areas that are directly within the city's operational influence.

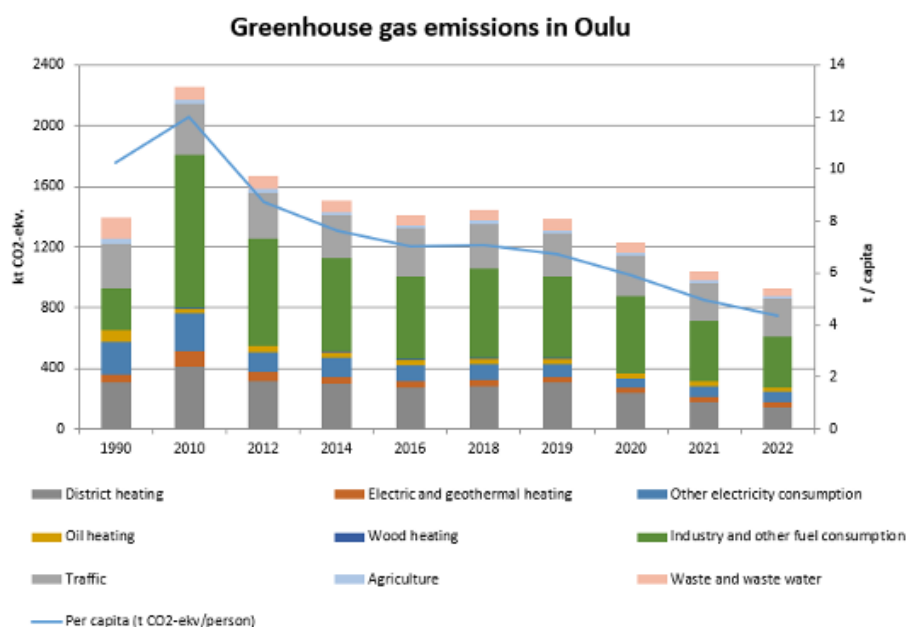
Like many other cities in Finland, Oulu calculates its total greenhouse gas emissions using the CO₂-report method, which aligns with the EU standard for calculating emission inventories.¹ The sectors included in the calculations are consumer electricity consumption, electric heating, geothermal heating, district heating, separate heating, road traffic, ports, railways, agriculture and waste management. Additionally, emissions from industry, machinery and industrial electricity consumption are assessed.

In 2022, total emissions, including the industrial share, were 928 kt CO₂-eq or about 4.4 tonnes per capita (Sitowise, 2023). That equals a decrease in emissions of about one-third or approximately 57% per capita compared to 1990 levels (see Figure 1). In 2022, the largest share of consumer emissions came from transport (43%) and district heating consumption (26%). Notably, emissions from district heating production had dropped to less than half of the 1990 level by 2022, whereas transport emissions per capita had only decreased by about one-fifth, making transport the slowest sector to transform in terms of consumer emissions.

Looking to the future, estimates suggest that total emissions in 2035 will be 430 kt CO₂-eq or about 69% lower than 1990 levels, falling short of the 80% reduction target. Given the short timeline, several barriers lie ahead. In particular, political priorities at both local and state levels have made the implementation of certain climate objectives challenging. The emphasis on local economic growth may conflict with long-term climate goals, while the austerity policies of the current government (Orpo's Cabinet, 2023-present) have created uncertainties about public funding and budget constraints, further complicating municipal strategies (Interviewee 14,

2024). The impact of political priorities is particularly evident in the land use and transport sectors, as the political majority at both local and national levels considers the development of road networks for motorised vehicles essential for economic growth, exacerbating the challenge of reducing emissions in the transport sector (Interviewee 17, 2024). These tensions highlight the need for integrated policies and strategies to achieve meaningful progress. In the following sections the strategies, challenges and opportunities to reduce carbon emissions within the land use, transport and buildings sectors in Oulu will be further explored.

FIGURE 9. GREENHOUSE GAS EMISSIONS IN OULU 2022. SOURCE: SITOWISE



Source: Sitowise

Land use

In 2013, the city of Oulu merged with four surrounding municipalities (Haukipudas, Kiiminki, Oulunsalo and Yli-Ii), expanding the administrative boundaries city to its current form. Aside from the central city area and smaller local centres, the region is predominantly rural, characterised by detached housing and vast forest areas.

Following the municipal merger, a Local Master Plan was developed with the aim of promoting sustainable and energy-efficient urban development across the entire municipal area (City of Oulu, 2016). The master plan does not specify quantitative climate targets, but provides strategic direction for land use planning, with qualitative goals for future development such as limiting urban sprawl, promoting functional diversity, increasing land use efficiency through densification and

developing a more networked urban structure. The plan also addresses sustainable mobility, with the goal of creating favourable conditions for the development of public transport in the future.

A notable element of the master plan is that it operates at two scales with respective timelines – 2030 and 2050 – to address both short-term and long-term urban planning needs. The 2030 plan covers the urban inner-city area, specifying land allocations for housing, employment, primary uses and supporting functions. By contrast, the 2050 plan provides a broader strategic vision for the entire municipal area, outlining long-term development areas based on population forecasts.

The "development zones", which guide land use, are another key element of the master plan. These zones are designated for both urban and rural areas, with specific development objectives tailored to each area. Accordingly, the zones vary in land use efficiency, functional diversity, urban appearance and environmental quality. With the aim of establishing a framework for sustainable growth, zones are categorised by development objectives, enabling more specific regulations to be detailed in lower-level plans. This approach means that the plan remains flexible, allowing for adaptability to local conditions and future changes.

Since the city owns few plots in the inner city, developing a functional mix in the city centre largely relies on private landowners, complicating comprehensive planning (Interviewee 15, 2024). Residential projects often yield higher returns, prompting private developers to prioritise housing in new construction. To address this challenge, the city uses economic incentives that encourage infill development, including discounts on land use fees, planning fees and agreement compensations. For instance, property owners are eligible to receive financial benefits for infill projects, enabling them to renovate buildings or add amenities like lifts. However, such incentives have their limitations, as target groups, such as housing cooperatives, are often reluctant to take on the long-term financial commitments and the risk of uncertain returns on investment from such projects. As a result, widespread use of these incentives remains challenging without additional support measures.

In contrast to the low land ownership in urban areas, the city of Oulu possesses vast forest areas – approximately 19,500 hectares – making it the largest owner of municipal forests in Finland. Recognised for their potential to act as carbon sinks, these forests are a key asset in offsetting emissions. However, the forest industry also plays a crucial role in the municipal economy, contributing significantly to employment and local revenue. As such, the city's approach to forest management is a frequent topic of discussion among policymakers and stakeholders (Interviewee 15, 2024). While climate change mitigation is a central theme in these discussions, the current principle for sustainable forest use is to maintain multiple functions. This means that carbon sequestration needs to be balanced with other uses such as

timber production, biodiversity and water conservation and recreation (City of Oulu, 2024).

Buildings and construction

The goals for achieving carbon neutrality in the construction sector include several key measures, which are outlined in the recent Environmental Programme (City of Oulu, 2022b), the Roadmap for Circular Economy (City of Oulu, 2021a) and the Climate Roadmap (City of Oulu, 2023). The latter operates with two timelines, with goals for 2026 and 2035. By 2026, certain steps are mandated, while additional measures are to be implemented more gradually. In the buildings sector, the primary goal for 2026 is to ensure energy efficiency in all public buildings. The first step is to incorporate carbon footprint calculations into all major municipal building projects. Additionally, efforts will be made to renovate, improve and maintain existing buildings to extend their lifespan. Between 2026 and 2035, the public sector aims to further develop low-carbon practices in construction, enhance the recycling and reuse of materials and increase the use of wood in municipal projects.

In recent years, the energy consumption of Oulu's municipal properties has been significantly reduced, particularly through adjustments in ventilation and lighting, resulting in lower consumption than in other major Finnish cities. As part of the Environmental Programme, the city monitors the energy efficiency and theoretical energy consumption of new buildings, calculating how much more efficient they are than the regulations require. A good example is Sivakka Oy, the city's rental housing company, which manages over 8,300 rental apartments. Sivakka's buildings are top-tier in energy efficiency, with electricity and heat increasingly produced from emission-free energy sources. New buildings always have an energy class of A+ and are equipped with solar panels, district heating and geothermal heat. In line with the Climate Roadmap, Sivakka's next mandate is to reduce emissions from construction and materials. In addition to the progress in the public sector, Oulu is nationally recognised for its work in guiding private and commercial builders in energy efficiency (Interviewee 16, 2024). This guidance is being extended to renovations.

Transport and mobility

Among the greatest challenges to achieving climate neutrality in Oulu is reducing the significant emissions from the transport sector. While reductions have been achieved across several sectors, emissions from road traffic have remained consistently high over the last decade and are estimated to account for 34% of residents' carbon footprint. However, the emphasis on sustainable transport has become increasingly explicit in steering documents such as the City Strategy (2023), the Local Master Plan (2016) and the Regional Transport Plan. In 2021, the city also drew up a Sustainable Urban Mobility Plan (SUMP) based on the EU-SUMP

concept. In this plan, a quantitative goal to steer concrete measures is clearly defined: at least 50% of all journeys should be made by walking, cycling and public transport by 2030 (City of Oulu, 2021b). The plan identifies decision-making, the city centre's traffic system and public transport as the pivotal areas for promoting sustainable mobility. To this end, five subgoals have been defined:

- Decision-making will support the long-term development of sustainable transport.
- The city centre will be a vibrant meeting place with 20% more people spending 20% more time there.
- Local environments will be pleasant and safe, with walking making up at least 23% of the modal share.
- Public transport will be a convenient choice, with a modal share of at least 7%.
- Cycling will be a smooth and attractive option all year round, with a modal share of at least 20%.

The high reliance on cars in Oulu is closely linked to the challenges in the land use sector, such as the sprawling urban structure and the lack of political commitment to ensuring higher density. Without consensus on restricting passenger cars, developing comprehensive public transport coverage is currently unattainable (Interviewee 17, 2024).

So far, the most successful aspect of sustainable transport planning in Oulu is the extensive cycling infrastructure. The city boasts a total of 900 km of bike lanes, including 14 km of high-quality cycling corridors known as *Baana*. Despite the long winter season, the average distance travelled by cycling in Oulu is more than twice the national average, reflecting the city's commitment to promoting cycling as a viable mode of transport. The Baana corridors provide direct and convenient routes that connect key residential areas with major destinations such as the city centre, schools, workplaces and recreational areas. The city is continually expanding the Baana network to cover more areas, improve connections and integrate new technologies for better traffic management and safety. The goal is to extend the network to 98 km by 2030 through upgrading existing cycling infrastructure to Baana standards and expanding it into new areas (City of Oulu, 2019). The plan also includes adding more covered bike parking facilities, increasing signage and wayfinding tools and further integrating cycling paths with public transport networks to support a seamless travel experience. These efforts aim to make cycling not only a practical choice for daily commutes but also an integral part of Oulu's overall transport system.

While a shift to lower-emission vehicles could accelerate emission reduction, in the adoption of electric vehicles (EVs) Oulu lags behind the more densely populated southern regions of Finland. Currently, there are no specific incentives for electric

vehicles in Oulu and public charging infrastructure is limited to larger parking facilities and private properties. However, efforts are underway to develop a comprehensive plan for public charging points, which might include incentives such as reduced parking fees at charging stations. Nevertheless, significant change in renewing the car stock will rely on national policies and incentives provided by the government.

BOX 9. BEST PRACTICE. TRANSPORT SECTOR, OULU. CYCLING ROUTES AND MAINTENANCE

To promote cycling and improve the quality of cycling routes, several high-quality cycling corridors called *Baanas* are planned to be implemented. A typical Baana project involves widening the cycling path and separating pedestrian and cycling lanes. The implementation of upcoming Baana projects is scheduled to last until 2030.

One of the key factors contributing to the success of Oulu's cycling infrastructure is its exceptional maintenance of cycling lanes, especially during winter. The city employs a rigorous snow ploughing regimen, ensuring lanes are cleared promptly and frequently. This maintenance is so thorough that bike lanes may be ploughed multiple times a night during heavy snowfall, keeping them safe and usable all year round.

Challenges and opportunities: a multilevel governance perspective

Spatial planning in Finland operates according to a hierarchical system involving national, regional and local authorities. In land use planning, regulatory instruments are tied to a hierarchical three-tiered zoning plan system: the regional plan, the local master plan and local detailed zoning plans. The regional and local master plans are guided by national land use objectives, which are drawn up at the beginning of each government term. However, these do not have regulatory power over lower-level plans and, in general, Finnish municipalities are considered to have significant autonomy in spatial planning.

In the buildings and construction sector, the Ministry of the Environment establishes national building codes, energy efficiency standards and environmental impact

regulations to promote sustainable construction. At the regional level, ELY Centres (Centres for Economic Development, Transport and the Environment) monitor compliance in terms of environmental impacts and heritage protection. At the local level, municipalities serve as the primary authorities for issuing building permits and supervising construction projects.

Policy capacity: vertical and horizontal governance tensions

Land use sector

Vertical governance tensions

In Finland, urban densification has been the guiding principle for planning on both the local and national level for over two decades. Since 2000, national guidelines have prioritised the consolidation of urban form, a focus that has been reinforced in recent years due to climate change mitigation aims. Central to the Finnish notion of "consolidation" is the development of urban areas within existing infrastructure. However, policy implementation has been weak, as urban sprawl continues across all major urban regions, including Tampere and Oulu (Ministry of the Environment, 2021)

To achieve climate neutrality in cities, coherent land use planning on the city-regional level is recognised as crucial, as settlement and commuting patterns drive emissions both within and outside city limits. While there is no dedicated authority operating at this level in Finland, there are a number of policy tools for coordination, with the most significant being the Land Use, Housing and Transport agreements (MAL agreements). These agreements are made between the state and municipalities in all the largest metropolitan regions in Finland. MAL agreements are contractual arrangements under which the state agrees to partially fund major infrastructure projects and municipalities agree to create city-regional planning frameworks and align their strategies for land use. The agreements are concluded for 12 years, but implementation plans and funding are renegotiated every four years – at the start of each government's term; that can make the implementation of some projects unpredictable. It should also be noted that these agreements do not hold statutory power over local zoning plans, meaning that there is no guarantee that local decision-makers will consistently adhere to the objectives set forth in the MAL agreements.

Horizontal governance tensions

In both Tampere and Oulu, the systematic adherence to master plans and other overarching strategies is a challenge. One weakness is the nature of planning decisions, with plans being approved on a case-by-case basis. More effective governance control could be achieved through stricter regulations but a prevailing

anti-regulation stance at the national and local level makes this an unlikely solution. Indeed, in both municipalities, cooperation with the private sector is viewed as a more efficient solution than imposing stringent rules (Interviewee 12, 2024; Interviewee 15, 2024). Moreover, the current government (Orpo's Cabinet) has – as part of its austerity policies – retracted the legal requirement for municipalities to develop local climate strategies, which was introduced by the preceding government (Marin's Cabinet, 2019-2023). While this regulatory reversal has not led Oulu and Tampere to abandon their climate strategies, the frequent changes in regulations demonstrate the uncertainties and shifting priorities surrounding climate policies.

In Tampere, the densification and functional mix of the inner city have been advanced by the extensive land ownership of the municipality. Identifying optimal solutions is, however, complicated as different trade-offs must be weighed up. For instance, the ambitious goals for housing production necessitate the use of undeveloped land and green fields, as densification of urbanised areas is a slow process compared to the construction of new areas supplying the city with thousands of housing units (Interviewee 11, 2024). This, in fact, goes against densification principles of saving natural land.

Another challenge in horizontal governance is the growing conflict between various efforts to promote sustainable development. For instance, the rise in environmental regulations and detailed ecological surveys affects where housing can be developed, which can complicate plans for larger cohesive urban structures and densification goals. In Oulu, preservation of natural areas and habitats is clearly rising on the political agenda, sometimes at the expense of densification efforts (Interviewee 15, 2024). This is partly due to how impacts are assessed and communicated. While the consequences of land use on biodiversity and nature can be relatively predictable and immediate, climate impacts are compounded over longer periods of time, making each planning decision seem less consequential for policymakers.

In Oulu, the dispersed urban fabric presents inherent challenges, as increasing densification and energy efficiency in a large, sparsely populated municipality with long distances to the city centre requires systematic implementation and coordination. However, such systematic implementation has been strained by political priorities that contradict climate goals. A particular challenge is the political support for developing detached housing, which is considered essential for the city's vitality and attractiveness (Interviewee 15, 2024). This preference leads to urban expansion and inefficiencies in public transport coverage, as many households rely on multiple cars. That leads, in turn, to increased demand for parking spaces and road infrastructure – responsibilities that fall to the planning unit. Consequently, planning resources are often diverted towards addressing parking and road capacity concerns, detracting attention from long-term sustainability goals (Interviewee 15, 2024).

Buildings and construction sector.

Vertical governance tensions

Although Finnish municipalities have a high degree of autonomy in planning and have various tools at their disposal for incentivising sustainable construction, the existing legal framework limits the most ambitious efforts as municipalities cannot demand that private developers surpass the requirements of the law with respect to environmental targets.

The Land Use and Building Act (132/1999), which regulates the buildings sector in Finland, is being revised at the time of writing and is set to come into effect in 2025. The outcome of the revision is highly anticipated as it will introduce new rules related to carbon emissions, including procedural and technical requirements. Among municipal representatives there are concerns that the law may weaken climate efforts, as recent amendments have weakened some requirements and some of the stricter provisions are set to be postponed until 2026. Municipal representatives in both Tampere and Oulu considered it likely that the government will eliminate some of the stricter requirements to reduce construction costs (Interviewee 12, 2024; Interviewee 16, 2024).

This issue is highly relevant, as not all private developers would oppose stricter regulations. In fact, a recent study in Tampere found that private developers in the region would welcome stricter climate regulations if these were mandated by the city (Interviewee 12, 2024). As the private market does not encourage developers to make these changes voluntarily, the greatest step towards sustainable practices remains dependent on regulatory tools. It should also be noted that while the City of Tampere has high land ownership – enabling the city to realise many of its ambitions – the low municipal land ownership in Oulu makes progress even more reliant on private developers. Compared to other metropolitan areas in Finland, Oulu also faces lower building pressure, meaning the relatively low competition on Oulu's private market leaves even fewer economic incentives to adopt sustainable practices (Interviewee 15, 2024).

Horizontal governance tensions

In terms of horizontal governance, representatives from both cities considered cross-departmental cooperation within their municipalities to be well-developed (Interviewee 12, 2024; Interviewee 16, 2024). Nevertheless, some conflicting interests arise due to the differing tasks and responsibilities of various units. Similarly to among representatives from the land use sector, such tensions were perceived not as conflicts but as an integral part of the working process (Interviewee 11, 2024; Interviewee 15, 2024).

A challenge related to conflicting interests is the difficulty in comparing different solutions with one another. For instance, in Tampere, the use of life cycle assessments (LCAs) may make the carbon reduction efforts of the public building unit appear ineffective (Interviewee 12, 2024). This is because LCAs assume a 50-year lifespan for buildings counting forwards, disregarding the actual longevity of older buildings, which may exceed 200 years. As a result, renovation efforts seem more carbon-intensive and expensive than the construction and maintenance of new buildings. Since a significant portion (roughly 70%) of the public construction budget is allocated to renovating older buildings – many of which are over a hundred years old and protected by heritage regulations – the building unit's emission reduction efforts have been called into question. This example illustrates how standardised assessment methods can misrepresent the environmental impact of renovation versus new construction, potentially undervaluing the long-term sustainability benefits of preserving older buildings.

Moreover, architectural requirements for public buildings add complexity. The challenge often lies in the high construction costs associated with using the most sustainable materials, limiting municipalities' ability to implement environmentally friendly solutions. While sustainable materials could reduce the carbon footprint of public buildings, their expense often exceeds public budget constraints.

Transport and mobility sector

Vertical governance

To support Finland's national goal of achieving carbon neutrality by 2035, a national 12-year traffic plan was drawn up in 2021. The plan outlines the largest infrastructure projects for the next 12 years and includes a yearly investment plan to support these initiatives. However, the actual budgets and implementation are subject to change, based on the political priorities of each government in office. The current government (Orpo's Cabinet, 2023-present) has signalled a shift in focus towards improving road infrastructure to strengthen national security and economic growth.^[25]

At the same time, national subsidies for sustainable transport modes, such as walking, cycling and public transport, have been cut, impacting the ability of both cities to fully implement plans on sustainable mobility. As a result, municipalities are tasked with finding innovative ways to continue supporting sustainable transport initiatives despite reduced funding.

25. Ministry of Transport and Communications, (23.05.2024), Press release: <https://valtioneuvosto.fi/en/-/1410829/minister-ranne-government-transport-projects-strengthen-finland-s-security-and-growth->

Horizontal governance

At the horizontal governance level, the main challenge in transport planning lies in balancing multiple objectives and finding common ground between different stakeholders' interests. While the city of Tampere has made considerable strides in developing sustainable transport services, decisions such as rejecting congestion charges or tolls highlight the political influences shaping Tampere's transport policies. While such measures could be part of the strategic toolkit, they currently lack political support both locally and nationally (Interviewee 13, 2024).

In Oulu, the dichotomy between promoting sustainable mobility and accommodating car use also causes tensions. Current strategic plans do not restrict car use or parking, reflecting the prevailing political stance that favours expansion of car capacity. This creates a challenging environment for advancing initiatives like walking, cycling and public transport, especially given Oulu's extensive rural areas, where private car use is already predominant. While there is political consensus around the overall vision and general strategies for increasing sustainable mobility at the local and regional level, actual solutions remain elusive. For instance, a comprehensive plan to reduce road traffic in favour of improving walking and cycling infrastructure in the city centre was recently prepared by the transport planning unit, but was dismissed by the city council as the political majority opposes any limitations on passenger cars (Interviewee 17, 2024).

Moreover, the objectives for "efficient public transport" in Oulu remain vague as there is no political consensus on what public transport solution should be developed. Different options such as light rail and bus rapid transit systems have been discussed but are still awaiting a decision. In this context, the mandate for transport planning in Oulu is to facilitate the development of *all* mobility modes, ultimately reducing the potential capacity for public transport, walking and cycling. Lastly, efforts to expand air traffic and commercial flights to the city highlight tensions between achieving emissions goals and political decisions to enhance the vitality and appeal of Oulu.

Institutional capacity: knowledge, relational resources and mobilisation capacity.

Knowledge capacity

Tampere and Oulu demonstrate strong knowledge capacity in urban sustainability and climate action, but their approaches reflect their distinct regional contexts. Tampere, as a rapidly growing city, has developed a structured and data-driven approach to emissions monitoring. It was the first Finnish city to introduce a climate budget, integrating emission reduction into financial planning (City of

Tampere, 2023). This approach allows for continuous monitoring, providing real-time emission tracking and progress indicators (City of Tampere, 2022). Moreover, Tampere has strengthened its in-house expertise in climate planning, hiring specialists in sustainable construction, energy efficiency and emissions assessment (Interviewee 10, 2024).

Oulu, as a smaller municipality, relies more on outsourced expertise for emissions assessments while gradually developing internal knowledge. While Oulu has well-developed internal competencies, limited political support for stricter regulations has led to fragmented efforts in climate adaptation, especially in land use and transport (Interviewee 17, 2024). However, Oulu has deep expertise in energy efficiency, enabling it to lead initiatives in energy-efficient construction and renewable heating solutions.

Relational Resources

Both cities are engaged in national and international climate networks, enabling them to share best practices and align with broader sustainability objectives. Tampere is a frontrunner city in Finland's HINKU network, collaborating with other municipalities to achieve carbon neutrality by 2030 (Tampere City Region, 2019). It has also received an EU Mission Label as part of the Net Zero Cities programme, providing access to international funding and research initiatives (Interviewee 10, 2024). Additionally, Tampere participates in the Green Building Council Finland, influencing national sustainability standards (Interviewee 11, 2024).

Both cities are members of the C6 city network, which brings together Finland's six largest cities (Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu) to collaborate, share best practices, coordinate climate measures and influence national policies. However, the network's role differs between the cities. For Tampere, the network has strengthened the collaboration between Helsinki and Tampere, helping to leverage Tampere's influence on national policies. While Oulu also benefits from the knowledge exchange, its geographical and economic context sets different pre-conditions. Unlike the other C6 cities, which are all located in southern and central Finland, the dispersed urban structures and lower population density in Northern Finland makes solutions less transferrable to Oulu (Interviewee 14, 2024). For instance, major state-funded public transport projects are more likely to be realised in the south as distances between urban areas are much shorter and the critical mass larger, highlighting the need for climate strategies and policy frameworks that account for different regional pre-conditions.

Public-private collaboration is another critical relational resource. In the construction sector, both cities prioritise cooperation when engaging the private sector in sustainability efforts (Interviewee 15, 2024; Interviewee 12, 2024). Tampere, for instance, hosts regular meetings with major contractors to encourage low-carbon construction, while Oulu integrates private sector engagement through

Business Oulu, facilitating investment in sustainable development. By fostering these relationships, both cities position the private sector as an active partner in climate action, rather than a passive recipient of regulations.

Mobilisation Capacity

Mobilisation capacity – the ability to translate plans into action – varies between Tampere and Oulu. In Tampere, there is strong political consensus on climate action, with carbon neutrality embedded in city strategy and financial planning (City of Tampere, 2023). Its Carbon Neutral Tampere 2030 Roadmap integrates emission reduction across departments, ensuring cross-sectoral implementation (City of Tampere, 2022). Moreover, public ownership of 70% of urban land enables Tampere to influence sustainable urban development directly (Interviewee 11, 2024). This has allowed for innovative zoning policies, such as requiring wood construction in specific areas and offering incentives for energy-efficient buildings. However, implementation challenges remain in the transport sector, where car dependency and budget constraints limit a rapid transition to sustainable mobility (Interviewee 11, 2024).

Oulu faces greater challenges in mobilising its climate plans. While the city has ambitious climate targets, political opposition to regulating car use and controlling urban sprawl has slowed progress (Interviewee 17, 2024). Oulu has successfully implemented energy efficiency measures in municipal buildings and housing, but land use planning remains a challenge, as low-density development continues to spread into rural areas (City of Oulu, 2016). Furthermore, the city's transport planning lacks a clear political mandate, delaying decisions on public transport expansion (Interviewee 17, 2024). Despite these obstacles, Oulu has successfully expanded its cycling infrastructure and now boasts the highest per capita cycling rates in Finland, supported by bike lanes that are maintained in winter (City of Oulu, 2019).



Photo: Unsplash.com

Key reflections and learnings from Finland

The cases of Tampere and Oulu highlight the diverse approaches Finnish cities take to sustainability and climate action, shaped by differences in political alignment, economic structure and regional context. While both cities demonstrate strong institutional capacity in various sectors, they also face challenges in governance coordination, policy implementation and behavioural shifts.

While national and local strategies highlight compact urban forms, inconsistent adherence to densification principles and trade-offs between sustainability goals and development priorities pose challenges in creating cohesive, low-carbon urban environments. Past urban planning decisions also shape sustainability efforts, particularly in Oulu, where a historically dispersed urban structure – reinforced by policies favouring detached housing and road expansion – poses challenges to densification and sustainability goals.

Further, the building and transport sectors illustrate tensions in regulatory autonomy and sustainability. In the buildings sector, national regulations slow the adoption of sustainable practices, as they limit the extent to which stricter local standards can be enforced. While the collaboration with private actors and economic incentives provide opportunities, significant advancements remain contingent on stronger regulatory frameworks and consistent policy support from the national level.

This is also evident in the transport sector, where state funding constraints and weak political support for car-restrictive measures (e.g. toll roads) at both national and local levels undermine efforts to expand sustainable alternatives. Meanwhile, intermunicipal coordination remains a challenge, as different municipalities and departments prioritise competing transport investments, slowing the integration of regional mobility strategies. As transport remains one of the most challenging sectors to decarbonise, both strong political commitment and shifts in societal preferences are imperative.

While both cities are committed to carbon neutrality, the ability to translate plans into action varies. Tampere's political cohesion and history of climate leadership have enabled strong interdepartmental coordination, ensuring that ambitious sustainability goals translate into concrete actions across municipal sectors. While Oulu is setting increasingly high climate ambitions, it is experiencing fragmented political will and inconsistencies between goals and actions. Nevertheless, Oulu's cycling infrastructure and energy-efficient housing initiatives demonstrate that even without full political alignment, significant progress is possible.

In summary, the experiences of Oulu and Tampere demonstrate that achieving climate neutrality will demand robust political will, solutions for adaptation to legacy systems and a commitment to fostering cultural and behavioural change. In the boxes below, some of the key challenges in Finland, their implications and possible actions are summarised.

CHALLENGE 1: Balancing environmental protection and urban cohesiveness.

Implications: Environmental preservation efforts can limit the development of dense and cohesive urban structures.

What can be done? Increase coordination between planning levels and clarify the long-term sustainability trade-offs of different planning alternatives.

CHALLENGE 2: Limited autonomy in setting requirements for the private sector in construction.

Implications: National regulation restricts municipalities' ability to set ambitious requirements in the private buildings sector, slowing down progress in the construction sector.

What can be done? Increase coordination and dialogue between the national and the local level to align goals. Allow for more stringent and adaptive green building standards.

CHALLENGE 3: No measures for limiting private car use.

Implications: The lack of restrictive measures, such as congestion fees, zero-emission zones and toll roads, make car use an attractive option, slowing down the transition towards sustainable mobility options.

What can be done? Advocate for the "polluter pays" principle to help finance and incentivise the use of sustainable mobility options. Increase awareness and foster behavioural change among citizens and stakeholders.

CHALLENGE 4: Limited funding for sustainable transport development.

Implications: Reliance on state funding for implementing sustainable transport solutions limits municipal control over projects.

What can be done? Advocate for the "polluter pays" principle to help finance and incentivise the use of sustainable mobility options. Seek alternative funding (such as EU funds and public-private partnerships).



Reykjavik Photo: Unsplash.com

9. ICELAND



CASE: REYKJAVÍK



Reykjavik. Photo: Unsplash.com

Background

Reykjavik, located within the Capital Region of Iceland, is the country's largest city and capital. It is located in southwestern Iceland. As of 2024, the population is estimated at just below 140,000, while the entire municipality spans an area of 273

km². Reykjavík is also the largest municipality in the Greater Reykjavík Area, which includes six municipalities and has a population of around 243,000 inhabitants as of 2024 (Hagstofa Íslands, n.d.).

Reykjavík is globally recognised for its commitment to innovation and technology. The city is home to the University of Iceland and Reykjavík University, both of which include research centres in various fields and sciences. The city also hosts several research units, centres, labs and institutes, which contribute to its vibrant technological ecosystem (Reykjavík, 2022). As a coastal city, Reykjavík has a significant maritime industry. The city's port, Reykjavík Harbour, is Iceland's principal seaport, providing comprehensive maritime support and hosting tourism on a large scale (Faxaflóahafnir, 2024). Public services such as education and healthcare are another dominant sector of Reykjavík's economy. Tourism also plays a vital role in the city's economy; Reykjavík attracts visitors from all over the world and hosts more than 2 million international visitors annually (Hagstofa Íslands, 2024).

Lastly, Reykjavík is at the forefront of renewable energy initiatives. The city is powered largely by green energy from hydro and geothermal sources (Reykjavík Energy, 2024). Reykjavík officials are taking unprecedented steps towards reducing the carbon output of city vehicles and are aiming for 100% of vehicles to be powered by energies free of greenhouse gas emissions by 2025 (Reykjavík, 2021). The city's transition from fossil fuels to renewables serves as an inspiration to other countries seeking to increase their share of renewable energy (Eggertsson, n.d.).

Strategic level: municipal goals and policies

Reykjavík has made a robust commitment to climate neutrality, as detailed in its Climate Action Plan for 2021–2025, which sets the goal of becoming carbon neutral by 2040 (City of Reykjavík, 2021). The city has been selected for a European collaboration on carbon-neutral and smart cities until 2030, positioning itself as an innovation hub for other European cities pursuing similar objectives (European Commission, 2022).

The city's climate policy was first introduced in 2009 and has been revised several times, evolving into the current Climate Action Plan, which sets greenhouse gas reduction targets through 2030. The city supports a carbon-neutral future through extensive green investments and careful assessment of each action's carbon dioxide equivalent impact, cost and implementation timeline (City of Reykjavík, 2019). Recent systematic efforts have emphasised environmental improvements and green investments, which are projected to account for approximately 24% of total investments over the next five years (City of Reykjavík, 2019). Green investments cover improvements in open spaces, maintenance of footpaths, upgrades to bus priority routes, replacement of garbage containers and more (Reykjavík, 2022).

A comprehensive approach to environmental responsibility is embedded in the city's Environmental and Resource Policy, which aligns climate action with urban

development, transport and nature preservation (City of Reykjavík, 2015). Biodiversity is recognised as a key factor in climate adaptation, with initiatives such as tree planting and wetland restoration featuring in the City of Reykjavík Policy on Biodiversity. Other sectoral plans, such as the Reykjavík Housing Plan, a waste management policy and the Green City Plan, further reinforce the city's commitment to carbon neutrality (City of Reykjavík, 2014, 2019, 2022a). The Green Deal serves as Reykjavík's overarching strategy, linking key environmental, economic and social policies under a unified vision for 2030 (City of Reykjavík, 2022c). With an emphasis on the environment, the economy and society, the Green Plan defines fifteen key priorities that act as a common guiding framework across the city.

The current Climate Action Plan builds upon the previous plan, which concluded in 2020, and is aligned with the Paris Agreement's framework of revising climate actions every five years while measuring progress biennially. The plan integrates goals from earlier policies, including the Reykjavík Municipal Plan 2010-2030, the Environmental and Resource Policy and the Action Programme for Waste Management. Development of the Climate Action Plan also involved significant public and stakeholder engagement. A steering group comprising elected officials, municipal staff and external experts oversaw the process, with more than 200 public proposals submitted online and consultations held with NGOs and businesses. The draft plan was reviewed by the City Committee on Environment and Health and the city council before being finalised (City of Reykjavík, 2021). The plan sets out fifteen key climate actions, eleven of which are primary and four supporting, each with specific carbon reduction targets. These initiatives focus on transforming Reykjavík's districts into pedestrian-friendly areas where essential services, green spaces and outdoor activities are accessible within a 15-minute walk or bike ride. Sustainable transport is central to this vision, with 80% of new housing development planned near the city's Bus Rapid Transit system, Borgarlína. An expanded cycling network will support Reykjavík's ambition to become a world-class cycling city, while improved public transport and compact urban planning will reduce car dependency.

Further measures include the implementation of citywide charging infrastructure for electric vehicles, the reduction of landfill waste through an enhanced recycling and recirculation plan and the promotion of greener construction practices. Reykjavík is also working with Carbfix and OR to develop solutions for CO₂ sequestration and is expanding climate forests in collaboration with the Reykjavík Forestry Society (Reykjavík, 2021; Reykjavík Energy, 2024). Supporting actions include eliminating fossil fuel use in municipal operations by 2025, with no new fossil fuel-powered vehicles or equipment having been procured since 2021. The city is also adapting to climate change through innovative water management solutions, improved flood control measures and the development of coastal recreational areas. In partnership with Festa, a centre for corporate social responsibility, Reykjavík is encouraging sustainable business practices across all sectors of the economy (Reykjavík, 2021).

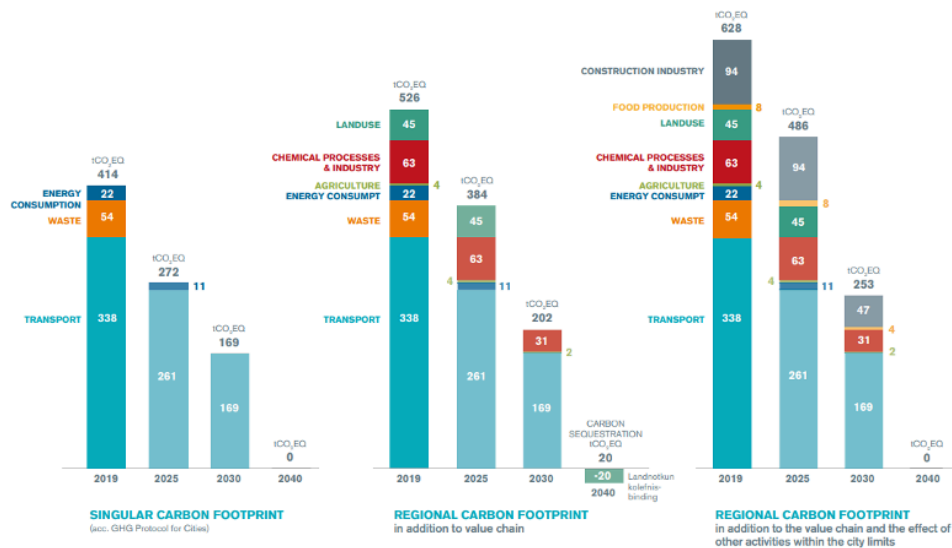
Greenhouse gas emissions are assessed using the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), ensuring consistency with international climate accounting standards. Reykjavík reports emissions at two levels: community-scale emissions, which encompass all emissions generated by residents, businesses, transport and land use, and municipal operations emissions, which include the city's fleet, public buildings and waste. Examination of the factors that the city of Reykjavík can influence shows that emissions from transport continue to account for the largest share of community-scale emissions. A simple carbon footprint analysis reveals that transport accounts for 82% of all emissions (EFLA, 2022). However, when additional factors are incorporated into a regional carbon footprint, including the value chain, the proportion of emissions attributed to transport decreases to 64%. When further effects are considered, such as the impact of other activities within city limits, transport's share of total emissions falls to 54%. This highlights the complexity and multifaceted nature of carbon emissions within a city context (Interviewee 18, 2024).

To project future developments, it is essential to assess the current situation and consider plans for future outcomes. The general zoning plan anticipates a 50% reduction in private car trips by 2030. This scenario projects a 5% annual reduction in transport emissions until 2025, with emissions halving by 2030 compared to 2019 levels. The goal is for all cars to be greenhouse gas (GHG) emission-free by 2040, resulting in zero emissions from transport by that year. Concurrently, the public Reykjavík Energy Company is aiming for carbon neutrality by 2030. This will significantly reduce GHG emissions from energy, with forecasts indicating a drop to zero emissions by 2030 (Reykjavík, 2021). In the waste sector, once the Sorpa Waste Management biogas and composting plant is operational, the landfill disposal of organic and combustible waste is expected to cease. The target is to reduce landfill emissions to near zero by 2025. Emissions from agriculture, construction and other sectors are projected to be halved by 2030, with the ambition for those sectors to achieve carbon neutrality by 2040 (Reykjavík, 2021).

While environmental responsibility is a cross-cutting issue spanning multiple departments, the Department of Environment and Planning is primarily responsible for climate actions, urban planning and environmental quality (City of Reykjavík, 2024c). The Department of Environment and Planning is also responsible for coordinating with the Global Covenant of Mayors, ensuring climate accounting is submitted according to this international treaty. The Finance Office handles the annual emission assessments from the city's operations. Supervision and follow-up of the new action plan will be managed by a political steering group, with particular attention to implementing a gender-based budget for Reykjavík. Other divisions also contribute, with the Finance and Risk Management Division overseeing green procurement and climate accounting, the Human Resources Division promoting workplace sustainability and the Service and Innovation Division advancing climate-focused projects (City of Reykjavík, 2024b). Looking ahead to 2040, achieving

carbon neutrality will require nearly complete emission reductions across all sectors, including fossil fuel use, waste creation and energy consumption (Interviewee 18, 2024).

FIGURE 10. CARBON FOOTPRINT IN REYKJAVÍK 2019-2030



Land use sector

Over the past few decades, Iceland's Capital Region has experienced significant growth in both land use and population. From the mid-1980s to 2012, the urban area expanded by 132%, while the population increased by 52%. This led to a 35% decrease in population density and an 86% increase in private car ownership (Borgarlína, 2022b, 2022a), which is indicative of urban sprawl and increased car dependency.

With continued population growth expected, authorities aim to reverse the trend by promoting sustainable urban development, increasing densification and enhancing public transport use (Interviewee 19, 2024). The transformation of transport, through the establishment of an efficient public transport network, aligns with international climate obligations and the Icelandic government's overall policy. By reducing private car use and, consequently, carbon emissions from land transport, the initiative contributes to meeting national and international obligations, encouraging the state to finance this large-scale transport transformation project that is now underway in the city of Reykjavík and the whole Capital Region (Lidmo et al., 2024).

This initiative, regarded as a necessary step to curb further urban sprawl, aligns with a comprehensive urban development perspective reflected in national policy as

well as the policies of the City of Reykjavík and the collective regional plan of the municipalities in the Capital Region (Reykjavík, 2022; Skipulagsstofnun, 2016, 2020; SSH, 2015). The collective regional plan has proven successful in preserving, protecting and developing green urban areas (Lidmo, J., Bogason, Á., & Turunen, E., 2020). However, to achieve the vision of more sustainable urban development, a transformation of the municipalities in the Capital Region and its suburbs, along with new modes of transport, is deemed necessary (SSH, 2015). Therefore, densification and better availability of public transport are seen as key factors for Reykjavík and its surrounding areas in reducing emissions.

Policy approaches and instruments related to land use for minimising carbon emissions are outlined in several sectoral plans. However, the City of Reykjavík's municipal master plan is the main policy document, with emphasis on densification, green infrastructure, public transport-oriented development and smart growth. Reykjavík prioritises limiting its past massive geographical expansion through the key strategies of densification and mixed land use. Densification aims to optimise land use within existing urban areas, reducing the need for expansion into undeveloped lands. Mixed land use integrates residential, commercial and recreational spaces, promoting vibrant, walkable neighbourhoods (Reykjavík, 2022).

Another approach to future and ongoing development is the concept of a 15-minute city. This approach ensures that essential services and amenities are accessible within a 15-minute walk or bike ride from residents' homes and that there is also access to public transport in the proximity. This reduces reliance on cars, lowers emissions and enhances the quality of life. Reykjavík's policy also prioritises development of brownfield sites over greenfield sites. Brownfield development involves repurposing previously used land, helping to preserve green spaces and reduces urban sprawl. This approach aligns with sustainable development goals by minimising environmental impact and promoting efficient land use (City of Reykjavík, 2022; City of Reykjavík, 2022b).

BOX 10. BEST PRACTICE. LAND USE, REYKJAVÍK. ÁRTÚNSHÖFÐI AND ELLIÐAÁRVOGUR: DISTRICT TRANSFORMATION

Ártúnshöfði and Elliðaárdalur represent Reykjavík's largest development area. Located in a former industrial area, their development is aimed to support the city's climate goals and promote sustainable urban development. The new district will include up to 8,000 housing units for approximately 20,000 residents. The development emphasises environmental sustainability, with a strong focus on green spaces and environmentally friendly construction practices. The area is designed to integrate high-quality public transport, including the proposed Borgarlína system, which will run through the centre of the district, enhancing connectivity and reducing reliance on cars.

The district's development aligns with Reykjavík's Green Plan, a comprehensive strategy for green investment, construction and job creation. The goal is for the district to undergo an environmental certification process, with the aim of it becoming the first district in Reykjavík to receive special environmental certification according to international standards. Emphasis is placed on walking, cycling and electric scooters to promote a pedestrian-friendly environment with minimal carbon emissions from transport.

Buildings and construction sector

The 2023 Reykjavík Housing Agreement marks a significant milestone in addressing the city's housing challenges. This comprehensive agreement aims to boost housing supply, with ambitious targets of constructing an average of 1,600 units annually until 2033. Notably, it prioritises affordability and social responsibility, dedicating 35% of new construction to affordable, sustainable and socially inclusive housing. That translates to approximately 5,600 such units over the decade. The agreement represents a transformative shift in Reykjavík's housing approach, with the aim of providing equitable access to adequate and comfortable housing for the city's residents while ensuring environmental and social sustainability (City of Reykjavík, 2024a).

Sustainable construction practices and proximity to eco-friendly transport infrastructure are considered crucial in pursuit of the initiative for socially responsible housing. The location of these developments is therefore expected to prioritise walkable access to services, recreational spaces and employment

opportunities. Additionally, the design and construction of new neighbourhoods must prioritise public health, environmental concerns and minimisation of household transport costs and carbon emissions (Interviewee 20, 2024).

The municipal master plan and Reykjavík's Green Plan also emphasise integrated housing and sustainable transport infrastructure plans (City of Reykjavík, 2022; City of Reykjavík, 2022c, 2024a). Evaluation of construction needs should consider climate change and the carbon footprint, with prioritisation of residential developments near public transport, walking and cycling routes (Interviewee 21, 2024). The City of Reykjavík has therefore emphasised sustainable construction practices like BREAAAM certification, minimisation of carbon footprints and optimisation of energy efficiency. Projects like Green Housing of the Future and C40 Reinventing Cities exemplify this commitment. Through such projects the city collaborates with designers, contractors, housing companies, investors and other stakeholders in the construction sector to reduce greenhouse gas emissions and environmental pollution (City of Reykjavík, 2024c). Furthermore, the city has made several pieces of land available for development, envisioned as green catalysts within the construction industry's value chain, thereby promoting the sector's environmental sustainability. The goal is to minimise negative environmental impacts by considering factors like building materials, emissions during construction, energy consumption, building flexibility and lifespan (Interviewee 20, 2024; City of Reykjavík, 2024a).

The Icelandic Housing Authority (HMS) has recently approved the implementation of mandatory Life Cycle Assessments (LCAs) and carbon footprint calculations for all building projects. Effective from 1 September 2025, applicants seeking building permits will be required to submit LCA results at both the design stage and upon project completion before the final inspection can occur (EFLA, 2024). LCAs provide an assessment of a building's environmental footprint, taking into account factors like energy consumption, water use, waste generation and greenhouse gas emissions. Similarly, carbon footprint calculations specifically focus on quantifying the total carbon emissions associated with the building's construction and operation (interviews, (EFLA, 2024). By making these assessments mandatory, Iceland – and by extension Reykjavík – aims to promote a more sustainable and environmentally conscious approach to the construction industry. The requirement to submit LCA and carbon footprint data will also provide valuable insights for design optimisation and material selection, ultimately contributing to a reduction in the environmental impact of buildings (Interviewee 20, 2024).

BOX 11. BEST PRACTICE. BUILDINGS SECTOR, REYKJAVÍK. BUILDING A GREENER FUTURE

The City of Reykjavík is taking a proactive approach to building a greener future, assuming a leading role in the collaborative project "Building a Greener Future", alongside key stakeholders in the construction industry. This project brings together the city of Reykjavík, Græn byggð (Green Construction), the Federation of Icelandic Industries, the Association of Local Authorities in Iceland, the Icelandic Road Administration, the Ministry of Infrastructure, the Environment Agency of Iceland and the Housing Financing Fund.

Through this joint initiative, the city is working closely with various industry players to develop and implement a roadmap for environmentally responsible construction practices towards 2030. The collaborating parties are actively exploring ways to minimise the lifetime carbon footprint of buildings, focusing on reducing emissions associated with construction sites, materials, energy consumption, infrastructure sharing and other relevant factors.

Within the scope of the Green Housing of the Future project (Grænt húsnæði framtíðarinnar), the city of Reykjavík offered a plot for development and the team from Iðá Real Estate Development presented the winning concept. This team aims to revolutionise the construction sector by reusing existing materials and resources that have already emitted carbon, while exploring additional design and construction strategies to significantly reduce future carbon emissions. Their goal is to achieve a 50-60% reduction in carbon footprint compared to a reference building (666 kg CO₂/m²).

Alongside the building design, the team plans to conduct a life cycle analysis to guide material selection. Furthermore, it is striving for a 40% reduction in energy consumption over the building's lifetime compared to traditional designs. Through this approach, the project stands as a pioneering example of circular economy principles in action, showcasing innovative solutions for sustainable construction and setting a new standard for environmentally responsible housing development.

Transport and mobility sector

The current Climate Account reveals that transport is the primary source of emissions in Reykjavík. However, the Icelandic government's climate action plan envisions a ban on new petrol and diesel car registrations by 2030, with the potential for this transition to occur even sooner in Reykjavík, which boasts well-developed electric vehicle infrastructure. Additionally, the implementation of *Borgarlína*, a new Bus Rapid Transit system, is expected to further drive the shift towards sustainable public transport, utilising renewable energy sources as outlined in the government's climate action plan and adopted by City of Reykjavík in its policies and plans (EFLA, 2022).

Reykjavík has previously taken steps to decrease car dependency in the city and aims to take further steps. Discussions on congestion taxes on cars in the central area have taken place and changes in laws, along with an agreement between the state and the municipalities in the Capital Region, make it possible to charge for the use of certain transport infrastructure.

The agreement between the state and the municipalities in the Capital Region encompasses various development projects aimed at fostering a more sustainable transport system across the entire metropolitan area. The objectives of this agreement are fourfold: (i) enhancing transport efficiency and diversifying travel modes, (ii) achieving a carbon-neutral society, (iii) improving road safety and (iv) promoting state and municipal collaboration for sustainable urban development. The most significant component of this agreement is *Borgarlína*, a Bus Rapid Transit (BRT) system in the Reykjavík area. Additionally, the agreement includes other infrastructure projects, such as the expansion of bicycle paths (Reykjavík, 2021; Stjórnarráð Íslands, 2019).

Reykjavík is typically considered a city with an exceedingly high level of car dependency. The city spans considerable geographical distances in relation to the number of inhabitants and the climate also makes reliance on cars for transport almost a necessity (Interviewee 21, 2024). Accordingly, Reykjavík's primary focus in its efforts to reduce emissions has been on the transport sector. This is mainly being implemented through introduction of the new Bus Rapid Transit system as well as continuous work to develop and maintain bicycle lanes, including during winter, making cycling a viable option as a year-round mode of transport (Interviewee 19, 2024; City of Reykjavík, 2019).

The Biking Plan in Reykjavík is integral to the city's broader vision for transport, urban development and enhanced quality of life. According to surveys, 27% of residents prefer biking as their means of commuting to work, with approximately 10% doing so consistently. The policy aims to establish the necessary infrastructure to enable those 27% to commute by bicycle (City of Reykjavík, 2022b).

Reykjavík's emission reduction will largely depend on mitigating emissions from road transport by decreasing the number of kilometres driven and emissions per

kilometre. The city aims to reduce the share of car trips to 58% by 2030, down from 73% in 2017. However, due to expected population growth, the actual number of car trips will likely remain the same, necessitating a reduction in emissions per kilometre driven. The adoption of eco-friendly vehicles has been rapid, with about 19% of new cars registered in 2020 being electric or plug-in hybrid. However, 48% of cars imported in 2020 still run on diesel or petrol. To significantly reduce traffic emissions, the number of eco-friendly vehicles must increase and the number of fossil fuel-powered vehicles must decrease rapidly.

Challenges and opportunities: a multilevel governance perspective

Spatial planning in Iceland is regulated through a hierarchical governance structure involving national, regional and local authorities. The Planning Act (Skipulagslög, No. 123/2010) provides the legal framework for land use, building regulations and transport infrastructure development. Iceland's governance structure is highly decentralised, with municipalities playing a key role in local planning and implementation. However, national authorities provide oversight, funding and strategic direction.

Land use planning in Iceland is governed by the Ministry for the Environment, Energy and Climate, which oversees national spatial planning policies and ensures compliance with environmental regulations. The National Planning Agency (Skipulagsstofnun) is responsible for reviewing and approving planning documents and conducting Strategic Environmental Assessments (SEA). At the regional level, regional planning committees coordinate land use across multiple municipalities. However, local municipalities play the key role, as they are responsible for municipal plans, zoning regulations and building permits.

The Ministry of Infrastructure oversees building regulations and enforces safety, energy efficiency and sustainability standards. The National Building Authority (Mannvirkjastofnun) ensures compliance with building regulations and supervises major construction projects. At the regional level, direct involvement is limited, but some regional development agencies perform advisory roles. Municipalities are the primary regulatory bodies for issuing building permits, supervising construction projects and enforcing zoning laws.

The Ministry of Infrastructure oversees national road networks, airports, harbours and public transport policy. The Icelandic Road and Coastal Administration (Vegagerðin) is responsible for maintaining national roads and ferry services. At the regional level, transport planning is coordinated through regional development plans. Municipalities manage local road networks, parking policies and public transport services in urban areas.

Policy capacity: vertical and horizontal governance tensions

Land use sector

Vertical governance

In the land use sector, Icelandic municipalities generally enjoy considerable autonomy to create and update municipal master plans that guide local spatial planning. Nonetheless, they must adhere to national guidelines, such as those outlined in the National Planning Policy (Skipulagsstofnun, 2016, 2020). That sometimes results in regulatory tensions and sustainability trade-offs.

In Reykjavík, vertical governance tensions arise in cases where state-owned land falls within municipal boundaries, such as the domestic airport, which remains under national jurisdiction despite being located in the municipality (Interviewee 29, 2024). Such cases require coordination between municipal and national authorities, sometimes leading to conflicting interests regarding land use priorities. Additionally, while municipal master plans provide long-term direction, they must be approved by the National Planning Agency to ensure that local initiatives align with national objectives (Lidmo et al., 2020). Despite these hierarchical constraints, Reykjavík retains considerable policymaking flexibility in areas not subject to national oversight, such as urban densification strategies and climate-oriented spatial planning.

Horizontal governance

The horizontal governance structure for land use in Reykjavík is characterised by cross-sectoral collaboration, involving departments responsible for transport, housing, environment and public health. While this integrated approach enhances comprehensive urban development, coordination of efforts across multiple municipal departments and agencies remains complex.

As the largest municipality in the Capital Region, Reykjavík must also coordinate land use planning and infrastructure projects with neighbouring municipalities through the regional plan, overseen by the Association of Municipalities in the Capital Region (SSH, 2015; Skipulagsstofnun, 2020). This can prove challenging since it involves coordinating planning efforts across administrative boundaries while addressing the specific needs and priorities of each individual municipality. One challenge lies in ensuring compatibility between neighbouring land uses and the creation of cohesive and functional spaces across borders. Coordination of multiple stakeholders and sectors can be challenging, requiring robust governance frameworks and clear communication channels (Interviewee 29, 2024). Public

engagement presents an additional challenge. Low public participation in planning discussions often limits citizen input, while in cases with high public engagement, discussions can become polarised, particularly on controversial land use decisions (Interviewee 29, 2024).

Despite these challenges, horizontal governance structures offer significant opportunities for intermunicipal cooperation. The regional plan, data-sharing initiatives and formal agreements strengthen cross-municipal coordination, promoting balanced and sustainable development. By harnessing these opportunities, municipalities in the Greater Reykjavík area have been able to address complex challenges, improve service delivery and join forces in the effort to create more cohesive, vibrant and sustainable communities. Within the municipality, collaboration between departments fosters better understanding of complex issues, leading to informed decisions and streamlined service delivery. Furthermore, it sparks innovation and agile responses to community needs (Interviewee 29, 2024).

Buildings and construction sector

Vertical governance

The governance of building regulations and housing policy in Iceland involves both national and municipal authorities as well as private sector actors. The national government establishes building standards, covering environmental performance, energy efficiency and sustainability requirements. Municipalities are responsible for zoning, permits and implementation, requiring cooperation across different public authorities, including planning agencies, environmental regulators and transport bodies (Lidmo et al., 2020). Public-private partnerships (PPPs) are also increasingly used for financing and developing infrastructure projects, but naturally they must adhere to the same set of guidelines, laws and regulations.

Recent regulatory changes reflect a growing emphasis on sustainability. The Icelandic Housing Authority (HMS) has approved the mandatory implementation of Life Cycle Assessments (LCAs) and carbon footprint calculations for all building projects. From September 2025, building permit applicants must submit LCA data at both the design stage and upon project completion (EFLA, 2024). By making these assessments mandatory, Iceland aims to promote a more sustainable and environmentally conscious approach to the construction industry. The requirement to submit LCA and carbon footprint data will also provide valuable insights for design optimisation and selection of materials, ultimately contributing to a reduction in the environmental impact of buildings (Interviewee 32, 2024). While this policy shift strengthens Reykjavík's progress on its sustainability goals, ensuring regulatory compliance while maintaining housing affordability is a key challenge moving forward.

Horizontal governance

Horizontal governance tensions arise from the complexity of meeting housing standards and environmental obligations while remaining financially competitive. Challenges include infrastructure constraints, transport congestion and meeting both housing demand and environmental targets. Balancing economic development, environmental sustainability and affordability requires cross-sectoral coordination, particularly as the city seeks to reduce urban sprawl while ensuring sufficient housing supply (Interviewee 32, 2024). In response, Reykjavík has adopted Smart Growth principles, promoting mixed-use development and transit-oriented housing strategies to minimise sprawl and reduce reliance on private vehicles. Public-private partnerships (PPPs) offer additional opportunities for innovative and affordable housing solutions (Interviewee 29, 2024). Although initial efforts to integrate housing, transport and environmental planning faced difficulties, ongoing coordination has led to more cohesive planning approaches, which are key to ensuring sustainable development (Interviewee 29, 2024).

Transport and mobility sector

Vertical governance

Governance of the transport sector in Reykjavík is shaped by multilevel coordination between municipal, national and state-owned agencies. While Icelandic municipalities have autonomy over local transport planning, large-scale infrastructure projects, such as the Borgarlína Bus Rapid Transit system, require substantial state funding and regulatory approval. This financial dependence on the national government can create delays and governance tensions, particularly when municipal and state priorities do not fully align (Interviewee 29, 2024; Interviewee 31, 2024).

A key aspect of Reykjavík's transport governance is the division of responsibilities between municipal and national authorities. In the Capital Region, some roads within the city come under state ownership and are maintained by the Transport Authority, while others are managed at the municipal level. Continuous intergovernmental coordination is therefore required to ensure a cohesive and efficient transport network. Additionally, multiple state institutions and municipal departments are involved in transport planning across the Greater Reykjavík area, further adding to the complexity of governance (Lidmo et al., 2024).

Despite the challenges, Reykjavík has been successful in structuring multilevel governance frameworks to manage transport transformation in the Capital Region. Formal agreements between the national government and municipalities in the Capital Region have facilitated resource sharing and policy alignment, making it possible to pursue large-scale projects aimed at sustainable mobility and reduction

of carbon emissions (Interviewee 29, 2024; Interviewee 31, 2024). While financial reliance on the state can be a constraint, the agreement between the state and municipalities in the Capital Region highlights the potential for collaborative funding and resource allocation, presenting opportunities for securing long-term investment in sustainable transport infrastructure.

Horizontal Governance Tensions

The development of an integrated and sustainable transport system in Reykjavík requires coordination not only between the various levels of government but also across municipal departments and neighbouring municipalities. However, achieving policy alignment and resource sharing across these different entities can be challenging, sometimes resulting in fragmented efforts and inefficiencies. Internally, ensuring that different departments work towards shared sustainability goals can prove challenging, particularly when projects require cross-sectoral resource allocation.

As Reykjavík forms part of a larger metropolitan region, transport planning must also account for commuting patterns, regional infrastructure needs and intermunicipal connectivity. The Association of Municipalities in the Capital Region plays a key role in coordinating these efforts, yet differences in municipal priorities, financial capacities and land use strategies can stall progress.

Institutional capacity: Knowledge, relational resources and mobilisation capacity

Knowledge Capacity

Reykjavík has a solid foundation of technical expertise and data-driven decision-making, particularly in emissions monitoring and climate accountability. As a member of the Global Covenant of Mayors for Climate and Energy and its predecessors since 2012, the city regularly publishes its Climate Account, which assesses carbon emissions across various sectors. Using the City Inventory Reporting and Information System (CIRIS) and in alignment with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), Reykjavík ensures transparent and standardised emission reporting (EFLA, 2022). This knowledge infrastructure enhances the city's ability to monitor and refine its climate strategies.

In the land use sector, Reykjavík collaborates with the Association of Municipalities in the Capital Region to share data and best practices for urban planning. This coordination enables a regional approach to sustainable development, although differences in municipal capacities and priorities present challenges in harmonising efforts. Likewise, in the buildings and construction sector, Reykjavík benefits from

specialised knowledge through initiatives such as the Green Housing of the Future project, which integrates research on sustainable construction materials and energy efficiency strategies. However, ensuring that all stakeholders – from municipal departments to private developers – remain aligned and committed to sustainable construction principles remains a challenge.

Reykjavík's transport sector also benefits from extensive local expertise. The city actively engages with municipal departments, state agencies and private stakeholders to design sustainable mobility solutions. Nevertheless, the implementation of these policies often requires ongoing adjustments due to evolving transport demands and regulatory constraints.

Relational Resources

Reykjavík actively engages in international, regional and national networks to enhance its relational resources. As a participant in the EU Smart City network, the city explores smart energy solutions for integration into urban development (European Commission, 2022). Reykjavík is also part of a Nordic capital cities network, which facilitates knowledge exchange and collective efforts on climate-related initiatives, including a joint declaration on climate change ahead of COP21 (Nordic Capitals, n.d.). These networks strengthen Reykjavík's ability to draw inspiration from global best practices while contributing to common sustainability goals.

At the regional level, cooperation among municipalities in the Capital Region is critical for coordinated land use planning and infrastructure development. However, managing these relationships can be complex due to differing local policies and financial constraints. In the buildings sector, Reykjavík collaborates with private developers and national agencies to promote sustainable construction. However, maintaining long-term commitment by all stakeholders remains a challenge. Similarly, in the transport sector, the city works closely with national transport agencies and international networks to enhance mobility solutions. However, ensuring alignment between state-level policies and local priorities requires continued negotiation and adaptation.

Mobilisation Capacity

Reykjavík's ability to translate knowledge and partnerships into action demonstrates its mobilisation capacity. As a participant in the Carbon Disclosure Project (CDP), the city publicly shares data on carbon consumption, fostering accountability and encouraging community engagement in climate initiatives (CDP, 2023). This transparency helps mobilise both public and private sector efforts towards emission reductions.

In the land use sector, municipal policies must align with national climate obligations, requiring careful coordination to balance local autonomy with broader

environmental commitments. While this alignment strengthens Reykjavík's contribution to national sustainability targets, it also adds complexity in navigating regulatory frameworks and policy adjustments.

In the buildings and construction sector, the city promotes sustainable practices through initiatives like the Green Housing of the Future project with the aim of reducing environmental impacts. Driving industry-wide change in construction methods, however, remains an ongoing effort requiring both regulatory support and market incentives.

Reykjavík's transport sector highlights the importance of mobilisation at multiple levels. The city engages residents through public consultations and stakeholder collaborations to promote green mobility solutions. However, achieving significant shifts in transport habits, such as reducing car dependency, requires sustained political commitment, infrastructure investments and initiatives to drive behavioural change.



Photo: Unsplash.com

Key reflections and learnings from Iceland

Reykjavík's efforts towards climate neutrality demonstrate both ambitious policy goals and strong institutional capacity, yet they also highlight the challenges of translating sustainability commitments into action. The city has developed comprehensive policies across the sectors of land use, buildings and transport, backed by international partnerships, regional collaboration and local expertise. While the city has made significant progress in aligning local strategies with national and international sustainability goals, governance tensions, resource constraints and coordination challenges persist.

Vertical governance tensions arise where national regulations limit local decision-making. This is particularly evident in land use, with state-owned land within city boundaries – such as Reykjavík's domestic airport – requiring coordination between municipal and national authorities. Similarly, in the buildings sector, the national government defines construction regulations and environmental standards, which municipalities must adhere to. The recent mandate for Life Cycle Assessments (LCAs) in building projects, while advancing sustainability goals, poses technical and financial challenges for developers, requiring new knowledge and compliance mechanisms.

In transport governance, Reykjavík depends on state funding for large-scale infrastructure projects, including the Borgarlína Bus Rapid Transit system. While multilevel governance structures have facilitated intergovernmental cooperation, financial dependence on the national government can delay implementation and limit municipal flexibility in transport planning. Nonetheless, the agreement between the state and municipalities in the Capital Region has proven instrumental in securing long-term investment in sustainable mobility solutions.

Horizontal governance tensions present another layer of complexity, particularly when it comes to coordinating infrastructure projects across the Greater Reykjavík area. As the largest municipality in the Capital Region, Reykjavík must align policies with neighbouring municipalities, ensuring that urban development, land use and transport plans are cohesive and complementary. While formal agreements and the regional plan help structure intermunicipal cooperation, differences in local priorities, financial capacities and planning frameworks can create obstacles to efficient regional development.

Reykjavík benefits from strong institutional capacity. The city's participation in local and international networks has reinforced technical expertise, data transparency and policy innovation. Systematic use of the Climate Account enables Reykjavík to track progress towards carbon neutrality with a high degree of accountability. However, translating this knowledge into effective local action remains an ongoing challenge, particularly in sectors like transport, where shifting away from car dependency requires significant infrastructure investments and behavioural change. In the following boxes we outline key challenges in Reykjavík and propose actions to be taken

CHALLENGE 1: Vertical Governance Tensions in Land use Planning

Implications: Conflicts may arise between national guidelines and municipal autonomy, especially in the case of state-owned land within municipal borders. This can cause delays and conflicts in decision-making for critical projects like Reykjavík's domestic airport.

What can be done? Establish regular consultation mechanisms between national and municipal bodies to streamline decision-making on shared land assets.

CHALLENGE 2: Horizontal Governance Tensions in Urban Development

Implications: Differing priorities among municipalities, especially in the Reykjavík Capital Region, lead to fragmented urban planning efforts. Lack of alignment can cause inefficiencies, impacting cohesive urban development and public infrastructure projects.

What can be done? Develop a regional framework for urban planning in the Capital Region to align priorities, supported by intermunicipal agreements.

CHALLENGE 3: Sustainability Trade-Offs in Densification Efforts

Implications: While densification promotes sustainability by reducing sprawl, it can also reduce green spaces and overburden existing infrastructure. This trade-off poses a challenge for municipalities in meeting environmental and social sustainability goals simultaneously.

What can be done? Encourage community input and implement green infrastructure solutions (such as rooftop gardens and green corridors) to balance density with nature.

CHALLENGE 4: Financial Dependence in Transport Infrastructure

Implications: Reliance on state funding for large transport projects (such as the Borgarlína Bus Rapid Transit system) may delay implementation due to financial constraints and governance tensions, limiting municipalities' control over project timelines and design.

What can be done? Establish state-local co-funding models and seek alternative financing (such as public-private partnerships) to ensure timely project delivery.



Trondheim. Photo: Unsplash.com

10. NORWAY



CASE: TRONDHEIM



Trondheim. Photo: Unsplash.com

Background information

Trondheim, situated within Trondheim municipality in Norway's Trøndelag county, is the largest urban hub in the area and the third-largest city in Norway. As of 2024, it has a population of 196,948 people, while the entire municipality has a population of 214,565 residents (Statistics Norway, 2024). It spans an area of 59.25 km² (341,11 km² for the whole municipality). In the last 20 years, the population has grown by approximately 40%, with a steady increase of 2,000-3,000 people per year.

Trondheim is also the main municipality in the metropolitan area, *Trondheim Regionen*, which encompasses nine municipalities and had a population of some 316,888 inhabitants as of 2023 (Statistics Norway, 2023b).

Trondheim is widely recognised as the technological capital of Norway. Indeed, technology and innovation are a cornerstone of its economy, with a robust presence in information technology, telecommunications and electronics. The Norwegian University of Science and Technology (NTNU) plays a significant role as one of the country's leading research centres in the fields of engineering, physics and natural sciences. Trondheim is also home to the headquarters of the Foundation for Scientific and Industrial Research (SINTEF), which is the largest independent research organisation in Scandinavia. Furthermore, as a coastal city, Trondheim has a strong maritime industry, offering services ranging from cargo handling to shipbuilding (UEP NTNU, 2018). Healthcare is another dominant sector in Trondheim's economy, with the regional hospital providing significant employment opportunities. Tourism also plays a vital role; the city attracts visitors with its medieval architecture, cultural heritage and outdoor attractions. Additionally, Trondheim participates in Norway's renewable energy initiatives, conducting research and development in renewable technologies, which, as it will be discussed, are a fundamental part of Trondheim's strategy to achieve climate neutrality.

Strategic level: municipal goals and policies

Trondheim has a strong political vision with respect to climate neutrality. As stated in the last comprehensive municipal plan, "*The main goal for Trondheim to take responsibility for a greener and more circular society is about creating a climate-neutral city, without nature or health-damaging pollution*" (Trondheim Municipality, 2022a, p. 25). Trondheim was selected as one of the [112 EU's climate-neutral and smart cities by 2030](#) (Cities Mission) in April 2022 and will therefore act as an experimentation and innovation hub for other European cities striving to achieve climate neutrality by 2030. In connection with this, the Municipal Energy and Climate Plan with the vision 2017-2030 (Trondheim Municipality, 2017) has been revised and a new plan, presenting the overarching aims and targets for climate action, was proposed and presented to the city council in March 2024 (Trondheim Municipality, 2024). The new plan has two overarching goals:

1. Direct greenhouse gas emissions shall be cut by at least 80% by 2030, compared to 2009 and
2. The city will be emission-free by 2050

The plan is based on nine priority areas: nature and land use, energy efficiency, mobility and transport, buildings and construction, consumption and waste, carbon

sequestration^[26] for climate neutrality, climate adaptation and social preparedness, just transition and public health and business and employment. The main responsibility for the climate plan in Trondheim lies with the department of climate and environment (*Klima- og miljøenheten*), which is also responsible for implementation of the plan. It should be noted that while the climate plan represents the overarching document for climate action, Trondheim has specific targeted strategies for sustainable land use, buildings and transport, and mobility.

Another important aspect of Trondheim's approach to climate neutrality is its involvement in various networks, which primarily facilitate the exchange of information and allow Trondheim to draw inspiration from other Norwegian and international cities. First, as mentioned above, Trondheim is part of the EU City Mission Network, through the project +CityxChange, which explores possibilities to integrate smart positive energy solutions. Trondheim is also part of the Big City Network (Storbynettverket), which involves eight municipalities in Norway. In addition, the top administrative management in the same municipalities engages in an administrative metropolitan network for knowledge exchange and to bring issues to the attention of other layers of government (Interviewee 22, 2024). It should also be noted that Trondheim hosts important knowledge institutions, namely the aforementioned NTNU and SINTEF, which represent a sound basis for research, development and innovation on climate matters.

The aforementioned goal of reducing direct emissions by 80% by 2030 was established politically in the previous climate plan (Trondheim Municipality, 2017). However, the new plan outlines four key objectives, namely for Trondheim to become a climate-neutral, energy-smart, circular and climate-resilient city (Interviewee 22, 2024). These goals are also informed by the experiences shared by other cities on climate practices and strategies (Interviewee 22, 2024) and, obviously, the monitoring of emissions in various sectors, which also form the basis for Trondheim's climate budget.^[27] Trondheim has included a dedicated climate budget in its municipal annual budget plan since 2018, with 2009 serving as the baseline for emission monitoring. Direct greenhouse gas emissions in Trondheim amount to just under half a million tonnes of CO₂ equivalents annually^[28] (Trondheim Municipality, 2021b), corresponding to approximately two tonnes of CO₂ equivalent per inhabitant. Greenhouse gas emissions in Trondheim were reasonably stable in the period 2009-2018, despite strong population growth. Within road traffic and heating, there has been a long-term decline in emissions over time. In manufacturing, emissions have also fallen from 2009, while emissions have started

26. Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide.

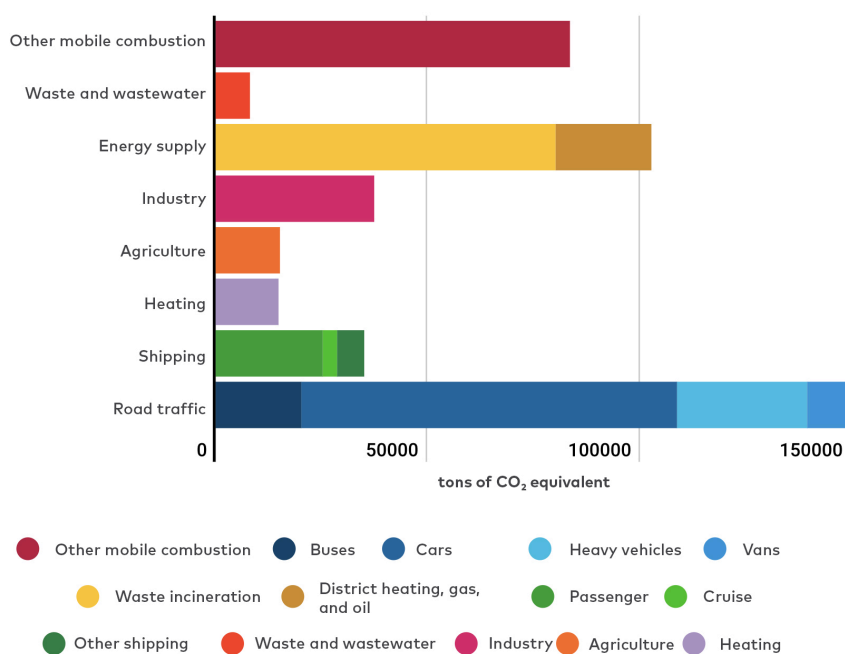
27. The climate budget is a management tool for following up on Trondheim's targets for emission reductions and other energy and climate targets. The climate budget is a separate chapter in Trondheim municipality's annual action and financial plan and includes an emissions framework for greenhouse gas emissions in Trondheim in the coming four-year period.

28. The total GHG emissions in Trondheim amounted to 485,000 tonnes in 2022, which is a reduction of approximately 20% from 2009. The GHG emissions in EU Member States were reduced by 32.5% in 2022 from 1990, while Norway only achieved 4.6%.

to increase again since 2016. In the climate budget, emissions are divided into eight sectors and further into several sub-sectors or sources^[29] (see also Figure 11). About three-quarters of the greenhouse gas emissions in Trondheim originate from only three sectors:

1. Road traffic accounts for about one-third of greenhouse gas emissions in Trondheim.
2. Energy supply is linked to district heating production and accounts for about a **quarter** of the total greenhouse gas emissions in Trondheim. Most of these emissions come from incineration of waste.
3. Other mobile combustion accounts for one-fifth of the emissions in Trondheim. This includes all non-road machinery that runs on tax-free diesel, such as construction machinery and tractors.

FIGURE 11. GREENHOUSE GAS EMISSIONS IN TRONDHEIM IN 2018 BY SECTOR AND SOURCE



Source: Norwegian Environment Agency

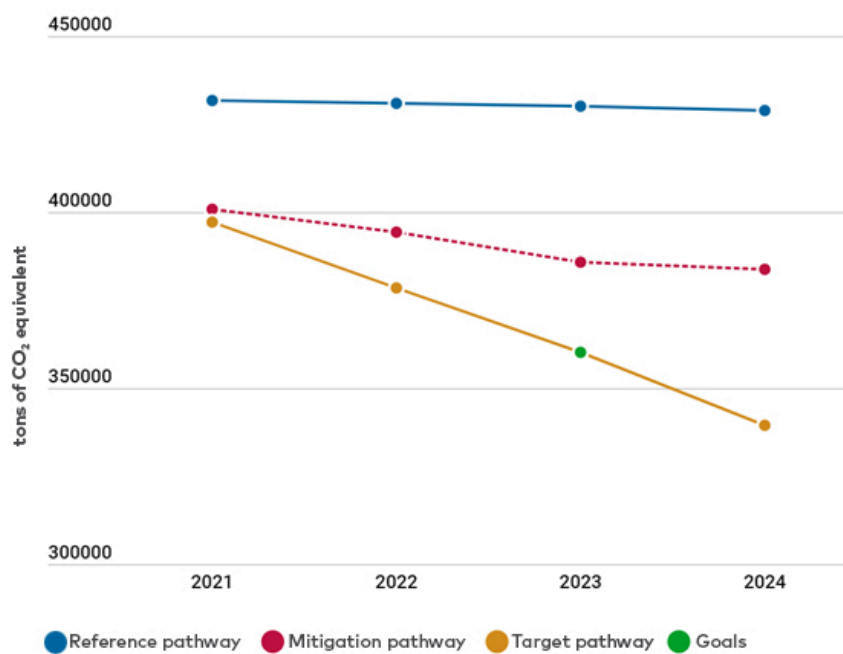
29. The emissions account shows emissions of the three greenhouse gases CO₂, methane (CH₄) and nitrous oxide (N₂O) distributed across nine sectors in Norwegian municipalities and counties.
<https://www.miljodirektoratet.no/tjenester/klimagassutslipp-kommuner/?area=170§or=-2>

The main source for emission figures used in Trondheim's climate budget is the Environmental Directorate's publication titled "Emissions of greenhouse gases in municipalities and counties" (The Norwegian Environment Agency, 2023). These figures cover the period from 2009 (as the baseline) and include greenhouse gas emissions of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Emission figures for each greenhouse gas are converted to a common unit, namely carbon dioxide equivalents (CO₂-eq). The entire time series is updated annually with a two-year time lag (Trondheim Municipality, 2021a). It should also be noted that all the figures on emissions for all the 356 Norwegian municipalities come from the Norwegian Environmental Agency (national level), with municipalities required to submit own reporting to the city council, the national government and the CDP – Carbon Disclosure Project. Trondheim was one of 119 cities in the world to be placed on the CDP's A-list for 2023. That recognises its systematic climate leadership, which fosters emission reduction and climate adaptation, making both the city and nature more resilient to climate change.

The emission ceiling is the core of the climate budget. The emission framework sets limits for the development of greenhouse gas emissions in Trondheim in the future, describing three scenarios (see Figure 12):

- **Baseline scenario:** the baseline scenario is a scenario for what will happen in the future if more measures are not implemented (business as usual).
- **Path of action:** the action path shows how various measures (e.g. emission-free construction sites, fossil-free public transport etc.) will contribute to reducing greenhouse gas emissions during the economic plan period of 2021-2021.
- **Goal path:** the target path is a scenario based on the city council's targets for emission reductions in 2023 and 2030.

FIGURE 12. TRONDHEIM EMISSIONS. BASELINE SCENARIO, ACTION PATH AND GOAL PATH FOR THE FINANCIAL PLAN PERIOD



Source: [Climate Budget, The emission framework 2021-2024](#)

As can be observed in Figure 12, there is a gap between the action and the target path, meaning that the planned actions have been estimated to lower emissions by 25% from 2009 instead of 30%, as stated in the city council goal. Updated figures are needed to show what the actual gap and the projections towards 2030 look like.

Despite making large strides forward, several challenges lie ahead. Transport and road traffic are significant contributors to emissions, while construction activities, especially those utilising combustion engines, also contribute substantially (Interviewee 22, 2024). Even stationary machinery involved in construction projects adds to this emission category. Waste management presents another significant challenge, with waste-to-energy incineration facilities being a notable source of pollution. Efforts are underway to tackle emissions from these sources through carbon capture and storage (CCS) initiatives, with a specific emphasis on reducing pollution from waste incineration. These challenges become even more complex when considering indirect emissions and the broader carbon footprint, highlighting the crucial need to address issues related to circular economy governance (Interviewee 22, 2024).

Land use sector

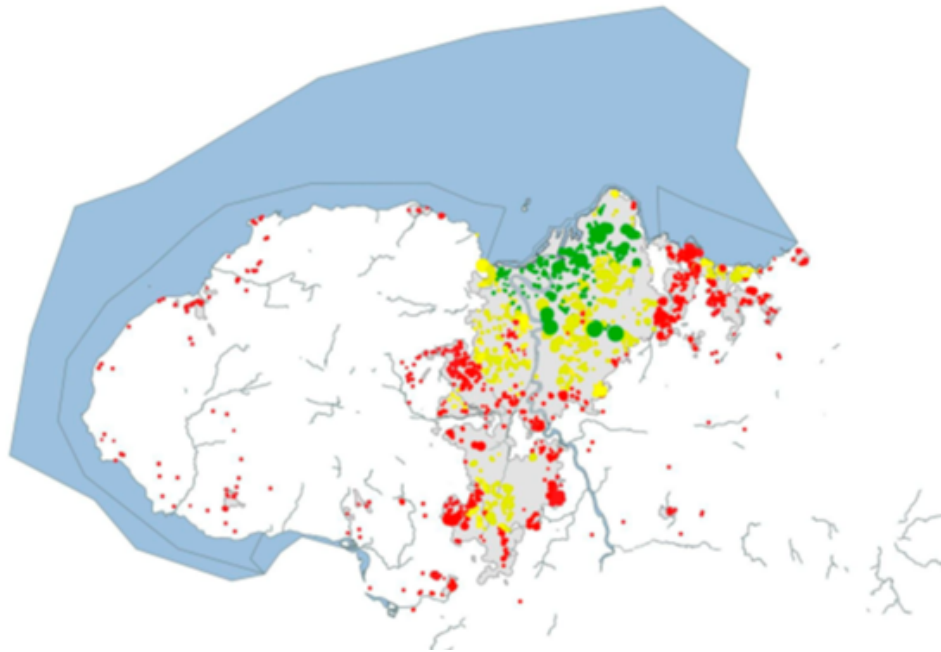
The goal of achieving an 80% reduction in GHG emissions by 2030 also applies to land use and the other spatial planning sectors examined in this project. The municipality of Trondheim has implemented densification as a tool for making the city more attractive since the mid-1990s. The need for densification is even greater that Trondheim is expected to have around 55,000 more inhabitants in 2050, requiring approximately 29,000 new housing units^[30] to accommodate that increase (Trondheim Municipality, 2019).

Three main types of densification are implemented in Trondheim: villa garden densification in single-family home areas, reshaping and reuse of areas such as ports and industrial areas and new construction within the construction zone (Trondheim Municipality, 2019). Brownfields and transport hubs are priority areas for development, with a polycentric spatial approach followed (Figure 13): for instance, densification is implemented in the city centre and in other local centres, with the aim of developing the 15-minute city (Interviewee 23, 2024).

Figure 13 below shows where housing was developed in the period 2010-2017. A total of 12,120 homes were built during this period, with about 50% of them built along public transport routes, in local centres and city centre areas as defined in the municipal plan (Trondheim Municipality, 2022a). The remaining 50% were built outside those areas. This shows that although housing construction has contributed to densification, around half of the housing has been developed outside the designated priority areas. In the last ten years, new homes in Trondheim have been distributed throughout nearly the entire city. While transport hubs and brownfields are designated as priority areas (Interviewee 23, 2024), only around one-third of housing has been developed in areas where it is easy to live without a car in everyday life. Greenfield development still occurs, and Trondheim has a history of urban sprawl, resulting in far lower overall population density than in cities such as Oslo or Copenhagen (Trondheim Municipality, 2019). Only a small part of Trondheim (mainly in the centre) is utilised, which has more than 100% usable area (BRA) or more than 10 dwellings per hectare.

30. Housing stock in Trondheim consists of approximately 23% detached houses, 30% residential buildings of under three stories (terraced houses and four-person dwellings) and 41% block buildings of three stories or more. Student housing, housing and service centres and other types of housing associations are included in the last seven percent (Trondheim Municipality, 2019).

FIGURE 13. HOUSING DEVELOPMENT IN TRONDHEIM. THE FIGURE INDICATES HOW HOUSING DEVELOPMENT IN THE LAST TEN YEARS HAS CONTRIBUTED TO THE NEED FOR TRANSPORT.



Homes marked green are homes where it is easiest to choose environmentally friendly transport solutions, while it is more challenging for people living in the homes marked red to opt for environmentally friendly transport solutions.

Source: Trondheim Municipality, 2019, p. 24

Regarding vertical development of the city, regulations are quite strict in the city centre, with existing building heights representing the upper limit. Regulations are more liberal for development outside the city centre but specific limits are set for high rises. This is particularly important in Norway, where reduced daylight for a significant portion of the year necessitates careful consideration of building heights and their impact on light penetration. In general, the aim is to promote a traditional urban form with about six to seven stories per building (Interviewee 23, 2024). Regarding other urban functions such as industrial and commercial areas, which occupy large amounts of land, the ambition is to foster better dialogue with the business community and present a plan for densification and improved utilisation of existing commercial space (Region of Trondheim, 2018). However, a systematic approach seems to be lacking.

Buildings and construction sector

In addition to the overarching goal of achieving an 80% reduction in emissions by 2030, the buildings sector has a crucial objective: achieving 100% emission-free buildings for municipally owned and developed structures (Interviewee 24, 2024). By 2025, all municipal building and construction projects must comply with emission-free standards. Emission-free considerations must be integrated early in the planning phase, encompassing infrastructure requirements like power access, charging options and emission-free solutions for construction machinery, building dryers and heating (Trondheim Municipality, 2023b).

Direct greenhouse gas emissions related to buildings and construction result primarily from the combustion of fuel in construction machinery and vehicles used for transporting masses, materials and staff. Emissions at the construction site account for approximately 14% of Trondheim's direct emissions. In addition, the construction industry has a significant carbon footprint due to energy use, land use changes and production and transport of building materials from value chains outside Trondheim. To cut these emissions, the environmental strategy on buildings and construction (Trondheim Municipality, 2023b) defines the following goals for municipal construction activities:

- Demolition projects must also take emission-free practices into account. Starting in 2025, all internal municipal projects must comply with emission-free construction standards. Until then, efforts should prioritise partially emission-free construction, with a strong push towards maximising the proportion of emission-free practices.
- Transport within the scope of construction projects has a significant climate impact, prompting Trondheim municipality to leverage its procurement power to encourage suppliers to adopt climate-friendly practices. By 2025, all purchases of goods and services involving vehicles weighing under 7.5 tonnes and accommodating up to eight people must use zero-emission or biogas vehicles.
- Energy efficiency is also crucial, with the municipality aiming to reduce specific energy consumption in its buildings annually by at least 1% through various means such as energy monitoring, demand management and the adoption of new technologies. Focus areas include solar cells, ground heating, heat pumps and energy exchange between buildings to minimise energy use and peaks.

- Material use plays a pivotal role in the climate footprint of projects, highlighting the need for environmentally friendly, low-emission and renewable materials. Environmental declarations on key materials and plans for material reuse must be integral to all projects, with durability and maintenance serving as vital strategies for emission reduction.
- Trondheim municipality shall prioritise value-preserving maintenance, favour rehabilitation over demolition and ensure flexibility in project design to accommodate changing needs. Opportunities for reuse of materials, equipment and fixtures must be explored and the related climate benefits documented, with overall progress plans reflecting the implications of reuse.
- Finally, the environmental efforts must comply with the Norwegian Standard ISO 14001 on environmental management. For larger new buildings and complete rehabilitation projects, BREEAM-NOR must be used as the environmental classification tool, with a minimum target of "Very Good". Certification must be assessed on a project-by-project basis (Trondheim Municipality, 2023b).

Specific requirements and energy efficiency standards for new buildings are mainly regulated at the national level through building codes (TEK 17), which define the minimum characteristics a building must possess in order to be legally constructed in Norway. TEK17 was revised in 2022, and from 1 July 2022, it became mandatory to prepare greenhouse gas accounts for apartment buildings and commercial buildings.^[31] Furthermore, it is expected that 20% of construction will be made according to passive house standards by 2025 (Andersson et al., 2023). In general, environmental efforts must comply with the Norwegian Standard ISO 14001 on environmental management. For larger new buildings and complete rehabilitation projects, BREEAM-NOR must be used as the environmental classification tool, with a minimum target of "Very Good". Certification must be assessed on a project-by-project basis (Trondheim Municipality, 2023).

Specific requirements for energy efficiency standards apply to retrofitting of existing building stock. Norway's energy efficiency efforts are overseen by the national agency Enova SF, owned by the Ministry of Climate and Environment. Subsidies are provided for various initiatives, including installation of hydronic heating and local electricity production. The primary focus is on comprehensive building energy upgrades, with reimbursement of up to 25% of costs, capped at NOK 100,000–150,000. The goal is to drive market change towards more sustainable solutions, reducing dependence on subsidies over time. Although a loan scheme is offered through the Norwegian Housing Bank ("*Husbanken*"), only a small

31. For specific requirements concerning energy efficiency, see: <https://www.dibk.no/regelverk/byggteknisk-forskrift-tek17/14/14-2>

number of households have utilised it annually, indicating potential issues. Additionally, a free advisory service called "Enova answers" assists households with energy retrofitting and subsidy inquiries. Norway's energy retrofit rate has stagnated at around 3.4% annually, despite some households driving up this figure (Egner et al., 2021).

BOX 12. BEST PRACTICE. BUILDINGS SECTOR. THE BRATTØRKAIA POWERHOUSE IN TRONDHEIM

The Brattørkaia Powerhouse aims to achieve three primary objectives: maximise clean energy production, minimise energy consumption and create a pleasant space for occupants and the community.

The building's energy production capabilities stem from the integration of 3,000 square metres of photovoltaic panels into both its façade and pentagonal roof, yielding up to 500,000 kWh of renewable energy annually. It functions as a miniature power plant in the heart of the city, with an energy storage system enabling it to retain energy during the long winter months when daylight hours are limited. Technologies used in the powerhouse include a well-insulated building envelope, airflow management systems to reduce heating needs, heat recovery ventilation and greywater recycling. Additionally, seawater is utilised for heating and cooling purposes, while high-efficiency appliances minimise energy consumption. The Brattørkaia Powerhouse, whose construction commenced in 2018 and was completed two years later, is one of the most efficient and iconic green buildings globally.

Transport and mobility sector

Transport is the primary contributor to greenhouse gas emissions in Trondheim, although remarkable progress has been made, with a 30% reduction since 2009. The Norwegian Environment Agency is the main body responsible for calculations and monitoring with regard to emissions from other sectors, including transport-related emissions. Under the monitoring system, emissions are measured in CO₂ equivalents, which means that the emissions for each gas are weighted according to its global warming potential (GWP).

Despite the progress that has been made, focusing on transport is crucial to achieve the ambitious target of an 80% reduction in overall emissions.

To attain this vision, several key strategies must be prioritised (Trondheim Municipality, 2024):

1. Reducing private car traffic: encouraging alternatives to private car use, such as public transport, cycling and walking, is pivotal to curbing emissions.
2. Transitioning to fossil-fuel-free or emission-free transport: rapidly phasing out fossil fuel-powered vehicles in favour of electric, hydrogen or other zero-emission alternatives is imperative.
3. Optimising land use: instead of further expansion of transport infrastructure, streets or lanes should be reallocated to accommodate pedestrians, cyclists and efficient public transport systems.

Despite these efforts, a specific challenge remains: achieving a 20% reduction in car traffic by 2030. Progress in this regard has been less than optimal, highlighting the need for intensified strategies and community engagement to reach this crucial milestone.

The Norwegian National Transport Plan (Norwegian Ministry of Transport, 2021) defines the goal of achieving zero growth in passenger car traffic in the major urban areas. Achievement of a zero-growth target alone does not suffice to mitigate emissions; a simultaneous shift towards emission-free solutions is needed. While emission-free technologies can help reduce emissions even in the face of traffic growth, the associated costs and demand for resources render this approach unsustainable. Conversely, prioritising traffic reduction, which is a crucial aim in Trondheim (Trondheim Municipality, 2024), yields numerous societal benefits:

- Accelerated energy and climate transition: with fewer emission-free vehicles required, the transition occurs more rapidly and cost-effectively.
- Reduced infrastructure demand: in a compact city with stagnant private car traffic, the need for road construction and other infrastructure diminishes. This not only lowers the carbon footprint but also preserves natural and agricultural areas, safeguarding vital assets like carbon sinks and flood protection.
- Enhanced accessibility and inclusiveness: prioritisation of public transport users and pedestrians fosters a more accessible and inclusive urban environment for all. Additionally, shorter traffic jams, cleaner air and improved traffic safety contribute to a healthier and more liveable city.

After years of car-centric urban development, the focus is now shifting towards creating a city that caters to the needs of both its inhabitants and the environment, with the aim of a harmonious coexistence between people and nature.

In addition to the climate plan, where mobility and transport are identified as one of the key sectors for achieving local climate goals, Trondheim also has a mobility strategy, which explore goals for the transport sectors and tools used at the local level to reduce emissions (Trondheim Municipality, 2022b).

The strategy is divided into six topics, which must be considered holistically, as achievement of mobility goals relies on a combination of actions to improve pedestrian, cycling and public transport infrastructure, limit traffic in residential and city centre areas, enhance the attractiveness of streets and reduce reliance on private vehicles. The actions outlined in the strategy are measures the municipality can implement under its own authority and through collaboration with other stakeholders. However, some actions depend on coordination with other authorities, such as county or state governments, particularly concerning roads, public transport and mobility-related regulations. All the topics are, in different ways, relevant to achieving the climate goals. The focus on pedestrian priority and on cycling infrastructure, for example, aims to shorten walking distances between key destinations and improve pedestrian and cycling infrastructure, thus disincentivising the use of private cars. Efforts to promote efficient public transport include increasing public transport use in growth areas, raising awareness through campaigns and ensuring the accessibility and safety of bus stops and interchanges.

Traffic calming in neighbourhoods involves concentrating car traffic on fewer roads, protecting residential and city centre areas from excessive traffic and improving road safety while reducing noise and air pollution. Active Parking Policies are employed to reduce car commuting and ownership, ensure adequate parking availability and prioritise shared parking solutions. Lastly, the focus on creating

attractive and accessible city centres aims to facilitate efficient and environmentally friendly mobility for goods and services and enhance street design to reflect local identity and incorporate green infrastructure. Together, these topics and measures form the backbone of Trondheim's mobility strategy, which sets out to foster a sustainable, accessible and vibrant urban environment.

The main tool used to fund these initiatives is [Miljøpakken](#) (Text box 1), also known as the Trondheim Package, which is a comprehensive urban transport package aimed at improving public transport, reducing traffic congestion and promoting environmentally friendly modes of transport in the city (Interviewee 25, 2024). The package includes measures such as expanding and enhancing public transport services, implementing toll rings or congestion charges to reduce traffic congestion, investing in infrastructure for pedestrians and cyclists and promoting electric vehicles and initiatives to reduce emissions and improve air quality. Funding for Miljøpakken comes from various sources, including the state, the county, the municipality and road tolls.^[32]

Overall, despite the challenges, there is optimism regarding the transition from fossil fuel-driven to emission-free vehicles among private car owners. This shift presents a significant opportunity to reduce emissions within the transport sector. Furthermore, the commitment of major companies to achieving their climate goals offers an opportunity for collaboration and support, especially in the heavy-duty vehicle sector. Public awareness campaigns and incentives, such as grants for electric bikes, provide opportunities to motivate behavioural change and promote the use of public transport. The principle of "polluter pays" offers an additional opportunity to incentivise sustainable practices within the transport sector. However, there is a need for more targeted tools to ensure equity and accessibility when implementing sustainability trade-offs.

32. For an overview of the tolls, see: <https://miljopakken.no/bomsystemet>

BOX 13. BEST PRACTICE. TRANSPORT SECTOR. BIKE LANES IN TRONDHEIM

Since 2008, the Miljøpakken initiative has overseen the construction of nearly 40 kilometres of dedicated cycling lanes and close to 10 kilometres of combined walking and cycling paths. While several sections boast commendable infrastructure, gaps remain and certain connections pose safety concerns for cyclists. Trondheim's ambitious goal is to establish a continuous cycling network spanning 180 kilometres. Currently, approximately 80% of Trondheim residents have access to bicycles, with electric bicycles comprising 15% of the total. An increasing number of individuals are opting for electric cargo bikes to facilitate their daily routines. However, the relatively steep price of these bikes is as a financial barrier for many prospective users.

CASE: KRISTIANSAND



Kristiansand. Photo: Unsplash.com

Background information

Kristiansand, located in the county of Agder in southern Norway, is the largest urban area in Kristiansand Municipality. It ranks as the fifth-largest city in Norway, with a population of 66,576 residents as of 2023 (Statistics Norway, 2023b), while the entire municipality has a total population of 115,569 residents (Statistics Norway, 2023a). Since 2000, the city's population has increased by approximately 8.7%. As part of a municipal reform, Kristiansand merged with the nearby municipalities of Søgne and Songdalen on 1 January 2020.

Geographically, Kristiansand features a mix of rugged coastlines, sandy beaches and forests and its coastline is dotted with an archipelago of islands. Economically, Kristiansand is quite diverse, with several key sectors driving its prosperity. The maritime and shipping industry is a cornerstone of the local economy. The city's port is among the busiest in Norway, handling a substantial amount of cargo and passenger traffic. This robust maritime activity is complemented by a significant shipbuilding industry and various logistics services. Tourism is another vital part of Kristiansand's economy.

In recent years, Kristiansand has also become a hub for technology and innovation. The city hosts a growing number of IT and electronics companies, supported by strong emphasis on research and development. The University of Agder plays a crucial role in this sector, fostering a vibrant academic community and driving technological advancements. The oil and gas industry also has a significant presence in Kristiansand, with companies providing essential equipment and services for offshore operations in the North Sea.

Strategic level: municipal goals and policies

In January 2023, Kristiansand's city council approved an ambitious new climate plan, setting forward-thinking climate goals for the city (Kristiansand Municipality, 2023a). This comprehensive climate and environmental strategy outlines how Kristiansand will transform into a socially equitable, low-emission society. A key aspect of this transition is the shift from a linear economy to a circular economy, with the focus on reducing the total climate footprint by addressing both direct and indirect emissions. To achieve these goals, the climate plan takes into consideration innovative solutions, co-creation and collaboration among the municipality, public actors, the university and research communities, businesses, voluntary organisations and citizens (Kristiansand Municipality, 2023b).

The climate plan, which is mainly the responsibility of the municipal climate and environmental department (Interviewee 26, 2024), emphasises seven key areas: 1) Land use and natural diversity; 2) Food and agriculture; 3) Green mobility and logistics; 4) Sustainable site and property development; 5) Consumption and waste; 6) Green transformation in the business world; 7) Climate management.

While the new climate plan does not define the specific aim of achieving climate neutrality (Interviewee 26, 2024), the municipality of Kristiansand sets the following ambitious climate goals:

1. Become a socially fair, low-emission society with an 80% reduction in direct greenhouse gas emissions by 2030 compared to 2015. As in the case of Trondheim, this goal is more ambitious than the one set nationally, which corresponds to a reduction in emissions of at least [55% by 2030](#).
2. Encourage the municipality and its citizens to achieve more with fewer resources.
3. Protect and preserve nature.

As detailed in the community section of the municipal plan "Stronger Together – Kristiansand Towards 2030", the goal is for Kristiansand to be a socially just, low-emission society with significantly reduced greenhouse gas emissions (Kristiansand Municipality, 2020). Furthermore, Kristiansand municipality is committed to ensuring a sustainable climate transition based on the principles of focusing on the

total climate footprint and transitioning to a circular economy. The "*Kortreist kvalitet*" (*short-distance quality*) report provides concrete recommendations for reducing greenhouse gas emissions and facilitating the transition to a low-emission society for the 12 Norwegian municipalities that participate in the Kortreist Kvalitet network (KS et al., 2020). The report identifies three levels of measures:

1. **Efficiency:** This involves actions that reduce emissions by improving existing technology within current structures and systems. An example is transitioning cars to run on electricity or renewable diesel.
2. **Concept Development:** This involves moderate system changes by developing new ways of performing activities or solving tasks, for instance, replacing private car use with bicycles or e-bikes.
3. **Transformation:** This includes major system changes that prevent emissions by reducing the need for energy and resource consumption, requiring more planning and collaboration. This level envisions a low-emission society with less demand for transport due to communities being planned with shorter distances between homes and workplaces.

Furthermore, the Kortreist Kvalitet network aims to be a platform for knowledge sharing among the participating municipalities and regions. That includes innovation projects in fields such as climate management, citizen participation, biogas, sustainable food production, climate communication, green mobility, co-creation and climate budgets (KS et al., 2020).

Climate goals

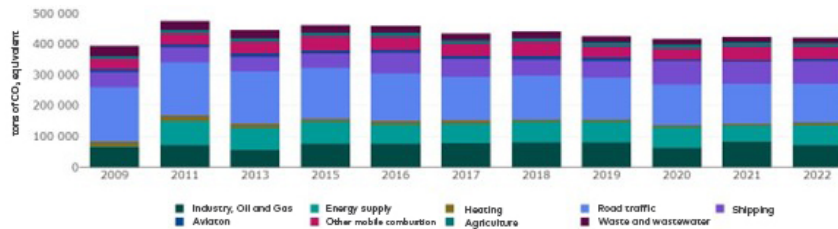
As already explored in the case of Trondheim, emissions in Kristiansand are monitored by the Norwegian Environment Agency (Miljødirektorat). As reported in the climate plan (Kristiansand Municipality, 2023b), the greenhouse gas emissions measured in Kristiansand comprise:

- Direct greenhouse gas emissions, which physically arise within Kristiansand municipality's borders.
- Indirect emissions, which arise outside Kristiansand's borders, but which are caused by the municipality's inhabitants and business life. These are approximately four to six times higher than the direct emissions.

In 2022, total greenhouse gas emissions in Kristiansand amounted to 422,159.6 tonnes of CO₂ equivalent (Kristiansand Municipality, 2023b).

Figure 14 presents direct emissions in Kristiansand for various sectors. As can be seen, road traffic is the largest source. Additionally, emissions are particularly high from the following sectors: industry, energy supply and combustion from diesel engines, motor vehicles and shipping, especially due to frequent calls for the ferries between Kristiansand and Hirtshals.

FIGURE 14. ANNUAL EMISSIONS IN KRISTIANSAND PER SECTOR



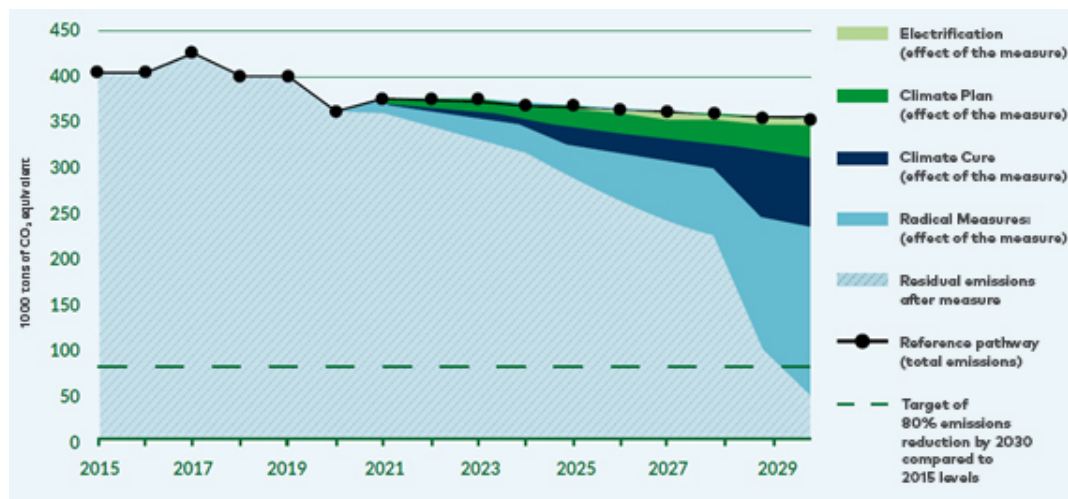
Source: [Miljødirektoratet](https://miljodirektoratet.no/)

The Centre for Climate Research (CICERO) and the Norwegian Transport Economics Institute (TØI) have developed a calculation model and a set of projections for greenhouse gas emissions in Kristiansand municipality through 2030 (Korsbakken et al., 2021). These projections include a reference path and estimates of the impact of various emission reduction measures. They illustrate potential developments in greenhouse gas emissions in Kristiansand under different scenarios and outline the efforts needed to achieve the municipality's goal of an 80% reduction in emissions from 2015 to 2030.

The reference path estimates how emissions may evolve without new measures or policies beyond those already adopted. This baseline is used to gauge the impact of additional measures. The emission reduction measures are categorised into four distinct packages, each with a thematic focus and increasing levels of effect and ambition:

1. **Electrification:** This package includes measures for the electrification of road transport. While the total reduction is modest and corresponds to 5,000 tonnes of CO₂ equivalents by 2030, the measures are straightforward to implement and send a strong signal of commitment. Key components include electrifying the bus fleet and taxi fleet and replacing all municipal light vehicles with zero-emission vehicles (Korsbakken et al., 2021).
2. **Climate Plan for 2021-2030:** This package includes relevant measures from the government's Climate Plan for 2021-2030 (The Ministry of Finance, 2019) that impact emissions in Kristiansand. The package encompasses a variety of measures across a range of sectors, aiming for a total reduction of 35,000 tonnes of CO₂ equivalents by 2030. The most significant measure is the requirement for biofuel use.
3. **Climate Cure 2030:** This package includes selected national measures from the Norwegian Environment Agency's report "Climate Cure 2030" (or equivalent local measures) that were not included in the Climate Plan but may still be relevant for Kristiansand (Norwegian Environment Agency, 2020). The measures cover various sectors including transport, land use and industry.
4. **Radical Measures:** This package includes more transformative measures, such as mandates for zero-emission solutions.

FIGURE 15. EFFECT OF VARIOUS PACKAGES OF MEASURES ON REDUCING GREENHOUSE GAS EMISSIONS IN KRISTIANSAND.



Source: Jan Ivar Korsbakken et al., 2021

As highlighted in the report, to achieve the 80% emission reduction target, it is critical that all these measures are implemented without exception. There is very limited scope to omit any measures, except possibly the zero-emission zone for cars, buses and vans (25,000 tonnes) due to significant reductions already achieved in these areas. However, if any measures from the previous packages fall short or if overall progress deviates from the reference path, implementing a zero-emission zone for all vehicle types will become necessary to stay on track.

In addition to the general climate plan, Kristiansand adopted a climate action plan in June 2030, which identifies concrete measures to help reduce both direct and indirect emissions (Kristiansand Municipality, 2023a). In the next sections, some of the main climate measures for the various spatial planning sectors will be explored.

Land use sector

The main document outlining the land use strategy for Kristiansand is the municipal master plan (Kristiansand Municipality, 2020). The new legally binding section of the municipal masterplan was approved by the municipal council in February 2024. The approach to reducing climate emissions related to land use in Kristiansand recognises the close interlink between land use and transport (Interviewee 27, 2024).

The target goal for the land use sector stated in the municipal masterplan is the same as the general climate goal for the city: an 80% reduction in emissions by 2030. The masterplan provides overarching guidelines for the municipality's physical development from a long-term perspective and identifies several key strategies to support achievement of the climate goals.

Demand for transport is to be reduced by coordinating housing, land use and transport planning, emphasising walking, cycling and public transport. The plan highlights the importance of prioritising the development of local centres with good accessibility between housing, services and meeting places to reduce greenhouse gas emissions and create a more inclusive and age-friendly society. Furthermore, attention is paid to the location of workplaces to help reduce the need for transport (Kristiansand Municipality, 2020).

Housing is mainly planned in and near development centres and in areas with frequent bus services, according to densification principles (Kristiansand Municipality, 2020). Centres are categorised into three levels based on visitation frequency and the area they serve. Although densification is indicated as the main land use strategy, Kristiansand has followed a relatively sprawling development pattern (Interviewee 27, 2024). The proportion of detached houses in Kristiansand is high. Single-family housing makes up around 70% of housing in the municipality (Kristiansand Municipality, 2022b). In recent years, efforts have been made to concentrate development in "local centres" to develop the 10-minute city concept and to create a society that is not only more environmentally friendly but also more socially inclusive (Interviewee 27, 2024). Key challenges arise here in relation to rural areas, where scattered development takes place. Here too the land use strategy is to develop housing in rural areas in connection to local centres where facilities and services are located (Kristiansand Municipality, 2022a).

The reallocation of agricultural land is to be prevented and a long-term boundary for development is to be established with the aim of preserving recreational and agricultural interests and preventing urban sprawl. As noted in the municipal strategy for blue and green infrastructure, safeguarding agricultural land and natural areas with water and sea contributes to health-promoting urban development, preserves biodiversity and limits the negative consequences of climate change (Kristiansand Municipality, 2022a). The municipal strategy for blue and green infrastructure further includes many climate adaptation measures that concern protection of biodiversity, protection of buildings from flooding and reuse instead of demolition of heritage buildings (Kristiansand Municipality, 2022a).

Buildings and construction sector

The municipal goal of achieving an 80% reduction in emissions by 2030 compared to the 2015 levels also applies to the buildings and construction sector in Kristiansand. In October 2021, the city council approved a thematic plan on reducing emissions in the buildings and construction sector. The plan defines overall goals, strategies and measures for the municipality's construction activities (Kristiansand Municipality, 2021). It should be noted that the strategy refers to municipal buildings and thus mainly to functions other than housing (which in Norway is mainly handled by private developers). For requirements regarding private buildings, the same aspects as described for Trondheim should be considered.

Kristiansand Municipality has established comprehensive climate and environmental goals for its buildings sector, focusing on optimising procurement, reducing greenhouse gas emissions and implementing sustainable building practices. Several key objectives have been defined. The municipality is actively working to strengthen its climate competence in the buildings sector, aiming to achieve sustainable and environmentally responsible development (Kristiansand Municipality, 2021). One of the primary strategies to achieve this is optimising procurement processes to enhance the sustainability of municipal buildings. By prioritising materials and construction methods that minimise environmental impact, the municipality is seeking to promote more sustainable practices. This includes fostering stronger dialogue between the municipality and construction players and ensuring that environmental and climate considerations account for at least 30% of the award criteria in procurement decisions (Interviewee 28, 2024).

An important focus is on optimising space use by observing densification principles. This involves combining building functions to reduce the overall square footage required, which in turn lowers the GHG emissions associated with both construction and operation. Additionally, all municipal construction projects now require implementation of an environmental follow-up plan (MOP). This plan outlines current environmental requirements, sets clear ambitions for sustainability and ensures systematic follow-up throughout the project's life cycle (Kristiansand Municipality, 2021). Optimising material use is another key priority. To minimise greenhouse gas emissions, the municipality assesses the combined environmental effect of materials rather than focusing solely on individual components. Environmental Product Declarations (EPDs) or equivalent labels are now required for at least the 15 main materials in a building. Moreover, the municipality is committed to minimising GHG emissions from buildings by implementing life cycle-based greenhouse gas budgets and accounts for all construction projects over 400 square metres or with an investment framework exceeding NOK 10 million. Greenhouse gas calculations are to be conducted according to the NS 3720 standard (Kristiansand Municipality, 2021).

The municipality has also set the ambitious goal of emission-free construction sites by 2025. Pilot projects are already underway to test zero-emission construction methods, with the target of increasing the percentage of such sites across all projects. In the meantime, sustainable biodiesel will be used until the electrification of construction machinery becomes more widespread (Kristiansand Municipality, 2021). Alongside these efforts, the municipality is committed to reducing waste on construction sites, with recent projects setting a waste generation target of no more than 25 kg per square metre and the goal of recycling over 90% of construction waste (Interviewee 28, 2024).

Energy efficiency is another crucial focus area. The municipality is investing in measures to reduce energy consumption in existing buildings and requires that all new buildings be designed according to passive house standards (NS 3700 for

residential buildings and NS 3701 for commercial buildings). For major renovation projects, passive house standards will also be prioritised. Where feasible, all new buildings are required to achieve energy class A. Finally, to support a circular economy, the municipality aims to evaluate existing buildings for potential reuse before planning new construction. Additionally, there is a strong emphasis on reusing materials in new projects. Climate adaptation is also integral to construction activities, with a focus on protecting biodiversity and ensuring that buildings are resilient to climate change impacts such as heavy rainfall, stormwater and flooding.

Transport and mobility sector

The overarching goals for the municipality of Kristiansand in the transport and mobility sector are aligned with national objectives aimed at sustainable urban transport, as outlined in the municipal climate plan (Kristiansand Municipality, 2023b). These goals are rooted in the Norwegian transport system, which prioritises reduction of private car traffic growth in major urban areas through the "Zero Growth Goal" established in the National Transport Plan of 2012. A national financing scheme supports these objectives, allowing municipalities to enter into agreements with the Ministry of Transport to receive funding. Kristiansand has successfully secured incentive agreements with the Ministry of Transport since 2009 (Interviewee 29, 2024). This funding has led to substantial improvements in the public transport system and a notable increase in passenger numbers.

Additionally, a road toll system implemented since 2009, with revised pricing in 2013 to discourage peak-hour traffic, contributed to achieving zero growth in private car traffic from 2012 until around 2019. However, a shift occurred in 2019 when traffic growth resumed, interrupted briefly by the COVID-19 pandemic in early 2020. Despite an initial drop in traffic, levels rebounded quickly in the latter half of 2020 and continued to rise in 2021 and 2022 (Interviewee 29, 2024). Notably, 2022 saw a 2.2% increase in traffic compared to the previous year. This situation presents a paradox, as private car traffic and public transport passenger numbers are growing concurrently despite modest population growth. This unexpected trend poses a challenge to maintaining the zero-growth goal and highlights the need for further analysis and strategic adjustments.

As addressed in the climate plan (Kristiansand Municipality, 2023b) transport in Kristiansand aims to be predominantly emission-free by 2030. The municipality sets several goals in this respect:

1. Actively promoting walking, cycling and public transport as the primary choices.
2. Facilitating shared mobility solutions to reduce the need for private vehicles.
3. Municipal purchases of vehicles and machinery that are emission-free or use sustainable renewable fuels.

To achieve these goals, several actions are listed in the climate Action Plan (Kristiansand Municipality, 2023a). The municipality aims to promote compact urban development by enhancing public transport, pedestrian pathways and cycling infrastructure. Information campaigns will play a key role in encouraging more residents to walk or cycle, while parking policies will be designed to limit car use. Kristiansand is also focused on expanding shared mobility options, such as car-sharing, bike-sharing and e-scooter programmes, which will be integrated seamlessly with public transport. Secure bike storage will be provided at key transport hubs to facilitate this shift. The municipality is committed to transitioning its own vehicle fleet to emission-free or sustainable alternatives and ensuring that construction sites are equipped with emission-free solutions. Additionally, emission-free waste collection vehicles will be encouraged and new public transport agreements will prioritise a high percentage of emission-free vehicles, including taxis, which will be required to meet these standards as part of municipal contracts. To support this transition, the municipality will assess and provide adequate charging infrastructure for taxis as well as for private and commercial vehicles. Kristiansand will also explore the introduction of zero-emission or low-emission zones and conduct feasibility studies for goods delivery distribution points in the city centre. Efforts to shift freight transport from road to rail and sea are planned, with phased requirements for zero-emission vehicles in procurement processes. In order to reduce the overall need for transport, the municipality will encourage the use of innovative and local solutions. This includes replacing physical meetings and gatherings with digital platforms where possible and prioritising locally produced products and services. These combined efforts aim to reduce emissions and foster more sustainable mobility (Kristiansand Municipality, 2023a).

Achieving the climate goals in the transport sector presents several challenges. A primary issue is the continuous growth in private vehicle traffic. Additionally, the way land is used and developed significantly impacts transport patterns. Spatial development dictates the locations of homes, workplaces and recreational areas, influencing how and where people travel. Coordinating land use with transport development is a significant challenge that must be addressed (Interviewee 29, 2024).

Challenges and opportunities: a multilevel governance perspective

In general, Norwegian municipalities enjoy broad autonomy in spatial planning. Under the legal framework of the Planning and Building Act, municipalities are authorised to specify which land use plans are to be developed and updated. Municipal masterplans, which govern local spatial planning, fall under their responsibility. Nevertheless, aligning land use approaches with climate neutrality goals is not an easy task and several challenges may arise.

In the transport and mobility sector, the national-level agenda is defined by the National Transport Plan, which outlines priorities for projects and funding allocation. This plan guides decisions on which initiatives receive financial support from the state, such as railway construction or road improvements. While the National Transport Plan does not directly impose enforceable regulations, it establishes climate goals that influence transport priorities. These goals include targets for reducing emissions from various vehicle types, thereby aligning decision-making with broader national objectives (Interviewee 25, 2024, p. 25). At the local level, laws and regulations are pivotal in shaping transport policies. Local governments enact rules related to emissions, traffic management, land use and infrastructure development, often reflecting national goals but tailored to local needs. Funding mechanisms, such as grants and subsidies from the national government, significantly impact local transport projects (Interviewee 25, 2024). Local governments must adhere to criteria outlined in the national plan to secure financial support, emphasising the connection between national policies and local actions.

With respect to the buildings sector, the main responsibility rests at the national level, with the regulatory framework established by the Planning and Building Act and the technical regulations (TEK). At the local level, municipalities have to comply with national-level requirements.

Policy capacity: vertical and horizontal governance tensions

Land use sector

Vertical governance tensions

In Norway, densification is the dominant strategy in land use discourse, with compact urban development being strongly pursued both at the national and at the local level. However, in both Trondheim and Kristiansand challenges persist in implementing a compact city approach, with sprawl continuing to shape development patterns in both cases.

In Trondheim, regulatory autonomy issues have arisen. Here, brownfields are priority areas for implementing densification interventions, as they are usually located in already built-up areas. Many of these brownfield areas were once used for waste disposal before newer methods like incineration became widespread. Now they are located in river valleys near the city centre but have become problematic due to the release of harmful gases and contaminants from the buried waste. This poses serious health risks, a concern that the national government takes seriously. Despite local leaders and politicians wishing to repurpose these areas for housing, the health hazards of building on former waste disposal sites are hard to ignore. Navigation of governance structures adds to the challenge. Even when there is universal agreement on goals, such as densifying already built-up areas, local authorities can find themselves restricted by national rules, limiting their ability to address local needs effectively (Interviewee 23, 2024).

In Kristiansand, challenges related to densification arise in selecting areas for development. A recent evaluation by the municipality identified areas to be potentially excluded from designation as development zones in the municipal plan. Some of these areas were deemed unsuitable due to their remote locations or steep terrain, which would increase transport demand and contribute to environmental encroachment. Their exclusion aligned with national land use objectives to reduce transport demand and preserve natural environments. However, political shifts led to fewer areas being removed than initially recommended. As a result, many areas continue to be designated as potential development zones, serving as a buffer for future expansion despite earlier proposals for their removal. This process highlights the tension between administrative planning recommendations and political decision-making at the local level (Interviewee 27, 2024). While national goals provide a general framework, their implementation requires local adaptation, introducing complexities. Local politicians may interpret national objectives in different ways, creating inconsistencies in planning decisions (Interviewee 27, 2024). In Kristiansand, the challenge is not a lack of local autonomy but rather conflicting

interpretations of national-level recommendations (Interviewee 27, 2024). The municipality plays a crucial role in implementing these goals, yet many of these discussions might be more effectively addressed at the regional or national level.

Horizontal governance tensions

Densification around transport hubs is a key strategy for reducing emissions by decreasing car dependency and improving access to public transport. However, in Trondheim, this approach is sometimes hindered by conflicts between municipal departments. For example, the Environmental Department's concerns over noise pollution often clash with the goal of increasing density near transit corridors. This tension highlights a common challenge in urban densification efforts. Similarly, competing priorities among departments advocating for seemingly beneficial initiatives can create obstacles. The Transport Department prioritises high-quality bicycle lanes to promote cycling, while urban planners focus on pedestrian-friendly nodes in local centres. Aligning these objectives is not always straightforward, as preferences for infrastructure – such as roundabouts, cycle paths and green spaces – often diverge. Nevertheless, negotiating these conflicts is considered a routine aspect of project development and consensus is typically reached (Interviewee 23, 2024).

Furthermore, densification also faces resistance due to concerns over green space loss, architectural identity and neighbourhood character. Transforming urban areas is inherently complex, involving property disputes, competing interests, high land values and significant financial investments for both public and private stakeholders (Trondheim Municipality, 2019). Lastly, increased land pressure in the city centre threatens valuable assets such as parks and cultural landmarks. Cultural attitudes and political pressures further complicate the process, as there is often an expectation to approve new developments despite preservation concerns.

In addressing local land use strategies, Kristiansand faces some significant challenges, particularly in integrating sustainability goals. The municipal plan emphasises the three dimensions of sustainability – environmental, economic and social – and recognises the complex interplay among these aspects and the UN Sustainable Development Goals. However, translating this vision into practical, day-to-day actions is a complicated task (Interviewee 27, 2024). One of the primary challenges is that of effectively measuring the social impact of local climate strategies. While environmental and economic impacts are more straightforward to quantify, social impacts, which often involve softer qualities of life, are more difficult to evaluate. Although there are local indicators for quality of life, assessing and improving these aspects remains challenging. Nevertheless, the municipality is working on projects where social impacts are the main theme, learning how to assess social qualities for neighbourhoods, such as in area-based development.

Another challenge in Kristiansand's urban development is the tension between previous trends of urban sprawl and the current goal of densifying city centres.

Densification aims to provide better access to essential services and activities within walkable distances, enhancing overall quality of life. However, ensuring that densified areas remain accessible and inclusive for all residents – especially for vulnerable groups – poses a significant challenge (Interviewee 27, 2024). Moreover, densification carries the risk of rising housing costs, potentially reducing affordability. While Kristiansand has been proactive in addressing this concern, often outperforming larger cities like Oslo in providing affordable housing (Interviewee 27, 2024), maintaining this balance will be crucial. Moving forward, Kristiansand must navigate the complexities of densification and inclusivity to ensure that urban development supports all residents fairly while upholding its sustainability commitments.

Buildings and construction sector

Vertical governance tensions

In Trondheim, a critical challenge arises in relation to emission-free construction sites. A key factor in this transition is the availability of electric construction machinery, such as engraving machines and loaders. However, the high costs of these machines place the financial burden on construction companies, which are often reluctant to invest without sufficient demand or financial support. At the same time, municipalities cannot legally require them to do so. This regulatory barrier is rooted in national legislation, specifically the Planning and Building Act (PBL). Authorities are exploring legal options to assess whether the law could be challenged, potentially granting municipalities greater authority to impose stricter environmental requirements on private developers. While the Planning and Building Act serves as a crucial governance tool for municipalities to reduce greenhouse gas emissions, Trondheim can only mandate emission-free practices on municipally developed sites, while privately led developments remain outside its control.

Like in Trondheim, in Kristiansand, the municipality's climate ambitions have generally exceeded national targets (Interviewee 28, 2024). The municipality has set the goal of an 80% reduction in emissions by 2030, surpassing the national target of 50-55%. While this reflects the municipality's strong commitment to sustainability, it has also sparked local debates about the potential need for recalibration to align more closely with national objectives. As the political landscape evolves, there may be a shift towards harmonisation to ensure that targets remain both ambitious and achievable (Interviewee 28, 2024). Although Kristiansand has maintained higher environmental standards, there is growing recognition that recalibrating its targets might be necessary to facilitate effective implementation and compliance.

Since January 2024, the Norwegian national government has introduced a new rule stating that [climate and environmental considerations are to given a weighting of at least 30% in public procurement](#). This strict regulation can be difficult to

navigate at the local level. Identifying the most impactful and cost-effective environmental measures is often challenging, leading to potential inefficiencies and higher costs. In Kristiansand, this issue ties in with the need for enhanced competence within the organisation as well as better support networks to provide guidance in climate actions (Interviewee 28, 2024).

Horizontal governance tensions

In Trondheim, communication practices among the various municipal departments are generally satisfactory. However, challenges may arise from the inherent diversity in operations and the unique demands they entail. Each unit functions as a system with inputs, outputs and a set budget. Some units collaborate with the private sector on projects where considerations such as climate impact may not always receive sufficient attention due to the lengthy and costly nature of the process. This can lead to misaligned expectations among units. For example, infrastructure projects like water and sewage operate differently from building projects, requiring particular types of machinery. Buildings may need tower cranes, while infrastructure projects require excavation equipment or electrical trucks. Achieving a 100% emission reduction in construction activities is challenging due to these differences. As a result, establishing a universal method for measuring emissions across all projects is complex. Despite these inevitable discrepancies, efforts are ongoing to foster dialogue and find solutions to bridge the gaps between units and their respective expectations (Interviewee 24, .

In Trondheim, electrification of the construction and infrastructure sectors presents both challenges and opportunities. While it will undoubtedly increase the demand for energy and power, it also creates opportunities for transitioning to more localised energy production. Regulatory support for initiatives, such as energy sharing between neighbouring buildings and properties, can be pivotal in meeting demands sustainably. Trondheim municipality is poised to lead by example through its own projects, encouraging contractors to use emission-free and climate-friendly technology.

Additionally, initiatives like the Positive CityxChange project provide valuable opportunities to test innovative solutions, such as energy sharing, which can ultimately drive comprehensive regulatory changes. Furthermore, regulatory revisions are essential to promote reuse and circular solutions within the construction and infrastructure industry. By fostering a circular and emission-free future, Trondheim can not only mitigate its environmental impact but also stimulate the growth of a sustainable economy.

Transport and mobility sector

Vertical governance tensions

In Kristiansand, financial constraints are one of the primary challenges, as without the national funding packages, it would be a significant challenge to meet the transport objectives (Interviewee 29, 2024). This is particularly true for the public transport service, which is severely underfunded. The complexity of county financing aside, the current funding system for public transport is not designed to drive substantial improvements. It merely maintains the status quo from the previous year, making it impossible to enhance service levels or efficiency significantly within the existing financial framework. For instance, doubling the frequency of bus lines would be unfeasible under normal funding conditions (Interviewee 29, 2024). Therefore, these national funding packages are crucial for Kristiansand as well as for other major urban areas in Norway. However, there is a notable disconnect between national goals and the associated funding. This is particularly evident in infrastructure development for biking. While it is possible for municipalities to prioritise such projects within their budgets, progress would be markedly slower without additional funding. Consequently, both toll road packages and the "byvekst-avtale" (growth agreements) are essential for enabling meaningful advancements (Interviewee 29, 2024).

The municipality of Trondheim lacks the authority to establish zero-emission zones^[33] without legal changes at the national level. This highlights the importance of understanding the role and limitations of cities in addressing environmental issues within the existing legal framework. As highlighted by the Norwegian Public Road Administration (2022), the challenge with implementing zero-emission zones in Norway lies in the need to reduce greenhouse gas emissions significantly by 2030 in alignment with national goals. While transitioning to zero-emission vehicles is a primary strategy, achieving this target also involves measures like implementing zero-emission zones in large cities and imposing a CO₂ tax on fuel. The Road Traffic Act grants some authority for imposing traffic restrictions to mitigate harmful effects, but there are doubts regarding its clarity and effectiveness for zero-emission zones. Consequently, recommendations by the Norwegian Public Road Administration include establishing a new legal framework to enable the effective enforcement of such zones. Additionally, municipalities can currently establish low-emission zones for local air quality reasons, but amendments are proposed for the inclusion of climate considerations (Norwegian Public Road Administration, 2022).

33. Geographically defined area on a public road which is exposed to local air pollution from cars and where the municipality has received consent to introduce a fee for driving. i.e. a zone where there are high fees for entering with a fossil fuel-driven vehicle

Horizontal governance tensions

In Kristiansand, regarding horizontal governance at the municipal level, interactions among various departments, including those not directly involved in transport, can sometimes lead to discussions over priorities and specific projects. For instance, collaboration with the engineering department helps determine the planning and implementation of bicycle routes. Similarly, coordination with the Parks and Green Areas Department influences decisions regarding street design, outdoor amenities like bicycle parking and the creation of paths for walking through green spaces (Interviewee 29, 2024). Moreover, engagement with building and planning authorities ensures that new developments integrate effectively with existing bike infrastructure and public transport routes, with the aim of optimising the local transport network over the long term (Interviewee 29, 2024). Additionally, interactions extend to other departments, where considerations like school consolidation by education authorities – intended to save costs but potentially impacting pupil commuting distances – highlight interconnected challenges. Similar dynamics are observed in relation to kindergartens and other public services, emphasising the complexity and interdependence of municipal governance efforts.

In Trondheim, challenges mainly arise due to the size of the municipality, making it difficult to navigate and find the appropriate contacts within different departments. Despite a shared willingness to cooperate, the sheer number of staff can hinder seamless collaboration. Although efforts are made to break down silos and foster integration, busy schedules and competing priorities sometimes prevail (Interviewee 25, 2024). Typically, departments work independently but come together for specific tasks or projects, demonstrating a tendency towards collaboration for smaller or larger endeavours. However, the ideal of seamless cooperation is not always achieved due to practical constraints.

Institutional capacity: knowledge, relational resources and mobilisation capacity

Knowledge Capacity

Both Trondheim and Kristiansand have well-established knowledge bases across the land use, buildings and transport sectors. Nevertheless, challenges remain in ensuring consistent expertise, integrating climate considerations into decision-making and keeping pace with evolving technical requirements.

Kristiansand benefits from a large and professional municipal staff, allowing for internal discussions and knowledge sharing on climate and environmental planning. However, knowledge is not always effectively disseminated across departments, creating gaps in implementation, particularly in operational units such as roads and

parks, where daily tasks can overshadow innovation efforts (Interviewee 27, 2024). Therefore, improving internal collaboration and spreading existing knowledge more effectively is crucial. Keeping knowledge up to date by attending conferences, courses and webinars and learning from successful projects in other municipalities or regions is an ongoing effort (Interviewee 27, 2024).

In Trondheim, there is strong technical competence across various municipal sectors, but governance complexities arise from management of political interests and competing agendas (Interviewee 23, 2024). One key area for improvement is enhancing the ability to interpret and analyse greenhouse gas emission data, particularly in land use planning, where measuring climate impact is becoming increasingly necessary. In the buildings sector, Trondheim has developed specialised expertise in sustainability and circularity, particularly in the reuse of materials such as furniture, timber and bricks (Interviewee 24, n.d.). However, ensuring that all employees have sufficient environmental expertise is an ongoing effort, requiring structured internal knowledge development and capacity-building programmes (Trondheim Municipality, 2023b).

In Kristiansand, climate knowledge in the buildings sector varies significantly across the organisation, creating obstacles to the consistent implementation of sustainability measures (Interviewee 28, 2024). Furthermore, the pressure to produce results under resource constraints limits the municipality's ability to dedicate time and staff to in-depth climate analysis (Interviewee 28, 2024).

Similarly, while the transport sector in both municipalities is supported by competent municipal staff, there is a reliance on consultants and research collaborations to fill expertise gaps (Interviewee 25, 2024; Interviewee 29, 2024). Trondheim, in particular, prioritises continuous learning and improvement, integrating external knowledge into municipal decision-making through research partnerships (Interviewee 25, 2024).

Relational Resources

Both municipalities actively participate in national and international networks to share best practices and enhance institutional knowledge. These networks serve as crucial platforms for exchanging experiences, developing strategies and keeping abreast of emerging climate solutions.

In land use planning, Kristiansand and Trondheim engage in intermunicipal networks focused on greenhouse gas emissions and urban planning, collaborating with cities such as Oslo and Bergen (Interviewee 23, 2024). Trondheim has also prioritised participation in the Storby Network, a leadership-focused platform for discussing climate strategies across major Norwegian cities. These collaborations allow municipalities to learn from national and international experiences, including case studies from cities such as Stavanger and even from Greenland (Interviewee 23, 2024).

The buildings sector in Trondheim is strengthened by participation in FutureBuilt, an initiative originally established in Oslo that now includes cities like Stavanger and Bergen. This membership enables Trondheim to contribute to and benefit from innovative sustainability projects, particularly in low-carbon construction and circular material use (Trondheim Municipality, 2023b). Kristiansand, while not as heavily involved in such programmes, maintains regional collaborations and works towards integrating climate considerations into municipal building policies.

In the transport sector, Kristiansand has established regional connections with road authorities at both the municipal and national levels. For biking initiatives, it participates in a county-wide network, leveraging its role as the largest city in the region to promote cycling infrastructure improvements (Interviewee 29, 2024). Trondheim, in turn, benefits from engagement with EU initiatives such as the EU City Mission, ensuring access to international expertise and financial resources (Interviewee 25, 2024). The municipality also has an EU advisor, who tracks opportunities for participation in European projects, bolstering its ability to engage when necessary (Interviewee 25, 2024).

While these networks provide valuable opportunities for collaboration, both municipalities face challenges in resource allocation and participation capacity. Engaging in multiple networks requires staff time and financial support; municipalities must strategically decide which platforms offer the most practical benefits for local climate action.

Mobilisation Capacity

Kristiansand and Trondheim have well-established governance structures for climate planning, but the effectiveness of implementation varies due to internal coordination issues, political considerations and capacity constraints.

In Kristiansand, despite having a large municipal workforce, climate integration remains uneven across departments. Certain units, such as land use planning, are well-equipped to incorporate sustainability principles, while others, like roads and parks, struggle to prioritise climate initiatives within their daily operations (Interviewee 27, 2024). Internal collaboration mechanisms are necessary to ensure climate knowledge is integrated across all municipal activities.

Trondheim has taken steps to mainstream environmental expertise across departments, assigning climate and environmental advisors to oversee both existing and new construction projects (Interviewee 24, n.d.). However, ensuring that these advisors can effectively influence municipal decisions and enforce sustainability standards remains a challenge. The municipality has recognised the need for increased cross-sectoral collaboration and better-defined responsibilities to translate expertise into action (Trondheim Municipality, 2023b).

Political considerations play a significant role in shaping municipal climate policies. In Kristiansand, political decision-making is sometimes misaligned with expert recommendations, particularly in the transport sector, where understanding the interdependencies between land use, mobility and emission reductions is crucial (Interviewee 29, 2024). Trondheim faces similar governance challenges, with competing political priorities potentially slowing down the adoption of ambitious climate measures (Interviewee 23, 2024).

Both municipalities also face challenges related to staff capacity. In Kristiansand, the need to deliver rapid results strains staff resources, making it difficult to prioritise long-term sustainability initiatives (Interviewee 28, 2024). Trondheim, despite its strong knowledge base, relies on consulting firms for market investigations and complex environmental analyses, underscoring the need for further development of internal expertise (Trondheim Municipality, 2023b).

Despite these challenges, both municipalities have opportunities to strengthen their governance and mobilisation capacity. Trondheim's participation in FutureBuilt positions it as a leader in innovative sustainable building, while Kristiansand's role in regional cycling and road infrastructure networks allows it to influence mobility planning beyond municipal borders. Additionally, both municipalities benefit from national and EU-funded initiatives, which can provide financial and technical support for progress on local climate goals.



Photo. Unsplash.com

Key reflections and learnings from Norway

Kristiansand and Trondheim both face significant challenges in their pursuit of climate neutrality through spatial planning, though their experiences differ due to local governance structures, geographical contexts and institutional capacities. Both cities strive for compact urban development as a key policy goal, yet they encounter obstacles in realising this ideal. In Trondheim, regulatory issues complicate local efforts, limiting local decision-making autonomy. However, the city's strong technical expertise and established participation in collaborative networks, such as FutureBuilt and the Storby Network, enhance its ability to navigate governance constraints and integrate sustainability into urban planning. By contrast, Kristiansand faces issues related to the suitability of development areas, with some proposed sites deemed unsuitable due to geography, leading to political conflicts over land use. Despite this, Kristiansand benefits from a large and professional municipal staff, which supports ongoing learning and adaptation, particularly in projects focused on assessing social impacts in urban development.

In the transport sector, both cities face hurdles. Trondheim is seeking to establish zero-emission zones but lacks the necessary legal authority, while Kristiansand's public transport development is hindered by financial constraints and inadequate funding. Despite these challenges, both cities have demonstrated success in securing external financial support and utilising mechanisms such as growth agreements and toll road packages to drive mobility improvements. Additionally, Kristiansand's active role in regional transport planning strengthens cross-sectoral collaboration, ensuring that sustainable mobility remains a key priority despite funding limitations.

Horizontal governance tensions also arise in both cities as various municipal departments work to align their priorities with climate goals. Trondheim experiences conflicts between environmental and transport interests, while Kristiansand faces challenges in integrating transport planning with urban design.

Institutional capacity is another factor that shapes each city's approach. Trondheim benefits from a strong expertise base, engaging in collaborative networks to share best practices. Furthermore, Trondheim's leadership in sustainable construction is evident in its commitment to emission-free municipal projects. Kristiansand, while possessing significant knowledge, struggles with inconsistent expertise across departments, affecting the implementation of climate initiatives. Overall, both Kristiansand and Trondheim are committed to climate neutrality. Despite being embedded in the same vertical governance framework, their paths reflect distinct local conditions that shape different levels of policy and institutional capacity. In the following boxes, we provide an overview of the key challenges faced by the Norwegian cities in achieving climate neutrality, as well as reflecting on the implications and possible ways to address them.

CHALLENGE 1: Regulatory complexity and limited local autonomy

Implications: Restricts cities' ability to tailor climate initiatives to local conditions, slowing down implementation. Slows down the shift to low-emission transport options and impacts cities' ability to meet climate goals.

What can be done? Increase coordination and dialogue between the national and the local level.

Seek alternative funding sources, such as public-private partnerships or EU grants.

Prioritise efficient resource allocation to ensure sustainable development.

CHALLENGE 2: Horizontal governance tensions

Implications: Results in fragmented efforts, making it difficult to develop cohesive, citywide climate strategies.

What can be done? Facilitate interdepartmental coordination to align objectives.

CHALLENGE 3: Need for greater institutional capacity and expertise

Implications: Slows down progress, as departments struggle to apply best practices consistently across all sectors.

What can be done? Continue participating in collaborative networks for knowledge sharing and policy innovation; invest in capacity-building programmes.



Lund. Photo: Unsplash.com

11. SWEDEN



CASE: LUND



Lund. Photo: Unspalsh.com

Background information

Lund is the twelfth largest municipality in Sweden, with a population of 130,288 people living in an area of 439.91 km² (SCB, Statistics Sweden, 2024). Approximately 80% of the population (94,393 inhabitants) lives in the city of Lund, which occupies only 6.18% of the municipal area (26.37 km

²). It is one of the densest cities in the Nordic Region with a population density of approximately 3,580 inhabitants/km² inhabitant. Its speedy growth, with 1,904 new residents in 2023, is expected to continue as forecasts indicate that the population will exceed 140,000 people by 2029 and reach approximately 146,000 people by the end of 2032 (Lund Municipality, 2024f).

Proximity to Malmö, the third-largest municipality in Sweden, along with a knowledge-based economy supported by the presence of Lund University (from 1666) and the European Spallation Source (ESS) – a major science facility involving more than 40 research institutes in Europe – contributes to a thriving labour market with a high share of employees in both the public sector (Region of Skåne and Lund Municipality) and private sector (e.g. Tetra Pak Packaging Solutions and Axis Communications AB).

Strategic level: municipal goals and policies

By 2030, Lund aims to become a climate-neutral and fossil fuel-free municipality that has adapted to a changing climate. The main programme addressing climate neutrality is *“Lunds kommuns programme för ekologisk hållbar utveckling 2021-2030”* (also referred to as *LundaEko III*) (Lund Municipality, 2021). The programme is divided into six topics: (1) consumption and production, (2) substances hazardous to the environment and health, (3) climate and energy, (4) housing and local environment, (5) biodiversity and (6) surface and groundwater. For each area, the document lists specific goals and the key parties responsible. In the online version of the document, the status of each goal's achievement can also be viewed.^[34] The programme sets out several key climate-related objectives for Lund Municipality:

- Annual consumption-based GHG emissions per inhabitant must be decreased. The emissions of municipal councils should not exceed 0.3 tonnes. (Consumption and Production, 1.3)
- Emissions and use of substances hazardous to the environment and health, including plastic particles, must be minimised in buildings, roads and facilities in the municipality. (Environmentally harmful substances)
- To become climate-neutral and fossil fuel-free with the aim of adapting to the changing climate, the municipality must work on areas including reduction in GHG emissions, tackling air pollution, carbon storage, energy efficiency and climate adaptation. (Climate and Energy, Objective)
- GHG emissions must be reduced by at least 65% by 2025 and by at least 80% by 2030 compared to 2010 levels. In 2045, the municipality must be climate-positive, with emissions approaching zero. (Climate and Energy, 3.1)

34. <https://lund.se/kommun-och-politik/hallbara-lund/ekologisk-hallbarhet>

Carbon storage must increase between 2021 and 2030. The municipal group must work on carbon dioxide capture. (Climate and Energy, 3.3)

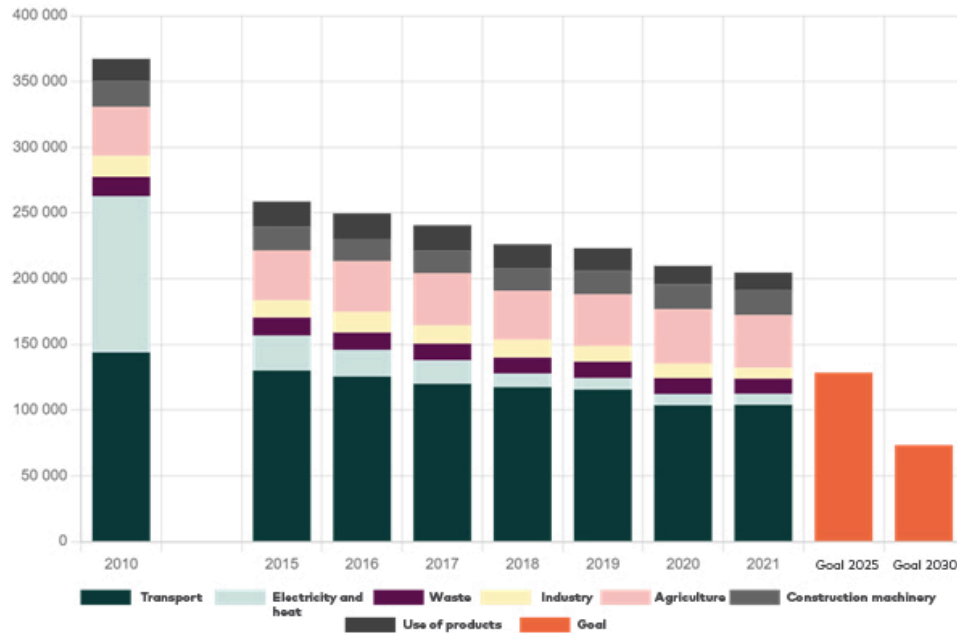
- Energy use must be decreased by at least 15% between 2015 and 2030. (Climate and Energy, 3.4)
- The local production of renewable electricity, heat and fuel must be at least 1,300 GWh in 2025, of which solar and wind must account for at least 100 GWh. In 2030, solar and wind must account for at least 150 GWh. (Climate and Energy, 3.5)

Currently, this document has been updated to include the main changes expected in relation to quantification of the emissions that should be curbed in the following years (Interviewee 31, 2024). A steering group and various working groups, involving a range of departments, municipal companies and even other municipalities depending on the thematic scope (e.g. public transport, water management), have been established to provide input into the new document.

Achieving climate neutrality by 2030 requires emissions to be reduced by at least 80% compared with the levels recorded in 2010 and for climate compensation measures to be implemented within the municipality (such as CO₂ absorption and storage in soil and vegetation). The municipality aspires to be climate-positive and with emissions approaching zero by 2045 (Viable Cities, 2023). These goals have been defined on the basis of the estimated GHG emissions that occur within the municipality's geographical boundaries (Scope 1) (Lund Municipality, 2024d). However, the municipality recognises consumption-based emissions under the goal of "consumption and production" and the adoption of several strategies for circular production and consumption (e.g. procurement, good, waste, business models and knowledge).

Lund's climate policy council plays a pivotal role in critical analysis of the municipality's emissions and strategic advice. The latest report warns that, to meet the targets, the municipality must double its emission reduction, achieving an average of 10% per year until 2030 (Lund Municipality, 2023). The municipality has been tracking emissions for many years, even prior to its engagement in national and international networks. The various municipal departments provide information about their climate performance in the yearly sustainability report. The municipality also reports to the networks it participates in, including ICLEI and the Covenant of Mayors, using the Climate Disclosure Project ([CPD](#)) as a platform for emission reporting.

FIGURE 16. GHG EMISSIONS IN LUND BY SECTOR



Source: [A climate-neutral Lund](#)

According to the latest statistics from 2021, emissions dropped by 45% compared to 2010, with the heating and electricity sectors being the main contributors to this decrease. Over the last 15 years, the municipal power company Krafringen has enabled conversion of the district heating system to fossil-free biofuels, which has contributed to lowering the total emissions significantly. The planning process for the next district heating plant KKV2 will take Lund to the next level, as Krafringen is implementing the largest low-temperature district heating in Brunnshög, powered by surplus heat from the nearby research facilities. Krafringen is investigating the possibility of storing wind power as hydrogen, allowing homeowners to use clean energy even in periods of lack of wind (Lund Municipality, 2024d). On the other hand, despite a reduction in emissions of almost 30% compared to 2010, the transport sector is the largest source of emissions, corresponding to about half of total emissions in the municipality.

While there are limits in steering society towards climate neutrality, the municipality has successfully driven its own operations in that direction, claiming to have achieved 99.4% fossil-fuel-free status. This is due to several measures, including investments in solar panels on new and existing municipal buildings (for example, the installation of five new solar systems on existing buildings in 2023 provided total output of 353,668 Kw/h per year) (Lund Municipality, 2024b).

The municipality considers the trade-offs between climate objectives and social and economic goals. Like Lunda Eko, the municipality has a document for social

sustainability and a business programme that takes economic sustainability into account. The interrelations between ecological and social sustainability are perceived in different ways. Pursuit of climate goals in the transport sector can go hand in hand with positive social and economic outcomes (e.g. biking and walking improve people's health, as well as providing cheaper opportunities for mobility). However, the municipality recognises the need to examine social differences in more detail. For example, the elderly are likely to be severely affected by climate change, and these nuances should be reflected in policymaking. Awareness of the implementation of policies that may be beneficial for one sector at the expense of another is also important. For example, Lund has made significant advances in terms of fossil-fuel-free heating and biogas from agriculture and food waste. While this has a positive impact on decreasing CO₂ emissions, there is also a risk that this circular system may jeopardise food security (Interviewee 32, 2024).

To finance the transition to climate neutrality, the municipality has had access to "green bonds" since 2017. These are loans issued by governments organisations and companies to finance sustainable projects worldwide, with unique tax benefits. The loans support investments in renewable energy (such as wind, solar and hydro), recycling efforts, clean transport and sustainable forestry (Lund Municipality, 2024c). The municipality also has an internal fund that draws on the business trips of civil servants. The department requiring the trip is charged 50% more than the travel costs. The extra payment goes to the funds used to finance sustainable projects. This is a smart mechanism for decreasing transport emissions from business trips and gaining resources for climate efforts.

Challenges to coordinating climate objectives across some departments arise in those departments not directly involved in reducing emissions. For example, the school department's core activity is education; incorporating sustainability practices into working routines is perceived as an extra task that needs to be performed with a limited budget. However, the opportunity to collaborate with local businesses and academia and develop methods and innovative solutions that can be replicated in other contexts, along with the possibility to tackle social goals while reducing emissions, are aspects mentioned with enthusiasm (Interviewee 31, 2024).

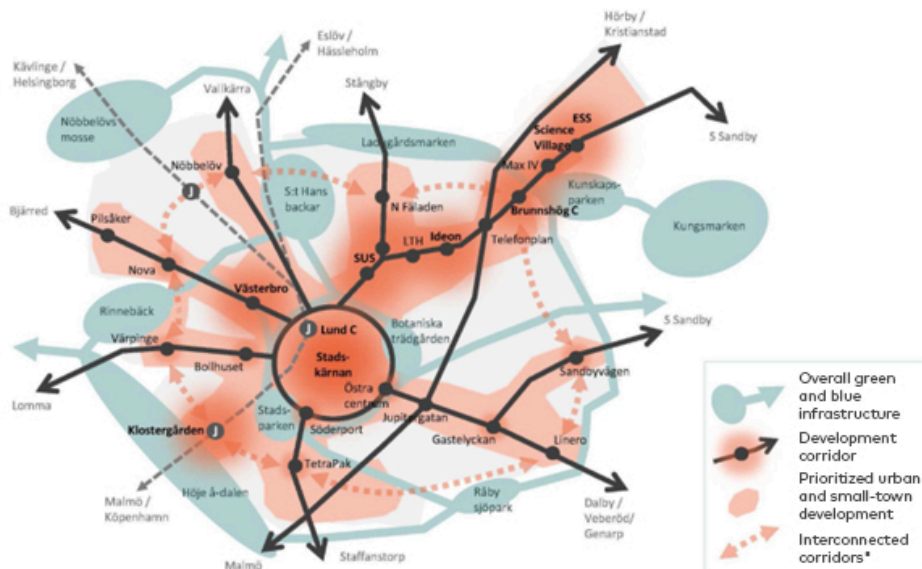
Land use sector

Lund's climate neutrality goals align with the ongoing revision of the comprehensive plan, which is expected to be published in 2025. The municipality is striving for a compact urban form to accommodate the expected growth of 30,000 new homes by 2050, with 20,000 planned to be built in the city of Lund and the remainder in the other eight urban cores and countryside. The master plan is based on six principles that guide the densification approach: (1) Development should encompass the whole of Lund; (2) Growth should occur through densification in a resource-efficient way; (3) Lund should be a sustainable and innovative driver of development in the Scania region; (4) A safe and attractive environment should be

ensured for everyone; (5) Lund should achieve climate neutrality; and (6) Lund's unique identity and attractiveness should be preserved.

Densification and a resource-efficient urban structure – preserving the development of agricultural land and focusing on developing areas with existing investments (infrastructure, schools, parks, services, multifunctional buildings etc.) are among the strategies pursued to achieve a compact urban form (Lund Municipality, 2024e). With the expansion of core areas and densification along the routes and nodes that connect neighbouring areas and promote mixed development, the strategy of "growing from the inside out" reinforces efficient public transport while maintaining a human-scale environment with boulevards in some of the main corridors. The projected 20,000 homes in Lund by 2050 are expected to be built in the existing neighbourhoods (e.g. Brunnshög, Sådra Råbylund and Västerbro), with the city centre accommodating multi-functional buildings (e.g. Lunda C. and Söderport).

FIGURE 17. LUND'S SPATIAL DEVELOPMENT



Source: Lund Municipality, 2024e

Lund is one of the Nordic cities with the highest population density and can be considered a 15-minute city due to its "sun shape" and the short distance from the city centre to its edges. A quick bike ride can easily cover the four kilometres that separate the city centre from the outskirts. Prioritising the development of areas where basic services (such as schools) are available is a densification strategy that optimises the capacity of the existing infrastructure and prevents the development of new infrastructure, thereby saving costs (Interviewee 30, 2024). However, the city's compact urban form and the resulting efficient mobility come at the expense

of green areas as Lund has notably low green space in square metres per inhabitant (Interviewee 32, 2024).

The city's rapid growth – driven by the presence of universities and research facilities such as the European Spallation Source (ESS) – and compact urban form have inevitably led to the use of agricultural areas for urban expansion. Unfortunately, the densification of existing areas and brownfield developments do not provide sufficient housing stock to support a thriving urban economy. However, the densification of brownfields raises concerns as these areas usually have low population density. To tackle this issue, Lund has developed a study that explores several alternatives, such as possibilities to build on top of existing buildings or subdivide the ownership of properties, as well as analysis of mobility patterns in these areas and ways in which different uses (residential, commercial) can coexist.

To address diverse housing needs, the municipality has promoted the development of mixed communities featuring apartments, townhouses and small villas. However, the higher price of single-family houses limits demand, contributing to maintenance of the compact development pattern.

Despite the absence of a document solely dedicated to climate adaptation and mitigation, the city places considerable emphasis on these issues, which are addressed in various documents. Safeguarding and strengthening ecosystem services in urban areas, preparedness to deal with extreme weather conditions and an urban design responsive to the changing climate are some of the aspects referred to in the ecological plan (Lund Municipality, 2021). The mitigation efforts, involving the mapping of areas with potential for carbon capture and storage, are worth mentioning here. For example, the upcoming comprehensive plan maps areas with organic-rich soils, which are significant sources of biogenic CO₂ emissions. Raising water levels in areas where they have been lowered can help to reduce emissions of strong greenhouse gases (Markensten et al., 2018). The municipality also recently invested in a tool called [Climate Calculator for Early Planning Stages](#), developed by Spacescape, IVL and Uppsala municipality (Interviewee 32, 2024). This tool assesses the suitability of various locations for development, which is important for estimating future climate impacts.

Regarding incentives for stakeholders to implement carbon-friendly measures in the land use sector, the municipality's decision to adopt compact urban forms with high densification is economically very attractive to developers, as maximisation of land use enables them to generate higher profits (Interviewee 32, 2024). Dense population structures also facilitate sustainable mobility and efficient resource utilisation. Nevertheless, densification should be implemented with caution and care to preserve, strengthen and develop green areas, which are fundamental not only for recreation but also for counteracting the effects of climate change, such as heavy precipitation, increasing heat waves and droughts (Lund Municipality, 2024e).

Buildings and construction sector

As outlined in the climate plan, emissions from the construction sector must be halved by 2025 and reach net zero in 2030. To achieve this goal, Lund is adopting a climate-neutral approach to the construction sector based on circularity principles. It is outlined in four steps guiding the construction and maintenance of municipal buildings:

- In step 1, maintenance is a prerequisite for ensuring the long service life of buildings, with refurbishment and adaptation prioritised over demolition
- Step 2 encourages the re-use of materials in facades or frames, indoor environments and public spaces, as well as recycling of excavated soil to avoid extraction of virgin materials
- Step 3 recommends the selection of renewable, recycled and low-impact materials
- Step 4 recommends the rational use of climate-harming materials only where strictly needed and in appropriate quantities. (Lund Municipality, 2023b)

The concept of circular buildings includes efficient use through multifunctionality. For example, schools are planned or renovated in such a way that other stakeholders can access parts of the building on evenings or weekends for other purposes. This reduces the need for the municipality to construct new buildings. Similarly, densification is pursued by extending existing structures (adding new floors to existing buildings) or converting them.

Cooperation between departments and dialogue with the buildings sector, especially with companies active in the region, have been key to integrating circular practices into building and planning. The lack of legal means to regulate the actions of the private sector is, to a considerable extent, overcome through the [LFM30](#) partnership, a network of stakeholders committed to making Malmö's construction, civil engineering and management sector climate-neutral by 2030. This network provides comprehensive and ambitious methodologies for estimating the emissions of the buildings sector, taking into account the entire value chain (e.g. from the manufacturing of materials and products to the operation and management of properties) and going beyond the climate declaration guidelines (Boverket, 2023) (Interviewee 30, 2024). The LFM30 framework is used by the municipality for calculating buildings' climate emissions (LFM30, 2023)

The municipality estimates emissions not only for new buildings but also for large refurbishment and renovation projects. Furthermore, through detailed planning, it is possible to compare emissions from the adoption of different solutions (such as preservation of existing buildings in new developments), providing a strong basis for decision-making that accounts for climate benefits.

Lund also strives to promote the use of fossil-fuel-free machinery to reduce emissions from the construction sector. The municipality owns electric machinery, reuses concrete for road construction and engages in dialogue with the private sector to discuss opportunities for accelerating the transition. For example, discussion with a logistics company led to the installation of a faster recharging station on the construction site, optimising the transport of materials and facilitating the use of electric vehicles (Interviewee 30, 2024).

Regarding energy efficiency, Lund has been active in renovating municipally owned housing. Indeed, the municipality owns approximately 20% of rental housing and is therefore well-positioned to drive refurbishment of the existing building stock. Furthermore, the municipality is responsible for the production of approximately 300 apartments per year (Interviewee 30, 2024). For example, LKF renovated houses built in 1969-1972 in Havamal and several stakeholders collaborated on the energy-efficiency renovation of the Linero^[35] neighbourhood, which was constructed in the 1970s. Under the green bonds scheme (Sustainalytics, 2024), the municipality is likely to obtain support for financing the acquisition, construction and renovation of buildings or for financing energy efficiency upgrades that satisfy particular criteria (e.g. renovations of buildings that result in a reduction of at least 30% in primary energy demand (PED); new residential buildings with PED at least 20% lower than the level required by BBR; energy-efficient doors, windows, light sources and LED lighting) (Lund Municipality, 2024c). The municipality is also integrating data from Boverket on energy declarations of the buildings as digital information, which will soon be used to inform planning decisions accounting for energy efficiency (Interviewee 30, 2024).

The municipality provides energy and climate advice free of charge to households, associations and SMS enterprises to reduce energy use and increase the share of renewable energy (e.g. installation of solar panels, which can assist in reducing costs and the climate impact (Lund Municipality, 2024a).

35. [A climate-neutral Lund](#)

BOX 14. BEST PRACTICE. BUILDINGS SECTOR, LUND

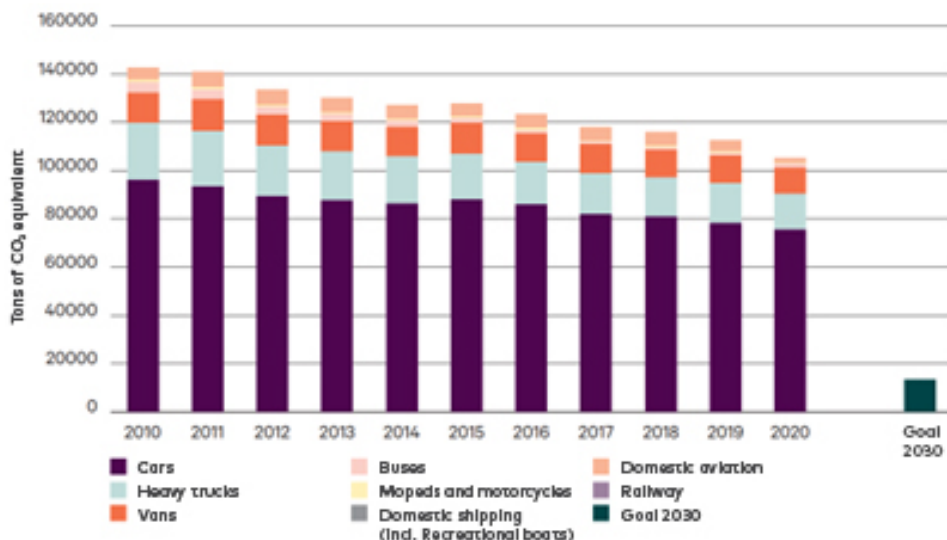
Lund Municipality Real Estate Company (LKF) is leading the construction industry towards sustainability, a journey that began with the financing of Xplorion, an innovative residential building located in Brunnshög district. The building serves as a living lab, showcasing climate-smart solutions for tenants' everyday lives (e.g. car-free living, car and bike sharing, energy self-sufficiency through solar energy, layout flexibility in apartments, reduced use of construction materials) and was named Building of the Year 2021 by the construction industry and Climate-Smart Housing of the Year by Public Housing Sweden.

In the current residential development, "Levla", which is set for occupancy in 2026, 61 apartments and six terrace houses are under construction. Some of the apartments are built with timber while others are constructed using climate-improved concrete that does not emit carbon and removes GHG from the atmosphere. The six terrace houses will feature recycled bricks, windows, doors, sanitary porcelain and floors, showcasing circularity and sustainability in the construction industry, which is responsible for 39% of carbon emissions. The limited number of parking spaces (only 35) and the use of the old manor house with cultural-historical value, as well as trees and nature being at the centre of the block, are further aspects that reinforce the commitment to sustainability and circularity.

Transport and mobility sector

Transport is responsible for 50% of climate emissions in Lund, making it the largest emission source. Compared with the sector's emissions across Sweden, where transport accounts for approximately one-third of total emissions, this share is significant and urgently needs to be decreased if Lund aims to achieve the goal of becoming climate-neutral by 2030. In fact, by 2030, transport emissions need to drop by 90% compared with the levels recorded in 2010 and there is a high risk that this goal will not be met (Lund Municipality, 2023). As shown in Figure 19, emissions have decreased but not sufficiently and passenger cars are responsible for the highest levels of CO₂ emissions in the sector.

FIGURE 18. TRANSPORT EMISSIONS IN LUND



Source: Lund Municipality, 2023

Despite having twice as many electric vehicles as the national average of 4%, the pace of electrification is slow. Considering the lifetime of a vehicle, many fossil fuel-driven vehicles are likely to still be in use by 2030. In addition, the number of kilometres travelled by bike per inhabitant has slightly decreased, so other strategies must be implemented to accelerate decarbonisation of the sector (Lund Municipality, 2023a).

The traffic strategy LundaMats has been providing approaches and tactics that rely on the connection between urban planning and traffic since 1999. Now in its third version, this document outlines six focus areas to support a sustainable transport system in Lund: (1) Development of the villages; (2) A vibrant city centre; (3) Business transport; (4) Regional commuting; (5) A growing Lund; and (6) Innovative Lund campaigns. (Lund Municipality, 2014). These focus areas address various aspects of transport planning.

Calculations of GHG emissions from the transport sector are performed at a higher level. The department specifically responsible for transport uses various indicators (e.g. number of users of different modes of transport) and the climate view framework^[36] (Shalit et al., 2023) to simulate the GHG emissions resulting from implementation of different policy options (e.g. cycle highways) as a tool to inform strategies on achieving the climate goals in the transport sector.

Climate goals are perceived as aligned with social and economic goals. For example, use of public transport fosters social interactions and is cheaper than using private vehicles. Cycling and walking bring health benefits, which in turn can reduce the strain on the healthcare system's budget.

36. The core of the methodology is outcome-based. It shows that reaching a particular outcome requires identification of specific levers for change, which are influenced by city attributes and modified by interventions resulting from formal decisions.

CASE: VÄXJÖ



Växjö. Photo: Anders Bergön

Background information

Territorially, Växjö is the second largest municipality and the economic and cultural centre of the Kronoberg region, which encompasses seven other municipalities in southern Sweden. The slightly hilly geography with dense forests and almost 150 inland lakes make up the unique landscape. The area of 1,914 km², of which 1,665 is land and 249 water, includes 12 urban areas with a total population of 97,574 inhabitants, resulting in a population density of 51 inhabitants/km².

The largest city is Växjö, which occupies an area of 38 km² and is home to over 72,200 inhabitants (around 74% of the total population in the municipality and about half of the population of the Kronoberg region), with the remaining 26% residents living in the other 11 urban cores. The city anticipates 30,000 new inhabitants by 2030 (Växjö Municipality, 2024).

Växjö boasts a thriving business community with a strong presence in the IT, forestry and wood industries. Proximity to Linnaeus University fosters collaboration, innovation and development, particularly at Växjö Linnæus Science Park. The

university, with 36,000 students, is a hub for national and international research, bolstered by a SEK 950 million donation from the Kamprad family and Inter IKEA. The establishment of the Information Engineering Centre (IEC) further solidifies Växjö's position as a leading IT region, offering businesses and researchers valuable networking and research opportunities (Växjö Municipality, 2022).

Strategic level: municipal goals and policies

Växjö has a long history of sustainable action. Restoration of its heavily polluted lakes in the 1970s and the transition to biomass district heating in 1980 are often regarded as early commitments to sustainability. The vision of becoming fossil fuel-free was defined back in 1996, prompted by climate concerns raised at the Rio Conference in 1992. In line with the conference outcomes on the role of the local level in driving sustainability, Växjö politicians sought and gained assistance from the Swedish Society for Nature Conservation on how to address sustainability at the local level. Between 1995 and 1998, meetings and discussions among researchers, local politicians, civil servants, the private sector and civil society were paramount to embedding the sustainability perspective in local governance. These efforts were internationally recognised when Växjö received the European Green Leaf Award 2018.

The "Sustainable Växjö Programme 2030" (Växjö Municipality, 2019) is the overarching document that describes what a sustainable Växjö 2030 means by outlining five overall target images, nine challenges and three principles for implementation. The target images represent the vision of becoming a municipality that is (1) climate- and environmentally smart; (2) safe and trustworthy; (3) fair and responsible; (4) growing and inclusive; (5) green and healthy. Each of these images recognises more than one challenge related to (1) biodiversity and ecosystems; (2) transport and travelling; (3) urban planning and community building; (4) consumption and production; (5) knowledge, lifelong learning and education; (6) labour market and business life; (7) health and well-being; (8) equity and equality and (9) safety and community. As each target image addresses several challenges, the document recognises the interdependence between nature and the environment, society and individuals. It emphasises the indivisibility of Agenda 2030 and the need to involve and cooperate with all stakeholders to transition to a sustainable future.

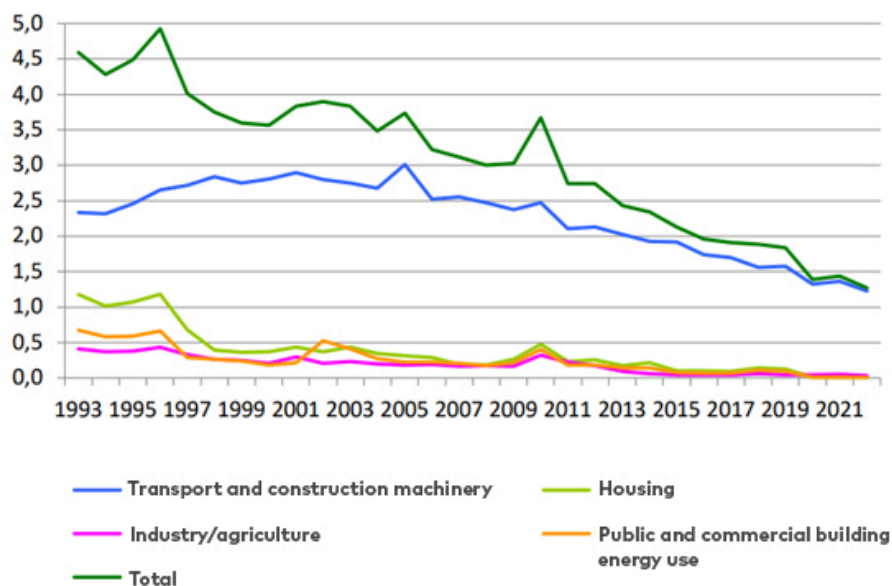
The principles underlying this document are (1) the transition to a sustainable society is implemented, developed and followed up in the best possible way by being an integrated part of the existing management process and control model; (2) everyone contributes to and works towards all target images and challenges in different ways and (3) Sustainable Växjö 2030 is the shared responsibility of everyone who lives and works in Växjö municipality.

The "Sustainable Växjö Programme 2030" serves as the basis for developing other sector-specific steering plans (e.g. energy, transport, waste management, climate

adaptation, use of wood) and other plans that contribute to pursuit of climate neutrality in various ways. Accordingly, the municipality does not have a standalone climate action plan. Instead, the Climate Contract (Viable Cities & Växjö Municipality, 2023), developed in partnership with Viable Cities, supports the development of a climate investment plan that sets out specific actions to achieve the long-term objectives of the sustainability programme in diverse areas (energy, transport).

Växjö's early commitment to sustainability is reflected in its continuous improvement in decreasing CO₂ emissions across sectors (see Figure 1). Compared with levels from 1993, total CO₂ emissions have decreased by 62% and the per capita figure has fallen by 72%. Between 2021 and 2022, the municipality achieved a reduction of approximately 14,260 tonnes or 10%, driven in particular by the obligation to reduce emissions from the transport sector (Växjö Municipality, 2023). These data show that the municipality has the capacity to drive progress towards climate neutrality.

FIGURE 19. VÄXJÖ'S CO₂ EMISSIONS PER CAPITA (VIALE CITIES & VÄXJÖ MUNICIPALITY, 2023)



In terms of governance, sustainability efforts are integrated into the ordinary work and decision-making processes of the municipality through a monitoring system that includes 50 indicators across a range of areas (such as waste management and transport). These indicators are assessed annually against the target images in the sustainability programme. The 15 budget goals have separate indicators, which

sometimes overlap with the sustainability indicators covering several topics (such as education, environmental goods and planning). The annual monitoring of these indicators, along with comparison of performance with cities of a similar size, provides a structured approach to advise politicians on prioritisation of investments. Nevertheless, despite being easy to communicate, this system has flaws as the annual comparison does not include trends over several years, which may lead to misinterpretations. For example, the indicator for bus travel seems to show very strong performance, but that is largely due to the significant drop in use that occurred during the pandemic (Interviewee 34, 2024).

On the other hand, the variety of indicators (such as air quality, gender equality and unemployment) within the monitoring systems allows for a reasonable evaluation of trade-offs between environmental, social and economic goals (Interviewee 34, 2024). Despite integration across sectors being facilitated by the monitoring system, some challenges still remain as every department has its own set of issues to address and priorities to place on the political agenda (Interviewee 34, 2024).

Regarding financing of the transition, taxpayer resources can be used to implement some inexpensive measures such as cycle paths. Furthermore, loans are used for larger climate investments. Unlike most municipalities in Europe, Swedish municipalities have easy access to loans due to their strong financial returns and stability. Nevertheless, political will is needed to secure resources as well as effective administration to ensure sustainable financial management. Lastly, Växjö has been successful in obtaining national and European funds, which, though modest, have been helpful for building know-how (e.g. building knowledge on passive housing) and facilitating exchange of experiences with other municipalities.

Land use sector

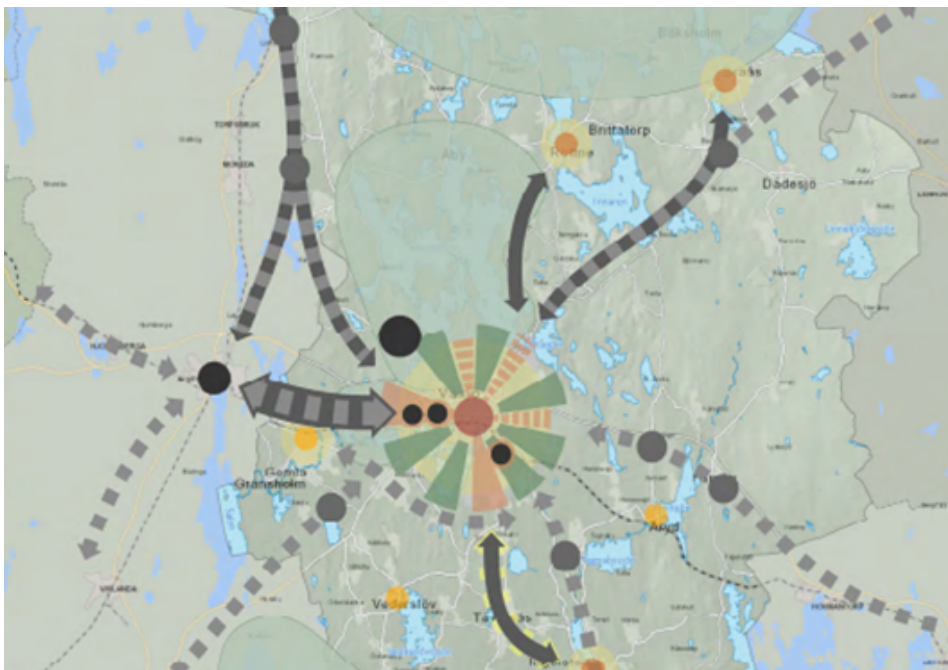
Växjö is a large municipality in geographical terms, with 25% of residents living in the countryside or in the smaller villages and the remaining population residing in Växjö city. The urban-rural character of the municipality reflects the polycentric regional structure. As shown in Figure 2, the "sun shape" spatial model consists of green fingers that converge towards the centre of Växjö city. These fingers also delineate five main functional areas (light pink shapes), with two of them having a regional function (fully filled light pink) as they link the city with two other important settlements, Gemla and Ingelstad, in the municipality. The other three functional areas (dashed light pink) host primary urban functions and support the highest levels of densification in the areas where the city's tallest buildings are situated.

This spatial model is influenced by the presence of lakes and forests, which limit the local administration in pursuing a compact urban form (Interviewee 35, 2024). The green and blue wedges that reach the city centre, in addition to creating easily accessible recreational areas for the population, also contribute to climate

adaptation (stormwater management), noise reduction and biological diversity (Växjö Municipality, 2021). Nevertheless, the green and blue infrastructure limits densification in the urban core, widening the urban boundaries and resulting in a spatial growth pattern that follows the road system. However, densification along axes and brownfield development are strategies used to reinforce public transport, enable the easy use of bikes and reduce emissions from transport, while limiting green land development (Interviewee 34, 2024). Mixed-use developments also serve to shorten distances for residents.

Upward densification in the city centre is limited by cultural heritage considerations and mostly takes place in specific areas in the southern centre of Växjö city, particularly in Telestads, where Linnaeus University is located, in Bäckaslöv, in Teleborg and in the northern part of Växjö city close to the airport in Nylanda. Despite encouraging single-family houses in the neighbouring settlements of Gemla and Ingelstad, the city of Växjö also permits low-density housing, with smaller plots for single-family homes available, as a strategy to provide a diverse urban environment that appeals to people with varying needs and expectations (Interviewee 35, 2024).

FIGURE 20. VÄXJÖ'S SPATIAL DEVELOPMENT MODEL



Source: Växjö Municipality, (2021)

In terms of incentives and instruments to drive urban development in a climate-friendly direction, the public ownership of land is a major advantage. Swedish legislation (Swedish Parliament, 2014) allows municipalities to set specific requirements and guidelines for land allocation agreements based on their targets. This enables the co-design of urban developments with various public and private actors, as the requirements are translated into the criteria for selecting developers to whom land is allocated for housing development.

Buildings and construction sector

Increasing energy efficiency and using renewable sources are the main strategies for reducing building-related GHG emissions. A building's climate footprint is largely determined by its total energy consumption, which depends on several factors such as climate, building envelope, building services and energy system, operation and maintenance, occupants' activities and behaviour and indoor environmental quality.

In Växjö, energy systems that supply the housing sector are approaching fossil-fuel-free, with a 96% share of renewables. However, to sustain the provision of green energy in the future, energy use must be reduced, especially electricity use. In 2022, CO₂ emissions from the housing sector totalled 358 tonnes, 80% of which resulted from electricity use and 20% from district heating (Viable Cities & Växjö Municipality, 2023).

The overall target of a 30% reduction in energy use by 2030 will require significant efforts to be made by the buildings sector. The wood house building strategy is one of the key initiatives to achieve the goal of fossil-free Växjö 2030 through the buildings sector. Compared with concrete and steel, timber construction can lessen carbon emissions substantially, as the production of building materials accounts for one-third of emissions from the construction sector, which is responsible for 40% of global emissions (Giacometti & Salonen, 2023). Wood is a non-fossil and renewable material that enables circularity and also binds carbon dioxide during the lifetime of the building (Växjö Municipality, 2018).

This strategy reflects the municipality's tradition of building with wood, which has developed since 1995, when legislation allowed wood-frame buildings with more than two floors. At that time, the city was a pioneer in showcasing the potential of this technology with the first five-storey wood-frame building in Sweden. Prompted by new legislation in 2004 that encouraged wood construction in Sweden (Regeringskansliet, 2004), Växjö formulated a wood-building strategy titled "More Wood in Construction 2005" (Växjö Municipality, 2005), followed by "Växjö – the modern wood city 2013" (Växjö Municipality, 2013).

The latest document set the target of 25% of new municipal buildings being constructed with timber. In the updated version of the strategy (Växjö Municipality, 2018), this target became more ambitious, with the share of municipal wood-based

buildings being increased to 50% by 2020 and the additional requirement that the new timber constructions need to include some form of climate impact reporting. (Växjö Municipality, 2018). In 2022, the goal was reached, with 50% of public buildings having wood frames^[37] (Interviewee 36, 2024). In addition, the municipality recently began to use Life Cycle Assessment (LCA)^[38] to estimate the embodied carbon in wood buildings. The use of LCA paves the way for fulfilling the aim of prioritising construction with the minimum climate impact throughout the construction process from 2025 (Växjö Municipality, 2018).

Regarding energy efficiency of the existing building stock, the Växjö energy plan (*Energiplan för Växjö kommun*, 2021) outlines refurbishment and property management as important pathways to reduce energy use and thereby curb emissions from the buildings sector (Viable Cities & Växjö Municipality, 2023). Innovative solutions for lessening energy consumption can be readily implemented in public buildings, while private buildings are subject to national legislation, with energy declarations being the most common instrument.

Ownership of a significant share of public housing is also advantageous in terms of refurbishments. (Viable Cities & Växjö Municipality, 2023). In 2021, Växjöbostäder began the renovation of 220 apartments in the Äpplet and Päronet blocks, located west of Växjö (Appelgren, 2021). Limitations arise with respect to lowering energy use in privately owned buildings. In such cases, the municipality relies on its sustainability programme (Växjö Municipality, 2019) and national legislation. Engagement in European projects is also beneficial; the municipality's participation in the READY project, which drove the refurbishment of 376 apartments and the City Hall building, is a case in point.

It is worth noting that the use of renewable energy in buildings has been incentivised at the national level, with legislation providing an exemption from building permits for installation of solar panels in single- and multi-family houses since 2020. In 2023, the share of renewable energy used in the residential sector in Växjö was 97.7%. The remaining 2.3% is from oil (0.5%) and nuclear energy (1.8%), produced outside the borders of Växjö.

With respect to incentives at the local level, the municipality awards an annual wood building prize, thereby encouraging engagement of the private sector. The municipality also enjoyed European^[39] and national support through its involvement in construction projects. In 2009, participation in an EU project on passive houses, despite offering limited financial support, was crucial for developing competencies that are currently fundamental for the construction of energy-efficient buildings in

37. The proportion of wood buildings is measured as a changing trend and is expected to increase over the years. Therefore, the statistics are compiled for each year's wood construction and aggregated over a period.

38. This method considers the entire environmental footprint of a building – from cradle to grave – from raw material extraction and production to disposal.

39. [SESAC](#) (Sustainable Energy Systems in Advanced Cities 2005-2011) and [READY](#).

the municipality (Interviewee 34, 2024).

Besides supporting wood construction for public buildings, the municipality actively uses land allocation and land development agreements to incentivise uptake of the technology by the private sector. Land allocation and development agreements have been an important instrument for the development of the Välle Broar neighbourhood, which showcases different phases of timber construction (see Text box 1).

BOX 15. BEST PRACTICE. BUILDINGS SECTOR, VÄXJÖ. WOOD CONSTRUCTION IN VÄLLE BROAR

Situated between Växjö city centre and the Linnaeus University campus, Välle Broar is an innovative area highlighting the municipality's leadership in modern wood construction. The multi-storey wood buildings showcase the architectural and design potential of this technology, driven by an innovative land allocation competition that encourages private sector adoption. Building on this success, the municipality has developed the Torparängen wood building project, consisting of 300 homes, including villas, rental apartments and tenant-owned apartments. In this project, the municipality collaborated with Linnaeus University, VKAB and local developers to study the entire process from planning to completion.

Transport and mobility sector

Transport and machinery account for 97% of Växjö's fossil carbon emissions and almost 60% of greenhouse gas emissions. In 2022, the amount of CO₂ emissions was 128,138 tonnes, which is the second lowest amount recorded to date. The steady decrease in emissions corresponds to the growing use of renewables such as biogas, which are produced locally from sewage sludge and food waste.

Nevertheless, to achieve climate neutrality by 2030, the most transformative work needs to be done within the transport sector. Efforts to lessen the environmental impact of transport are strongly linked to citizens' mobility needs, as approximately 54% of emissions are from passenger vehicles, 18% from heavy trucks and buses, 15% from work machines, 9% from light trucks and other vehicles and 4% from airplanes that are re-fuelled at the airport.

Decreasing private vehicle trips is a challenging prospect, considering that the municipality includes rural settlements. Nevertheless, the distance travelled by car per inhabitant has been declining (Viable Cities & Växjö Municipality, 2023). The

number of trips by bus has been strongly affected by COVID-19 and has not yet reached levels similar to before the pandemic despite a steady increase from 2011 to 2019. On the other hand, the number of bike users in the municipality is increasing.

Transport and mobility planning relies on emission data as well as regional statistics that provide information on public transport, travel surveys covering users' preferences, modes of transport used for trips, travel destinations and strategically placed meters that inform about the number of vehicles circulating in the city (Interviewee 37, 2024).

The municipality employs a three-step approach to enhance sustainable mobility: (1) ensuring good bicycle and public transport infrastructure, (2) informing people and (3) changing behaviour (SWEKO, 2023). These steps are supported by measures that prioritise bicycles and public transport while restricting accessibility and discouraging the use of private vehicles (narrow lanes, increasing parking fees, temporary car-free areas). The municipality implements campaigns to change the behaviour of citizens and businesses. In addition, the municipality has established partnerships with schools and associations. For example, collaboration with schools has led to the adoption of measures that promote safety (e.g. designated pick-up areas for kids).

Challenges and opportunities: a multilevel governance perspective

Swedish municipalities have substantial autonomy in spatial planning. Within the framework of the Planning and Building Act and the Environmental Code they manage land use through two key instruments: (1) the municipal comprehensive plan (*översiktsplan*), which provides non-binding strategic guidance aligned with national and regional goals and (2) the detailed development plan (*detaljplan*), which is legally binding (Boverket, 2013).

In the building sector, Sweden adheres to the EU Energy Performance in Buildings Directive (European Parliament, 2018), requiring long-term strategies for energy-efficient renovations. National energy efficiency standards are set by Boverket, which regulates primary energy thresholds (Boverket, 2019) and mandates energy declarations for large public and leased buildings to track consumption and improve performance (Boverket, 2016; Swedish Parliament, 2006).

In the transport sector, Trafikverket oversees long-term transport planning. It is revised in each government term (Trafikverket, 2018), with the current plan covering 2022–2033. In line with national directives, regional councils develop regional transport plans, while municipalities are responsible for local roads, harbours, airports, stations and land use planning. However, municipalities have limited authority over transport infrastructure, including cycle path expansions linking various areas.

Policy capacity: vertical and horizontal governance tensions

Land use sector

Vertical governance tensions

Coordination challenges between climate objectives and governance levels are evident in both Växjö and Lund, though their urban conditions shape these dynamics differently. In Lund, the compact structure of the city limits the potential for densification. As a result, growth pressures have led to the expansion of urban areas into agricultural land (Interviewee 32, 2024). This sprawl trend creates a direct conflict between the environmental law, which prioritises the protection of farmland, and municipal autonomy in urban planning, highlighting the need for better alignment between the Swedish Environmental Code and the Planning and Building Act.

Other national policies also influence the conversion of agricultural land into urban areas. For example, the central government's decision to locate the European Spallation Source (ESS)^[40] in Lund has increased development pressures, complicating efforts to balance urban growth with carbon neutrality. Additionally, brownfield redevelopments in Lund have raised concerns, as their dispersed locations could undermine urban compactness (Interviewee 32, 2024). Alternative strategies, such as infill development, subdivided ownership of brownfield areas and mobility analysis, are among alternatives that have been studied to better understand how to balance these competing objectives.

By contrast, Växjö's large territorial boundaries and lower density provide flexibility for infill development while preserving green areas. However, historical preservation – designed to protect the city's cultural heritage – limits upward densification, creating tensions with climate-focused urban strategies that emphasise higher-density development (Interviewee 35, 2024). Furthermore, national legislation places sole responsibility for stormwater management on municipalities, restricting collaboration with private landowners for more effective solutions to the challenges posed by increased precipitation (Interviewee 35, 2024).

Efforts to influence national policy offer one avenue for overcoming these barriers. Indeed, Växjö's participation in the Swedish municipalities' association has proven to be an effective platform for lobbying for national policies that support climate neutrality at the local level (Interviewee 34, 2024). On the other hand, lack of

40. The European Spallation Source (ESS) is a multi-disciplinary research facility that uses high-energy protons to create neutrons. It is a pan-European project with 13 European nations as members, including the host nations Sweden and Denmark. Some 2,000-3,000 guest researchers are to carry out experiments at ESS each year.

regional planning coordination with neighbouring municipalities is seen as hindering shared infrastructure development and integrated approaches to housing, transport and mobility in Lund, resulting in inefficiencies.

Horizontal governance tensions

One of the greatest challenges in Lund is the pressure to grow while achieving carbon neutrality. While densification is seen as climate-friendly, it reduces green spaces and gives rise to issues like pollution and noise (Interviewee 32, 2024). Land use conflicts can arise when deciding whether to develop new projects on agricultural land or recreational areas. Similarly, afforestation projects near the city spark land use debates, as they also compete with agricultural land (Interviewee 32, 2024).

In Växjö, land use planning faces challenges due to stakeholder disagreements and social trade-offs, which have slowed the implementation of climate strategies (Interviewee 35, 2024). Moreover, entrenched public sector practices (path dependencies) and the time required to legitimise transformative urban policies further slow climate adaptation (Interviewee 35, 2024). Lastly, a municipal official also noted that the broad scope of Växjö's sustainability and climate neutrality agenda has made it more difficult to focus efforts on specific priorities (Interviewee 35, 2024).

(Interviewee 35, 2024; Växjö Municipality, 2021)

Buildings and construction sector

Vertical governance

Misalignment between national and local policies remains one of the greatest obstacles in the buildings and construction sector across the analysed Swedish municipalities. In both Växjö and Lund, improving the energy performance of buildings is a major challenge, as municipalities cannot directly influence the refurbishment of privately owned housing.

In Växjö refurbishment and building management are recognised as crucial pathways for lowering energy consumption (Viable Cities and Växjö Municipality, 2023; Energiplan för Växjö kommun, 2021). While energy-saving innovations are relatively easy to implement in public buildings, private sector buildings remain subject to national regulations, with performance certificates serving as the primary policy instrument. Municipal officials expressed scepticism about the effectiveness of energy performance certificates in motivating individual homeowners to adopt efficiency measures (Interviewee 36, 2024), due to the lack of follow-up and enforcement mechanisms as well as their weak impact on property values (Swedish National Audit Office, 2021). Nevertheless, owning a significant share of public housing allows Växjö to implement refurbishment on a large scale (Viable Cities & Växjö Municipality, 2023).

Municipal officials in Växjö also noted that national taxation policies on renewable energy sources in buildings disproportionately burden local governments. Rather than being calculated based on the energy output of photovoltaic (PV) systems, these taxes are levied on the owner, significantly increasing costs for municipal companies installing solar panels on public buildings (Interviewee 34, 2024). Additionally, the discontinuation of support for energy efficiency improvements of at least 20% in multi-dwelling buildings consuming over 100 kWh/m² per year has further hampered efforts to reduce CO₂ emissions from the buildings sector (Energimyndigheten, 2021), (2021).

Beyond promoting wood construction in public buildings, Växjö actively uses land allocation and land development agreements to incentivise private sector adoption of timber technology. However, municipal officials noted a misalignment between European climate policy and Växjö's climate strategy. Specifically, European legislation questions wood's sustainability as an energy source. These regulations fail to account for Swedish and Finnish forest management practices, where reforestation is integral and use of wood residues for energy production is considered a circular practice (Interviewee 34, 2024). Ultimately, these regulations shape definitions of sustainability and, by doing so, steer the allocation of financial resources to specific solutions.

In Lund, the regulatory framework outlined in Boverket's Building Regulations raises concerns (Boverket, 2019). While these regulations safeguard the quality of living environments, they may be restrictive when applied to the renovation of existing buildings (Interviewee 30, 2024). At the same time, the current CO₂/m² targets for new buildings were considered too lenient and insufficiently ambitious to drive meaningful reductions in the construction sector. The lack of legal means to regulate the actions of the private sector is, however, partly mitigated by LFM30, a partnership-driven initiative that brings together actors from Malmö's construction, civil engineering and property management sectors. This network has played a pivotal role in decarbonising the construction sector by developing robust methodologies to steer the industry towards higher environmental standards in buildings.

Horizontal governance tensions

Various questions and perspectives arise when transitioning to climate-friendly buildings. In Lund, one of the greatest challenges for cross-sectoral governance is the often limited time available to explore different solutions while adhering to tight schedules, as well as the need to adjust procurement routines to acquire the best materials and/or services. (Interviewee 30, 2024). Other obstacles are the need for further resources (e.g. finances and expertise) to raise awareness, build consensus and comply with the requirements (e.g. climate calculations) to fully implement administrative routines that support the sector's decarbonisation (Interviewee 30,

2024). However, the cooperation between different departments in Lund and dialogue with the buildings sector, especially with companies active in the region, has been instrumental in anchoring circular practices in building and planning.

Transport and mobility sector

Vertical governance tensions

Despite advances in curbing emissions, the transport sector is still the largest emitter in both municipalities, requiring drastic measures to meet the 2030 targets. A major governance challenge is the misalignment of transport planning priorities across different levels of government and limitations in local autonomy (Interviewee 33, 2024). Lund officials point out that Trafikverket (the Swedish Transport Administration) prioritises national objectives while overlooking regional commuting needs, making it difficult for municipalities to implement coherent mobility strategies (Interviewee 33, 2024).

In Växjö, the city faces delays in improving pedestrian and cycling infrastructure due to Trafikverket's control over key roadways. For example, a planned pedestrian and bicycle path between Växjö and Gemla (13 km southeast of Växjö) has yet to be realised because it falls under Trafikverket's jurisdiction rather than that of the municipality. Trafikverket's low budget (around 1%) for bicycle lane construction is also noted as a shortcoming in improving Växjö's sustainable mobility. Additionally, a lack of financial support for awareness campaigns limits the promotion of sustainable travel behaviours.

Both municipalities express concern over Sweden's relaxation of biofuel blending regulations, which could increase CO₂ emissions by 16% compared to 2022 levels (Interviewee 33, 2024; Interviewee 34, 2024). Växjö also warns that national policies discouraging electric vehicle production undermine local decarbonisation efforts. With Sweden favouring a CO₂-intensive economy, Växjö perceives EU-level policies such as Fit for 55 (European Council, 2024) as the most reliable driving force for national governments to make progress on climate action (Interviewee 37, 2024).

Ultimately, a lack of political will is seen as the greatest barrier to implementing the necessary changes. In Växjö, officials emphasise that transport directly affects people's daily lives, making politicians reluctant to adopt bold measures that could significantly cut emissions but may meet with public resistance (Interviewee 37, 2024). Lund officials also noted that the effect and response to transport policies are usually slower than in other sectors (e.g. energy), where the government can swiftly influence behaviours. Dependence on private cars, the force of habit and the passive attitude to climate issues create additional hurdles in reducing fossil-fuel-based transport (Interviewee 33, 2024).

Horizontal governance tensions

Lund has long maintained a well-integrated governance approach to transport,

with policies anchored across various municipal departments. The LundaMaTs strategy (since 1999) has ensured continuity across political cycles, allowing for long-term planning, implementation and management of mobility initiatives. As a university city, Lund has a large population of young people, who are more open to behavioural change (Interviewee 33, 2024). Collaboration with academia and businesses has also driven transport innovation in the municipality. Nevertheless, sustainable transport alternatives are not yet sufficiently attractive to replace private car use on a large scale. Making transport data more visible to increase public awareness and urgency is a challenge. Additionally, a lack of strong advocates and champions in the transport system limits momentum for decarbonisation (Interviewee 33, 2024).

Växjö also benefits from strong cooperation between internal departments, but municipal officials lack political support to implement necessary emission reduction measures in the transport sector. In both cities, fear of public backlash and re-election concerns have led to hesitancy at the political level, delaying critical policy changes.

Institutional capacity: knowledge, relational resources and mobilisation capacity.

Lund and Växjö demonstrate strong institutional capacity in climate governance, yet knowledge gaps, coordination challenges and political inertia slow down the transition to carbon neutrality. This section explores the municipalities' knowledge capacity, relational resources and mobilisation efforts.

Knowledge capacity

Both municipalities have established expertise in climate-related governance but continue to face knowledge gaps in certain areas. In land use planning, Lund has advanced competencies in water management, climate mitigation and circular economy strategies. The municipality has invested in tools such as the Climate Calculator for Early Planning Stages, which assesses the suitability of different locations for development based on climate impact. However, despite these advancements, there is a recognised need for further knowledge on the carbon sink potential of soils and green spaces as well as strategies to counteract the increasing impact of extreme precipitation.

Växjö, by contrast, has a long history of climate performance monitoring, which provides a solid foundation for identifying priority areas and emission reduction strategies. The city actively shares experiences with other Swedish municipalities through the Climate Municipalities Association, which has been instrumental in refining its climate governance approach. Nevertheless, it still lacks methodologies to estimate emissions from land consumption and the built environment, relying instead on a learning-by-doing approach (Interviewee 34, 2024).

In the buildings sector, Växjö has positioned itself as a leader in wood construction, benefiting from Sweden's early adoption of cross-laminated timber (CLT) technology. The local market for CLT production has expanded significantly, creating favourable conditions for further integration of timber construction into the city's climate strategy. However, despite this expertise, the municipality recognises the need to strengthen its capacity in climate calculations and emission declarations to enable accurate comparisons of building materials and life cycle impacts.

Lund, on the other hand, has focused on circular construction and material reuse, working closely with the LFM30 network to establish ambitious methodologies for assessing emissions across the entire construction value chain. The municipality is optimistic about the growing interest in circular buildings, yet uncertainties remain regarding the quality and risks of using recycled materials as well as the economic trade-offs between new construction and renovation. Additionally, knowledge gaps persist in balancing energy efficiency with material resource use, making it difficult to determine the most climate-friendly building choices.

In the transport sector, Lund has developed extensive knowledge in sustainable mobility through long-standing cooperation with academia, external consultants and European-funded projects. Programmes such as BASE – Brunnshög automated sustainable electromobility – have contributed to advancing the city's transport policies. However, despite this expertise, Lund lacks a clear roadmap for meeting its 2030 climate targets. A draft roadmap has been developed, but due to the politically sensitive nature of its proposed measures, it has not yet been formally presented to decision-makers.

Växjö, meanwhile, has turned to alternative methods to gather insights on mobility patterns, including public surveys that examine attitudes towards traffic safety, pollution and transport behaviour. The municipality has successfully challenged the assumption that car dependency is essential for economic vitality by demonstrating that cyclists and pedestrians contribute nearly as much to local businesses as car owners, despite taking up significantly less space. This data-driven approach has strengthened Växjö's argument for prioritising sustainable transport infrastructure.

Relational Resources

Both municipalities actively engage in national, European and international networks that enhance their institutional capacity. In the field of land use and climate governance, Växjö is heavily engaged in multiple climate action networks, including the Global and European Covenant of Mayors, ICLEI and Energy Cities. The municipality also participates in Sustainable Småland, a regional network that fosters collaboration between local businesses, academia and government institutions. These partnerships provide Växjö with access to best practices and external expertise, strengthening its ability to influence policy at the national and EU levels.

Similarly, as a member of the European 100 Climate-Neutral Cities initiative, Lund has positioned itself as a key player in international climate governance. Through its involvement in the NetZero Cities EU Programme, the municipality collaborates with Louven to address governance challenges related to cross-sectoral coordination and financial partnerships. Additionally, Lund received recognition from WWF as Climate City of the Year 2022, further cementing its role as a frontrunner in municipal climate action.

In the buildings sector, Växjö has fostered strong public-private partnerships to advance timber construction. Collaborations with Linnaeus University, the forestry group Södra and national organisations such as CBBT and Trädstad Sverige have helped the municipality develop a comprehensive wood construction strategy. The establishment of a triple-helix alliance between the public sector, academia and private industry has enabled Växjö to integrate timber technology into municipal planning at multiple levels.

Lund, by contrast, has focused on strengthening internal expertise through partnerships with LFM30, Malmö, Helsingborg and private developers. Informal knowledge sharing between municipal planners has led to the creation of discussion forums on fossil-free construction, further facilitating regional collaboration. The municipality's participation in the Viable Cities network has also allowed it to fund a specialised architect position dedicated to circularity in buildings, which has since been extended with municipal funding.

In the transport sector, Växjö and Lund participate in various networks that promote sustainable mobility. Växjö is a member of Fossil Free Sweden and Svenska Cykelstäder, a network of municipalities committed to advancing cycling infrastructure. Lund maintains long-standing collaboration with Malmö and Helsingborg on regional transport planning and has established regular stakeholder meetings to discuss mobility challenges. The municipality's LundaMaTs strategy, established in 1999, has ensured continuity in its transport policies across political cycles, making it a key governance tool for long-term mobility planning.

Mobilisation Capacity

Both municipalities have adjusted their administrative structures to strengthen climate governance, but challenges remain in fully mobilising resources and implementing ambitious policies. Since 2019, Lund has consolidated its municipal-owned companies under Lunds Rådhus AB, creating a unified framework for environmental and climate action. The Climate Policy Council, established in 2018, provides independent oversight of municipal emissions, issuing annual reports that assess progress towards climate goals. A recent report warned that to stay on track for 2030 targets, Lund must double its annual emission reductions.

Växjö, despite its smaller municipal administration, has benefited from strong cross-sectoral coordination facilitated by its Sustainability Plan. However,

entrenched public sector practices (path dependencies) continue to slow transformational change and the municipality faces challenges in legitimising bold urban planning decisions.

In the buildings sector, Växjö has assigned responsibility for its wood construction strategy to VKAB, a public company that oversees land sales, development agreements and municipal infrastructure projects prioritising timber. This has provided a mechanism for integrating sustainability into real estate transactions. Lund, on the other hand, has taken a more regulatory approach, embedding circular construction principles into municipal guidelines and requiring developers to adhere to high environmental standards. However, ensuring that all municipal departments are fully engaged in this transition remains a challenge, as interest and expertise vary among civil servants.

In the transport sector, political hesitation remains a significant barrier to implementation.

In Lund, integrating climate considerations into transport planning is still perceived as an additional administrative burden and staffing shortages have slowed policy development. The municipality has drafted a roadmap for transport decarbonisation, but its ambitious measures have yet to be presented to political leaders. Växjö faces similar governance challenges, particularly in its reliance on Trafikverket for road and cycling infrastructure improvements.

Despite strong municipal support for non-fossil mobility, national-level apathy has hindered the expansion of bicycle infrastructure. However, upcoming administrative changes in both municipalities, including the merging of planning and technical departments in Lund and improved coordination in Växjö, are expected to enhance the cities' ability to align transport goals with broader sustainability strategies.



Photo: Unsplash.com

Key reflections and learnings from Sweden

Växjö and Lund face shared challenges in achieving climate neutrality while navigating Sweden's decentralised land use planning system. The cities enjoy autonomy under national laws but must align local goals with broader environmental standards. Both Lund and Växjö strive for climate neutrality through brownfield redevelopment and densification along transit corridors. However, their distinct spatial patterns present different challenges and opportunities.

While Lund's dense urban structure aligns with the 15-minute city model, its density limits its infill options, pushing expansion into agricultural areas – a trade-off between urban growth and environmental preservation. By contrast, Växjö's more dispersed urban form, with more available land, allows for flexible development but restrictions arise from the need to preserve cultural heritage sites, limiting upward densification.

In the transport sector, both municipalities struggle with limited resources and conflicting governance priorities. Trafikverket's national focus restricts funding for local transit initiatives, affecting cycling infrastructure in Växjö and slowing Lund's mobility goals. Additionally, limited political support hampers bold climate policies in the transport sector, as leaders fear backlash from disruptive measures.

In the construction sector, both municipalities prioritise renewable energy and energy-efficient refurbishments but take distinct approaches. Växjö focuses on

wood construction, particularly in public buildings, positioning it as a leader in climate-neutral construction. By contrast, Lund emphasises circular construction practices, collaborating with local companies through the LFM30 network to promote sustainable standards and support private sector decarbonisation. However, national energy mandates limit municipal influence over private sector improvements and high taxes on renewable energy act as barriers.

With respect to funding, Swedish municipalities, unlike most municipalities in Europe, can easily secure loans due to their strong financial returns and stability. Possible solutions include leveraging municipal budgets through instruments like water service charges and green bonds and seeking project funding from national programmes and EU grants. Measures to strengthen society's emergency preparedness and mitigate climate disasters are also sponsored by the government. VINNOVA, Formas and Mistra also play an important role in funding the transition to climate neutrality (Klimatanpassning, 2021).

In addition, Swedish municipalities benefit from the support of Kommuninvest AB, a credit market company driven by Kommuninvest Cooperative Society, a voluntary membership-based organisation of Swedish municipalities and regions with 295 members. The organisation focuses on providing financing for local government sector development, offering secure investment opportunities for investors and serving as a centre of expertise in municipal financial management and long-term sustainability (Kommuninvest, n.d.).

Institutional capacity is strong in both cities, as they leverage local expertise and partnerships to drive carbon-friendly initiatives. Växjö's wood-based strategy involves collaboration with academia and industry to deepen knowledge, while Lund collaborates with regional stakeholders, creating a model of integrative governance. Yet, both cities face resource constraints, particularly in time and funding, that limit their climate ambitions. Their approaches – Växjö's focus on timber technology and Lund's circular practices – showcase complementary strategies but emphasise the need for enhanced support, streamlined governance and political will to realise ambitious climate targets. In the following boxes, we provide an overview of the key challenges faced by the Swedish cities in achieving climate neutrality, reflecting on their implications and possible ways to address them.

CHALLENGE 1: Balancing Urban Expansion with Environmental Protection

Implications: Limited land availability in urban centres leads to development spreading into surrounding green spaces or agricultural lands, creating tension between growth and environmental goals.

What can be done? Need for better coordination between national regulations for protecting natural and agricultural land as well as the need for sustainable urban development.

CHALLENGE 2: Conflicting Governance and National-Local Priorities

Implications: National-level policies often prioritise large infrastructure projects, leaving local governments with limited resources and autonomy to implement tailored climate solutions.

What can be done? Strengthen coordination between national and local authorities to align climate policies and funding mechanisms.

CHALLENGE 3: Limited Influence over Private Sector Practices in Construction

Implications: Local authorities have limited power to regulate private construction, meaning that many buildings are not being built or renovated to meet climate-neutral standards. National mandates often focus on energy efficiency but do not cover the broader environmental impact of construction practices, such as material use or waste.

What can be done?

- Implement stronger incentives for green building certification and sustainable construction practices at the local level.
- Advocate for updated national building codes that require climate-friendly construction methods and materials.

Increase collaboration with private developers to promote sustainable building practices through financial incentives and partnerships.

CHALLENGE 4: Resource Constraints (Time, Funding and Capacity)

Implications: Limited time and budget for climate initiatives restrict the pace of progress, especially for long-term projects requiring major investments

What can be done?

- Secure additional funding from national and international sources, including EU climate funds and green bonds, to support local initiatives.
- Foster collaboration among municipalities, private companies and academia to share resources, knowledge and funding for climate projects.

Continue participation in collaborative networks for knowledge sharing and policy innovation; invest in capacity-building programmes.

PART III

KEY LEARNINGS AND RECOMMENDATIONS



Photo: Tina Stafrén/imagebank.sweden.se

12. NORDIC LEARNINGS ON CLIMATE NEUTRALITY

As outlined in the report, Nordic cities encounter a range of challenges in their pursuit of climate neutrality through spatial planning. These challenges stem from multilevel governance complexities, particularly in regulatory autonomy and financial independence, as well as misalignments and coordination gaps within municipal departments. On the other hand, Nordic cities have been at the forefront of pioneering innovative climate strategies. Our analysis identified several country-specific opportunities and challenges across the land use, buildings and construction, and transport and mobility sectors, emphasising how cities leverage their policy tools and economic and knowledge resources to address various sets of obstacles.

In this concluding chapter, based on our analysis and the discussions held during a stakeholder workshop at the Nordregio Forum 2024 (see Chapter 5), we provide a comprehensive perspective on Nordic opportunities and challenges in pursuing climate neutrality, identifying shared cross-country weaknesses and strengths. We aim to offer actionable insights for local governments to enhance their climate efforts and achieve their climate neutrality goals. The chapter begins by exploring key weaknesses across the Nordic Region, including regulatory limitations, geographical constraints, path dependencies and prevailing mindsets. We then highlight the inherent strengths of Nordic cities, focusing on the assets and practices that can be leveraged to drive climate progress. Lastly, we present concluding reflections, outlining the roles of critical actors in the transition to climate neutrality and suggesting areas for future research.

Nordic weaknesses

The pursuit of climate neutrality in cities across the Nordic Region is hindered by a set of systemic weaknesses embedded in their governance, regulatory frameworks, financial dependencies and societal preferences. These challenges manifest themselves across various sectors of spatial planning and reflect broader regional complexities.

Regulatory Aspects

- **Land use:** Despite most municipalities having strategic land use plans that emphasise climate neutrality, the often fragmented and project-based approach to spatial planning poses challenges for cohesive urban strategies. Municipalities frequently engage in extensive negotiations with developers, which can undermine comprehensive planning efforts and limit long-term climate goals.
- **Buildings and construction:** National and local regulations related to the buildings sector are not always aligned, complicating the integration of sustainability standards into new buildings, construction processes and retrofitting of the existing building stock. Furthermore, conflicts often arise between developers' varying levels of commitment and willingness to adopt greener practices and limitations in national or local regulations concerning the standards applicable to buildings.
- **Transport and mobility:** The adoption of tolls and congestion fees – key tools to curb emissions – remains inconsistent across the region. A general lack of polluter-pays policies weakens incentives for reducing transport-related emissions and can hinder progress towards climate neutrality.
- **Cross-sectoral:** Current tools for assessing emissions often fall short in capturing the full scope of climate impacts. Future advancements should focus on developing more comprehensive and precise mechanisms to measure and manage emissions across sectors. Enhanced life cycle assessments, improved integration of indirect emissions and methodologies to account for biodiversity and social impacts are essential for informed decision-making and impactful climate policies.

Path Dependencies

- **Cross-sectoral:** The inherited urban form of many Nordic cities reflects past planning decisions, such as urban sprawl, which limits opportunities for efficient land use and transit-oriented development.
- **Land use:** The distribution and location of available land for development often do not align with climate neutrality objectives, limiting strategic land use planning.

Geographical Differences

- **Transport and mobility:** There are significant geographical differences in the Nordic Region, influencing accessibility, development and resource allocation. These variations are often not taken into account sufficiently in transport regulations aimed at achieving climate neutrality. The uneven

implementation of transport schemes across Nordic cities creates disparities in the availability and effectiveness of sustainable mobility solutions. Remote areas, in particular, face pronounced challenges due to lower population densities and limited infrastructure investments, making it difficult for these regions to access and adopt low-emission transport options effectively.

Financial Issues

- **Buildings and construction:** Financial schemes for retrofitting and energy-efficient construction are often inadequate, exacerbating inequalities and creating risks of energy poverty. Households in lower-income brackets are disproportionately affected, as they struggle to afford necessary upgrades.
- **Cross-sectoral:** Nordic cities rely heavily on funding from national governments to implement climate initiatives, yet these funds are often insufficient to meet ambitious targets. This financial dependence limits local governments' autonomy and ability to innovate. Additionally, the slow implementation of investment projects for transport infrastructure poses a significant challenge, as decisions made years or even decades ago may no longer align with current political priorities or climate goals.

Preferences and mindsets

Mindsets and habits are as crucial to the climate transition as policy changes. Public preferences for traditional urban forms and car-dependent lifestyles often conflict with sustainability goals, making behavioural change essential. For example, while densification and reduced car use are critical for lowering emissions, they challenge established habits and preferences, particularly in suburban and rural areas. Balancing these preferences with the urgent need for sustainable transitions remains a persistent challenge for Nordic cities.

Nordic strengths

The Nordic Region has several key strengths that position its cities as leaders in climate transition efforts.

Urban planning and climate strategy

- **Integration of spatial planning and climate goals.** Climate neutrality strategies are increasingly embedded in the spatial planning frameworks of Nordic cities, which are characterised by strong political commitment to the climate effort. Cities are implementing compact urban development models, green infrastructure and mixed land use to reduce emissions

- **Pioneering energy-efficient building standards.** Nordic cities have a strong foundation in energy-efficient construction, benefiting from stringent building codes, financial incentives and innovative material use. The ability to integrate circular economy principles into the construction sector further enhances sustainability and contributes to lowering carbon footprints.
- **Sustainable mobility and public transport investments.** Investments in sustainable transport systems, including electrified public transport, cycling infrastructure and pedestrian-friendly urban design, position Nordic cities as leaders in green mobility. The shift towards low-emission zones, car-free urban areas and electrification of public transport fleets support broader climate neutrality goals.

Institutional and financial capacity

- **Institutional capacity.** This includes a strong foundation of knowledge, well-established networks and the ability to mobilise resources effectively. Engagement in transnational and intermunicipal collaborations enables Nordic cities to scale up successful climate initiatives and attract funding from EU programmes and other international organisations. These partnerships also facilitate policy experimentation and access to external funding and research supporting new models across different urban contexts.
- **Municipal autonomy in decision-making.** Nordic municipalities generally benefit from significant autonomy in spatial planning, empowering local governments to craft and implement climate strategies tailored to their specific contexts. This flexibility boosts innovation and enables solutions that address local needs and challenges effectively. Coupled with a robust taxation system, Nordic cities are well-equipped with tools to regulate emissions and promote greener practices through targeted incentives and policies.
- **Abundant renewable energy resources.** Many Nordic cities have access to substantial renewable energy sources such as hydropower, wind and biomass. This energy mix provides a foundation for decarbonising key sectors, including transport, heating and electricity generation, making it easier to transition to climate-neutral urban environments.

Public engagement

- **Citizen participation.** While challenges exist in mobilising all stakeholders, there is growing emphasis on participatory governance and citizen involvement in climate action. Cities are increasingly incorporating public consultation processes, co-creation initiatives and community-driven climate projects into their activities to foster a sense of collective responsibility for sustainability.

Key areas of focus for future actions

While Nordic cities have demonstrated strong leadership in climate transition efforts, there are still areas that require further development to ensure long-term success. Addressing governance alignment, enhancing public engagement, strengthening collaboration and refining regulatory mechanisms will be crucial in overcoming existing challenges and accelerating progress towards climate neutrality. The following key focus areas outline necessary actions and the stakeholders responsible for driving them forward.

- **Vertical and horizontal multilevel governance alignment.** Despite the discussed strengths, greater alignment across governance levels is essential to enhance the effectiveness of climate actions. Avoiding siloed decision-making and fostering collaboration between local, regional and national authorities can ensure cohesive strategies and reduce inefficiencies. Enhanced funding mechanisms are also crucial to empower municipalities to scale up their climate initiatives and meet ambitious targets. **Who should act:** National, regional and local governments
- **Public engagement should be a focal point for future efforts.** Targeted communication campaigns can raise awareness and inspire behavioural change, helping citizens understand the benefits of sustainable choices and increasing support for bold policies. Additionally, they can effectively disseminate information about available incentives, ensuring that target audiences are well-informed. These campaigns can also serve as a bridge between policy and public action, ensuring a collective commitment to climate goals. **Who should act:** National and local governments and climate networks
- **Increasing mobilisation towards climate efforts.** Strengthening Nordic cities' capacity to collaborate with businesses, research institutions, communities and supporting knowledge sharing and partnership with other municipalities can help drive progress in aligning policies with climate ambitions. **Who should act:** Local governments and climate networks
- **Expanding the use of taxation and regulatory frameworks to hold polluters accountable can accelerate progress.** By implementing fees and tools that reflect the true environmental cost of emissions, Nordic cities can generate revenue to fund sustainable projects while incentivising greener practices across all sectors. **Who should act:** National and local governments
- **Harmonisation of emission calculation across Nordic countries.** This would be essential to ensure consistency, transparency and comparability in tracking progress towards climate goals. Unified frameworks can also enable better cross-border collaboration, policy alignment and the effective allocation of resources for climate neutrality. **Who should act:** National and local governments and climate networks

Final considerations

Nordic cities are well-positioned to lead the global transition to climate-neutral urban areas, since local authorities have ambitious goals, hold significant power and demonstrate strong institutional capacities. However, achieving these ambitious goals requires coordinated efforts across all levels of governance, sectors and society, addressing existing gaps and limitations. The following considerations highlight the path forward:

Achieving climate neutrality is a collective endeavour requiring engagement of all societal and institutional levels. While local public authorities have specific responsibilities in fields such as land use planning and construction, citizens and private sector stakeholders must also play an active role. Cooperation between municipal branches is essential to ensure integrated decision-making. Partnerships between local governments, regional authorities and national policymakers can foster alignment and avoid fragmented efforts. Beyond institutional actors, a cultural shift is needed, fostering new ways of thinking and discussing sustainability to drive systemic change.

To refine climate strategies further, future research should examine critical aspects such as the environmental and social implications of imported materials, logistics and infrastructure. Understanding the full life cycle of materials, including their impacts in other parts of the world, is vital to ensuring that Nordic climate neutrality efforts do not have unintended consequences abroad. Studies should also explore ways to enhance local supply chains and circular practices to reduce dependency on imported resources.

In summary, the path to climate neutrality in the Nordic Region relies on harnessing the collective efforts of all actors, addressing existing gaps in knowledge and tools and ensuring that local actions align with global sustainability principles. By building on the Region's strengths and addressing these challenges, Nordic cities can continue to be a model and test arena for sustainable development.

REFERENCES

- Aarhus Municipality. (2020). *PÅ VEJEN MOD FOSSILFRIHED Klimastrategi 2020-2030*.
- Aarhus Municipality. (2021a). *Forslag til ET GRØNNERE AARHUS MED MERE BLÅT: Tillæg nr. 105 til Kommuneplan 2017*.
- Aarhus Municipality. (2021b). *Forslag til ET GRØNNERE AARHUS MED MERE BLÅT: Tillæg nr. 105 til Kommuneplan 2017*.
- Aarhus Municipality. (2021c). *GRØN GENSTART AF AARHUS Klimahandlingsplan 2021-2024*.
- Aarhus Municipality. (2023a). *NETVÆRK OG NÆRVÆR: FORSLAG TIL PLANSTRATEGI 2023*.
- Aarhus Municipality. (2023b). *PÅ VEJ MELLEM BY OG LAND: Værktøjskasse for grøn mobilitet i den fysiske planlægning*.
- Aarhus Municipality. (2024a). *Aarhus i tal (Befolkning i tal)*.
<https://ledelsesinformation.aarhuskommune.dk/Embed#vfs://Global/AARHUS-I-TAL/BEFOLKNING I TAL.xview>
- Aarhus Municipality. (2024b). *Aarhus i tal (Erhverv i tal)*.
<https://ledelsesinformation.aarhuskommune.dk/Embed#vfs://Global/AARHUS-I-TAL/ERHVERV I TAL.xview>
- Andersson, L. E., Andersen, K. S., Johansson, S., Pinayur Kannan, S. K., Krekling Lien, S., Qiu, K., Martin, V., Mata, E., Oikkonen, V., Pinel, D., Sandvall, A., Wisell, T., Stårnbratt, M., & Delgado, B. M. (2023). *Nordic Energy Outlooks—Final report WP3 Energy efficiency and conservation*. <https://www.nordicenergy.org/wordpress/wp-content/uploads/2023/02/WP3-report-Energy-efficiency-and-conservation-1.pdf>
- Appelgren, O. (2021). *Växjöbostäder renoverar 220 lägenheter*. Vxonews.
<https://www.vxonews.se/nyheter/vaxjobostader-renoverar-220-lagenheter/>
- Arbaci, S. (2019). *Paradoxes of Segregation: Housing Systems, Welfare Regimes and Ethnic Residential Change in Southern European Cities* (1st ed.). Wiley.
<https://doi.org/10.1002/9781118867365>
- Berg, B. L. (2001). *Qualitative Research Methods for the Social Sciences*. Allyn and Bacon.
- Borgarlínan. (2022a). *Af hverju Borgarlínan?* Borgarlínan. <https://borgarlinan.is/um-borgarlinuna/afhverju-borgarlinan#betra-fyrir-umhverfid>
- Borgarlínan. (2022b). *Hvað er Borgarlínan?* Borgarlínan. <https://borgarlinan.is/um-borgarlinuna/hvad-er-borgarlinan>

Bouwma, I. M., Gerritsen, A. L., Kamphorst, D. A., & Kistenkas, F. H. (2015). *Policy instruments and modes of governance in environmental policies of the European Union: Past, present and future*.

Boverket. (2016). *Boverkets föreskrifter och allmänna råd (2007:4) om energideklaration för byggnader*. <https://www.boverket.se/sv/lag--ratt/forfattningssamling/gallande/bed---bfs-20074>

Boverket. (2019). *Boverket's building regulations – mandatory provisions and general recommendations, BBR (BFS 2011:6 with amendments up to BFS 2018:4)*. <https://www.boverket.se/en/start/publications/publications/2019/boverkets-building-regulations--mandatory-provisions-and-general-recommendations-bbr/>

Boverket. (2023). *Klimatdeklaration en digitala handbok från Boverket*. <https://www.boverket.se/sv/klimatdeklaration/>

Bramley, G., & Power, S. (2009). Urban form and social sustainability: The role of density and housing type. *Environment and Planning B: Planning and Design*, 36(1), 30–48. <https://doi.org/10.1068/b33129>

Burton, E., Jenks, M., & Williams, K. (2000). *Achieving Sustainable Urban Form (1st ed.)*. Routledge. <https://doi.org/10.4324/9780203827925>. Routledge.

C40. (2018). *Consumption-based GHG Emissions of C40 Cities*. C40. https://cdn.locomotive.works/sites/5ab410c8a2f42204838f797e/content_entry5ab410fb74c4833febe6c81a/5ad4c0c274c4837def5d3b91/files/C40_GHGE-Report_040518.pdf?1540555698

C40, ARUP, & University of Leeds. (2019). *The Future of Urban Consumption in a 1.5°C World* [Headline Report]. C40 Cities. https://www.c40.org/wp-content/uploads/2023/04/2270_C40_CBE_MainReport_250719.original-compressed-1-2.pdf

Cavicchia, R., Peverini, M., Friesenecker, M., Munson, L., Susani, A., & Waneska De Jesus, K. (2023). *Greener housing, but affordable? A study of synergies and conflicts between environmental policy instruments and access to housing*. Sciences Po Urban School. <https://www.sciencespo.fr/ecole-urbaine/sites/sciencespo.fr/ecole-urbaine/files/Rapport%20greenhousing.pdf>

Chen, L., Msigwa, G., Yang, M., Osman, A. I., Fawzy, S., Rooney, D. W., & Yap, P.-S. (2022). Strategies to achieve a carbon neutral society: A review. *Environmental Chemistry Letters*, 20(4), 2277–2310. <https://doi.org/10.1007/s10311-022-01435-8>

City of Amsterdam. (n.d.). *Building blocks for the new strategy Amsterdam circular*. https://api.amsterdamsmartcity.com/storage/media/45/c_61367_6232c4d6-fc39-426c-98c3-905ce0841d0c.pdf

City of Oulu. (2016). *Uuden Oulun yleiskaava*. <https://www.ouka.fi/suunnitelmaj-hankkeet/uuden-oulun-yleiskaava>

City of Oulu. (2018). *Oulun kaupungin kestävän energian ja ilmaston toimintasuunnitelma (SECAP)*.
https://www.ouka.fi/sites/default/files/attachments/CoM_Oulu_SECAP_18122018.pdf

City of Oulu. (2019). *Oulun pyöräilyn baanaverkko 2030*.
<https://www.ouka.fi/media/2890/download>

City of Oulu. (2021a). *Oulun kaupunki Kiertotalouden tiekartta*.
<https://www.ouka.fi/media/4401/download?inline>

City of Oulu. (2021b). *SUMP Oulun kestävän kaupunkiliikkumisen suunnitelma*. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/<https://www.ouka.fi/media/2924/download?inline>

City of Oulu. (2023). *Ilmastotyön tiekartta*.
https://www.ouka.fi/sites/default/files/attachments/Oulu_Ilmastoty%C3%B6n_tiekartta.pdf

City of Oulu. (2024). *Metsien hoito ja käyttösuunnitelma 2024–2033*.
<https://www.ouka.fi/media/3986/download>

City of Oulu. (2022a). *Kaupunkistrategia Oulu 2030*.
<https://www.ouka.fi/media/292/download>

City of Oulu. (2022b). *Oulun kaupunki Ympäristöohjelma 2026*.
<https://www.ouka.fi/media/2133/download>

City of Reykjavík. (2021). *City of Reykjavik Climate Action Plan for 2021-2025*. City of Reykjavík. <https://reykjavik.is/sites/default/files/reykjavikclimateactionplan2021-2025.pdf>

City of Reykjavík. (2022).). *Reykjavík Master Plan*. City of Reykjavík.
https://reykjavik.is/sites/default/files/2022-05/AR2040_utgafa_screen_0.pdf

City of Reykjavík. (2014). *The future of waste management in Reykjavík – Action plan 2015 – 2020*. City of Reykjavík.
https://reykjavik.is/sites/default/files/USK/adgerdaaetlun_i_urgangsmalum_i_reykjavik_til_2020.pdf

City of Reykjavík. (2015). *Reykjavík's Environmental and Resource Policy*. City of Reykjavík.
https://reykjavik.is/sites/default/files/rvk_umhverfis_og_audlindastefna_low.pdf

City of Reykjavík. (2019). *The Green City*. City of Reykjavík.

City of Reykjavík. (2022a). *City of Reykjavík Housing Plan*. City of Reykjavík.
https://reykjavik.is/sites/default/files/2022-11/Husnaedisatlungu_Reykjavikur-Uppfaerd_november_2022.pdf

City of Reykjavík. (2022b). *Reykjavík Cycling Plan Program*. City of Reykjavík. [https://reykjavik.is/sites/default/files/ymis_skjol/skjol_frettir/hjolreidaaetlun_reykjavikur_2021-2025 - mai 2021.pdf](https://reykjavik.is/sites/default/files/ymis_skjol/skjol_frettir/hjolreidaaetlun_reykjavikur_2021-2025_-_mai_2021.pdf)

City of Reykjavík. (2022c). *The Green Deal*. City of Reykjavík. https://reykjavik.is/sites/default/files/2023-01/Gr%C3%A6na%20Plani%C3%B0_%C3%8DSL_lowres.pdf

City of Reykjavík. (2024a). *Reykjavík Housing Policy 2024-2033*. City of Reykjavík. https://reykjavik.is/sites/default/files/2024-05/husnaedisaetlun_reykjavikur_2024-2033_samthykkt_21._desember_2023_endurbaett_framsetning_og_utlit-1.pdf

City of Reykjavík. (2024b). *Reykjavík—Svið*. City of Reykjavík. <https://reykjavik.is/svid>

City of Reykjavík. (2024c). *Umhverfis- og skipulagssvið*. City of Reykjavík. <https://reykjavik.is/umhverfis-og-skipulagssvid>

City of Tampere. (n.d.). *Tampereen väestösuunitte 2022-2024*. <https://app.powerbi.com/view?r=eyJrIjojNmNkZTY1YmMtZDVIMS00MWMwLTgxZTEtMGVjOGY3OTdmNWJyIiwidCI6ImRkZTVkYzEyLWJkM2MtNGMwNi04NWNjLTM0MzYxZWZlOWFkNCIsImMiOiJl9&pageName=ReportSection>

City of Tampere. (2021a). *Pohjois-Tampereen strateginen yleiskaava—Selostus*.

City of Tampere. (2021b). *SUSTAINABLE URBAN MOBILITY PLAN SUMP*. https://www.tampere.fi/sites/default/files/2022-05/SUMP_taitto2021_englanti.p%C3%A4ivitetty.pdf

City of Tampere. (2022a). *Climate Neutral Tampere 2030 Roadmap*. https://www.tampere.fi/sites/default/files/2024-03/climate_neutral_tampere_roadmap_0.pdf

City of Tampere. (2022b). *Tampereen kaupungin asunto- ja maapolitiikan linjaukset 2022-2025*. https://www.tampere.fi/sites/default/files/2022-09/Tampereen%20kaupungin%20asunto-%20ja%20maapolitiikan%20linjaukset%202022-2025_web%20%281%29_0.pdf

CSE, & TCPA. (2023). *Spatial Planning for Climate Resilience & Net Zero*. <file:///C:/Users/rebecca.cavicchia/Downloads/Spatial-planning-for-climate-resilience-and-net-zero-CSE-TCPA.pdf>

Cucca, R., & Ranci, C. (2022). Urban Policy in Times of Crisis: The Policy Capacity of European Cities and the Role of Multi-Level Governance. *Urban Affairs Review*, 58(6), 1493–1522. <https://doi.org/10.1177/10780874211041710>

Danish Energy Agency. (2023). *Denmark's Climate Status and Outlook*. <https://ens.dk/en/our-services/projections-analyses-and-models/denmarks-energy-and-climate-outlook>

Davoudi, S., Crawford, J., & Mehmood, A. (2010). Planning for Climate Change: Strategies for Mitigation and Adaptation for Spatial Planners. In *The Town Planning Review* (Vol. 81, p. 719). <https://doi.org/10.2307/41064641>

EFLA. (2022). *Loftslagsbókhald Reykjavíkurborgar 2021*. EFLA. <https://reykjavik.is/sites/default/files/2022-07/101197-MIN-01-V02%20Loftlagsb%C3%B3khald%20Reykjav%C3%ADkurborgar%202021.pdf>

EFLA. (2024). *Kolefnisspor bygginga verður að kröfu á Íslandi*. EFLA. <https://www.efla.is/frettir-og-blogg/kolefnisspor-bygginga-verdur-ad-krofu-a-islandi>

Eggertsson, D. B. (n.d.). The Reykjavik Green Deal: On the carbon neutral city and public health (thelancet.com). *TheLancet.Com*. <https://www.thelancet.com/pdfs/journals/lanplh/PIIS2542-5196%2821%2900009-7.pdf>

Egner, L. E., Klöckner, C. A., & Pellegrini-Masini, G. (2021). Low free-riding at the cost of subsidizing the rich. Replicating Swiss energy retrofit subsidy findings in Norway. *Energy and Buildings*, 253, 111542. <https://doi.org/10.1016/j.enbuild.2021.111542>

Energimyndigheten. (2021). *Panorama—Sweden*. <https://panorama-sweden.com/?action=db173e6f-82c8-42db-bb2c-52fce2112b13>

Energiplan för Växjö kommun. (2021). Växjö Kommun. <https://www.vaxjo.se/download/18.313cf36515d1bde9ee3226fd/1636700500781/Energiplan%20f%C3%B6r%20V%C3%A4xj%C3%B6%20kommun.pdf>

European Commission. (2016). *FUTURE BRIEF: No net land take by 2050?*

European Commission. (2022). *Energy and smart cities*. European Commission. https://energy.ec.europa.eu/topics/research-and-technology/energy-and-smart-cities_en

European Council. (2024). *Fit for 55*. Council of European Union. 13 April 2023

European Parliament. (2023). *What is carbon neutrality and how can it be achieved by 2050?* European Parliament. <https://www.europarl.europa.eu/topics/en/article/20190926STO62270/what-is-carbon-neutrality-and-how-can-it-be-achieved-by-2050>

European Parliament and European Council. (2021). *REGULATION (EU) 2021/1119 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')*. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1119>

European Parliament, C. of the E. U. (2018). *Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (Text with EEA relevance)*. <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32018L0844>

- Faxaflóahafnir. (2024). *Um Faxaflóahafnir*. Facaflóahafnir.
<https://www.faxaflaohafnir.is/sagan/>
- Franzen, A., & Mader, S. (2018). Consumption-based versus production-based accounting of CO2 emissions: Is there evidence for carbon leakage? *Environmental Science & Policy*, 84, 34–40. <https://doi.org/10.1016/j.envsci.2018.02.009>
- Giacometti, A., & Salonen, H. (2023). *Innovation Dynamics in Wood Construction in Sweden and Finland* (Working Paper 2023:2). Nordregio.
<https://pub.nordregio.org/wp-2023-2-gringo/gringo.pdf>
- Golubchikov, O. (2011). Climate neutral cities: How to make cities less energy and carbon intensive and more resilient to climatic challenges. *New York and Geneva: United Nations, Economic Commission for Europe (UNECE)*.
- Guðdísardóttir, A. K. (2021). *Consumption-based carbon footprint assessment of the European countries using two different allocation principles* [Master thesis, Faculty of Civil and Environmental Engineering University of Iceland].
<https://skemman.is/bitstream/1946/38488/3/Thesis%20-%20Final%20version%20-AKG.pdf>
- Gustavsson, E., Elander, I., & Lundmark, M. (2009). Multilevel governance, networking cities, and the geography of climate-change mitigation: Two Swedish examples. *Environment and Planning C: Government and Policy*, 27(1), 59–74.
- Hagstofa Íslands. (n.d.). *Mannfjöldi eftir sveitarfélögum*. Mannfjöldi Eftir Sveitarfélögum. <https://hagstofa.is/talnaefni/ibuar/mannfjoldi/sveitarfelog-og-byggdakjarnar/>
- Hagstofa Íslands. (2024). *Fjöldi ferða og gistingu eftir tegund ferðamanna, 2009-2023*. Hagstofa Íslands.
https://px.hagstofa.is/pxis/pxweb/is/Efnahagur/Efnahagur_thjodhagsreikningar_ferdathjonustureikningar_ferdathjonustureikningar/SAM08005.px
- Healey, P. (2020). *Collaborative planning: Shaping places in fragmented societies*. Bloomsbury Publishing.
- Hickmann, T. (2021). Locating cities and their governments in multi-level sustainability governance. *Politics and Governance*, 9(1), 211–220.
- Hofstad, H. (2012). *Compact city development: High ideals and emerging practices*. 1–23.
- Huang, B., Xing, K., Pullen, S., & Liao, L. (2020). Exploring Carbon Neutral Potential in Urban Densification: A Precinct Perspective and Scenario Analysis. *Sustainability*, 12(12), 4814. <https://doi.org/10.3390/su12124814>
- Ibraeva, A., Van Wee, B., Correia, G. H. de A., & Pais Antunes, A. (2021). Longitudinal macro-analysis of car-use changes resulting from a TOD-type project: The case of Metro do Porto (Portugal). *Journal of Transport Geography*, 92, 103036.
<https://doi.org/10.1016/j.jtrangeo.2021.103036>

- IPCC. (2022). *IPCC Sixth Assessment Report Working Group III: Mitigation of Climate Change*. <https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-9/>
- Jong, M. de, Joss, S., Schraven, D., Zhan, C., & Weijnen, M. (2015). Sustainable–smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. *Journal of Cleaner Production*, 109, 25–38. <https://doi.org/10.1016/j.jclepro.2015.02.004>
- Kazepov, Y. (2010). *Rescaling social policies: Towards multilevel governance in Europe* (Vol. 38). Ashgate Publishing, Ltd.
- Kern, K., & Alber, G. (2009). Governing Climate Change in Cities: Modes of Urban Climate Governance in Multi-Level Systems. *Proceedings of the International Conference on Competitive Cities and Climate Change*. international conference on Competitive Cities and Climate Change, Milan, Italy,.
- Klimatanpassning. (2021). *Swedish Portal for Climate Change Adaptation*. Klimatanpassning. <https://www.klimatanpassning.se/en/roles-and-responsibilities/financing#:~:text=Obtaining%20funding%20for%20climate%20change%20adaptation%20can%20represent%20a%20challenge>
- Kommuninvest. (n.d.). *Kommuninvest*. Kommuninvest. <https://kommuninvest.se/eng/homepage/aboutus.4.35de2c7b1900fda7e6273e1.html>
- Korsbakken, J. I., Romundstad, R. M., Aamaas, B., & Madslien, A. (2021). *Kristiansands klimagassutslipp mot 2030 Referansebane og tiltakspakker REPORT 2021:05*. CICERO and (TØI). <https://pub.cicero.oslo.no/cicero-xmlui/bitstream/handle/11250/2774917/CICERO%20Rapport%202021.05%20Kristiansand%20kommune%20referansebane%20og%20tiltakspakker%20%282%29.PDF?sequence=1&isAllowed=y>
- Korsnes, M., Loewen, B., Dale, R. F., Steen, M., & Skjølsvold, T. M. (2023). Paradoxes of Norway's energy transition: Controversies and justice. *Climate Policy*, 23(9), 1132–1150. <https://doi.org/10.1080/14693062.2023.2169238>
- Kristiansand Municipality. (2020). *Sterkere sammen – Kristiansand mot 2030. Kommuneplanens samfunnsdel 2020–2030*. https://www.kristiansand.kommune.no/contentassets/a24ef3a9861b4fdab0d2f208d3d7bceb/15.10.20_kristiansand-kommune---rev.-rapp.-samfunnsdel-komm.plan_06.10.20.pdf
- Kristiansand Municipality. (2021). *Temaplan Klima- og miljøstrategi Bygg og anlegg*. https://www.kristiansand.kommune.no/contentassets/6ba5acec23c0445aa1fe1ad1906fc280/klima--og-miljostrategi-for-bygg-og-annlegg_vedtatt-27.10.21.pdf
- Kristiansand Municipality. (2022a). *Fagnotat blå- og grønn arealbruk*. <https://www.kristiansand.kommune.no/Util/login.aspx?ReturnUrl=%2fcontentassets%2f731ab6cea23b4bd295a9271d2fa16d66%2ffagnotat--bla-gronn-med-forside.pdf>

Kristiansand Municipality. (2022b). *Kommuneplanens arealdel for Kristiansand 2023 -2034 Fagnotat – Senterområder, stedsutvikling og boligbygging*.
<https://www.kristiansand.kommune.no/contentassets/58378213047d4080acb73d0b4dbc5b7d/fagnotat-senteromrader-og-stedsutvikling.pdf>

Kristiansand Municipality. (2023a). *Handlingsplan til strategi for omstilling til et bærekraftig lavutslippssamfunn*.
https://www.kristiansand.kommune.no/contentassets/5aff899b1e2f472dbc92cefe2556982b/12234-handlingsplan---klima--og-miljostrategi-250423--a4_korrektur-4.pdf

Kristiansand Municipality. (2023b). *Omstilling til et bærekraftig lavutslippssamfunn*.
<https://www.kristiansand.kommune.no/contentassets/9d88979f9f5f487d873757d4895e090b/12234-kortversjon---klima--og-miljostrategi-020223---a4.pdf>

KS, Cicero, Insam, & Civitas. (2020). *KORTREIST KVALITET Strategi og handlingsplan 2020*. https://www.kortreistkvalitet.no/wp-content/uploads/2020/02/Strategi-og-handlingsplan-2020_pr-februar-20.pdf

Lauvaux, T., Gurney, K., Miles, N., Davis, K., & Richardson, S. (2020). Policy Relevant Assessment of Urban CO 2 Emissions. *Environmental Science and Technology*, 54(16), 10237-10245. <https://doi.org/10.1021/acs.est.0c00343>

Lee, J., & Jung, S. (2023). Towards Carbon-Neutral Cities: Urban Classification Based on Physical Environment and Carbon Emission Characteristics. *Land*, 12(5), 968.

LFM30. (2023). *LFM30:s Metod för klimatbudget*. https://lfm30.se/wp-content/uploads/2023/04/LFM30_Metod_Klimatbudget_Version_1.7.pdf

Lidmo, J., Bogason, Á., & Turunen, E. (2020). *The legal framework and national policies for urban greenery and green values in urban areas*. Nordregio.
<https://doi.org/10.6027/R2020:3.1403-2503>

Lidmo, J., Brynteson, M., & Bogason, Á. (2024). *National Support Initiatives in Nordic Spatial Planning* (Nordregio) [Nordregio].
<https://doi.org/10.6027/R2024:61403-2503>

López, I., Ortega, J., & Pardo, M. (2020). Mobility Infrastructures in Cities and Climate Change: An Analysis Through the Superblocks in Barcelona. *Atmosphere*, 11(4), 410. <https://doi.org/10.3390/atmos11040410>

Ludlow, D. (2006). *Urban Sprawl in Europe—The Ignored Challenge*.
<https://api.semanticscholar.org/CorpusID:1887790>

Lund Municipality. (2014). *LUNDAMATS III: Strategy for a sustainable transport system in Lund Municipality*.
https://lund.se/globalassets/lund.se/traf_infra/lundamats/lundamats_iii_eng.pdf

Lund Municipality. (2021). *LundaEko Lunds kommuns program för ekologisk hållbar utveckling 2021–2030*.

<https://lund.se/download/18.2899fac318093d2b72817dd7/1680612611704/Lunds%20kommuns%20program%20f%C3%B6r%20ekologisk%20h%C3%A5llbar%20utveckling%202021-2030.pdf>

Lund Municipality. (2023). *Klimatpolitiska råd—Lund Kommun—Raport 2023*.

<https://lund.se/download/18.71752c65188516e45df9e4d/1685706372422/Klimatpolitiska%20r%C3%A5det,%20%C3%A5rsrapport%202023.pdf>

Lund Municipality. (2024a). *Energy and Climate Advice*. Lund Municipality.

<https://lund.se/bygga-och-bo/min-bostad/energi/energi--och-klimatradgivning>

Lund Municipality. (2024b). *How Lund Municipality works to use less electricity and energy*.

<https://lund.se/kommun-och-politik/hallbara-lund/tillsammans-skapar-vi-hallbara-lund/sa-sparar-lunds-kommun-energi>

Lund Municipality. (2024c). *Lund Municipality Green Bond Framework*. Lund Municipality.

<https://lund.se/download/18.68b7cf2318df2d68cf71126/1709218393902/Green%20Bond%20Framework%20Lund%202024.pdf>

Lund Municipality. (2024d). *Together for the climate*. Lund Municipality.

<https://lund.se/kommun-och-politik/sa-arbetar-vi-med/ett-klimatneutralt-lund>

Lund Municipality. (2024e). *Välkommen till Lunds kommuns översiktsplan*

Samrådsförslag, beslutat av kommunstyrelsen 14 februari 2024. Lund Kommun.

<https://experience.arcgis.com/experience/d15d7f2edcba444084631a591afb42f1/page/V%C3%A4lkommen/>

Lund Municipality. (2024f). *Lund in Numbers*. <https://lund.se/kommun-och-politik/fakta-om-lund/lund-i-siffror>

Lwasa, S., Seto, K. C., Bai, X., Blanco, K. R., Gurney, S., Kilis, O., Lucon, J., Murakami, J., Pan, A., Sharifi, A., & Yamagata, Y. (2022). Urban systems and other settlements.

In *IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. doi:

[10.1017/9781009157926.010](https://doi.org/10.1017/9781009157926.010)

Madureira, A. M., & Möllers, A. (2005). *URBAN SPRAWL IN THE ÖRESUND REGION*

- How Skåne is facing the Challenge. [https://www.diva-](https://www.diva-portal.org/smash/get/diva2:831402/FULLTEXT01.pdf)

[portal.org/smash/get/diva2:831402/FULLTEXT01.pdf](https://www.diva-portal.org/smash/get/diva2:831402/FULLTEXT01.pdf)

Markensten, T., Reiter, L., Bodin, P., Hasund, K. P., Svensson, E., & Nyberg, M. (2018).

Återväntning av organogen jordbruksmark som klimatåtgärd. Jordbrukverket.

https://www2.jordbruksverket.se/download/18.398404781668c84d6edeac8c/-1540291633301/ra18_30.pdf

Ministry of the Environment. (2021). *Finland's Report on the Implementation of the New Urban Agenda*.

[https://www.urbanagendaplatform.org/sites/default/files/2021-07/NUA%20Report FINLAND Min.Env .%20FINAL%20%283%29 O.pdf](https://www.urbanagendaplatform.org/sites/default/files/2021-07/NUA%20Report%20FINLAND%20Min.Env.%20FINAL%20%283%29%20.pdf)

Mueller, K. L., Lauvaux, T., Gurney, K. R., Roest, G., Ghosh, S., Gourdji, S. M., Karion, A., DeCola, P., & Whetstone, J. (2021). An emerging GHG estimation approach can help cities achieve their climate and sustainability goals. *Environmental Research Letters*, 16(8), 084003. <https://doi.org/10.1088/1748-9326/ac0f25>

Muñiz, I., & Rojas, C. (2019). Urban form and spatial structure as determinants of per capita greenhouse gas emissions considering possible endogeneity and compensation behaviors. *Environmental Impact Assessment Review*, 76, 79–87. <https://doi.org/10.1016/j.eiar.2019.02.002>

Næss, P., Næss, T., & Strand, A. (2011). Oslo's Farewell to Urban Sprawl. *European Planning Studies*, 19(1), 113–139. <https://doi.org/10.1080/09654313.2011.530395>

Næss, P., Saglie, I.-L., & Richardson, T. (2020). Urban sustainability: Is densification sufficient? *European Planning Studies*, 28(1), 146–165. <https://doi.org/10.1080/09654313.2019.1604633>

Nordic Council of Ministers. (2018). *Declaration from the Nordic Ministers for Climate and the Environment from Sweden, Denmark, Norway, Finland, Iceland, the Faroe Islands and Åland on COP24, the UN Climate Change conference*. Norden. <https://www.norden.org/en/declaration/nordic-statement-cop-24>

Nordic Council of Ministers. (2019). *Declaration on Nordic Carbon Neutrality*. Norden. <https://www.norden.org/en/declaration/declaration-nordic-carbon-neutrality>

Nordic Council of Ministers. (2020). *Norden som världens mest hållbara och integrerade region Förslag till handlingsplan 2021–2024*. Nordic Council of Ministers. <http://norden.diva-portal.org/smash/get/diva2:1461194/FULLTEXT03.pdf>

Nordic Council of Ministers. (2024). *Policy Options for Reducing Consumption-Based Emissions—A Nordic Survey (2024:545; TemaNord)*. Nordic Council of Ministers. <https://pub.norden.org/temanord2024-545/temanord2024-545.pdf>

Nordic Energy Research. (2021). *Renewable Energy in the Nordic—2021*. Nordic Energy Research. <https://pub.norden.org/nordicenergyresearch2021-03/>

Norwegian Environment Agency. (2020). *KLIMAKUR 2030*. <https://www.miljodirektoratet.no/globalassets/publikasjoner/m1625/m1625.pdf#page=6>

Norwegian Ministry of Transport. (2021). *National Transport Plan 2022–2033*. <https://www.regjeringen.no/contentassets/117831ad96524b9b9eaadf72d88d3704/en-gb/pdfs/stm202020210020000engpdfs.pdf>

- Norwegian Public Road Administration. (2022). *Null- og lavutslippssone*. <https://www.regjeringen.no/contentassets/4e83ba77c57a4731be425ca2bd20bb23/null-og-lavutslippssone-rapport-fra-statens-vegvesen.pdf>
- Nowak, M., Monteiro, R., Cantos, J., & Vagiona, D. (2023). *Spatial Planning Response to the Challenges of Climate Change Adaptation: An Analysis of Selected Instruments and Good Practices in Europe*. <https://doi.org/10.3390/su151310431>
- OECD. (2012). *Compact City Policies*.
- Olsson, N. O. E., Nyström, J., & Pyddoke, R. (2019). Governance regimes for large transport infrastructure investment projects: Comparative analysis of Norway and Sweden. *Case Studies on Transport Policy*, 7(4), 837–848. <https://doi.org/10.1016/j.cstp.2019.07.011>
- Open Data DK. (n.d.). *Population forecast 2020-2034 divided by urban area*. <https://www.opendata.dk/city-of-vejle/befolkningsprognose-2018-2033-fordelt-pa-byomrade#resource-1.jan.2020-1.jan.2034>
- Patacchini, E., Zenou, Y., Henderson, J. V., & Epplé, D. (2009). Urban Sprawl in Europe. *Brookings-Wharton Papers on Urban Affairs*, 125–149. JSTOR.
- Pedersen, A. B. (2022). *Energimærkning og opvarmning i kommunale bygninger*. DI Analyse.
- Polk, M. (2011). Institutional capacity-building in urban planning and policy-making for sustainable development: Success or failure? *Planning, Practice & Research*, 26(2), 185–206.
- Ramaswami, A., & Chavez, A. (2013). What metrics best reflect the energy and carbon intensity of cities? Insights from theory and modeling of 20 US cities. *Environmental Research Letters*, 8(3), 035011. <https://doi.org/10.1088/1748-9326/8/3/035011>
- Realdania. (2017). *Urban Media Space*. <https://www.realdania.org/whatwedo/grants-and-projects/urban-mediaspace-aarhus>
- Regeringskansliet. (2004). *Mer trä i byggandet—Underlag för en nationell strategi för att främja trä i byggandet*. Näringsdepartementet. <https://www.regeringen.se/contentassets/622a4cddc02a4026a3bc3c4f5d5b94aa/mer-tra-i-byggandet---underlag-for-en-nationell-strategi-for-att-framja-tra-i-byggandet-ds-20041/>
- Region of Trondheim. (2018). *Strategi for næringsarealutvikling i Trondheimsregionen Sutterø næringsareal*. https://trondheimsregionen.no/wp-content/uploads/2018/11/180928_vedtatt_Strategi-for-n%C3%A6ringsarealutvikling-i-Trondheimsregionen_sammendrag.pdf

- Rérat, P. (2012). Housing, the Compact City and Sustainable Development: Some Insights From Recent Urban Trends in Switzerland. *International Journal of Housing Policy*, 12(2), 115–136. <https://doi.org/10.1080/14616718.2012.681570>
- Reykjavík Energy. (2024). *About Reykjavík Energy*. Reykjavík Energy. <https://orkuveitan.is/en/about-or/operations/reykjavik-energy/>
- Rocha, J. C., Peterson, G., Bodin, Ö., & Levin, S. (2018). Cascading regime shifts within and across scales. *Science*, 362(6421), 1379–1383. <https://doi.org/10.1126/science.aat7850>
- Sanchez, Nn. G., & Arango-Franco, S. (2018). *The new urban peripheries, 1990-2014: Selected findings from a global sample of cities*.
- SCB, Statistics Sweden. (2024). *Kommuner i siffror*. <https://kommunsiffror.scb.se/?id1=1281&id2=null>
- Shalit, T., Dixon, M., & Eklöw, K. (2023). *Data-Driven Transitions*. Climate View. <https://www.climateview.global/en/framework>
- Sharifi, A. (2020). Trade-offs and conflicts between urban climate change mitigation and adaptation measures: A literature review. *Journal of Cleaner Production*, 276, 122813. <https://doi.org/10.1016/j.jclepro.2020.122813>
- Sharifi, A. (2021). Co-benefits and synergies between urban climate change mitigation and adaptation measures: A literature review. *Science of The Total Environment*, 750, 141642. <https://doi.org/10.1016/j.scitotenv.2020.141642>
- Sitowise. (2023). *CO2-raportti 2023 Oulu*. [https://www.ouka.fi/sites/default/files/attachments/CO2-raportti Oulu 13062023.pdf](https://www.ouka.fi/sites/default/files/attachments/CO2-raportti_Oulu_13062023.pdf)
- Skipulagsstofnun. (2016). *Landsskipulagsstefna 2015-2026 ásamt greinargerð, Skipulagsstofnun, Reykjavík, september 2016*. https://www.landsskipulag.is/media/pdf-skjol/Landsskipulagsstefna2015-2026_asamt_greinargerð.pdf
- Skipulagsstofnun. (2020). *Tillaga að landsskipulagsstefnu – Loftslag, landslag, lýðheilsa – Viðauki við Landsskipulagsstefnu 2015–2026*. Skipulagsstofnun. <https://www.skipulag.is/media/landsskipulagsstefna-vidbaetur/Tillaga-ad-vidauka-vid-landsskipulagsstefnu-2015-2026.pdf>
- Sovacool, B. K., Noel, L., Kester, J., & Zarazua de Rubens, G. (2018). Reviewing Nordic transport challenges and climate policy priorities: Expert perceptions of decarbonisation in Denmark, Finland, Iceland, Norway, Sweden. *Energy*, 165, 532–542. <https://doi.org/10.1016/j.energy.2018.09.110>
- SSH, - Samtök sveitarfélaga á höfuðborgarsvæðinu. (2015). *Höfuðborgarsvæðið 2040 – Svæðisskipulag höfuðborgarsvæðisins 2015-2040*. SHH.

- Stähle, A. (2017). *Closer together: This is the future of cities*. SCB Distributors.
- Statistics Norway. (2024). 07459: *Population, by region, contents and year*.
<https://www.ssb.no/en/statbank/table/07459/tableViewLayout1/>
- Statista. (2022). *Distribution of carbon dioxide emissions produced by the transportation sector worldwide in 2022, by sub sector*.
<https://www.statista.com/statistics/1185535/transport-carbon-dioxide-emissions-breakdown/>
- Statistics Finland. (2023). *Population density, Oulu 2023*.
- Statistics Norway. (2023a). *Population and area, by region, contents and year*.
<https://www.ssb.no/en/statbank/table/11342/tableViewLayout1/>
- Statistics Norway. (2023b). *Population and land area in urban settlements. 05212: Population, by region, contents and year*.
<https://www.ssb.no/en/statbank/table/05212/tableViewLayout1/>
- Stjernberg, M., Vasilevskaya, A., & Penje, O. (2024). *Towards a grid-based Nordic territorial typology—A new tool for analysis across the urban-rural continuum*. Nordregio. <https://doi.org/10.6027/R2024:91403-2503>
- Stjórnarráð Íslands. (2019). *Sáttmáli um samgöngur á höfuðborgarsvæðinu, Stjórnarráð Íslands, september 2019*. Stjórnarráð Íslands.
- Sustainalytics. (2024). *Second-Party Opinion: Lund Municipality Green Bond Framework* [Second-Party Opinion]. Sustainalytics.
<https://lund.se/download/18.28e91ce418e5fac24fbe15d/1711626197792/Lund%20Municipality%20Green%20Bond%20Framework%20Second-Party%20Opinion%202024.pdf>
- SWECO. (2023). *Potential och utmaningar för ökat cyklande: Region Sörmland*. SWECO. <https://www.sweco.se/wp-content/uploads/sites/3/2023/11/Potential-och-utmaningar-for-okat-cyklande.pdf>
- Swedish National Audit Office. (2021). *The energy performance certificate system—Clear purpose but unclear goal*.
https://www.riksrevisionen.se/download/18.34b4331217abce4982c760c/1626684538335/RiR%202021_21_ENG.pdf
- Swedish Parliament. (2006). *Lag (2006:985) om energideklaration för byggnader*.
<https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2006985-om-energideklaration-for-sfs-2006-985/>
- Swedish Parliament. (2014). *Lag (2014:899) om riktlinjer för kommunala markanvisningar*. <https://beta.rkrattsbaser.gov.se/sfs/item?bet=2014%3A899&tab=forfattningstext>
- Tampere City Council. (2023). *The City of Action, Tampere City Strategy 2030*.

Tampere City Council. https://www.tampere.fi/sites/default/files/2022-06/The%20Tampere%20City%20Strategy%202030_0.pdf

Tampere City Region. (2019). *Hiilineutraali Tampereenseutu 2030 Tiekarttaselvitys*. <https://tampereenseutu.fi/wp-content/uploads/2020/09/Hiilineutraali-Tampereenseutu-2030-raportti.pdf>

The Ministry of Finance. (2019). *Meld. St. 13 (2018 –2019). Muligheter for alle. Fordeling og sosial bærekraft*.

The Norwegian Environment Agency. (2023). *Klimagassregnskap for kommuner og fylker*. <https://www.miljodirektoratet.no/publikasjoner/2023/desember-2023/klimagassregnskap-for-kommuner-metoderapport/>

Trafikverket. (2018). *Förslag till nationell plan för transportsystemet 2018–2029 Remissversion 2017-08-31 (058)*. Trafikverket. <http://trafikverket.diva-portal.org/smash/get/diva2:1363916/FULLTEXT02.pdf>

Trap Danmark. (2020). *Vejle*. <https://trap.lex.dk/Vejle>

Trondheim Municipality. (2017). *Kommunedelplan: Energi og klima 2017-2030*. <https://www.trondheim.kommune.no/globalassets/10-bilder-og-filer/10-byutvikling/miljoenheten/klima-og-energi/kommunedelplan-energi-og-klima130618.pdf>

Trondheim Municipality. (2019). *Boligfortetting i Trondheim—Status og muligheter. Et kunnskapsgrunnlag for Byutviklingsstrategien—Strategi for areal- og transportutvikling fram mot 2050*. https://www.trondheim.kommune.no/globalassets/10-bilder-og-filer/10-byutvikling/byplankontoret/1b_off-ettersyn/2019/byutviklingsstrategi-trondheim--strategi--arealtrsp-2050/7.-boligfortetting-i-trondheim---status-og-muligheter.pdf

Trondheim Municipality. (2021a). *Beregningsgrunnlag for klimabudsjett 2021*.

Trondheim Municipality. (2021b). *Klimagassutslipp i Trondheim*. <https://sites.google.com/trondheim.kommune.no/kommunedir-forslag-til-hoep/3-klimabudsjett/3-2-klimagassutslipp-i-trondheim>

Trondheim Municipality. (2022a). *Kommuneplanens samfunnsdel 2020-2032. Trondheimsløftet*. https://drive.google.com/file/d/14SSzEywANmEdLh_TgCOxQzIR39Z8ldgR/view

Trondheim Municipality. (2022b). *Mobilitetsstrategi for Trondheim*. https://www.trondheim.kommune.no/globalassets/10-bilder-og-filer/11-politikk-og-planer/planer/temaplaner/mobilitetsstrategi-for-trondheim_revidert-etter-vedtak-1.pdf

Trondheim Municipality. (2023a). *Klimaveideler for plan-og byggesaker i Trondheim kommune*. <https://drive.google.com/file/d/1HUcHR-JtY1aBjDuz2M1WpH22jgjpSbyd/view>

- Trondheim Municipality. (2023b). *Miljøstrategi for bygg og anlegg 2023–2026*. <https://www.trondheim.kommune.no/contentassets/daefc75e0c524594a29e803124c82b1f/miljostrategi-2023---2026-13.12.22-versjon-2-1.pdf>
- Trondheim Municipality. (2024). *Klimaløftene. Kommunedelplan for energi og klima 2024 – 2030*. <https://www.trondheim.kommune.no/globalassets/10-bilder-og-filer/17-barekraft/kommunedelplan-for-energi-og-klima-vedtatt.pdf>
- Trygg, K., & Wenander, H. (2022). Strategic spatial planning for sustainable development – Swedish planners' institutional capacity. *European Planning Studies*, 30(10), 1985–2001. <https://doi.org/10.1080/09654313.2021.2001792>
- UEP NTNU. (2018). *Sustainable Economy in Trondheim*.
- UNECE. (2011). *Climate Neutral Cities: How to make cities less energy and carbon intensive and more resilient to climatic challenges*. United Nations Economic Commission for Europe. https://unece.org/DAM/hlm/documents/Publications/climate.neutral.cities_e.pdf
- Växjö Municipality. (2005). *Mer trä i byggandet*. Växjö Kommun. <https://www.vaxjo.se/download/18.313cf36515d1bde9ee32c95a/1499862554813/Mer%20Tr%C3%A4%20strategi%20V%C3%A4xj%C3%B6.pdf>
- Växjö Municipality. (2013). *Växjö the modern wooden city. Växjö Municipality's Wood Construction Strategy*. Växjö Kommun. https://www.vaxjo.se/download/18.313cf36515d1bde9ee3205fb/1499862527332/Tr%C3%A4byggnadsstrategi_ENG_webb.pdf
- Växjö Municipality. (2018). *Växjö – Europas första Moderna Trästad. Med hållbarhet som grund i byggande*. <https://www.vaxjo.se/download/18.cfac4d716951d944dd1a4cb/1551961221853/V%C3%A4xj%C3%B6%20kommuns%20tr%C3%A4byggnadsstrategi%20-%20layout%20version.pdf>
- Växjö Municipality. (2019). *Hållbara Växjö 2030*. Växjö Kommun. https://www.vaxjo.se/download/18.58d9f57a16d9ce07d02dd012/1571219603597/H%C3%A5llbarhetsprogrammet%20H%C3%A5llbara%20V%C3%A4xj%C3%B6%202030_antaget%20av%20KF.pdf
- Växjö Municipality. (2021). *Växjö kommuns översiktsplan*. Växjö Kommun. <https://www.vaxjo.se/sidor/trafik-och-stadsplanering/vaxjo-vaxer/sa-planerar-vi/oversiktlig-planering.html>
- Växjö Municipality. (2022). *About Växjö*. Växjö Kommun. <https://www.vaxjo.se/sidor/politik-och-demokrati/english/about-vaxjo.html>
- Växjö Municipality. (2024). *About Växjö*. Växjö Kommun. <https://www.vaxjo.se/sidor/politik-och-demokrati/english/about-vaxjo.html>
- Vejle 24. (2022). *Vejle Municipality*. <https://vejle24.dk/vejle-kommune>

- Vejle Amts Folkeblad. (2022). *I fire dage var Vejle Danmarks ottendestørste by—Men så blev tallet rettet: Byen bider dog konkurrenterne i haserne og er tæt på at rykke op i by-hierarkiet*. <https://vafo.dk/vejle/i-fire-dage-var-vejle-danmarks-ottendestørste-by-men-saa-blev-tallet-rettet-byen-bider-dog-konkurrenterne-i-haserne-og-er-taet-paa-at-rykke-op-i-by-hierarkiet>
- Vejle Municipality. (n.d.). *Lokalplan 1404 Bæredygtighedsvurdering*.
- Vejle Municipality. (2018). *Mobilitetsplan 2018-2030—Et visionskatalog*.
- Vejle Municipality. (2020a). *Biodiversitetsplan 2020-2024*.
- Vejle Municipality. (2020b). *Klimaplan 2020-2050*.
- Vejle Municipality. (2021). *Kommuneplan 2021-2033 for Vejle Municipality*.
- Vejle Municipality. (2022a). *Strategi for bæredygtigt byggeri*.
- Vejle Municipality. (2022b). *Vejle i tal*.
- Vejle Municipality. (2023a). *Blågrøn strategi*.
- Vejle Municipality. (2023b). *Grønt visionstillæg til mobilitetsplan 2023-2030*.
- Vejle Municipality. (2023c). *Vækstbarometer*. <https://www.vejle.dk/om-kommunen/fakta-om-os/rapporter-og-analyser/vaekstbarometer/>
- Vejle Municipality. (2023d). *Vækstbarometer December 2023*.
- Vejle Municipality. (2023e). *Vejle med vilje—Byrådets vision for Vejle Municipality*.
- Vejle Municipality. (2023f). *Vejles klimaregnskab*. <https://www.vejle.dk/borger/klima-og-energi/vejles-klimaregnskab/>
- Viable Cities. (2023). *Lund _Climate City Contract 2030*. https://viablecities.se/wp-content/uploads/2024/04/Klimatkontrakt_Lund_2023_EN.pdf
- Viable Cities, & Växjö Municipality. (2023). *Växjö Climate Contract 2030*.
- Wang, X., Wang, G., Chen, T., Zeng, Z., & Heng, C. K. (2023). Low-carbon city and its future research trends: A bibliometric analysis and systematic review. *Sustainable Cities and Society*, 90, 104381. <https://doi.org/10.1016/j.scs.2022.104381>
- WCED. (1987). *Our Common Future*.
- Westerink, J., Haase, D., Bauer, A., Ravetz, J., Jarrige, F., & Aalbers, C. B. E. M. (2013). Dealing with Sustainability Trade-Offs of the Compact City in Peri-Urban Planning Across European City Regions. *European Planning Studies*, 21(4), 473–497. <https://doi.org/10.1080/09654313.2012.722927>
- Wiedmann, T., Chen, G., Owen, A., Lenzen, M., Doust, M., Barret, J., & Steele, K. (2020). Three-scope carbon emission inventories of global cities. *Journal of Industrial Ecology*, 25(3), 735–750. <https://doi.org/10.1111/jiec.13063>

World Resources Institute, ICLEI, & C40. (2019). *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories: An Accounting and Reporting Standard for Cities*. World resource Institute.

https://ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf

Xue, J., Næss, P., Stefansdottir, H., Steffansen, R., & Richardson, T. (2020). The hidden side of Norwegian cabin fairytale: Climate implications of multi-dwelling lifestyle. *Scandinavian Journal of Hospitality and Tourism*, 20(5), 459–484.

<https://doi.org/10.1080/15022250.2020.1787862>

Yin, R. K. (2009). *Case Study Research: Design and Methods*. SAGE.



APPENDIX

APPENDIX A. KEY EUROPEAN CLIMATE POLICIES, INITIATIVES AND STRATEGIES

Document	Year	Goals and Targets	Impact on Cities
Energy Performance of Buildings Directive (EPBD)	2010 (initial), revised 2018 and 2021	Improve energy performance of buildings, through mandatory energy performance standards, energy certificates and the goal for all new buildings to be nearly zero-energy by 2020 (public buildings by 2018). Further revisions focus on decarbonising existing building stock by 2050.	Incentivises cities to adopt stricter building codes and renovate older structures. Promotes the use of smart technologies and renewable energy in urban building design.
2030 Climate and Energy Framework	2014	Curb GHG: reduction of 40% by 2030 and of 80-95% by 2050; increase the share of RE as a share of EU-wide gross final energy consumption to 27%; improve energy efficiency by 27%; achieve 30% reduction in emissions from ESR by 2030 (baseline 2005); removal of CO ₂ emissions through LULUCF management by 310 MtCO ₂ -eq until 2030.	Fosters the adoption of stricter climate action plans to meet GHG reduction goals, such as zero-emission zones and transitioning away from fossil fuel energy. Encourages green infrastructure (e.g. parks, green roofs) to support carbon sequestration and urban cooling. Promotes large-scale retrofits for municipal and private buildings. Incentivises rigorous monitoring systems to measure progress of cities.
Renewable Energy Directive (RED)	2018	Establishes binding renewable energy (RE) targets for EU Member States, with a focus on increasing the share of RE by at least 32%. The revised RED (RED II and III) emphasises energy efficiency, decarbonisation and sustainable bioenergy use.	Encourages the integration of RE systems (e.g. solar, wind) into urban infrastructure (e.g. solar panels on public buildings). Incentivises the creation of decentralised energy systems such as urban renewable energy communities. Encourages the electrification of public transport, heating and cooling systems using renewables. Promotes building energy performance to support renewable heating and cooling systems.

Land Use, Land Use Change and Forestry (LULUCF) Regulation	2018	Requires EU countries to ensure that emissions from land use and forestry are offset by equivalent removals, with stricter targets set for 2030.	Promotes tree planting and forest preservation within and around urban areas. Carbon accounting: cities are indirectly impacted as Member States report urban land use and forestry activities that affect national carbon budgets. Incentivises cities to prioritise projects that enhance carbon sequestration (e.g. urban forests, greenbelts, nature-based-solutions).
European Green Deal	2019	EU to achieve climate neutrality by 2050 (baseline 1990 emissions).	Encourages smart cities initiatives, sustainable urban planning and investments in green infrastructure. Focuses on reducing pollution and transitioning to a circular economy in urban settings.
Renovation Wave Initiative	2020	Double the annual energy renovation rate by 2030. Ensure all new buildings are zero-emission by 2030. Renovate 35 million buildings by 2030.	Encourages large-scale retrofitting of public and private buildings. Promotes energy efficiency measures such as better insulation and efficient heating and cooling systems.
Circular Economy Action Plan (CEAP)	2020	Although primarily focused on resource efficiency, the CEAP influences urban land use by encouraging sustainable construction and the reuse of materials.	Encourages the regeneration of underused urban land, reducing the need for new land development. Promotes use of recycled materials and modular designs in urban building projects.
EU Biodiversity Strategy for 2030	2020	Protect 30% of EU land and sea areas, restore degraded ecosystems and increase urban green spaces to tackle biodiversity loss and climate change.	Incentivises cities to expand and maintain green infrastructures (e.g. parks, green roofs, corridors) to sequester carbon and reduce urban heat islands. Encourages cities to restore degraded urban areas (e.g. brownfields) into functional ecosystems. Promotes climate-resilient development with tree planting and wetland restoration to mitigate flooding and improve air quality.
European Climate Law	2021	Official target of 55% emission reduction by 2030 from 1990 levels as a step towards reaching climate neutrality in 2050.	Establishes a framework for local governments to align their policies with EU climate goals, encouraging urban planning that reduces emissions.

Fit for 55: legislative package	2021	Curb GHG: 50% reduction by 2030; increase the share of RE by 40% by 2030; improve energy efficiency to 36% (final energy consumption) and 39% (primary consumption) by 2030; reduce emissions from the EU ETS sectors by 62% by 2030.	Expands the Emissions Trading System (ETS) to include buildings and road transport, which are sectors critical for cities. Energy Performance of Buildings Directive (EPBD): sets ambitious renovation targets to improve energy efficiency in buildings. Renewable Energy Directive (RED): encourages the integration of renewable energy into city infrastructure, including heating and cooling networks.
EU Climate Adaptation Strategy	2021	Integrates land use planning into climate adaptation efforts, emphasising resilience to climate impacts like heatwaves and flooding.	Recommends that cities incorporate adaptation measures into land use planning, such as buffer zones for flood-prone areas. Promotes urban wetlands, rain gardens and retention basins to manage water and reduce climate risks. Encourages cities to align climate adaptation with mitigation in land use strategies.
REPowerEU plan (in tandem with the Ukraine war)	2022	Reduce EU dependence on Russian fossil fuels and accelerate the green energy transition. Increase the share of RE to 45%, energy efficiency and energy diversification.	Promotes energy resilience through urban investments in energy storage, distributed renewable systems and diverse energy sources. Incentivises cities to accelerate projects like solar panel installations, heat pumps and district heating systems. Focuses on improving energy security for urban areas, reducing vulnerability to energy supply disruptions. Supports behavioural change campaigns to reduce energy consumption, e.g. public awareness of energy efficiency.
EU Sustainable Urban Mobility Framework (SUMF)	2023	Updated the original SUMF concept (2013). Prioritises sustainable transport systems.	Encourages densification around public transport hubs, reducing urban sprawl. Promotes reallocating road space for cycling, walking and green corridors. Impacts land use by shifting the focus to pedestrian-friendly and emission-free urban centres.
Nature Restoration Law (Proposed, Pending Adoption)	2024	Mandates the restoration of degraded ecosystems and includes urban-specific restoration targets.	Obligates cities to restore urban rivers, wetlands and degraded habitats. Encourages adaptive rewilding and sustainable landscaping practices. Supports dual-purpose projects to mitigate emissions and enhance resilience.

APPENDIX B. TABLE OF INTERVIEWS

City	Interviewee	Date	Sectors	National Network/Ministry
Vejle (DK)	Interviewee 1	15.12.2023	Strategic Level	
	Interviewee 2	31.01.2024	Land Use	
	Interviewee 3	12.01.2024	Building	
	Interviewee 4	07.02.2024	Transport	
	Interviewee 38	15.12.2023		DK2020
Aarhus (DK)	Interviewee 5	28.02.2024	Strategic Level	
	Interviewee 6	08.03.2024	Land Use	
	Interviewee 8, 9	05.04.2024, 11.04.2024	Building	
	Interviewee 7	21.03.2024	Transport	
Tampere (FI)	Interviewee 10	05.04.2024	Strategic Level	
	Interviewee 11	17.04.2024	Land Use	
	Interviewee 12	17.04.2024	Building	
	Interviewee 13	20.05.2024	Transport	
	Interviewee 39	20.03.2024		HINKU
Oulu (FI)	Interviewee 14	05.04.2024	Strategic Level	
	Interviewee 15	03.04.2024	Land Use	
	Interviewee 16	22.04.2024	Building	
	Interviewee 17	07.06.2024	Transport	

Reykjavík (IS)	Interviewee 18	19.06.2024	Strategic Level
	Interviewee 19	20.06.2024	Land Use
	Interviewee 20	19.06.2024	Building
	Interviewee 21	20.06.2024	Transport
Trondheim (NO)	Interviewee 22	27.02.2024	Strategic Level
	Interviewee 23	06.03.2024	Land Use
	Interviewee 24	13.03.2024	Building
	Interviewee 25	06.03.2024	Transport
Kristiansand (NO)	Interviewee 26	23.04.2024	Strategic Level
	Interviewee 27	19.03.2024	Land Use
	Interviewee 28	25.04.2024	Building
	Interviewee 29	21.03.2024	Transport
Lund (SE)	Interviewee 30	18.06.2024	Strategic Level
	Interviewee 31	25.06.2024	Land Use
	Interviewee 32	30.05.2024	Building
	Interviewee 33	26.04.2024	Transport
Växjö (SE)	Interviewee 34	26.04.2024	Strategic Level
	Interviewee 35	08.05.2024	Land Use
	Interviewee 36	07.05.2024	Building
	Interviewee 37	16.05.2024	Transport
	Interviewee 40	26.04.2024	Viable Cities

APPENDIX C. TABLE OF DOCUMENTS

Aarhus (DK)

Strategic level	
Document title	Publisher, year
På vejen mod fossilfrihed, Klimastrategi 2020-2030	Aarhus Municipality, 2020
Grøn genstart af Aarhus, Klimahandlingsplan 2021-2024	Aarhus Municipality, 2021
Kommuneplan 2018	Aarhus Municipality, 2018
Land use sector	
Minutes, Aarhus City Council d. 21-02-2024	Aarhus Municipality, 2024
Netværk og nærvær: forslag til planstrategi 2023	Aarhus Municipality, 2023
Forslag til et grønnere Aarhus med mere blåt: Tillæg nr. 105 til Kommuneplan 2017	Aarhus Municipality, 2021
Et grønnere Aarhus, Aarhus Municipalitys politik for naturen og det grønne	Aarhus Municipality, 2020
Administrationsgrundlag for Grøn norm	Aarhus Municipality, 2021
Buildings sector	
LCA i processen	Aarhus Municipality, n.d.
Bæredygtige almene boliger - Et dialogværktøj til øget bæredygtighed og CO ₂ -neutralitet for almene boliger i Aarhus Municipality	Aarhus Municipality, 2022
Energimærkning og opvarmning i kommunale bygninger	Asger Bjerg Pedersen, 2022
Miljø- og energirigtigt byggeri i Aarhus Municipality	Aarhus Municipality, 2013 (2022)
Transport sector	

På vej mellem by og land, Værktøjskasse for grøn mobilitet i den fysiske planlægning	Aarhus Municipality, 2023
Mobilitetsplan Aarhus midtby	Aarhus Municipality, 2018
Veje til fremtiden 2020, Trafikplan for Århus Midtby Handlingsplan	Aarhus Municipality, 2003
Cykelhandlingsplan 2017	Aarhus Municipality, 2017

Vejle (DK)

Strategic level	
Document title	Publisher, year
Planstrategi 2019	Vejle Municipality, 2019
Klimaplan 2020-2050	Vejle Municipality, 2020
Vejle med vilje: byrådets vision for Vejle Municipality	Vejle Municipality, 2022
Land use sector	
Lokalplan 1404: Bæredygtighedsvurdering	Vejle Municipality, 2023
Kommuneplan 2021-2033 for Vejle Municipality	Vejle Municipality, 2021
Vejle's Resilience Strategy	Vejle Municipality and The Rockefeller Foundation, n.d.
Blågrøn Strategi	Vejle Municipality, 2023
Biodiversitetsplan	Vejle Municipality, 2020
Buildings sector	
National strategi for bæredygtig byggeri	Indenrigs og boligministeriet, 2021
Strategi for bæredygtig byggeri	Vejle Municipality, 2022
Transport sector	
Grønt visionstillæg til mobilitetsplan 2023-2030	Vejle Municipality, 2023
Mobilitetsplan 2018-2030 – Et visionskatalog	Vejle Municipality, 2018

Tampere (FI)

Strategic level	
Document title	Publisher, year
Sustainable Tampere 2030 Guidelines	City of Tampere, 2018
The City of Action – Tampere City Strategy 2030	City of Tampere, 2021
Carbon Neutral Tampere 2030 Roadmap	City of Tampere, 2022
Tampereen ilmastobudjetti ja ilmastotavoitteet	City of Tampere, 2023
Land use sector	
Kantakaupungin yleiskaava 2040	City of Tampere, 2017
Tampereen kaupungin asunto- ja maapolitiikan linjaukset (MAL) 2022–2025	City of Tampere, 2021
Carbon Neutral Tampere 2030 Roadmap	City of Tampere, 2022
Buildings sector	
Tampereen kaupungin asunto- ja maapolitiikan linjaukset (MAL) 2022–2025	City of Tampere, 2021
Carbon Neutral Tampere 2030 Roadmap	City of Tampere, 2022
Transport sector	
Sustainable urban mobility plan SUMP	City of Tampere, 2021
Tampereen kaupungin asunto- ja maapolitiikan linjaukset (MAL) 2022–2025	City of Tampere, 2021
Carbon Neutral Tampere 2030 Roadmap	City of Tampere, 2022

Oulu (FI)

Strategic level	
Document title	Publisher, year
Kaupunkistrategia Oulu 2030	City of Oulu, 2022
Oulun kaupunki - Ympäristöohjelma 2026	City of Oulu 2023
Oulun kaupunki - Ilmastotyön tiekartta	City of Oulu 2023
Oulun kaupungin SECAP	City of Oulu 2018
Land use sector	
Uuden Oulun yleiskaava	City of Oulu, 2016
Metsien hoito ja käyttösuunnitelma 2024–2033	City of Oulu, 2024
Buildings sector	
Oulun kaupunki. Ympäristöohjelma 2026	City of Oulu, 2023
Oulun kaupunki. Ilmastotyön tiekartta	City of Oulu, 2023
Oulun kaupunki. Kiertotalouden tiekartta	City of Oulu, 2021
Transport sector	
SUMP Oulun Kestävän Kaupunkiliikunnan Suunnitelma,	City of Oulu, 2021
Baanaverkkosuunnitelma 2030	City of Oulu, 2019

Reykjavík (IS)

Strategic level	
Document title	Publisher, year
City of Reykjavík Climate Action Plan for 2021-2025	City of Reykjavík, 2021
The Green Deal	City of Reykjavík, 2022
Environmental and Resource Policy	City of Reykjavík, 2015
City of Reykjavík Climate Action Policy	City of Reykjavík, 2016
Land use	
City of Reykjavík Master Plan	City of Reykjavík, 2022
Regional planning of the Capital Region 2015-2040	Association of Municipalities in the Capital Region, 2015
The Green City	City of Reykjavík, 2019
Reykjavík Housing Policy 2024-2033	City of Reykjavík, 2024
Buildings sector	
Reykjavík Housing Policy 2024-2033.	City of Reykjavík, 2024
Umhverfis- og skipulagssvið	City of Reykjavík, 2024
City of Reykjavík Master Plan	City of Reykjavík, 2022
The Green Deal	City of Reykjavík, 2022
Transport sector	
Loftslagsbókhald Reykjavíkurborgar	EFLA, 2022
Climate Action Plan for 2021-2025	City of Reykjavík, 2021
Sáttmáli um samgöngur á höfuðborgarsvæðinu, Stjórnarráð Íslands	Stjórnarráð Íslands, 2019
The Green Deal	City of Reykjavík, 2022

Trondheim (NO)

Strategic level	
Document title	Publisher, year
Kommunedelplan: energi og klima 2017-2030	Trondheim Municipality, 2017
Klimaløftene. Kommunedelplan for energi og klima 2024 – 2030	Trondheim Municipality, 2024
Kommuneplanens samfunnsdel 2020-2032. Trondheimsløftet	Trondheim Municipality, 2022
Land use sector	
Vedlegg til Byutviklingsstrategi for Trondheim mot 2050. Boligfortetting i Trondheim - status og muligheter	Trondheim Municipality, 2019
Klimaløftene. Kommunedelplan for energi og klima 2024 – 2030	Trondheim Municipality, 2024
Kommuneplanens samfunnsdel 2020-2032. Trondheimsløftet	Trondheim Municipality, 2022
Buildings sector	
Miljøstrategi for bygg og anlegg 2023 – 2026	Trondheim Municipality, 2023
Transport sector	
Klimaløftene. Kommunedelplan for energi og klima 2024 – 2030	Trondheim Municipality, 2024
Mobilitetsstrategi for Trondheim	Trondheim Municipality, 2022
National Transport Plan 2022–2033	Norwegian Ministry of Transport, 2021

Kristiansand (NO)

Strategic level	
Document title	Publisher, year
Omstilling til et bærekraftig lavutslippssamfunn	Kristiansand Municipality, 2023
Handlingsplan til strategi for omstilling til et bærekraftig lavutslippssamfunn	Kristiansand Municipality, 2023
Sterkere sammen – Kristiansand mot 2030. Kommuneplanens samfunnsdel 2020–2030	Kristiansand Municipality, 2020
Land use sector	
Sterkere sammen – Kristiansand mot 2030. Kommuneplanens samfunnsdel 2020–2030	Kristiansand Municipality, 2020
Kommuneplanens arealdel for Kristiansand 2023 -2034 Fagnotat – Senterområder, stedsutvikling og boligbygging	Kristiansand Municipality, 2022
Fagnotat blå- og grønn arealbruk	Kristiansand Municipality, 2022
Buildings sector	
Temaplan Klima- og miljøstrategi Bygg og anlegg	Kristiansand Municipality, 2021
Transport sector	
Handlingsplan til strategi for omstilling til et bærekraftig lavutslippssamfunn.	Kristiansand Municipality, 2023
Omstilling til et bærekraftig lavutslippssamfunn	Kristiansand Municipality, 2023

Lund (SE)

Strategic level	
Document title	Publisher, year
LundaEKO	Lund Municipality, 2014
Climate City Contract 2030	Viable Cities and Lund Municipality, 2023
Klimatpolitiska råd - Lund Kommun - rapport 2023.	Lund Municipality, 2023
Lund Municipality Green Bond Framework	Lund Municipality, 2024
Together for the climate.	Lund Municipality, 2024
LundaEKO	Lund Municipality, 2014
Climate City Contract 2030	Viable Cities and Lund Municipality, 2023
Klimatpolitiska råd - Lund Kommun - rapport 2023.	Lund Municipality, 2023
Land use sector	
Lunds kommuns översiktsplan Samrådsförslag	Lund Municipality, 2024
LundaEko Lunds kommuns programme för ekologisk hållbar utveckling 2021–2030.	Lund Municipality, 2021
Buildings sector	
LundaEKO	Lund Municipality, 2014
Plan för klimatneutralt byggande och anläggning.	Lund Municipality, 2023
Lund Municipality Green Bond Framework	Lund Municipality, 2024
Transport sector	
LUNDAMATS III: Strategy for a sustainable transport system in Lund Municipality.	Lund Municipality, 2014

Växjö (SE)

Strategic level	
Document title	Publisher, year
Växjö Climate Contract	Viable Cities, Växjö Municipality, 2023
Växjö Sustainability Programme	Växjö Municipality, 2018
Land use sector	
Växjö Comprehensive Plan	Växjö Municipality, 2021 [A1] [A2]
Climate adaptation plan for Växjö municipality	Växjö Municipality, 2020
Housing supply plan	Växjö Municipality, 2020
Buildings sector	
Wood Building Strategy	Växjö Municipality, 2018
Energy Plan	Växjö Municipality, 2018
Transport sector	
Transport Plan	Växjö Municipality, 2021
Cycle Route Plan	Växjö Municipality, 2019

APPENDIX D. INTERVIEW GUIDES

Interview guide 1. Strategic level

Overarching visions and political will

1. Is the municipality engaged in any international, European or national voluntary climate city networks? If yes, which?
2. Which kind of support does the municipality get from its engagement in this network?
3. Which is the responsible department / division for the development of the climate plan?
4. How is the climate plan anchored in other departments/divisions? (e.g. do you have a board with representatives from different units/departments/divisions)?
5. Do you have any mechanism/tool/methodology to estimate the trade-offs between the climate goals vs. economic and social issues?
6. What are the main challenges to promoting coordination across sectors within the municipality to meet climate goals?
7. What are the main challenges to aligning the climate goals with regional and national authorities?
8. How do you finance the implementation of climate initiatives across the departments?
9. Do you have climate funds in your municipal budget?
10. Which kind of instruments (economic, regulations, information) do you use to steer development towards climate neutrality?

Goals and target

1. How was the climate goal set for the municipality?
2. Which methodology was used to set this goal?
3. What is the baseline emission year the municipality works with for pursuing this goal?
4. Which kind of GHG emission inventory does the municipality employ to

account for the emissions?

5. Through which sectors does the municipality aim to pursue this goal?
6. How does the municipality monitor its progress towards climate neutrality?
7. What are the main challenges related to curbing the emissions in the municipality?
8. What are the opportunities to achieve the goals?

NC-NC follow-up

1. In the NC-NC project, we analyse how municipalities in the Nordic Region seek to become carbon-neutral, with a focus on spatial planning tools and practices. To this end, we have selected a number of sectors: (1) Land use; (2) Buildings; (3) Transport and mobility. What is your opinion about our selection? Any advice?
2. Which documents would you recommend us to read related to the sectors mentioned?
3. Could you share the contact details of people from these various sectors that we could interview?

Interview guide 2. Land use sector

The questions in this interview aim to understand: (1) how the municipality regulates land consumption for urban development and (2) how land use is a strategy for pursuing climate neutrality

Approach/instruments

1. What are the overarching goals of the municipality regarding urban development and land use for carbon neutrality?
 - a. How does the municipality plan for urban expansion: (i) outward sprawl; (ii) upward, by way of vertical growth; or (iii) infill/brownfield development, where unused, abandoned or underutilised lands within existing urban areas are developed or rehabilitated.
 - b. What kind of urban form model is the municipality following (compact city, 15 minute city, doughnut city)? How?
 - c. If compact city is the model: How does the municipality deal with densification? Are there any regulations that limit/impede the consumption of natural land?
 - d. How are the land use zones established?
2. Does the municipality have land use mitigation /adaptation strategies to enhance carbon neutrality?
 - a. What are the strategies for the preservation and development of green and blue infrastructures? E.g. afforestation, green factor indicators
3. Does the municipality follow any guidelines/indicators to estimate the carbon emissions resulting from the consumption of land?
 - a. Is the effectiveness of land use strategies for climate neutrality estimated?
4. Does the municipality make use of innovative regulations or incentives/disincentives to use the urban land more efficiently? E.g. Incentives for developers or developing particular areas of the city, implementation of particular functions to promote mixed uses.

Governance/institutional capacity

5. What are the synergies and conflicts between regulations at different governance levels?
6. What are the municipal departments involved in land use regulations, mitigation and adaptation strategies? Are there cross-sectoral challenges?
7. Does your department have the necessary expertise to deal with climate goals related to land use?
8. Do you exchange knowledge and experiences with other municipalities or networks to learn how to pursue carbon neutrality through urban land use? What is the role of networks?

Challenges and opportunities

9. What are the main challenges to regulating land use planning for pursuing climate neutrality in your municipality?
10. What are the opportunities?
11. Do you consider the trade-offs between pursuing climate objectives and social and economic goals? If yes, how? Do have any tool, methodology, procedure to do this?

Good practice and follow-up

12. Do you have any best practice in terms of policy/instruments/regulations that you use to pursue carbon neutrality through land use regulations?
13. Which documents would you recommend us to read to have a better overview of the strategies related to land use for carbon neutrality? Is there anyone else that we could interview to get a better understanding?

Interview guide 3. Buildings and construction sector

The questions in this interview aim to understand: (1) requirements for new buildings, (2) requirements for retrofitting of the existing building stock, (3) building density.

Approach and instruments

1. What are the overarching goals of the municipality regarding the buildings sector for carbon neutrality?
2. Are buildings' emissions monitored? If yes, how? What kind of indicators are used? (ask if there are documents on the matter)
3. How is energy efficiency in new construction regulated? What are the standards/requirements?
4. How is energy retrofitting of the existing building stock regulated?
5. What are the existing incentives and support schemes? Are they at national or local level?

Governance/institutional capacity

6. What are the synergies and conflicts between regulations at different governance levels?
 - Is there enough funding?
 - Does the national level have specific expectations without giving the necessary financial support?
 - Are all the needed regulations in place?
7. What are the municipal departments involved in buildings' regulations? Are there cross-sectoral challenges?
8. Does your department have the necessary expertise to deal with climate goals related to buildings?
9. Do you exchange knowledge and experiences with other municipalities or networks to learn how to pursue carbon neutrality through the buildings sector? What is the role of networks?

Challenges and opportunities

10. What are the main challenges to regulating buildings' energy efficiency for pursuing climate neutrality in your municipality?
11. What are the opportunities?
12. Do you consider the trade-offs between pursuing climate objectives and social and economic goals? If yes, how? Do have any tool, methodology, procedure to do this?

Best practice and follow-up

13. Do you have any best practice in terms of policy/instruments/regulations that you use to pursue carbon neutrality through building regulations?
14. Which documents would you recommend us to read to have a better overview of the strategies related to buildings' regulations for carbon neutrality? Is there anyone else that we could interview to get a better understanding?

Interview guide 4. Mobility and transport sector

The questions in this interview aim to understand (1) mobility and transport strategies for climate neutrality.

Approach and instruments

1. What are the overarching goals of the municipality regarding transport and mobility for carbon neutrality?
2. Are the emissions of modes of transport monitored? If yes, how? What kind of indicators are used? (ask if there are documents on the matter)
3. What are the existing incentives and support schemes? Are they at national or local level?
 - a. Incentives for electric cars
 - b. Traffic tolls
 - c. Parking fees

Governance/institutional capacity

4. What are the synergies and conflicts between regulations at different governance levels?
 - o Is there enough funding?
 - o Does the national level have specific expectations without giving the necessary financial support?
 - o Are all the needed regulations in place?
5. What are the municipal departments involved in transport and mobility regulations? Are there cross-sectoral challenges?
6. Does your department have the necessary expertise to deal with climate goals related to transport and mobility?
7. Do you exchange knowledge and experiences with other municipalities or networks to learn how to pursue carbon neutrality through urban mobility and transport? What is the role of networks?

Challenges and opportunities

1. What are the main challenges to regulating transport and mobility for pursuing climate neutrality in your municipality?
2. What are the opportunities?
3. Do you consider the trade-offs between pursuing climate objectives and social and economic goals? If yes, how? Do have any tool, methodology, procedure to do this?

Best practice and follow-up

4. Do you have any best practice in terms of policy/instruments/regulations that you use to pursue carbon neutrality through transport and mobility?
5. Which documents would you recommend us to read to have a better overview of the strategies related to transport and mobility for carbon neutrality? Is there anyone else that we could interview to get a better understanding?

Interview guide 5. National climate networks

Mandate and support to the municipalities

1. Could you provide us with an overview of the work (tasks, mandate) your organisation performs in supporting municipalities to pursue carbon neutrality?
2. How do municipalities become affiliated with your organisation? Are there any selection criteria or requirements to join? If so, which?
3. How do you interact with the municipalities affiliated with your organisation? (e.g. How often? Which kind of forums?)
4. Does your organisation enhance the exchange of knowledge between the municipalities? If yes, how?
5. Do you collaborate with other international networks (e.g. C40) or Nordic networks (CONCITO, HINKU, Viable Cities)? If yes, how? If not, would you be interested in sharing experiences with the Nordic networks? E.g. Would you be willing to participate in a panel online discussion with the other networks of cities that strive for climate neutrality?

Measuring and monitoring emissions

6. Does your organisation employ a standard procedure (e.g. C40 guidelines or other) to measure and monitor the emissions of all affiliated municipalities? If yes, please explain.
7. If not, please explain how the municipalities account for their emissions?
8. Is there any national database with available data for calculation/monitoring of the emissions at the local level? If yes, which one? If not, from where do the municipalities get information about the emissions?
9. What are the most challenging data/indicators to get information about?

Climate neutrality and multilevel governance

10. How is the work of the municipalities towards carbon neutrality developing? Is there growing interest from the municipalities in getting support/advice to pursue climate neutrality?
11. Which sectors have been the most challenging/promising in terms of curbing emissions?
12. What are the main challenges? (e.g. multilevel governance misalignment-incoherence between national and local strategies, funding, lack of knowledge)

13. In your opinion, what are the most effective instruments (incentives, information, regulations) to steer the development towards climate neutrality?

NC-NC and the network

14. In the NC-NC project, we analyse how municipalities in the Nordic Region seek to become carbon neutral, with a focus on spatial planning tools and practices. To this end, we have selected a number of sectors: (1) Land use; (2) buildings; (3) Transport and mobility. What is your opinion about your selection?
15. We are studying the following cities X and X in your country. Would you like to share some knowledge about them?
16. Would you share some documents that would help us gain a better overview of the work you perform with the municipalities?

ABOUT THIS PUBLICATION

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